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ALBERTA OIL SANDS ENVIRONMENTAL RESEARCH PROGRAM

Acute Lethality of Mine Depressurization Water to Trout-Perch (*Percopsis omiscomaycus*) and Rainbow Trout (*Salmo gairdneri*), Volume II

Project AF 1.1.2
July 1979

Sponsored jointly by

Alberta ENVIRONMENT

Environment Canada / Environnement Canada

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

ALBERTA OIL SANDS ENVIRONMENTAL RESEARCH PROGRAM

RESEARCH PROGRAM

These research reports describe the results of investigations funded under the Alberta Oil Sands Environmental Research Program, which was established by agreement between the Governments of Alberta and Canada in February 1975 (amended September 1977). This 10-year program is designed to direct and co-ordinate 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 Canada-Alberta Agreement or other reports in the series should be directed to:

Alberta Oil Sands Environmental Research Program
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Acute Lethality of Mine Depressurization Water to Trout-Perch (*Percopsis omiscomaycus*) and Rainbow Trout (*Salmo gairdneri*), Volume II

Project AF 1.1.2

This report may be cited as:

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

and

The Hon. John Fraser
Minister of the Environment
Environment Canada
Ottawa, Ontario

Sirs:

Enclosed is the report "Acute Lethality of Mine Depressurization Water to Trout-Perch (*Percopsis omiscomaycus*) and Rainbow Trout (*Salmo gairdneri*), Volume II".

This report was prepared for the Alberta Oil Sands Environmental Research Program, through its Aquatic Fauna Technical Research Committee (now the 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

A.H. Macpherson, Ph.D
Member, Steering Committee, AOSERP
Regional Director-General
Environment Canada
Western and Northern Region

ACUTE LETHALITY OF MINE DEPRESSURIZATION WATER TO TROUT-PERCH (*Percopsis omiscomaycus*) AND RAINBOW TROUT (*Salmo gairdneri*), VOLUME II

DESCRIPTIVE SUMMARY

BACKGROUND

In order to conduct oil sands mining operations in the surface mining region of the Athabasca oil sands deposits, most regions require depressurization of the basal sandstone formations. The groundwater produced by depressurization operations is of poor enough quality to be toxic to fish. The purpose of this project is to provide information regarding the acute lethality of oil sands mining and extraction plant wastewaters to fish. Specific objectives were to provide toxicity information on a specific wastewater using Athabasca River water as the diluent and to compare the value of field toxicity studies and the predictive accuracy of laboratory bioassays using treated waters rather than natural waters.

ASSESSMENT

This report is presented in two volumes: Volume I contains discussion and summary of results whereas Volume II provides backup data. The report has been reviewed by various AOSERP researchers, representatives of the oil sands industry, Alberta Environment, and Environment Canada and the University of Alberta. Although the conclusions of the report do not necessarily reflect the views of Alberta Environment or Environment Canada it is the impression of AOSERP management that the researchers have addressed and defined acute toxicity of mine depressurization water to two species of fish. The mention of trade names for commercial products does not constitute an endorsement or recommendation for use. The Alberta Oil Sands Environmental Research Program is satisfied with the efforts put forth by the researchers in this project and accepts this report,

"Acute Lethality of Mine Depressurization Water To Trout-Perch and Rainbow Trout" as important and valid work. Volume I is recommended for wide distribution and and Volume II is recommended for placement in the Alberta Environment Library.

S.B. Smith, Ph.D
Program Director
Alberta Oil Sands Environmental
Research Program

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Research Manager
Water System

ACUTE LETHALITY TO MINE DEPRESSURIZATION WATER TO TROUT-PERCH (*Percopsis omiscomaycus*) AND RAINBOW TROUT (*Salmo gairdneri*)

VOLUME II

by

W. LAKE and W. ROGERS

Alberta Environment
Water Quality Control Branch

for

ALBERTA OIL SANDS ENVIRONMENTAL RESEARCH PROGRAM

AF 1.1.2

July 1979

ABSTRACT

Mine depressurization water obtained from five wells on Lease 17 held by Syncrude Canada Limited, was examined for chemical composition and acute toxicity to two species of fish.

In the first series of experiments, mine depressurization water was diluted with various proportions of water obtained from the Athabasca River, and trout-perch (*Percopsis omiscomaycus*) were exposed to these mixtures for up to 10 days. These experiments were performed in a mobile laboratory located in Fort McMurray. The 96-hour lethal concentrations (LC_{50}'s) ranged from 20% by volume (Well No. 5) to 48% by volume (Well No. 1). The 96-hour LC_{50}'s for the composite samples ranged from 35% by volume to 45% by volume.

Similar studies were undertaken in the second series of experiments in Edmonton, using rainbow trout (*Salmo gairdneri*) with Edmonton City water as the diluent. Four of the five wells previously tested were studied, with resulting 96-hour LC_{50}'s of between 20% and 40% by volume for Well No. 2, and 60% and 80% by volume for the other three wells. In addition, a study was performed on a composite of these four wells to determine the effect of storage time on toxicity. It was observed that toxicity decreased after 10 days storage (96-hour LC_{50}'s of between 40% and 60% volume to between 60% and 80% by volume) but then increased (96-hour LC_{50} of 15.2% by volume) after 20 days storage.

Considerable variations in toxicity were found between wells and even water from a single well varied in toxicity depending on the time the sample was obtained and how long it had been stored. Variations in the chemical composition of the mine depressurization water were observed for such components as zinc, nickel, and iron between sample periods, as well as for concentrations of sodium, chloride, and other components from well to well.

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ACKNOWLEDGEMENTS

This research project AF 1.1.2 was funded by the Alberta Oil Sands Environmental Research Program, a joint Alberta-Canada research program established to fund, direct, and co-ordinate environmental research in the Athabasca Oil Sands area of north-eastern Alberta.

1. SUMMARY OF SAMPLING AND TESTING OF WELL NO. 1, 2900 E - 1000 S

Well No. 1
2900 E - 1000 S

Date of Bioassays: A. September 30, 1976
B. February 22, 1977

Type of Bioassays: A. 96 hr. Semi Static Replacement
B. 96 hr. Semi Static Replacement

Type of Fish: A. Trout Perch *(Percopsis omiscomaycus)*
B. Rainbow Trout *(Salmo gairdneri)*

Dilution Water: A. Athabasca River Water
B. City of Edmonton Treated Water

Mean Survival Times: A. 100% = 1.95
80% = 6.40
60% = 30.05
B. 100% = 6.16
80% = 7.1
60% = 86.0

96 hr. LC_{50}(%): A. = 48.0 (Sprague)
= 50.1 (42.2 - 58.0) (Reed & Muench)
B. = 64.0 (Sprague)
= 58.5 (47.9 - 71.4) (Litchfield)
= 64.8 (59.3 - 70.3) (Reed & Muench)

1.1 TEST NO. 9 BIOASSAY DATA, 30 SEPTEMBER 1976

Data presented here include:

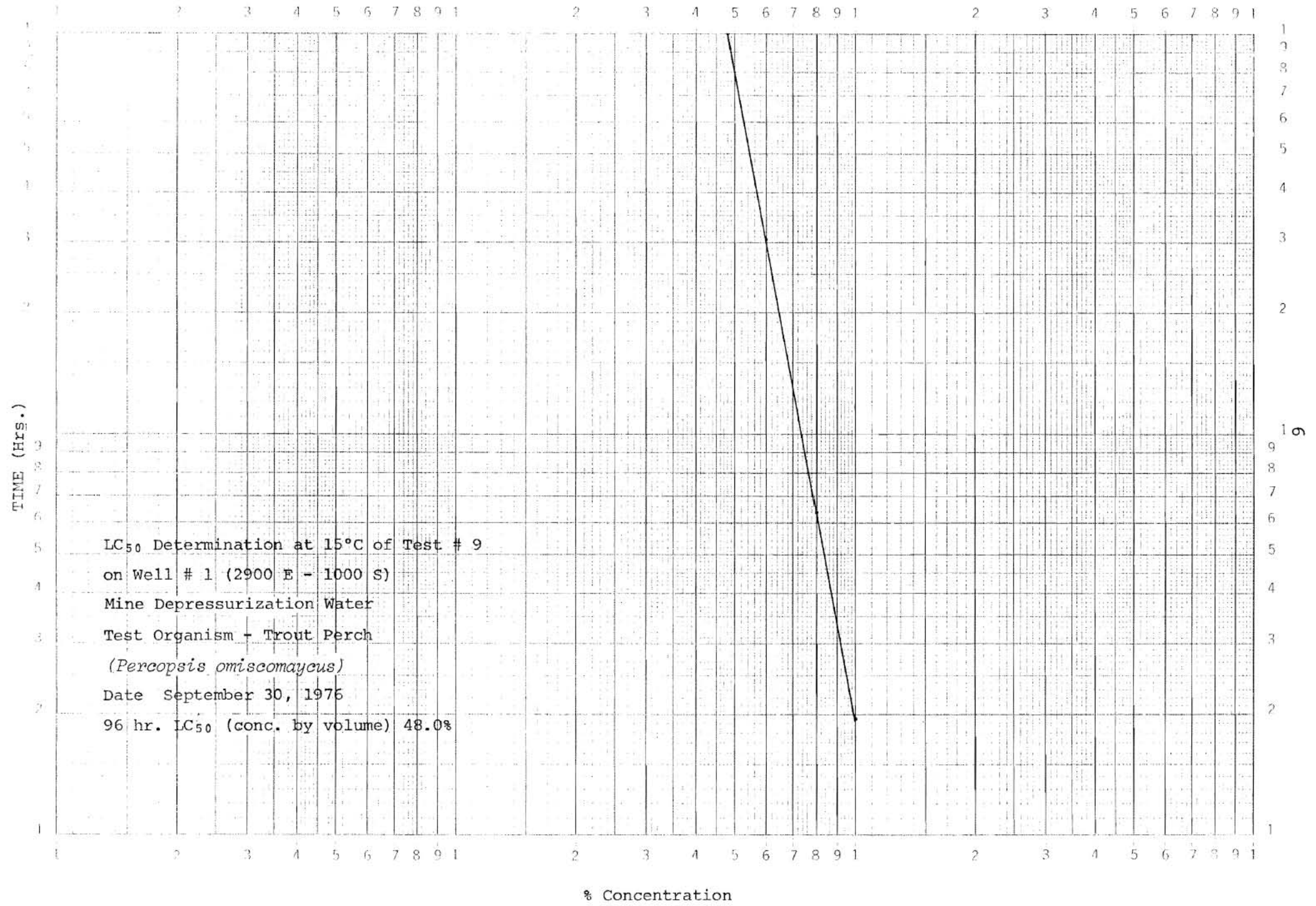
1. cumulative mortality of Trout-perch (*Percopsis omiscomaycus*);
2. graphical determination of LC_{50} and MSTs (Litchfield 1949); and
3. lethal concentration determination (Woolf 1968).

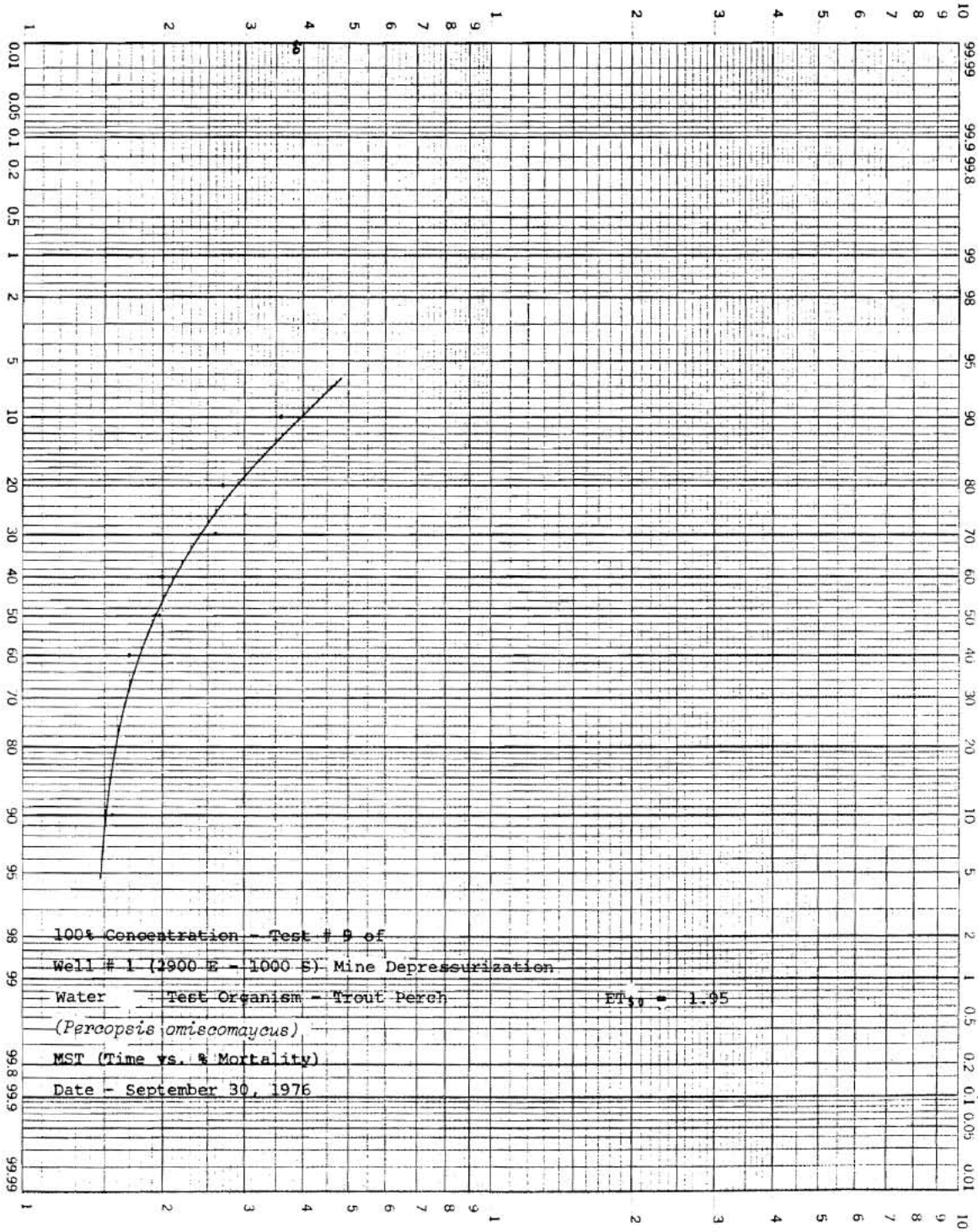
TEST # 9 MINE DEPRESSURIZATION WATER SEMI-STATIC REPLACEMENT OF WELL # 1 TEST DATE SEPTEMBER 30/76

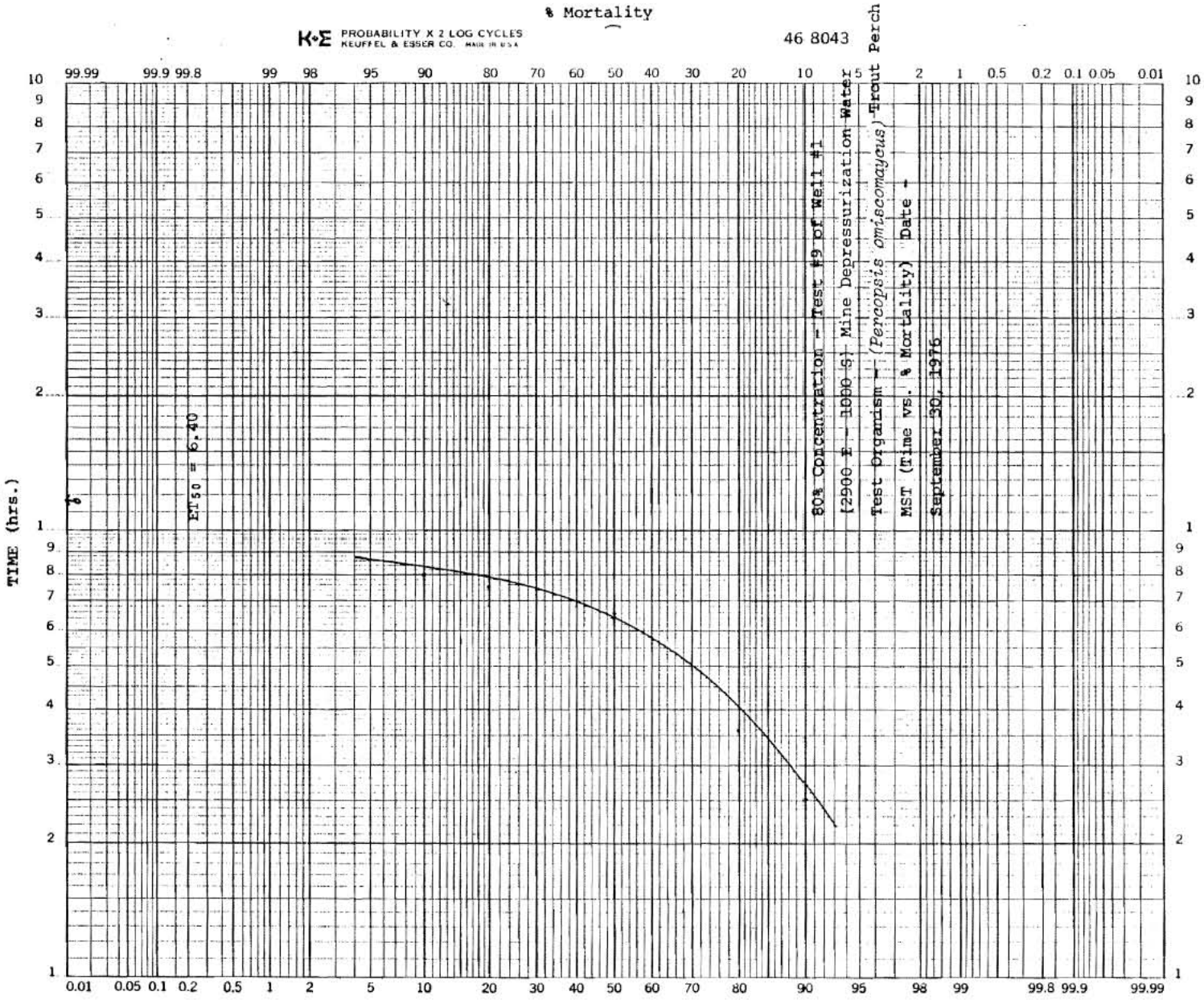
CONCENTRATIONS (MEAN & RANGE)

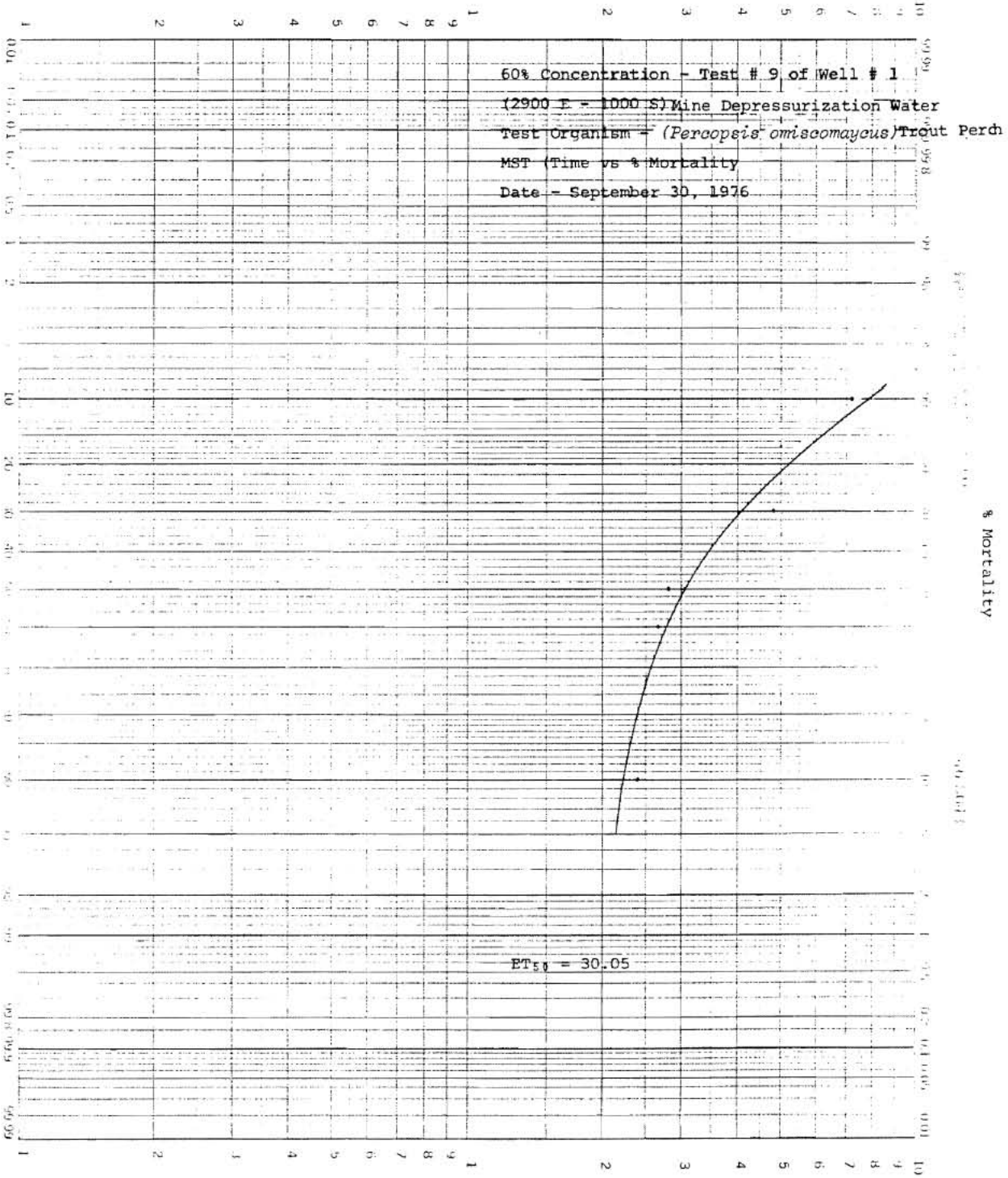
PARAMETERS	CONTROL 5 readings	20% 5 readings	40% 5 readings	60% 5 readings	80% 2 readings	100% 2 readings
Temperature (	11.0 ± 6.14	11.0 ± 6.36	11.0 ± 6.18	10.9 ± 6.00	13.0 No Range	13.0 No Range
Dissolved Oxygen (mg/l)	10.5 ± .19	10.3 ± .37	9.9 ± .53	9.7 ± .42	10.0 Range (9.7-10.4)	10.1 Range (9.9-10.4
pH	8.31 ± .00	8.19 ± .14	8.06 ± .10	8.12 ± .15	8.57 Range (8.55-8.60)	8.56 Range (8.56-8.57
Conductivity (µs/cm)	240	4854	8917	> 10,000	> 10,000	> 10,000
Fish Length (cm.)			4.2 ± .15			
Fish Weight (gm.)			.6 ± .04			
Number Fish/Dilution	5	5	5	5	5	5
Number Dilutions/Conc.	2	2	2	2	2	2
Volume of Dilutions	20	20	20	20	20	20
LT_{50} (Hrs.)				30.05	6.40	1.95
LC_{50} (Conc. by Vol.)	48.0%					

46 7320




TIME (Hrs.)
% Mortality
46 8043
K+E PROBABILITY X 2 LOG CYCLES KEUFFEL & ESSER CO
100% Concentration - Test # 9 of
Well # 1 (2900 E - 1000 S) Mine Depressurization
Water Test Organism - Trout Perch ET99 = 1.95
(Percopsis omiscomaycus)
MST (Time vs. % Mortality)
Date - September 30, 1976


% Mortality
K•Σ PROBABILITY X 2 LOG CYCLES
KEUFFEL & ESSER CO.
46 8043
99.99 99.9 99.8 99 98 95 90 80 70 60 50 40 30 20 10 5 2 1 0.5 0.2 0.1 0.05 0.01
0.01 0.05 0.1 0.2 0.5 1 2 5 10 20 30 40 50 60 70 80 90 95 98 99 99.8 99.9 99.99
TIME (hrs.)
ET50 = 6.40
80% Concentration - Test #9 of Well #1
(2900 ₴ - 1000 S) Mine Depressurization Water
Test Organism - (Percopsis omiscomaycus) Trout Perch
MST (Time vs. % Mortality) Date -
September 30, 1976


TIME (Hrs.)
60% Concentration - Test # 9 of Well # 1
(2900 E - 1000 S) Mine Depressurization Water
Test Organism - (Percopsis omiscomaycus) Trout Perch
MST (Time vs % Mortality
Date - September 30, 1976
% Mortality
ET50 = 30.05

LETHAL CONCENTRATION DETERMINATION

WELL NO. 1

(2900 E - 1000 S)

2.5 Hrs.

Concentration	N	No. Dead	No. Alive	Accumulated Dead	Accumulated Alive	Total	Cumulative Mortality %
Control	10	0	10	0	53	53	0
20	10	0	10	0	43	43	0
40	10	0	10	0	33	33	0
60	10	0	10	0	23	23	0
80	10	1	9	1	13	14	7.1
100	10	6	4	7	4	11	63.6

LC_{50} = 95.2

LETHAL CONCENTRATION DETERMINATION

WELL NO. 1

(2900 E - 1000 S)

12 Hrs.

Concentration	N	No. Dead	No. Alive	Accumulated Dead	Accumulated Alive	Total	Cumulative Mortality %
Control	10	0	10	0	40	40	0
20	10	0	10	0	30	30	0
40	10	0	10	0	20	20	0
60	10	0	10	0	10	10	0
80	10	10	0	10	0	10	100
100	10	10	0	20	0	20	100

LC_{50} = 70 $\pm$ 7.1

LETHAL CONCENTRATION DETERMINATION

WELL NO. 1

(2900 E - 1000 S)

24 Hrs.

Concentration	N	No. Dead	No. Alive	Accumulated Dead	Accumulated Alive	Total	Cumulative Mortality %
Control	10	0	10	0	39	39	0
20	10	0	10	0	29	29	0
40	10	0	10	0	19	19	0
60	10	1	9	1	9	10	10
80	10	10	0	11	0	11	100
100	10	10	0	21	0	21	100

$LC_{50} = 68.9 \pm 6.8$

LETHAL CONCENTRATION DETERMINATION

WELL NO. 1

(2900 E - 1000 S)

48 Hrs.

Concentration	N	No. Dead	No. Alive	Accumulated Dead	Accumulated Alive	Total	Cumulative Mortality %
Control	10	0	10	0	33	33	0
20	10	0	10	0	23	23	0
40	10	0	10	0	13	13	0
60	10	7	3	7	3	10	70
80	10	10	0	17	0	17	100
100	10	10	0	27	0	27	100

$LC_{50} = 54.3 \pm 9.0$

LETHAL CONCENTRATION DETERMINATION

WELL NO. 1

(2900 E - 1000 S)

72 Hrs.

Concentration	N	No. Dead	No. Alive	Accumulated Dead	Accumulated Alive	Total	Cumulative Mortality %
Control	10	0	10	0	30	30	0
20	10	1	9	1	20	21	4.8
40	10	0	10	1	11	12	8.3
60	10	9	1	10	1	11	90.9
80	10	10	0	20	0	20	100
100	10	10	0	30	0	30	100

$LC_{50} = 50.1 \pm 7.9$

LETHAL CONCENTRATION DETERMINATION

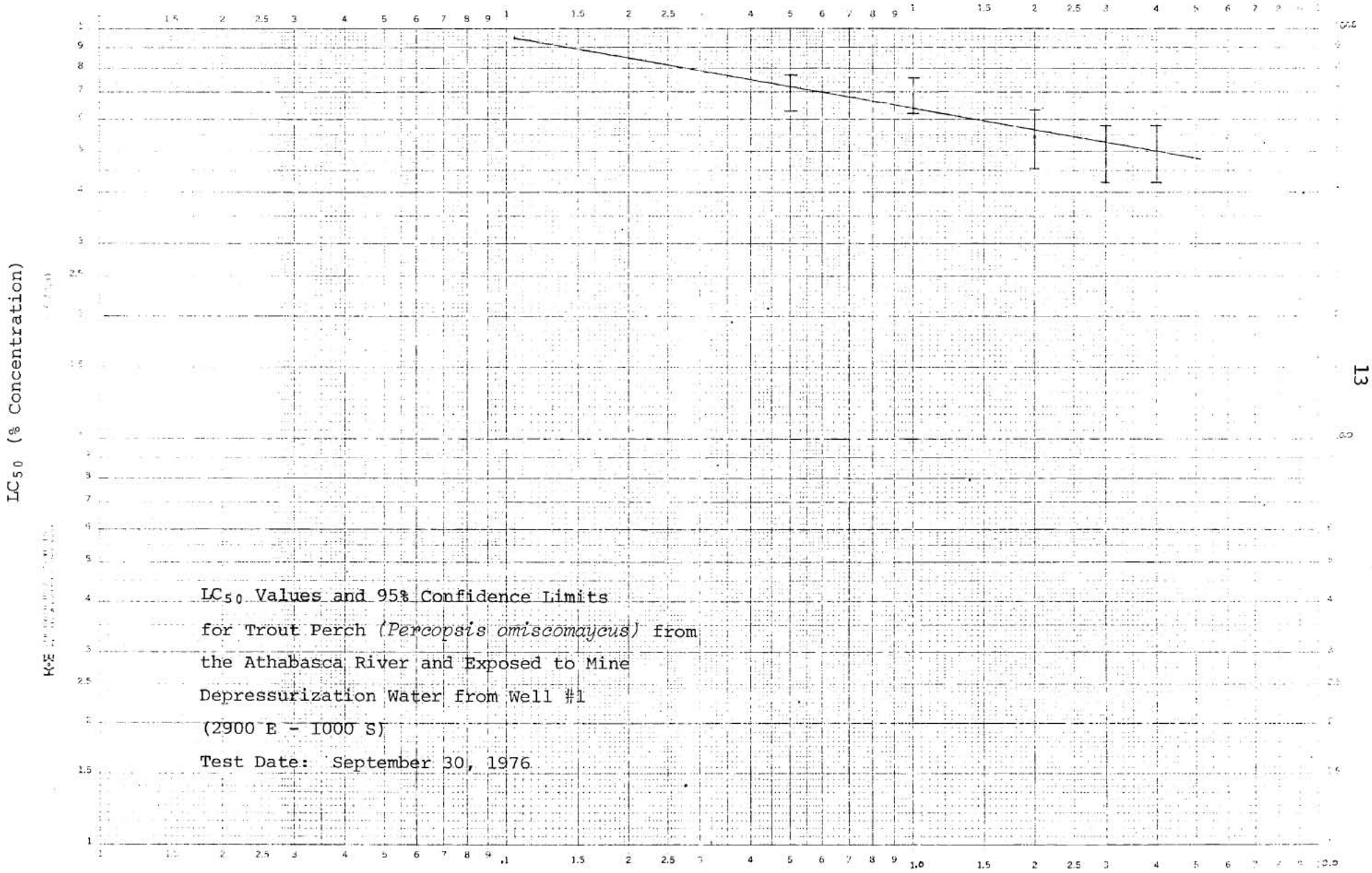
WELL NO. 1

(2900 E - 1000 S)

96 Hrs.

Concentration	N	No. Dead	No. Alive	Accumulated Dead	Accumulated Alive	Total	Cumulative Mortality %
Control	10	0	10	0	30	30	0
20	10	1	9	1	20	21	4.8
40	10	0	10	1	11	12	8.3
60	10	9	1	10	1	11	90.9
80	10	10	0	20	0	20	100
100	10	10	0	30	0	30	100

$LC_{50} = 50.1 \pm 7.9$


LC_{50} (% Concentration)
LC_{50} Values and 95% Confidence Limits
for Trout Perch *(Percopsis omiscomaycus)* from
the Athabasca River and Exposed to Mine
Depressurization Water from Well #1
(2900 E - 1000 S)
Test Date: September 30, 1976

1.2 CHEMISTRY DATA (JUNE TO OCTOBER 1976)

Data presented here includes a summary of chemistry analysis of mine depressurization water collected from Syncrude's Lease 17 and compared to analysis of Athabasca River water.

96 hr. LC_{50} = 48.0%

MST (hrs.) 100% = 1.95

80% = 6.40

60% = 30.05

MINE DEPRESSURIZATION WATER

SYNCRUDE LEASE 17

CHEMISTRY DATA SITE #1 2900 E - 1000 S

	POLLUTION CONTROL LAB		SAMPLE DATES 1976			CHEMEX LABS (ALTA) LTD.							
			JUNE		JULY			JULY		AUGUST			
PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	14	28	08	NAQUADAT CODE	DETECTION LIMIT	22	28	04	18	26***	26
Calcium	20105L	2.0	40.0	82.0	318.0	20103L	0.002	68.0	7.0	54.0	34.0	137	63.0
Magnesium	12102L	1.0	47	114	96	12102L	0.001	92.0	100.0	90.0	91.0	86.9	87.0
Sodium	11102L	0.1	3433	5781	4588	11102L	0.5	4750	4500	4900	4450	4600	4400
Potassium	19102L	0.1	27.1	33.3	24.7	19102L	0.5	36.0	31.0	30.0	32.0	40.0	38.0
Chloride	17203L	1.0	4101	7180	6667	17203L	0.5	7303	5900	6100	5500	5600	6000
Sulphate	16306L	10.0	49	10*	24	16306L	1.0	0.5	0.2	0.5	0.9	25	0.6
Alkalinity T	10101L	5.0	2701	2034	2410	10101L	1.0	1850	2764	2360	2330	2364	2192
pH	10301L	0.0	8.1	8.4	7.4	10301L	0.0	7.2	7.2	7.2	7.8	7.0	7.0
Carbonate	06301L	5.0		32		06301L	1.0	0.0	0.0	0.0	0.0	0.0	0.0
Bicarbonate	06201L	5.0	3293	2415	2937	06201L	1.0	2255.2	3369.3	2876.8	2840.3	2881.7	2672.1
Hardness T.	10604L	5.0	295	676	1191	10603L	1.0	548.6	429.2	505.4	459.5	700.0	515.5
Fluoride	09107L	0.05	0.75	0.80	0.92	09105L	0.1	0.80	0.72	0.88	0.92	-	0.78

* less than

CHEMISTRY DATA SITE # 1 2900 E - 1000 S

PARAMETERS

	September				October	MEAN	RANGE		
	02	08	15	24	28**	19		Low	- High
Calcium	63.0	52	38	48	73	70	76.47	7	- 318
Magnesium	87.0	78.8	81.2	88	86	100	88.32	47	- 114
Sodium	4500	4900	5000	4875	4850	5000	4701.73	3433	- 5781
Potassium	39.5	32	33	44	55	42	35.84	24.7	- 55
Chloride	6050	6560	6700	6500	6000	6950	6207.4	4101	- 7303
Sulphate	0.6	0.5	0.8	0.5	0.5	1.9	7.69	0.5	- 49.3
Alkalinity T	2334	2236	2256	2450	2400	2230	2327.37	1850	- 2764
pH	7.3	7.6	7.6	8.1	7.9	7.6	7.55	7.0	- 8.4
Carbonate	0.0	0	0	0	0	0	2.46	0.0	- 32
Bicarbonate	2845.2	2725.7	2750.1	2986.6	2925.6	2718.4	2832.76	2255.2	- 3369.3
Hardness T.	515.5	454.3	429.2	482.2	536.3	586.5	554.93	295	- 1191
Fluoride	0.78	0.77	0.84	0.77	1	1.05	0.84	0.72	- 1.05

CHEMISTRY DATA SITE #1 2900 E - 1000 S

	POLLUTION CONTROL LAB					CHEMEX LABS (ALTA) LTD.				SAMPLE DATES 1976			
			JUNE		JULY			JULY		AUGUST			
PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	14	28	08	NAQUADAT CODE	DETECTION LIMIT	22	28	04	18	26***	26
Silica	14102L	0.5				14101L	0.02	5.0	5.9	3.4	3.9	16.	3.5
Conductivity	02041L	0.2	14500	24400	20000	02041L	1.0	22000	19200	18800	17500	18400	22000
Odor	02001L	0.0	10	10		02001L	1.0	16	16	16	16		8
Color	02011L	1.0	98	98	97	02011L	1.0	5*	5*	5*	5*		5*
Color T_2	02011L	1.0	99	99	98								
Color T_3	02011L	1.0	97	97	96								
Tanin & Lignin	06551L	0.1	0.2	0.4	0.4	06551L	0.1	1.30	1.70	0.50	0.65		0.90
T.R.	10471L	10.0	14720	14676	13106								
T.F.R.	10571L	10.0				10451L	1.0	12720	13060	12480	11384		12010
T.F.R.F.				19140	12604	10551L	1.0	12100	11020	12208	10900		11460
T.N.F.R.						10401L	1.0	5.2	3.2	8.4	13.6		22.0
T.N.F.R.F.						10501L	1.0	4.0	0.4	3.6	8.0		15.2
Turbidity	02073L	0.0	2	3		02073L	0.0	6.5	6.5	26.7	15.4		7.5
Surfactants	10701L	0.05	1.74	1.30	0.90	10701L	0.02	0.02	0.02	0.02*	0.02*		0.02*
Humic Acids						00000L	2.0	2.0*	2.0*	1.0*	1.0*		1.0*
T.O.C.	06001L	2.0	9319	200	286	06001L	1.0	20	20	30	10		20

* less than

CHEMISTRY DATA SITE # 1 2900 E - 1000 S

PARAMETERS	September					October	MEAN	RANGE	
	02	08	15	24	28**	19		Low	- High
Silica	3.6	3.7	3.8	3.9	3.9	3.9	5.03	3.4	- 5.9
Conductivity	21000	19500	19300	19800	19500	23000	19926.65	18400	- 24400
Odor	16	8	8	2	8	8	10.92	8	- 16
Color	5*	5*	5*	5*	5*	5*	24.86	5*	- 98
Color T							98.6	98	- 99
Color T_3							96.6	96	- 97
Tanin & Lignin	0.35	0.65	0.4	0.2	0.5	0.8	0.64	0.2	- 1.7
TR							14167.3	13106	- 14720
TFR	11940	12800	12980	13105	12895	13595	12633.56	11384	- 13595
TFRF	11350	12560	12460	12640	12425	13075	12610.95	10900	- 19140
TNFR	9.2	16	16.8	14.4	10.8	12.4	12.08	3.2	- 22
TNFRF	0.8	10.8	12	3.6	5.2	3.6	6.09	0.4	- 15.2
Turbidity	15.0						10.3	2	- 26.7
Surfactants	0.02*	0.02*	0.02*	0.06	0.06	0.05	0.3	0.02*	- 1.74
Humic Acids	1.0*	1.0*	1.0*	1.0*	1.0*	1.0*	1.16*		
TOC	20	50	20	20	20	75	722.16	10	- 9319

CHEMISTRY DATA SITE #1 2900 E - 1000 S

	POLLUTION CONTROL LAB					CHEMEX LABS (ALTA) LTD.							
			JUNE		JULY			JULY		AUGUST			
PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	14	28	08	NAQUADAT CODE	DETECTION LIMIT	22	28	04	18	26***	26
T.I.O.C.	06051L	2.0	450	433	464	06501L	0.5	630	680	620	630		620
Nitrite	07205L	0.1	0.1*		0.1*								
NO_2 & NO_3	07105L	0.1	0.1*	0.033	0.1*	07110L	0.01	0.01*	0.07	0.01*	0.01*		0.03
NH_3	07555L	0.05		8.76	7.76	07506L	0.005	4.8	4.3	5.40	6.00		4.20
Nitrogen Tk	07003L	0.05	11.01	9.89	7.22	07013L	0.3	10.5	11.70	7.60	7.40		7.70
Phosphate T	15407L												
Phosphorus T	15256L	0.05	0.58	0.62	0.44	15406L	0.003	0.075	0.175	0.11	0.08		0.14
Phosphorus O	15256L			0.210		15256L	0.003	0.016	0.005*	0.08	0.08		0.07
Phenol	06532L	0.001				06532L	0.002	0.006	0.001*	0.001*	0.015		0.016
Oil & Grease	06521L	1.0	4.5	4.8		06521L	0.1	0.8	3.5	0.3	0.3		
Sulphide	06101L	0.02		0.02*		16101L	0.05	0.06	0.05	0.05*	0.05*		0.05*
Cyanide	06601L	0.002	0.01*	0.01*		00000L	0.1	0.01*	0.01*	0.01*	0.01*		0.01*
Hydrocarbon T	06500L	0.001		0.011	0.45	00000L	1.0	68.4	5.0*	0.1*	0.1*		0.1*
B.O.D.	08201L	0.01		8.0									
C.O.D.	08301L	5.0	126.7	155.5	74.5	08301L	5.0	535.9	737.4	73.5	60.0		160.0
Cadmium	48302L	0.001	0.019			24101L	0.003	0.012	0.015	0.033	0.016	0.001*	0.032
Chromium^{+6}	24101L	0.002	0.002*	0.002*	0.002*	24101L	0.003	0.007	0.004	0.004	0.016	0.015*	0.007
Copper	29305L	0.001				29306L	0.01	0.023	0.022	0.026	0.20	0.003	0.014

CHEMISTRY DATA SITE # 1 2900 E - 1000 S

PARAMETERS

	September				October	MEAN	RANGE	
	02	08	15	24	28**	19		Low - High
T.I.O.C.	670	590	280	470	640	475	546.54	280 - 680
Nitrite							0.1*	
NO_2 & NO_3	0.02	0.01*	0.01*	0.01*	0.02	0.01*	0.004	0.01* - 0.07
NH_3	4.60	5.70	7.7	7.7	7.7	6.9	6.27	4.2 - 8.76
Nitrogen Tk	6.00	14.5	11.5	9.3	11.6	8.5	9.6	6.0 - 14.5
Phosphorus T	0.24	0.16	0.07	0.12	0.11	0.7	0.26	0.07 - 0.62
Phosphate T								
Phosphorus O	0.04	0.01	0.02	0.04	0.07	0.11	0.06	0.005* - 0.21
Phenol	0.029	0.001*	0.001*	0.002	0.006	0.012	0.008	0.001* - 0.029
Oil & Grease	0.1*	3.5	2.5	0.9	0.5	0.13	1.82	0.1* - 4.8
Sulphide	0.5*	0.05*	0.05*	0.05*	0.05*	0.05*	0.05	0.02* - 0.06
Cyanide	0.01*	0.01*	0.01*	0.01*	0.01*	0.01*	0.01*	
Hydrocarbon T	0.1*	4.2		0.4	0.2		7.2	0.1* - 68.4
B.O.D.							8.0	
C.O.D.	177.0	317	179	536	520	100	268.04	60 - 737.4
Cadmium	0.039	0.001*	0.001*	0.001*	0.001*	0.001*	0.013	0.001* - 0.039
Chromium $^{+6}$	0.005	0.004	0.003*	0.003*	0.003*	0.003*	0.006	0.002* - 0.016
Copper	0.014	0.005	0.001*	0.019	0.002	0.001	0.02	0.001* - 0.2

CHEMISTRY DATA SITE #1 2900 E - 1000S

	POLLUTION CONTROL LAB					CHEMEX LABS (ALTA) LTD.				SAMPLE DATES 1976			
			JUNE		JULY			JULY		AUGUST			
PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	14	28	08	NAQUADAT CODE	DETECTION LIMIT	22	28	04	18	26***	26
Iron	26302L	0.02	0.4	0.3	0.4	26304L	0.05	0.950	1.10	0.95	0.97	0.06	0.90
Lead	82302L	0.003				82302L	0.002	0.034	0.40	0.064	0.060	0.004*	0.092
Manganese	25004L	0.008				25004L	0.01	0.200	0.19	0.12	0.170	0.18	0.170
Silver	47303L	0.001				47301L	0.01	0.015	0.005	0.005*	0.01	-	0.005
Zinc	30305L	0.001				30305L	0.01	0.012	0.20	0.044	0.020	0.039	0.056
Vanadium	23301L	0.05				23301L	0.05	0.01*	0.03	0.001*	0.001*	0.001*	0.001*
Selenium	34102L	0.0002						0.0031	0.0033	0.0027	0.002*	0.005*	0.0005*
Mercury	8003L	0.0001	0.001*	0.0001*	0.0001*			0.0043	0.0036	0.0003	0.0009	-	0.0002*
Arsenic	33104L	0.0002		0.0002*	0.0002*			0.005*	0.005*	0.005*	0.005*	0.005*	0.005*
Nickel	28302L	0.001	0.003					0.100	0.096	0.105	0.095	0.002*	0.122
Aluminum	13005L	0.02						0.080	0.13	0.08	0.09	0.005*	0.09
Cobalt	27302L	0.001						0.096	0.078	0.075	0.085	0.002	0.096
Boron	05102L	0.1						0.95	1.96	2.48	6.62	4.81	2.43

CHEMISTRY DATA SITE # 1 2900 E - 1000 S

PARAMETERS

	September				October	MEAN	RANGE	
	02	08	15	24	28**	19		Low - High
Iron	0.85	0.19	0.24	7.45	1.4	0.45	1.11	0.06 - 7.45
Lead	0.072	0.002*	0.002*	0.002*	0.006	0.002*	0.034	0.002* - 0.092
Manganese	0.155	0.125	0.12	0.183	0.158	0.17	0.18	0.12 - 0.2
Silver	0.005	0.005*	0.005*	0.005*	0.005	0.005*	0.007	0.005* - 0.015
Zinc	0.038	0.012	0.001*	0.008	0.009	0.016	0.04	0.001* - 0.2
Vanadium	0.001*	0.001*	0.001*	0.001*	0.001*	0.001*	0.004	0.001* - 0.03
Selenium	0.0005	0.005*	0.001	0.0005*	0.0005*	0.0005*	0.0013	0.0005* - 0.0033
Mercury	0.0002*	0.0026	0.0048	0.0002*	0.0028	0.0001	0.0015	0.0001* - 0.0048
Arsenic	0.005*	0.0005*	0.005*	0.001	0.001	0.001*	0.0034	0.0002* - 0.001
Nickel	0.098	0.002*	0.002*	0.002*	0.002*	0.004	0.048	0.002* - 0.122
Aluminum	0.02	0.09	0.12	0.09	0.07	0.06	0.077	0.005* - 0.13
Cobalt	0.086	0.002*	0.002*	0.002*	0.002*	0.002*	0.044	0.002* - 0.096
Boron	3.10	1.96	2.93	2.65	1.74	2.1	2.81	0.95 - 6.62

CHEMISTRY DATA SITE #1 2900 E - 1000 S

PARAMETERS	POLLUTION CONTROL LAB NAQUADAT CODE	DETECTION LIMIT	JUNE 14	JUNE 28	JULY 08	CHEMEX LABS (ALTA) LTD. NAQUADAT CODE	DETECTION LIMIT	JULY 22	JULY 28	AUGUST 04	AUGUST 18	SAMPLE DATES 1976 26***	26
Pesticides	00000L			0.0001*									
T.D.S.	00205L	0.0	9319	14421	13164							11924.5	
P.C.B.'s	00000L	0.0001		0.0001*	0.0001*								
Carbon T.	06006L	2.0	1194	633	750								

Conductivity in microsiemens/cm

Turbidity in J.T.U.

Metals as Totals mg/l

Alkalinity and Hardness expressed as Calcium Carbonate

Nitrite, NO_2 & NO_3, NH_3 expressed as N

Phosphorus T. expressed as PO_4

Phosphorus O expressed as P

pH in pH units

* less than

CHEMISTRY DATA SITE #1 2900 E - 1000 S

PARAMETERS	September 02	08	15	24	28**	October 19	MEAN	RANGE Low - High
Pesticides							0.001*	
T.D.S.		11924.5					12207.13	9319 - 14421
P.C.B.'s							0.0001*	
Carbon T							859	633 - 1194

SUMMARY OF CHEMISTRY ANALYSIS OF

MINE DEPRESSURIZATION WATER COLLECTED FROM

SYNCRUDE'S LEASE 17 AND COMPARED TO ANALYSIS

OF ATHABASCA RIVER WATER

WELL #1 2900E - 1000S

PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	DATE OF BIOASSAY SAMPLE SEPT.28/76	WELL PROFILE MEANS AND RANGES L - H	ATHABASCA RIVER SEPT.28/76	RIVER PROFILE MEANS AND RANGES L - H
Calcium	20103L	0.002	73.0	76.47 7.0 - 318.0	26.0	31.35 17.5 - 40.0
Magnesium	12102L	0.001	86.0	88.32 47.0 - 114.0	6.8	6.57 4.5 - 10.0
Sodium	11102L	0.5	4850.0	4701.73 3433.0 - 5781.0	8.0	9.29 5.9 - 36.0
Potassium	19102L	0.5	55.0	35.84 24.7 - 55.0	0.4	0.91 0.4 - 1.5
Chloride	17203L	0.5	6000.0	6207.4 4101.0 - 7303.0	1.4	6.11 1.0 - 51.0
Sulphate	16306L	1.0	0.5	7.69 0.5 - 49.3	14.6	13.8 0.5 - 41.0
Alkalinity T	10101L	1.0	2400.0	2327.37 1850.0 - 2764.0	84.0	86.69 66.8 - 129.0
pH	10301L	0	7.9	7.55 7.0 - 8.4	7.6	7.5 6.8 - 8.3
Carbonate	06301L	1.0	0.0	2.46 0.0 - 32.0	0.0	0.0
Bicarbonate	06201L	1.0	2925.6	2832.76 2255.2 - 3369.3	102.4	105.76 81.4 - 158.0
Hardness T	10603L	0.1	536.3	554.93 295.0 - 1191.0	92.9	89.1 63.5 - 138.0
Conductivity	20401L	1.0	19500.0	19926.65 18400.0 - 24400.0	193.0	185.7 132.0 - 270.0
Surfactants	10701L	0.02	0.06	0.3 0.2* - 1.74	0.002*	0.03 0.02* - 0.09
T.O.C.	06001L	1.0	20.0	722.16 10.0 - 9319.0	19.0	25.82 10.5 - 70.0
T.I.O.C.	06051L	1.0	640.0	546.54 280.0 - 680.0	19.0	19.44 11.0 - 40.0
Phenol	06532L	0.002	0.006	0.008 0.001* - 0.29	0.009	0.005 0.001* - 0.022

WELL # 1 2900E - 1000S (Continued)

PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	DATE OF BIOASSAY SAMPLE	WELL PROFILE MEANS AND RANGES L - H	ATHABASCA RIVER	RIVER PROFILE MEANS AND RANGES L - H
Oil & Grease	06521L	0.1	0.5	1.82 0.1* - 4.8	0.4	0.56 0.1* - 5.0
Sulphide	16101L	0.05	0.05*	0.05 0.02* - 0.06	0.5*	0.05*
Cyanide	00000L	0.1	0.01*	0.01*	0.01*	0.01*
Hydrocarbon T	00000L	1.0	0.2	7.2 0.1* - 68.4	0.1*	0.9 0.001* - 2.0
C.O.D.	08301L	5.0	520.0	268.04 60.0 - 737.4	64.0	86.83 37.0 - 267.0
Cadmium	48302L	0.001	0.001*	0.013 0.001* - 0.039	0.001*	0.002 0.001* - 0.019
Chromium $^{+6}$	24101L	0.003	0.003*	0.006 0.002* - 0.016	0.003*	0.004 0.002* - 0.018
Copper	29306L	0.01	0.002	0.02 0.002* - 0.2	0.009	0.019 0.002 - 0.059
Iron	26304L	0.05	1.4	1.11 0.06 - 7.45	2.1	7.26 0.9 - 63.0
Lead	82302L	0.002	0.006	0.034 0.002* - 0.092	0.012	0.0056 0.002* - 0.026
Manganese	25304L	0.01	0.158	0.18 0.02 - 0.2	0.063	0.24 0.056 - 1.7
Silver	47301L	0.01	0.005	0.007 0.005* - 0.015	0.005*	0.005*
Zinc	30304L	0.01	0.009	0.04 0.001* - 0.2	0.015	0.053 0.014 - 0.069
Vanadium	23301L	0.02	0.001*	0.004 0.001* - 0.03	0.003	0.0004
Selenium	34302L	0.00015	0.0005*	0.0013 0.0005* - 0.0033	0.005*	0.0012 0.0005* - 0.001
Mercury	80011L	0.0002	0.0028	0.0015 0.0001* - 0.0048	0.0002*	0.0067 0.0001* - 0.004
Arsenic	33004L	0.001	0.001	0.0034 0.0002* - 0.001	0.009	0.0065 0.0025* - 0.02
Nickel	28302L	0.002	0.002*	0.048 0.002* - 0.122	0.002	0.014 0.002* - 0.02
Aluminum	13302L	0.5	0.07	0.077 0.005* - 0.13	0.62	2.0 0.43 - 10.6

WELL #1 2900E - 1000S (Continued)

PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	DATE OF BIOASSAY SAMPLE SEPT.28/76	WELL PROFILE MEANS AND RANGES L - H	ATHABASCA RIVER SEPT.28/76	RIVER PROFILE MEANS AND RANGES L - H
Cobalt	27302L	0.002	0.002*	0.044 0.002* - 0.096	0.002*	0.005 0.002* - 0.043
Boron	05105L	0.05	1.74	2.81 0.95 - 6.62	0.16	0.2 0.01 - 1.51
Carbon T				859.0 633.0 - 1194.0		44.5 41.0 - 48.0

Conductivity in microsiemens/cm

Turbidity in J.T.U.

Metals as Totals mg/l

Alkalinity and Hardness expressed as Calcium Carbonate

Nitrite, NO_2 + NO_3, NH expressed as N

Phosphorus T expressed as PO_4

Phosphorus O expressed as P

pH in pH units

* less than

Analysis by Chemex Labs (Alberta) Ltd.

SUMMARY OF CHEMISTRY ANALYSIS OF

MINE DEPRESSURIZATION WATER COLLECTED FROM

SYNCRUDE'S LEASE 17 AND COMPARED TO ANALYSIS

OF ATHABASCA RIVER WATER

WELL #2 5300E - 1400S

PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	DATE OF BIOASSAY SAMPLE AUG.9/76	WELL PROFILE MEANS AND RANGES L - H	ATHABASCA RIVER AUG.9/76	RIVER PROFILE MEANS AND RANGES L - H
Calcium	20103L	0.002	72.0	82.25 16.0 - 228.0	25.0	31.35 17.5 - 40.0
Magnesium	12102L	0.001	200.0	151.89 65.0 - 210.0	7.2	6.57 4.5 - 10.0
Sodium	11102L	0.5	6900.0	6377.66 4500.0 - 7900.0	5.9	9.29 5.9 - 36.0
Potassium	19102L	0.5	45.0	48.49 36.9 - 65.0	1.0	0.91 0.4 - 1.5
Chloride	17203L	0.5	10500.0	8732.86 5250.0 - 10500.0	5.1	6.11 1.0 - 51.0
Sulphate	16306L	1.0	0.5*	9.93 0.05* - 78.0	27.0	13.8 0.5 - 41.0
Alkalinity T	10101L	1.0	2760.0	2910.28 2085.0 - 4368.0	80.0	86.69 66.8 - 129.0
pH	10301L	0	7.3	7.46 6.9 - 8.8	8.1	7.5 6.8 - 8.3
Carbonate	06301L	1.0	0.0	8.37 0.0 - 134.0	0.0	0.0
Bicarbonate	06201L	1.0	3364.4	3532.51 2270.0 - 5324.0	97.5	105.76 81.4 - 158.0
Hardness T	10603L	0.1	1003.2	997.47 336.4 - 1377.0	92.1	89.1 63.5 - 138.0
Conductivity	20401L	1.0	32000.0	28561.11 17100.0 - 40000.0	220.0	185.7 132.0 - 270.0
Surfactants	10701L	0.02	0.02*	0.29 0.02* - 1.88	0.02*	0.03 0.02* - 0.09
T.O.C.	06001L	1.0	50.0	67.94 10.0 - 348.0	12.0	25.82 10.5 - 70.0
T.I.O.C.	06051L	1.0	700.0	692.38 538.0 - 820.0	23.0	19.44 11.0 - 40.0
Phenol	06532L	0.002	0.001*	0.01 0.001* - 0.09	0.001*	0.005 0.001* - 0.02

WELL #2 5300E - 1400S (Continued)

PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	DATE OF BIOASSAY SAMPLE AUG.9/76	WELL PROFILE MEANS AND RANGES L - H	ATHABASCA RIVER AUG.9/76	RIVER PROFILE MEANS AND RANGES L - H
Oil & Grease	06521L	0.1	0.1*	1.98 0.1* - 7.6	0.1*	0.56 0.1* - 5.0
Sulphide	16101L	0.05	0.05*	0.06 0.05* - 0.11	0.05*	0.05*
Cyanide	00000L	0.1	0.01*	0.01*	0.01*	0.01*
Hydrocarbon T	00000L	1.0	0.1*	20.76	0.1*	0.9
C.O.D.	08301L	5.0	108.0	294.62 30.0 - 1000.0	64.0	86.93 37.0 - 267.0
Cadmium	48302L	0.001	0.024	0.017 0.001* - 0.049	0.0001*	0.002 0.001* - 0.01
Chromium $^{+6}$	24101L	0.003	0.019	0.0079 0.002* - 0.019	0.005	0.004 0.002* - 0.01
Copper	29306L	0.01	0.032	0.012 0.001* - 0.032	0.006	0.019 0.002 - 0.05
Iron	26304L	0.05	0.7	0.69 0.05 - 2.45	2.9	7.26 0.9 - 63.0
Lead	82302L	0.002	0.09	0.04 0.002* - 0.142	0.002*	0.0056 0.002* - 0.02
Manganese	25304L	0.01	0.14	0.22 0.09 - 0.225	0.11	0.24 0.056 - 1.7
Silver	47301L	0.01	0.02	0.0099 0.005* - 0.02	0.005*	0.005*
Zinc	30304L	0.01	0.086	0.02 0.003 - 0.086	0.03	0.053 0.014 - 0.06
Vanadium	23301L	0.02	0.001*	0.007 0.001* - 0.05	0.001*	0.004 0.001* - 0.01
Selenium	34302L	0.00015	0.0031	0.0019 0.0005* - 0.009	0.002*	0.0012 0.0005* - 0.0018
Mercury	80011L	0.0002	0.0003	0.0004 0.0001* - 0.0007	0.0002*	0.0067 0.0001* - 0.0044
Arsenic	33004L	0.001	0.005*	0.006 0.0002* - 0.02	0.005*	0.0065 0.0025* - 0.02
Nickel	28302L	0.002	0.16	0.089 0.002* - 0.195	0.08	0.014 0.002* - 0.08
Aluminum	13302L	0.5	0.07	0.12 0.005* - 0.44	1.50	2.1 0.43 - 10.6

WELL #2 5300E - 1400S (Continued)

PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	DATE OF BIOASSAY SAMPLE AUG.9/76	WELL PROFILE MEANS AND RANGES L - H	ATHABASCA RIVER AUG.9/76	RIVER PROFILE MEANS AND RANGES L - H
Cobalt	27302L	0.002	0.13	0.79 0.002* - 0.165	0.002*	0.005 0.002* - 0.043
Boron	05105L	0.05	0.52	2.73 0.52 - 7.08	0.05	0.2 0.01 - 1.51
Carbon T				862.5 839.0 - 886.0		44.5 41.0 - 48.0

Conductivity in microsiemens/cm

Turbidity in J.T.U.

Metals as Totals mg/l

Alkalinity and Hardness expressed as Calcium Carbonate

Nitrite, NO_2 + NO_3, NH expressed as N

Phosphorus T expressed as PO_4

Phosphorus O expressed as P

pH in pH units

* less than

Analysis by Chemex Labs (Alberta) Ltd.

1.3 TEST NO. 19 BIOASSAY DATA, 22 FEBRUARY 1977

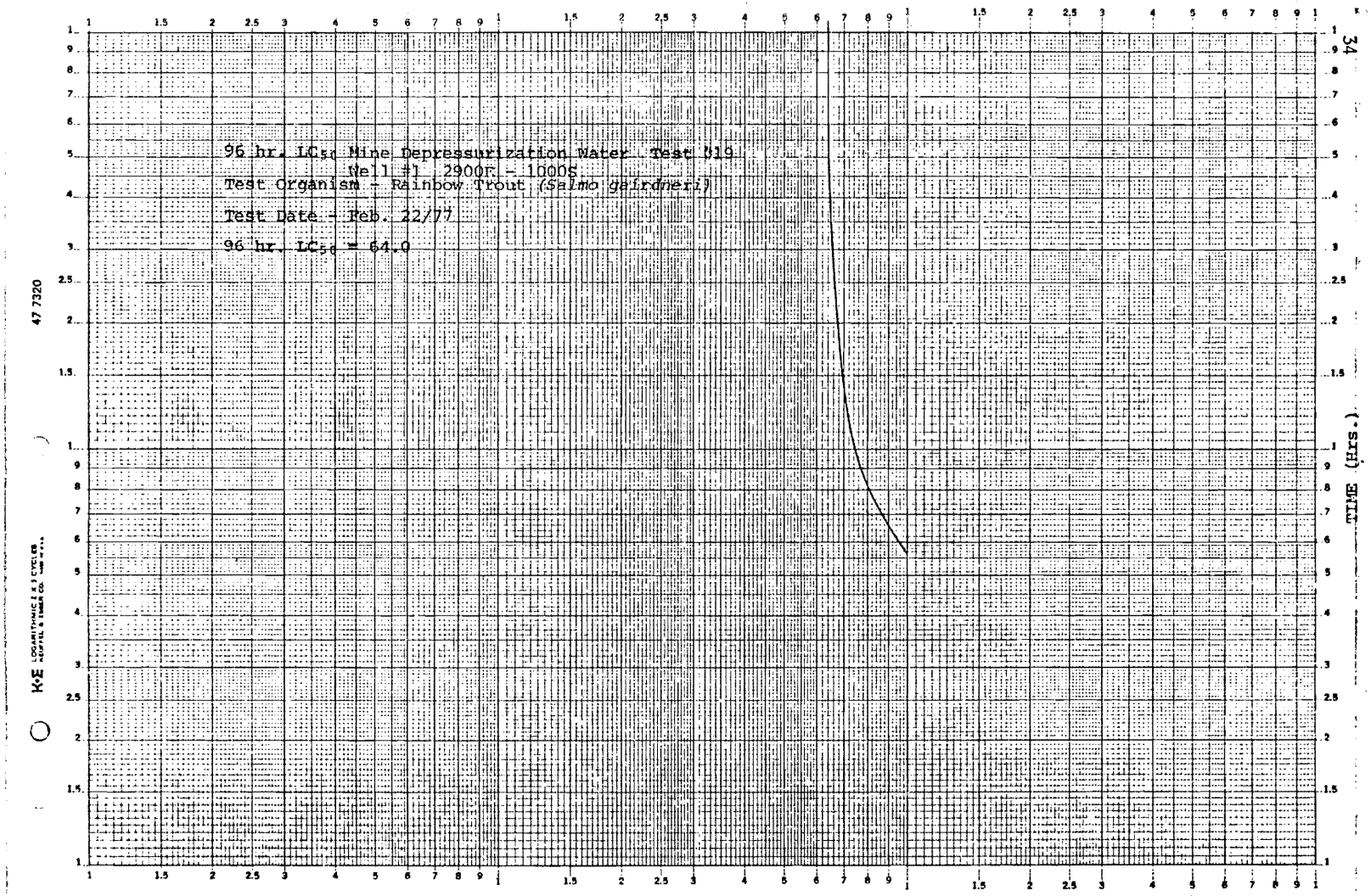
Data presented here include:

1. cumulative mortality of rainbow trout (*Salmo gairdneri*);
2. graphical determination of LC_{50} and MST's (litchfield 1949); and
3. lethal concentration determination (Woolf 1968).

TEST #19 MINE DEPRESSURIZAITON WATER SEMI-STATIC REPLACEMENT WELL #1 TEST DATE FEBRUARY 22, 1977

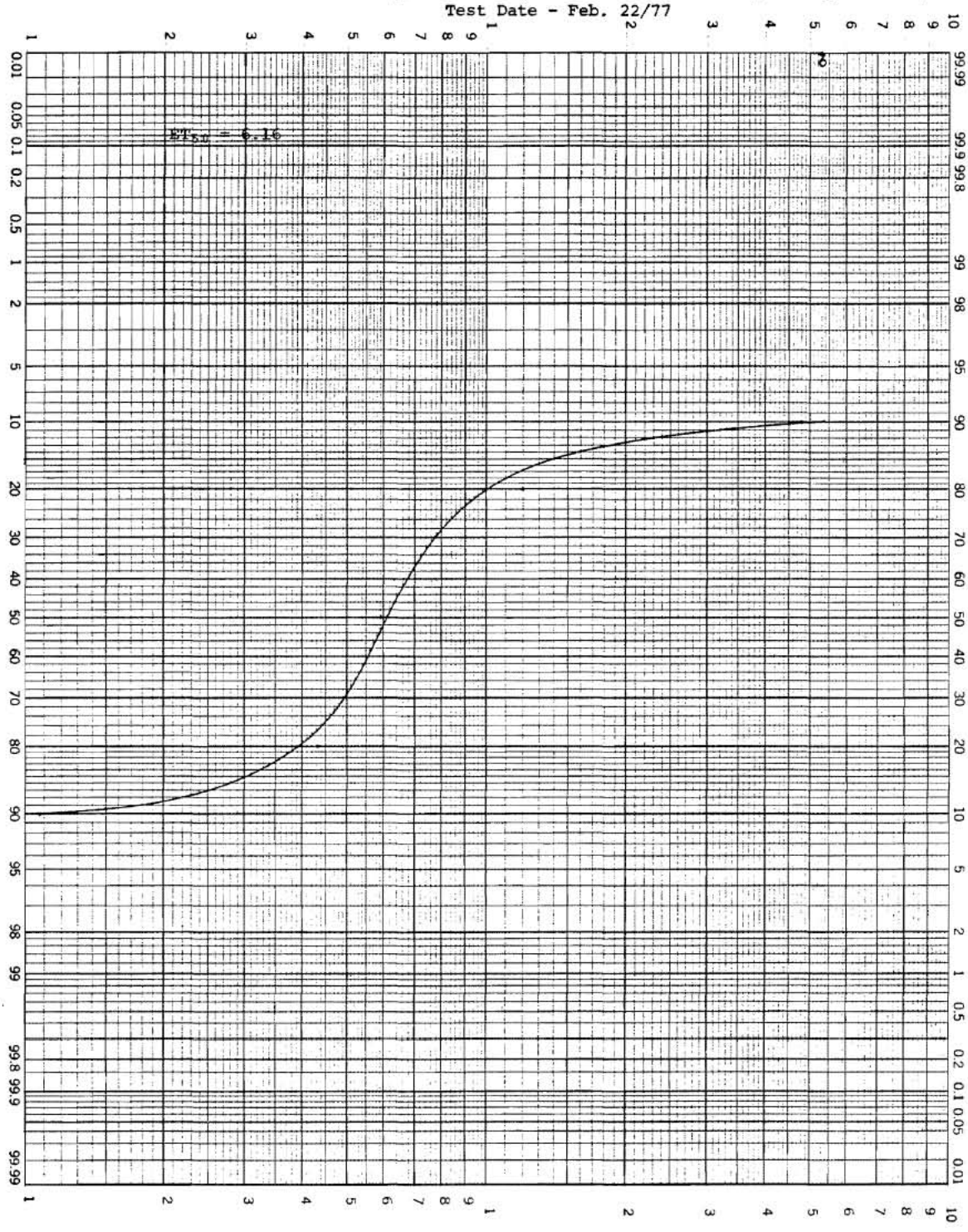
CONCENTRATIONS (MEAN & RANGE)

PARAMETERS	CONTROL 5 Readings	20% 5 Readings	40% 5 Readings	60% 5 Readings	80% 5 Readings	100% 5 Readings
Temperature (°C)	17.29 15.0 - 19.0	17.36 15.0 - 19.0	17.29 15.0 - 19.0	17.38 15.0 - 19.0	17.42 15.0 - 19.0	16.44 12.0 - 18.5
Dissolved Oxygen (mg/ℓ)	9.4 8.7 - 10.4	9.27 8.6 - 10.2	9.07 8.4 - 9.9	8.51 7.0 - 9.8	8.42 6.7 - 9.7	7.76 5.5 - 9.1
pH	7.65 7.52 - 7.85	8.15 7.22 - 8.79	8.16 7.46 - 8.76	8.15 7.38 - 8.79	8.05 7.33 - 8.69	7.80 7.21 - 8.55
Conductivity (µs/cm)	157.5 150 - 170	3970.83 3750 - 4400	6875 6000 - 7500	9291.67 8000 - 10500	13375 12000 - 14000	14750 13500 - 16500
Salinity (ppt Cl)	0.0	2.5	4.0	6.0	8.5	10.0
Fish Length (cm)			TOTAL 5.94 ± .55			
Fish Weight (gm)			TOTAL 2.19 ± .73			
Loading Density (gm/ℓ)			TOTAL 0.055			
Number Fish/Dilution	10	10	10	10	10	10
Number Dilutions/Conc	1	1	1	1	1	1
Volume of Dilutions (ℓ)	40	40	40	40	40	40
LT_{50} (Hr.)				86.0	7.1	6.16
LC_{50} (Conc by Vol)	64.0%					

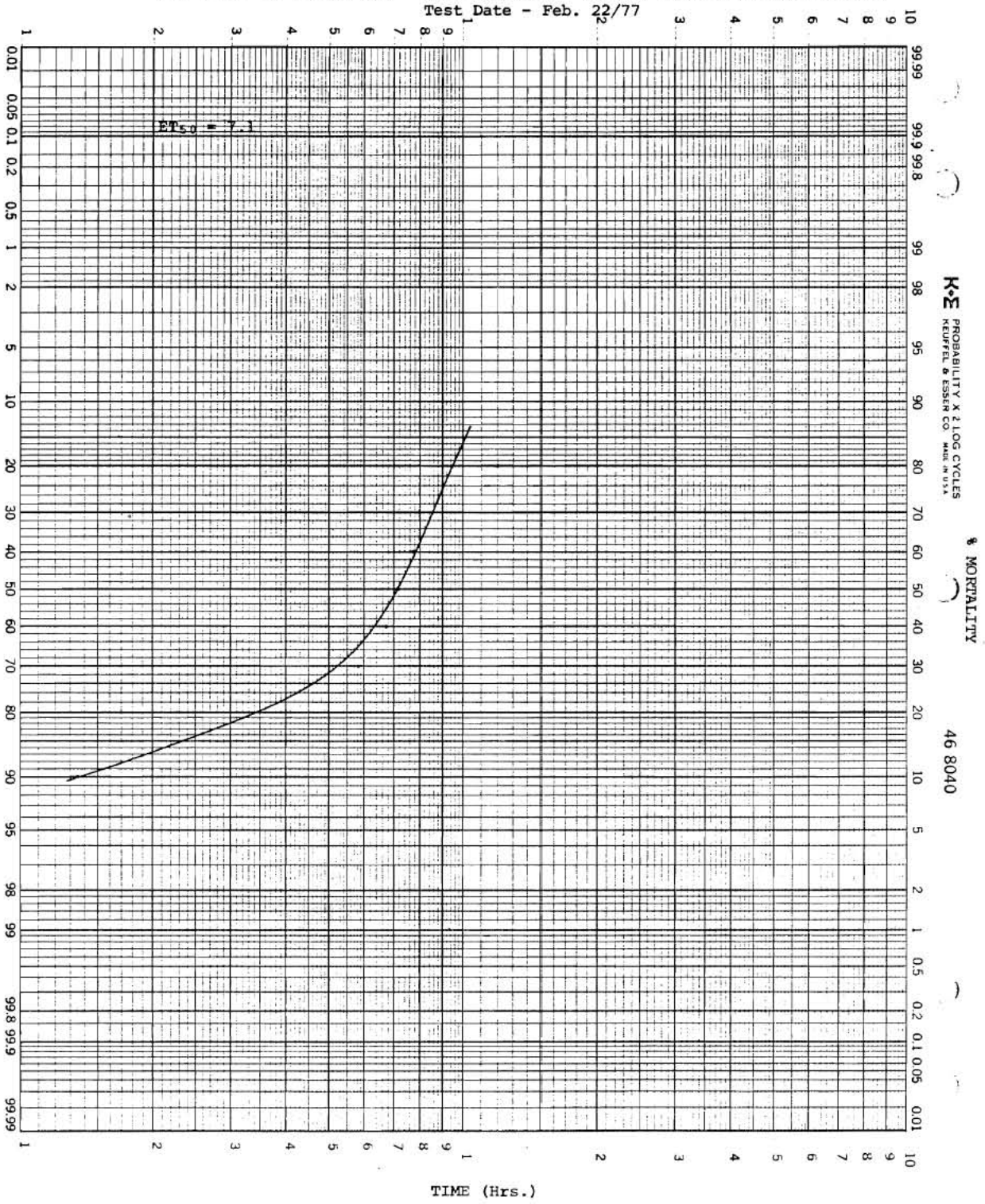

96 hr. LC50 Mine Depressurization Water - Test #19
Well #1 2900E - 1000S
Test Organism - Rainbow Trout (Salmo gairdneri)
Test Date - Feb. 22/77
96 hr. LC50 = 64.0
TIME (Hrs.)
% CONCENTRATION (By Volume)
K+E LOGARITHMIC 3 X 3 CYCLES
47 7320

35

100% Concentration Mine Depressurization Water Test #19 Well #1 2900E - 1000S
MST (Time vs. Mortality) Test Organism - Rainbow Trout *(Salmo gairdneri)*
Test Date - Feb. 22/77

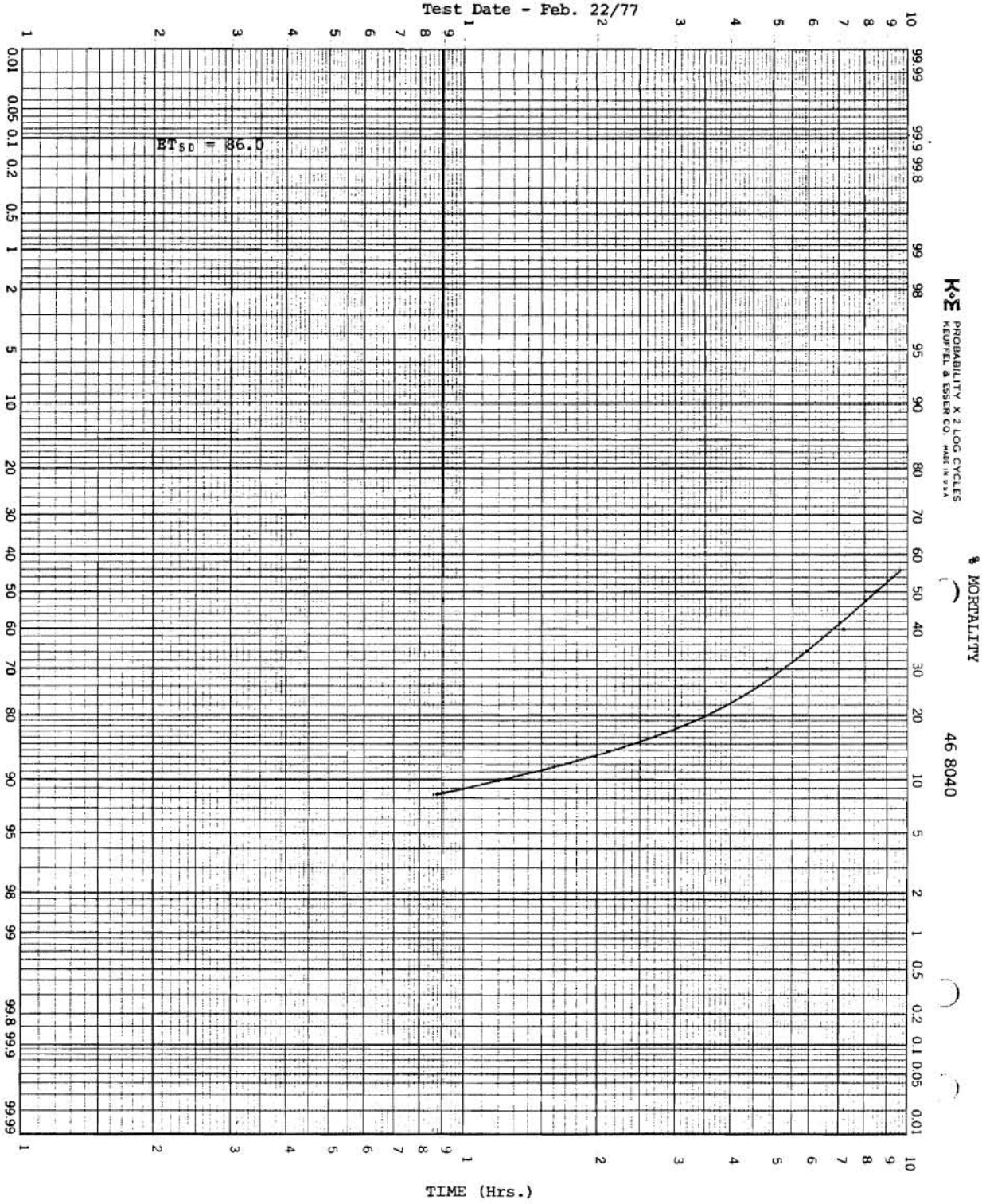


80% Concentration Mine Water Discharge Test #19 Well #1 2900E - 1000S
MST (Time vs. Mortality) Test Organism - Rainbow Trout *(Salmo gairdneri)*
Test Date - Feb. 22/77



37

60% Concentration Mine Depressurization Water Test #19 Well #1 2900E - 1000S
MST (Time vs. Mortality) Test Organism - Rainbow Trout *(Salmo gairdneri)*
Test Date - Feb. 22/77



MINE DEPRESSURIZATION WATER TEST #19 WELL #1 2900E - 1000S

TEST ORGANISM - RAINBOW TROUT *(Salmo gairdneri)*

TEST DATE - FEB. 22/77

PARTIAL RESPONSE DETERMINATION OF 96-hr. LC_{50} (LITCHFIELD & WILCOXON)

Calculations

% Concentration	% Mortality Observed	% Expected	Corrected	Observed minus Expected	$(Chi)^2$ (Nomograph 1)
20	0	0	omit <0.01		
40	10	8.0		2.0	0.0055
60	40	52.0		12.0	0.058
80	90	86.0		4.0	0.013
100	100	97.0	99.0	2.0	0.014
					0.0905

Number of concentrations plotted = k = 4

Average number of fish/concentration = 10

$(Chi)^2 = 0.0905 \times 10 = 0.905$

Degrees of freedom, n = k - 2 = 2

$(Chi)^2$ from Table 2 for n of 2 = 5.99 0.905 is less than 5.99, therefore, the data are not significantly heterogeneous.

$ED_{84} = 73.5$ $ED_{50} = 58.5$ $ED_{16} = 46.5$

$$S = \frac{ED_{84}/ED_{50} + ED_{50}/ED_{16}}{2} = \frac{1.25 + 1.25}{2} = 1.25$$

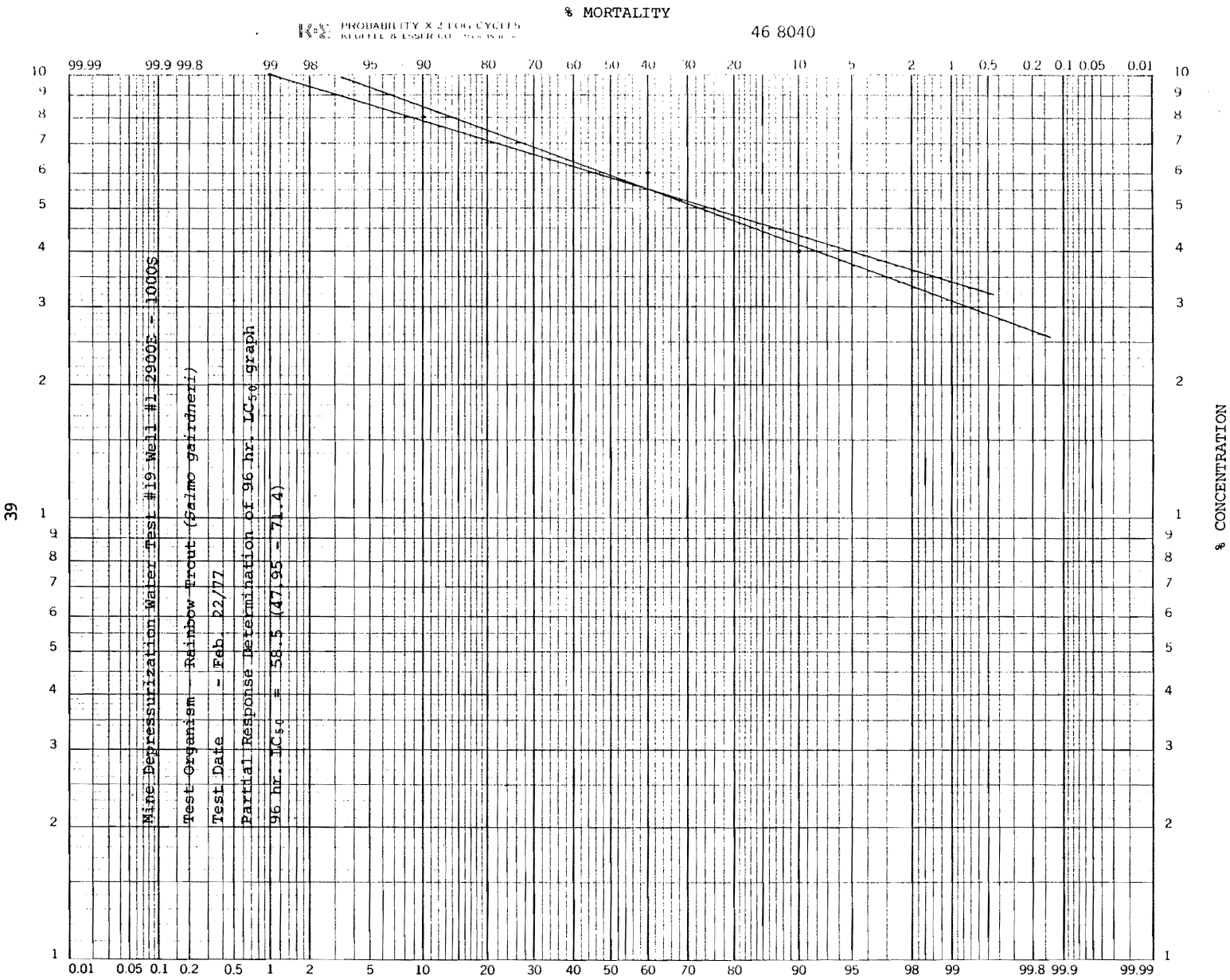
$N^1 = 10$

$f_{ED_{50}} = S^{2.77/\sqrt{N^1}} = S^{\text{exponent}}$

$= S^{2.77/3.6} = S^{0.876}$

= 1.22 from Nomograph 2

96 hr. LC_{50} with 95% Confidence Limits = 58.5 (47.95 - 71.4)


% MORTALITY
PROBABILITY X 2 LOG CYCLES
KEUFFEL & ESSER CO.
46 8040
99.99 99.9 99.8 99 98 95 90 80 70 60 50 40 30 20 10 5 2 1 0.5 0.2 0.1 0.05 0.01
10 9 8 7 6 5 4 3 2 1
Mine Depressurization Water Test #19 Well #1 2900S - 1000S
Test Organism - Rainbow Trout (Salmo gairdneri)
Test Date - Feb. 22/77
Partial Response Determination of 96 hr. LC50 graph
96 hr. LC50 = 58.5 (47.95 - 71.4)
0.01 0.05 0.1 0.2 0.5 1 2 5 10 20 30 40 50 60 70 80 90 95 98 99 99.8 99.9 99.99
% CONCENTRATION

1.4 CHEMISTRY DATA (FEBRUARY 1977)

Data presented here includes a summary of chemical analysis of mine depressurization water collected from Syncrude's Lease 17 and compared to analysis of City of Edmonton treated water.

96 hr. LC_{50} = 64.0 (Sprague)

M.S.T. = Conc.	100%	80%	60%
M.S.T. (hrs.)	6.16	7.1	86.0

MINE DEPRESSURIZATION WATER

SYNCRUDE LEASE 17

CHEMISTRY DATA SITE #1

2900E - 1000S

	POLLUTION CONTROL LAB		SAMPLE DATES-1977			RANGES		
PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	Feb. 9	Feb. 22**	Mean	L	-	H
Calcium	20105L	2.0	113.0	86.0	99.5	86.0	-	113.0
Magnesium	12102L	1.0	85.0	87.0	86.0	85.0	-	87.0
Sodium	11102L	0.1	4714.0	4687.0	4700.5	4687.0	-	4714.0
Potassium	19102L	0.1	31.5	39.2	35.35	31.5	-	39.2
Chloride	17203L	1.0	7154.0	5778.0	6466.0	5778.0	-	7154.0
Sulphate	16306L	10.0	10.0*	45.0	27.5	10.0*	-	45.0
Alkalinity	10101L	5.0	2240.0	2666.0	2453.0	2240.0	-	2666.0
pH	10301L	0.0	8.0	7.4	7.7	7.4	-	8.0
Carbonate	06301L	5.0	0.0	0.0	0.0			
Bicarbonate	06201L	5.0	2730.0	3250.0	2990.0	2730.0	-	3250.0
Hardness T	10604L	5.0	635.0	574.0	604.5	574.0	-	635.0
Fluoride	09107L	0.05	0.73	0.66	0.695	0.66	-	0.73
Silica	14102L	0.5	5.1	5.3	5.2	5.1	-	5.3
Conductivity	02041L	0.2	21500.0	20500.0	21000.	20500.	-	21500.
Odor	02001L	0.0	1.0	1.0	1.0			
Color	02011L	1.0	100.0	100.0	100.0			

POLLUTION CONTROL LAB

PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	SAMPLE DATES-1977 Feb. 9	Feb. 22**	MEAN	RANGES L - H
Color T_2	02011L	1.0	99.0	100.0	99.5	99.0 - 100.0
Color T_3	02011L	1.0	97.0	100.0	98.5	97.0 - 100.0
Tanin & Lignin	06551L	0.1	0.6	0.5	0.55	0.5 - 0.6
T.R.	10471L	10.0	13203.0	13928.0	13565.0	13202.0 - 13928.0
T.F.R.	10571L	10.0	12946.0	13630.0	13303.0	12946.0 - 13630.0
T.F.R.F.						
T.N.F.R.						
T.N.F.R.F.						
Turbidity	02073L	0.0	5.0	4.0	4.5	4.0 - 5.0
Surfactants	10701L	0.05	1.9	1.8	1.85	1.8 - 1.9
Humic Acids						
T.O.C.	06001L	2.0	72.0		72.0	
T.I.O.C.	06051L	2.0	183.0		183.0	
Nitrite	07205L	0.1	0.1*	0.1*	0.1*	
NO_2 & NO_3	07105L	0.1	0.1*	0.1*	0.1*	
NH_3	07555L	0.05	6.16	7.58	6.87	6.16 - 7.58
Nitrogen Tk	07003L	0.05	15.86	7.97	11.92	7.97 - 15.86
Phosphorus T	15001L	0.05	0.15	0.25	0.20	0.15 - 0.25
Phosphate T	05407L					
Phosphorus O	15256L					
Phenol	06532L	0.001	0.021	0.064	0.043	0.021 - 0.064
Oil & Grease	06521L	1.0	3.9	6.9	5.4	3.9 - 6.9

SITE 1

PARAMETERS	POLLUTION CONTROL LAB NAQUADAT CODE	DETECTION LIMIT	SAMPLE DATES 1977 Feb. 9	Feb. 22*	MEAN	RANGES LOW - HIGH
Sulphide	06101L	0.02	0.02*	0.02*	0.02*	
Cyanide	06601L	0.002	0.03		0.03	
Hydrocarbon T	06500L	0.001				
B.O.D.	08201L	0.01	4.8		4.8	
C.O.D.	08301L	5.0	70.4	292.4	181.4	70.4 - 292.4
Cadmium	48302L	0.001	0.001*	0.001*	0.001*	
Chromium^{+6}	24101L	0.002	0.002*	0.002*	0.002*	
Copper	29305L	0.001	0.002	0.001*	0.0015	0.001* - 0.002
Iron	26302L	0.05	0.58	0.82	0.7	0.58 - 0.82
Lead	82302L	0.003	0.003*	0.003*	0.003*	
Manganese	25004L	0.008	0.22	0.203	0.21	0.203 - 0.22
Silver	47303L	0.001	0.001*	0.001*	0.001*	
Zinc	30305L	0.001	0.019	0.009	0.014	0.009 - 0.019
Vanadium	23301L	0.05				
Selenium	34102L	0.0002		0.0002*	0.0002*	
Mercury	80003L	0.0001	0.0001*	0.0001*	0.0001*	
Arsenic	33104L	0.0002	0.0002*	0.0002*	0.0002*	
Nickel	28302L	0.001	0.001*	0.005	0.003	0.001* - 0.005
Aluminum	13005L	0.02				
Cobalt	27302L	0.001	0.001*	0.001*	0.001*	
Boron	05102L	0.1				

SITE 1

PARAMETERS	POLLUTION CONTROL LAB NAQUADAT CODE	DETECTION LIMIT	SAMPLE DATES 1977 Feb. 9	Feb. 22*	MEAN	RANGES LOW - HIGH
Pesticides	00000L					
T.D.S.	00205L	0.0	13453.0	12323.0	12888.0	12323.0 - 13453.0
P.C.B.'s	00000L	0.0001				
Carbon T	06006L	2.0	255.0		255.0	

Conductivity in microsiemens/cm

Turbidity in J.T.U.

Metals as Totals mg/ℓ

Alkalinity and Hardness expressed as Calcium Carbonate

Nitrite, NO_2 & NO_3, NH_3 expressed N

Phosphorus T expressed as PO_4

Phosphorus O expressed as P

pH in pH units

* less than

** sample taken for bioassay

SUMMARY OF CHEMISTRY ANALYSIS OF

MINE DEPRESSURIZATION WATER COLLECTED FROM

SYNCRUDE'S LEASE 17 AND COMPARED TO ANALYSIS

OF CITY OF EDMONTON TREATED WATER

WELL #1 2900E - 1000S

PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	DATE OF BIOASSAY FEB.22/77	WELL PROFILE MEANS & RANGES L - H	TREATED WATER FEB.22/77	TREATED WATER PROFILE MEANS & RANGES L - H
Calcium	20105L	2.0	86.0	99.5 86.0 - 113.0	23.0	22.5 22.0 - 23.0
Magnesium	12102L	1.0	87.0	86.0 85.0 - 87.0	9.0	10.5 9.0 - 12.0
Sodium	11103L	0.1	4687.0	4700.5 4687.0 - 4714.0	237.0	65.0 4.0 - 237.0
Potassium	19103L	0.1	39.2	35.35 31.5 - 39.2	4.5	1.75 0.8 - 4.5
Chloride	17203L	1.0	5778.0	6466.0 5778.0 - 7154.0	7.0	2.8 0.1* - 7.0
Sulphate	16306L	10.0	45.0	27.5 10.0* - 45.0	505.0	164.25 46.0 - 505.0
Alkalinity T	10101L	5.0	2666.0	2453.0 2240.0* - 2666.0	60.0	56.25 46.0 - 66.0
pH	10301L	0	7.4	7.7 7.4 - 8.0	8.3	8.18 8.1 - 8.3
Carbonate	06301L	5.0	0.0	0.0		
Bicarbonate	06201L	5.0	3250.0	2990.0 2730.0 - 3250.0	73.0	68.25 56.0 - 80.0
Hardness T	10604L	5.0	574.0	604.5 574.0 - 635.0	96.0	100.5 96.0 - 108.0
Conductivity	02041L	0	20500.0	21000.0 20500.0 - 21500.0	260.0	217.0 188.0 - 260.0
Surfactants	10701L	0.05	1.8	1.85 1.8 - 1.9	0.05*	1.07 0.05* - 0.13
T.O.C.	06001L	2.0		72.0		
T.I.O.C.	06051L	2.0		183.0		
Phenol	06532L	0.001	0.064	0.043 0.021 - 0.064	0.001*	0.001*

WELL #1 2900E - 1000S (Continued)

PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	DATE OF BIOASSAY FEB.22/77	WELL PROFILE MEANS & RANGES L - H	TREATED WATER FEB.22/77	TREATED WATER PROFILE MEANS & RANGES L - H
Oil & Grease	06521L	0.02	6.9	5.4 3.9 - 6.9		2.1
Sulphide	16101L	0.02	0.02*	0.02*		
Cyanide	06601L	0.002		0.03		
Hydrocarbon T	06500L	0.001				
C.O.D.	08301L	5.0	292.4	181.4 70.4 - 292.4	6.4	5.47 5.0* - 6.4
Cadmium	48302L	0.001	0.001*	0.001*	0.001*	0.001*
Chromium^{+6}	24101L	0.002	0.002*	0.002*	0.002*	0.002*
Copper	29305L	0.001	0.001*	0.0015 0.001* - 0.002	0.001*	0.001*
Iron	26302L	0.05	0.82	0.7 0.58 - 0.82	0.80	0.27 0.06 - 0.80
Lead	82302L	0.003	0.003*	0.003*	0.003*	0.003*
Manganese	25304L	0.008	0.203	0.21 0.203 - 0.22	0.008*	0.008*
Silver	47303L	0.001	0.001*	0.001*		
Zinc	30305L	0.001	0.009	0.014 0.009 - 0.019	0.002	0.005 0.002 - 0.007
Vanadium	04303L	0.01				
Selenium	34102L	0.0002	0.0002*	0.0002*		
Mercury	80011L	0.0001	0.0001*	0.0001*		0.0001*
Arsenic	33104L	0.0002	0.0002*	0.0002*		
Nickel	28302L	0.001	0.005	0.003	0.001*	0.001*
Aluminum						
Cobalt	27302L	0.001	0.001*	0.001*	0.00*	0.001*
Boron						
Carbon T.	06006L	2.0		255.0		

WELL #1 2900E - 1000S (Continued)

Conductivity in microsiemens/cm
Turbidity in J.T.U.
Metals as Totals mg/l
Alkalinity and Hardness expressed as Calcium Carbonate
Nitrite, NO_2 + NO_3, NH_3 expressed as N
Phosphorus T expressed as PO_4
Phosphorus O expressed as P
pH in pH units
* less than

Analysis by Department of Environment, Pollution Control Division Laboratory

2. SUMMARY OF SAMPLING AND TESTING OF WELL NO. 2 5300 E - 1400 S

Well No. 2

5300E - 1400S

Date of Bioassays: A. (1) August 9, 1976
(2) August 23, 1976

B. February 22, 1977

Type of Bioassays: A. (1) 96 hr. Semi Static Replacement
(2) 96 hrs. Semi Static Replacement

B. 96 hr. Semi Static Replacement

Type of Fish: A. (1) Trout Perch *(Percopsis omiscomaycus)*
(2) Trout Perch *(Percopsis omiscomaycus)*

B. Rainbow Trout *(Salmo gairdneri)*

Dilution Water: A. (1) Athabasca River Water
(2) Athabasca River Water

B. City of Edmonton Treated Water

Mean Survival Times: A. (1) 100% = 1.91 (1.86 - 1.95)
80% = 4.17
60% = 6.9 (6.16 - 7.73)
40% = 22.1 (19.95 - 24.49)
(2) 40% = 9.80 (6.81 - 14.11)
35% = 11.0 (8.52 - 14.2)
30% = 41.0

B. 100% = 7.1 (6.43 - 7.85)
80% = 0.69 (0.62 - 0.77)
60% = 30.5
40% = 34.2 (30.67 - 38.13)

Well No. 2

96 hr. LC_{50}(%): A. (1) = 22.6 (Sprague)
= 28.3 (Reed & Muench)

(2) = 29.9 (Sprague)

B. = $20 < LC_{50} < 40$ (Sprague)
= 37.5 (25.9 - 54.5) (Litchfield & Wilcoxen)
= 38.4 (32.7 - 44.1) (Reed & Muench)

2.1 TEST NO. 3 BIOASSAY DATA, 9 AUGUST 1976

Data presented here includes:

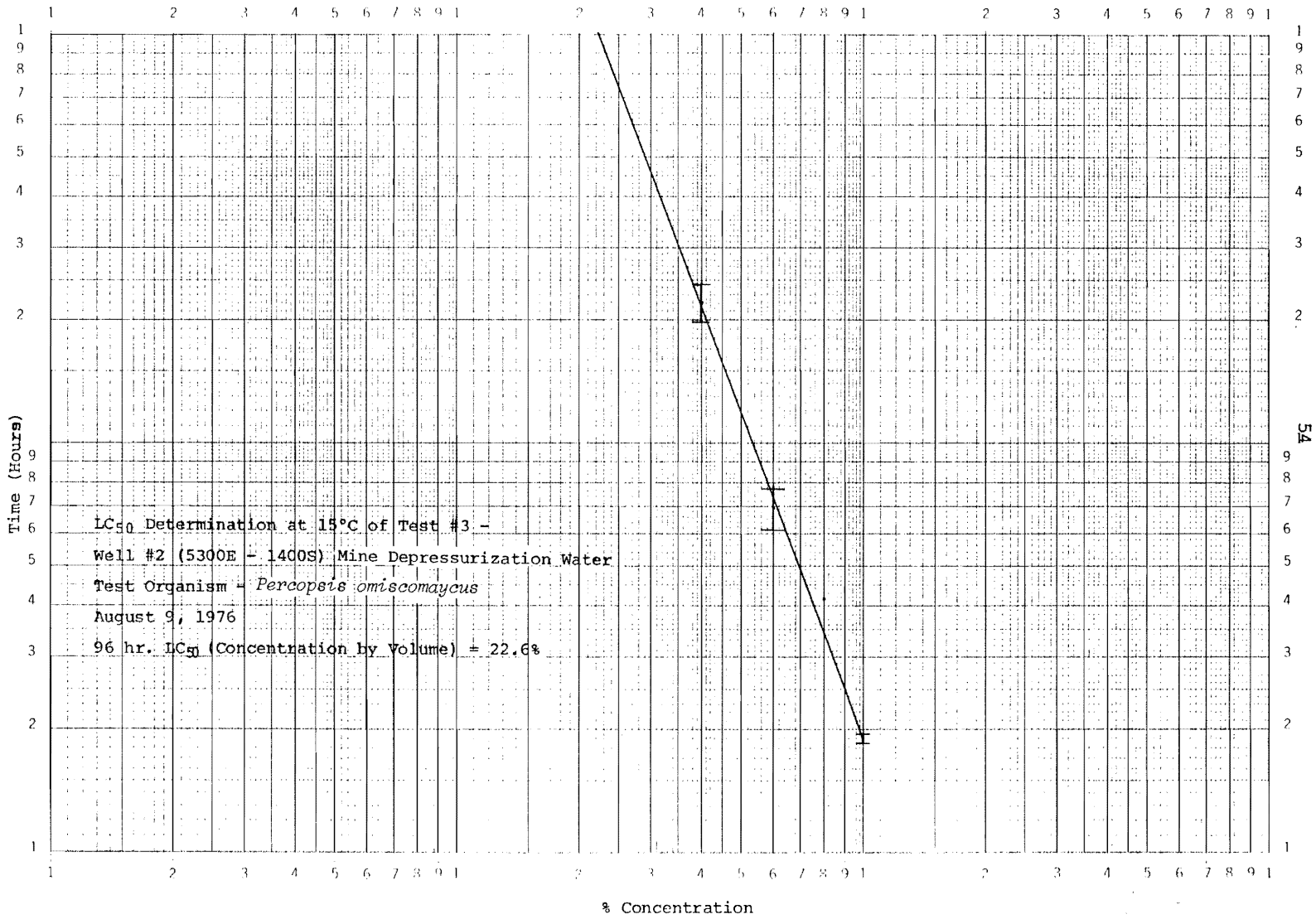
1. cumulative mortality of Trout-perch (*Percopsis omiscomaycus*); and
2. graphical determination of LC_{50} and MST's (Litchford 1949).

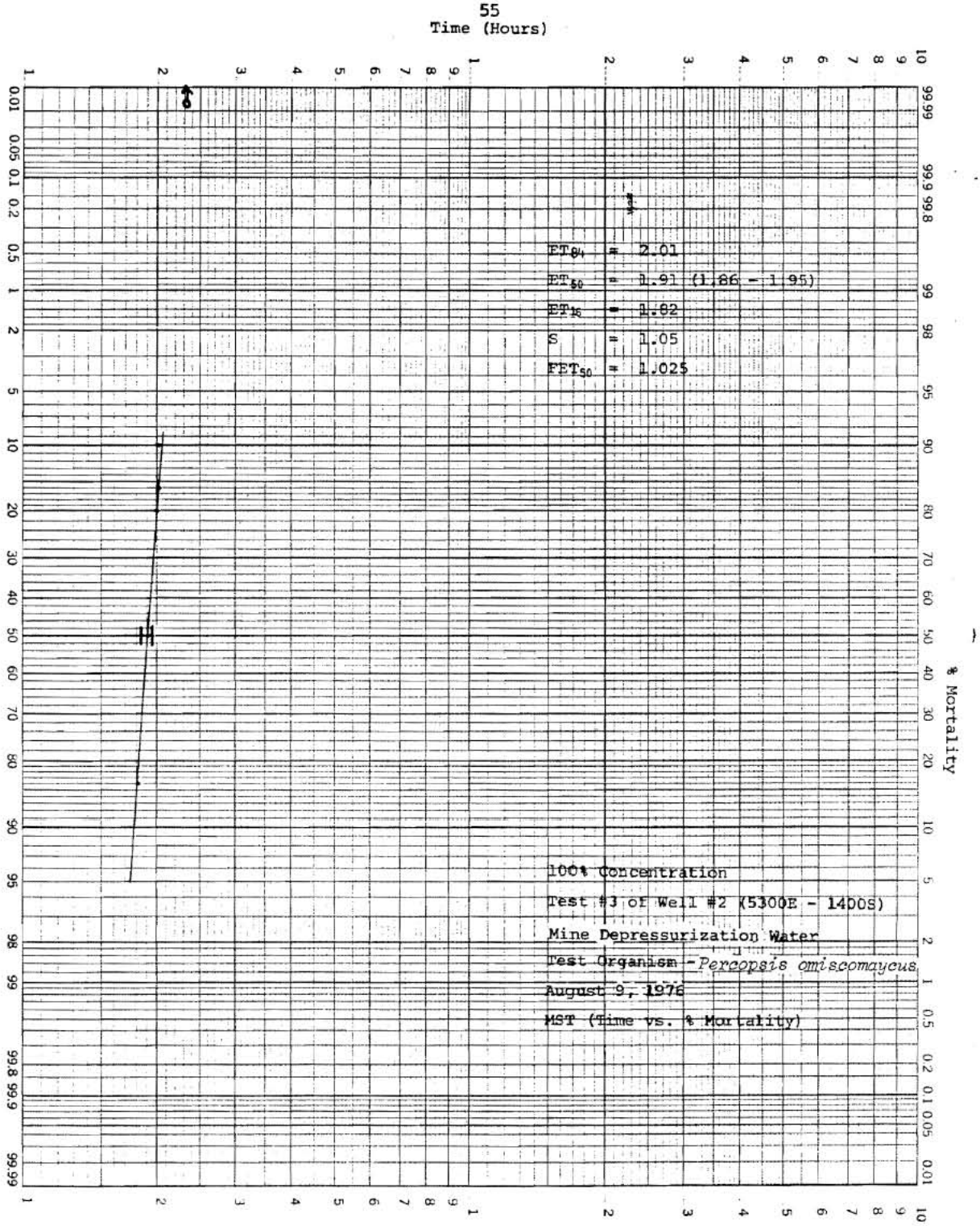
TEST # 3 MINE DEPRESSURIZATION WATER SEMI STATIC REPLACEMENT WELL # 2 TEST DATE AUGUST 23/76

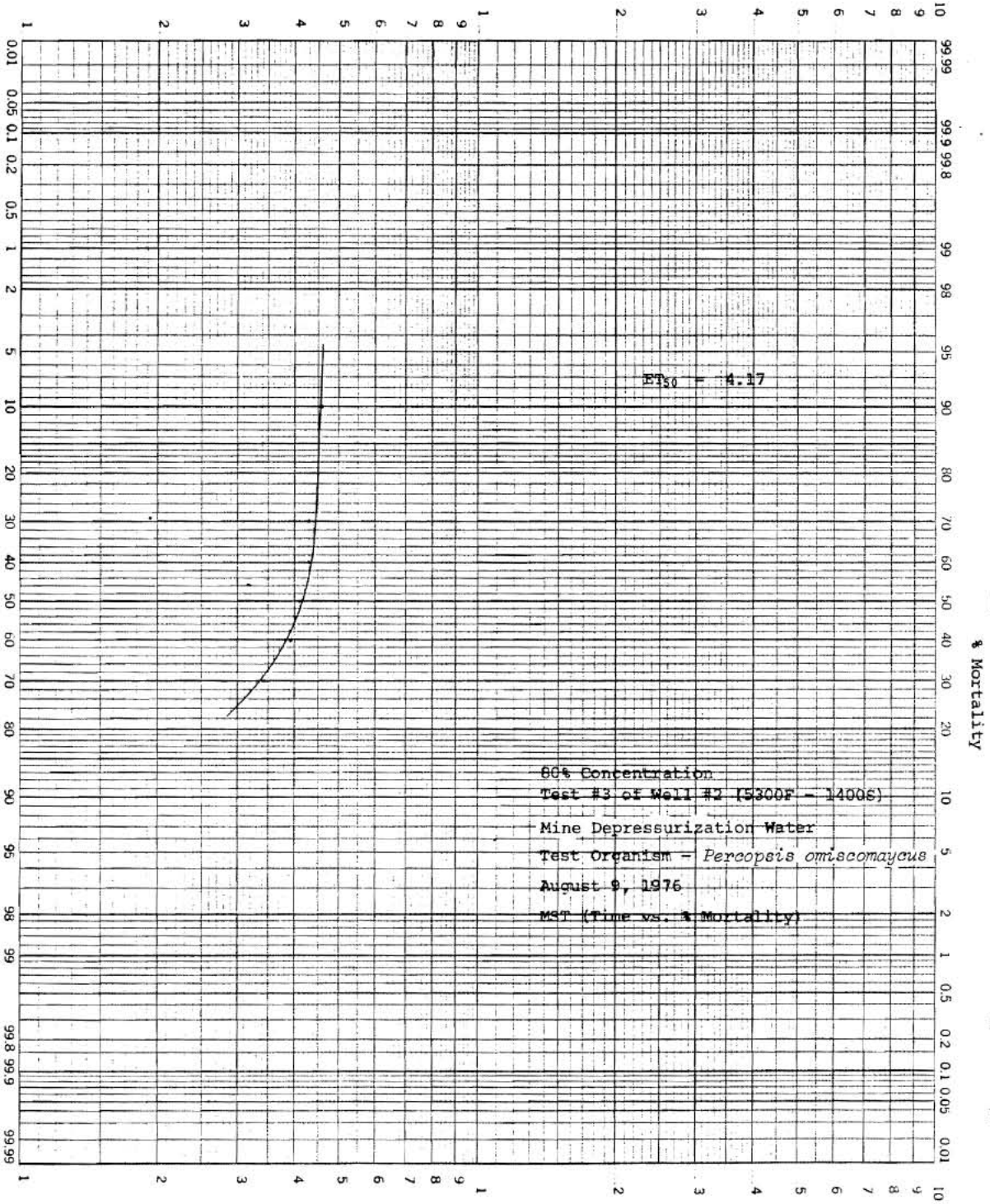
CONCENTRATION (MEAN & RANGE)

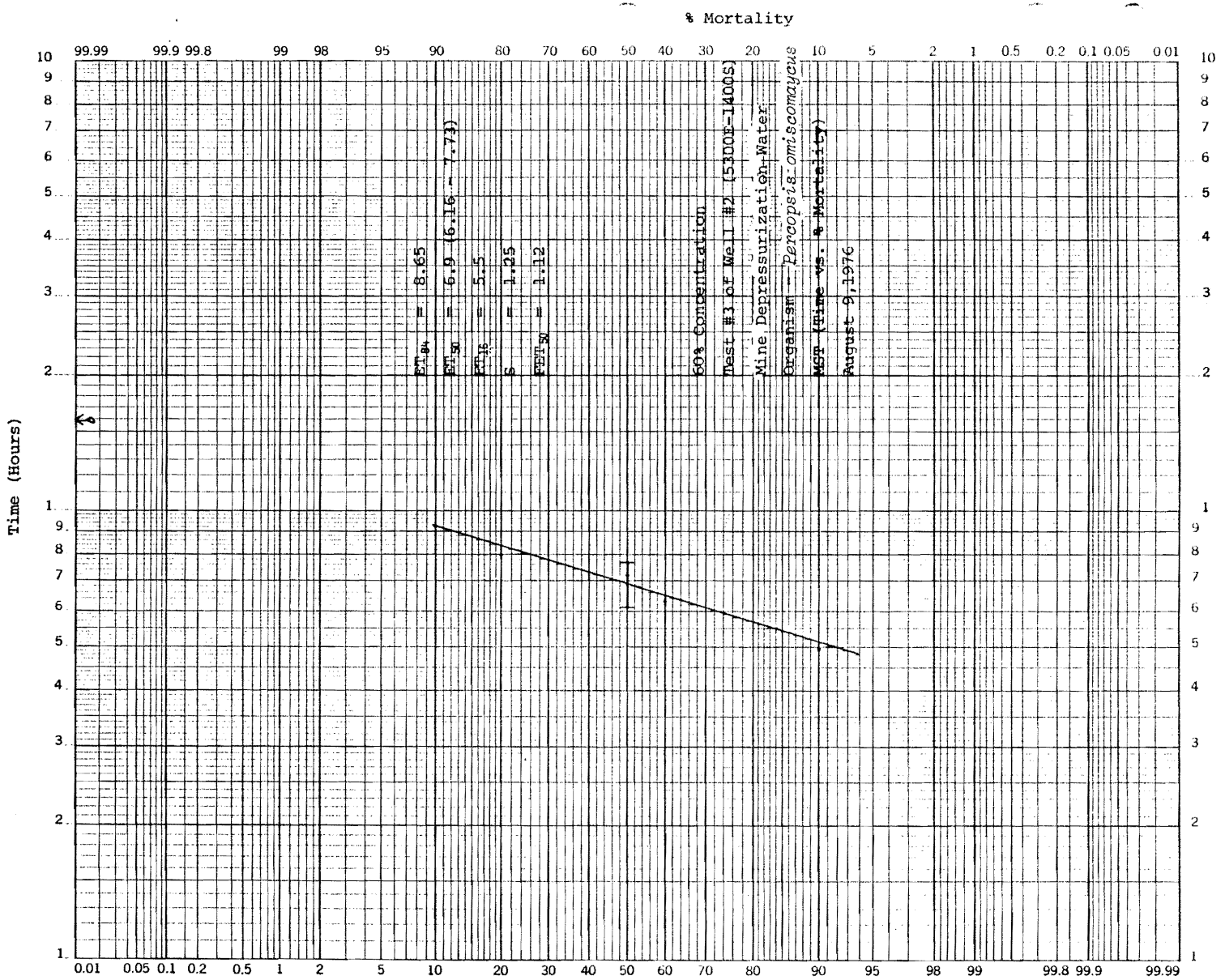
PARAMETERS	CONTROL 5 Readings	20% 5 Readings	40% 5 Readings	60% 2 Readings	80% 2 Readings	100% 2 Readings
Temperature (°C)	15.2 ± .33	15.2 ± .33	15.5 ± .40	15.75 Range (15.5-16.0)	15.5 No Range	15.5 No Range
Dissolved Oxygen (mg/l)	9.6 ± .13	9.6 ± .13	9.6 ± .17	8.7 Range (8.1- 9.3)	8.55 Range (7.8-9.3)	9.8 Range (9.7 -9.9)
pH	8.33 ± .01	8.62 ± .13	8.63 ± .12	8.13 Range (7.65-8.62)	7.80 Range (7.62-7.99)	8.09 Range (8.05-8.14)
Conductivity (µs/cm)	219	6712	> 10,000	> 10,000	> 10,000	> 10,000
Fish Length (cm.)			5.95 ± .39			
Fish Weight (gm)			2.13 ± .90			
Number Fish/ Dilution	5	5	5	5	5	5
Number Dilutions/ Conc.	2	2	2	2	2	2
Volume of Dilutions (l.)	20	20	20	20	20	20
LT_{50} (hrs.)			22.1 (19.95-24.49)	6.9 (6.16-7.73)	4.17	1.91 (1.86-1.95)
LC_{50} (Conc. by Vol.)	22.6%					

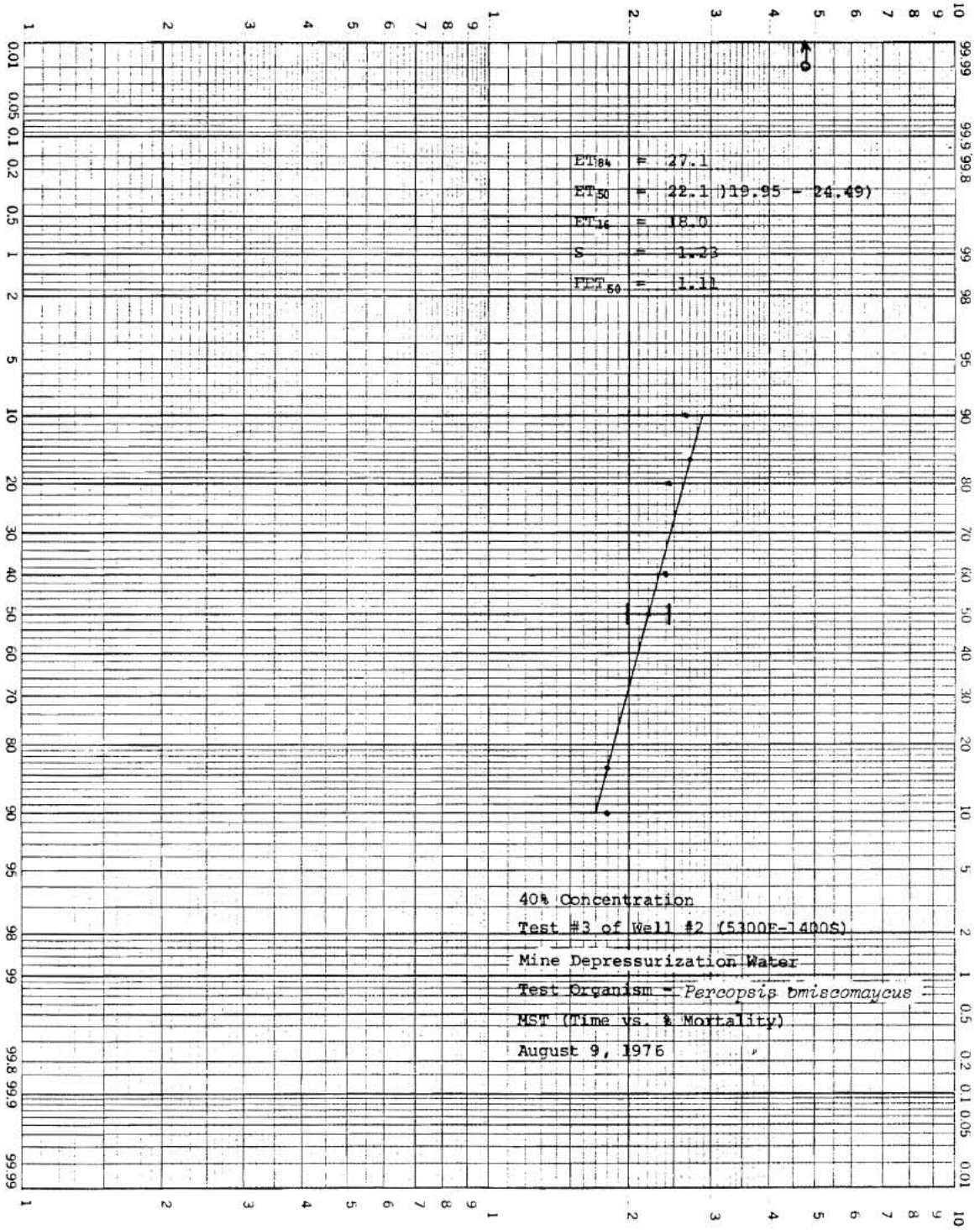
46 7320




Time (Hours)
% Mortality
ET_{84} = 2.01
ET_{50} = 1.91 (1.86 - 1.95)
ET_{16} = 1.82
S = 1.05
FET_{50} = 1.025
100% Concentration
Test #3 of Well #2 (5300E - 14D0S)
Mine Depressurization Water
Test Organism - *Percopsis omiscomaycus*
August 9, 1976
MST (Time vs. % Mortality)


Time (Hours)
% Mortality
ET_{50} = 4.17
80% Concentration
Test #3 of Well #2 (5300F - 14006)
Mine Depressurization Water
Test Organism - *Percopsis omiscomaycus*
August 9, 1976
MST (Time vs. % Mortality)


% Mortality
99.99 99.9 99.8 99 98 95 90 80 70 60 50 40 30 20 10 5 2 1 0.5 0.2 0.1 0.05 0.01
0.01 0.05 0.1 0.2 0.5 1 2 5 10 20 30 40 50 60 70 80 90 95 98 99 99.8 99.9 99.99
Time (Hours)
ET84 = 8.65
ET50 = 6.9 (6.16 - 7.73)
ET16 = 5.5
S = 1.25
FET50 = 1.12
60% Concentration
Test #3 of Well #2 (5300'-14005)
Mine Depressurization Water
Organism - Percopsis omiscomaycus
MSR (Time vs. % Mortality)
August 9,1976


Time (Hours)
ET_{84} = 27.1
ET_{50} = 22.1)19.95 - 24.49)
ET_{16} = 18.0
S = 1.23
FDT_{50} = 1.11
40% Concentration
Test #3 of Well #2 (5300E-1400S)
Mine Depressurization Water
Test Organism - *Percopsis omiscomaycus*
MST (Time vs. % Mortality)
August 9, 1976
K+E PROBABILITY X 2 LOG CYCLES
KEUFFEL & ESSER CO.
46 8043

2.2 TEST NO. 4 BIOASSAY DATA, 23 AUGUST 1976

Data presented here include:

1. cumulative mortality of Trout-perch (*Percopsis omiscomaycus*);
2. graphical determination of LC_{50} and MST's (Litchfield 1949); and
3. lethal concentration determination (Woolf 1968).

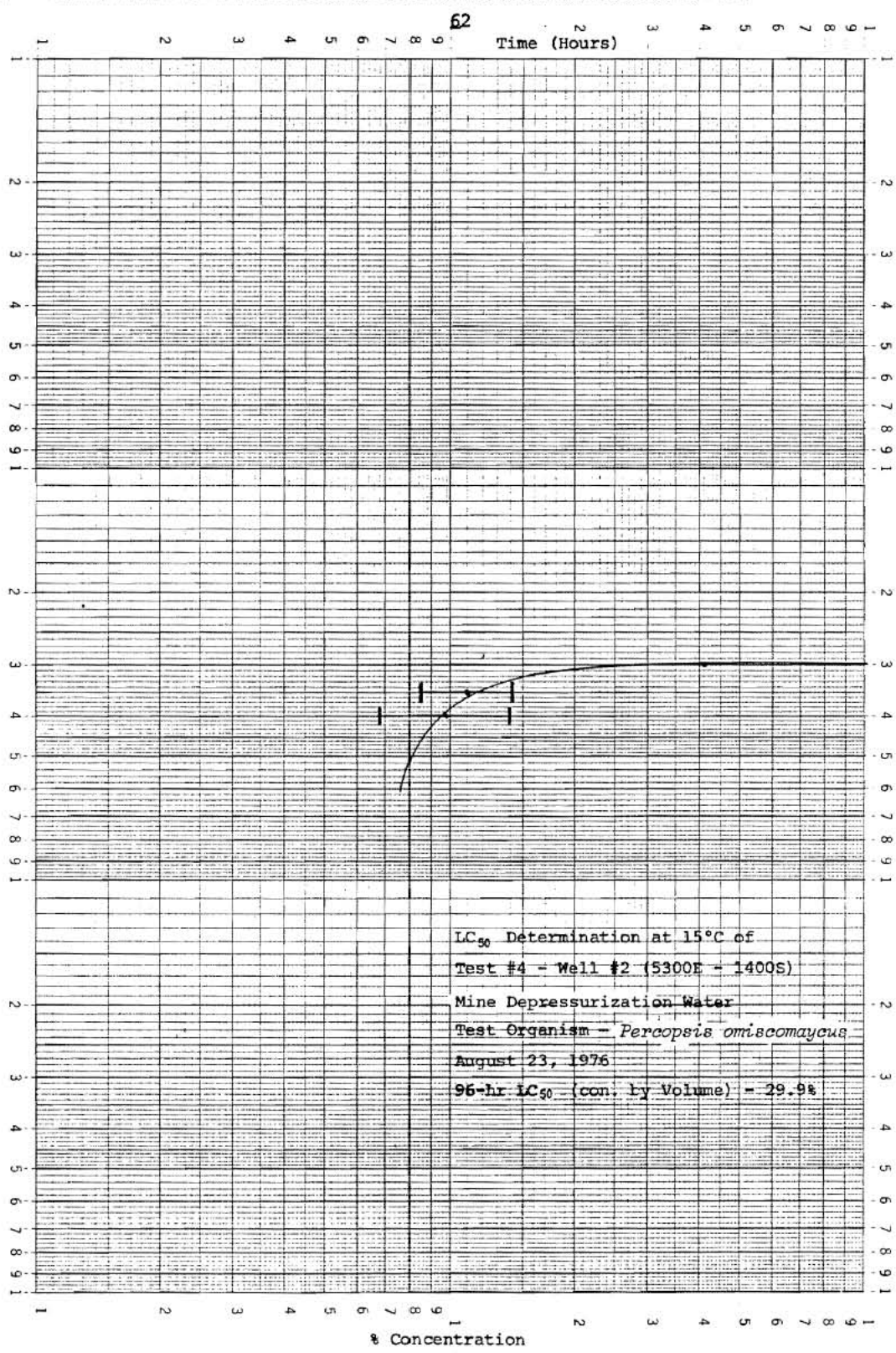
TEST # 4 MINE DEPRESSURIZATION WATER SEMI-STATIC REPLACEMENT OF WELL # 2 TEST DATE August 23/76

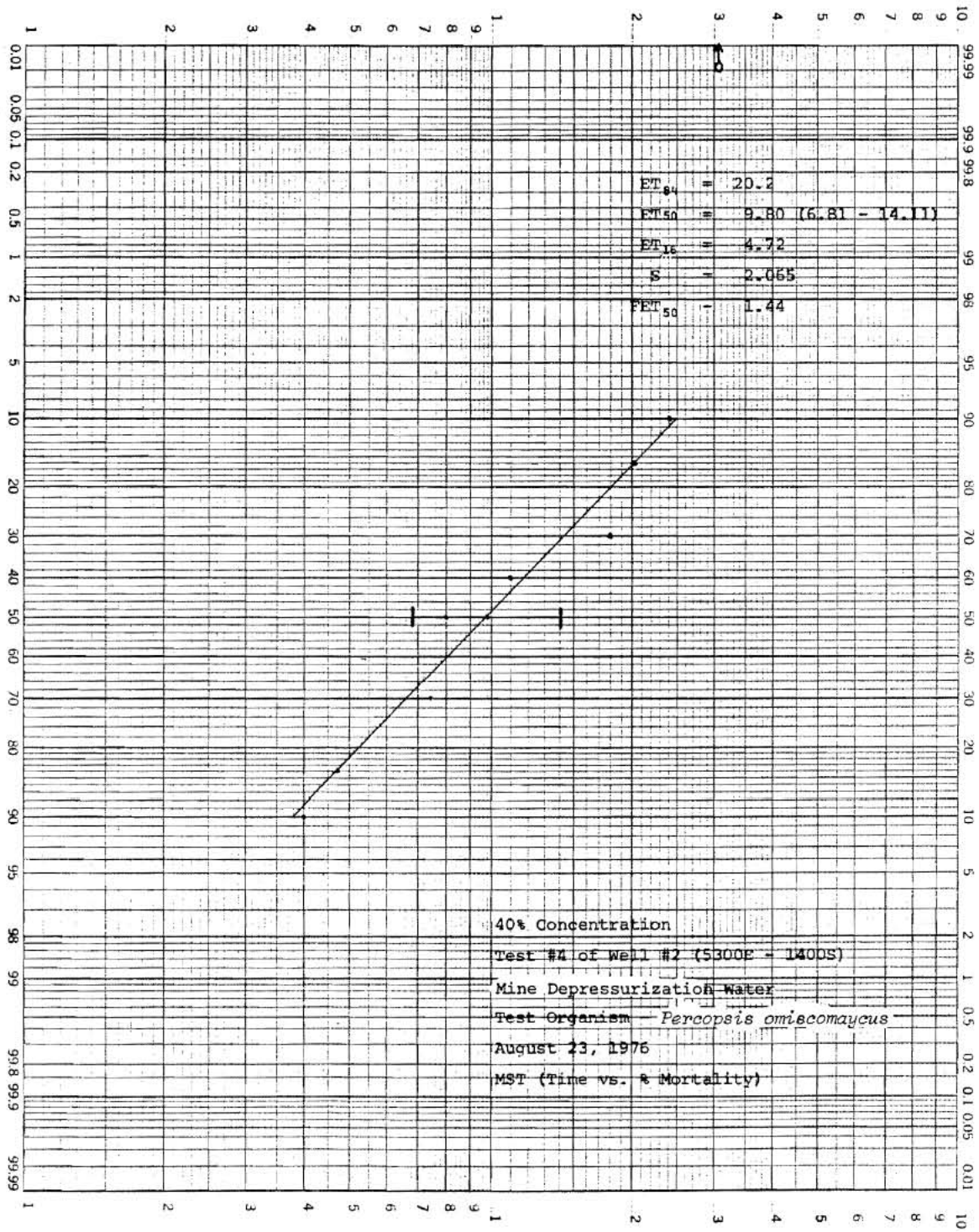
CONCENTRATIONS (MEAN & RANGE)

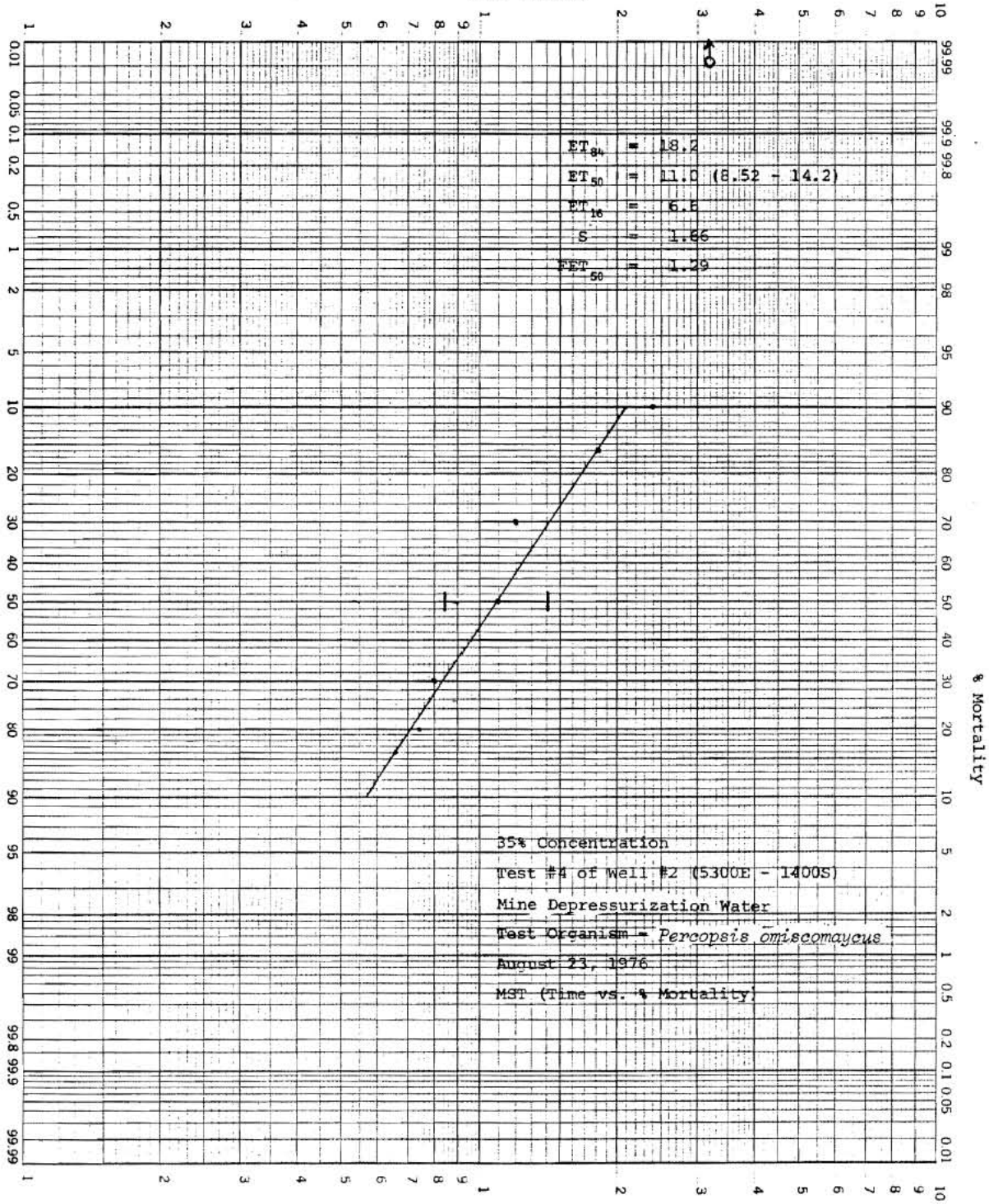
PARAMETERS	CONTROL 5 readings	20% 5 Readings	25% 5 Readings	30% 5 Readings	35% 5 Readings	40% 5 Readings
Temperature (°C)	14.8 ± .32	14.8 ± .32	14.8 ± .32	14.8 ± .32	14.6 Range (13.5-15.5)	14.5 Range (13.5-15.5)
Dissolved Oxygen (mg/l)	9.5 ± .14	9.4 ± .16	9.5 ± .14	9.6 ± .13	9.7 Range (9.5-9.9)	9.6 Range (9.4-9.8)
pH	8.31 ± .00	8.69 ± .31	8.64 ± .26	8.82 ± .29	9.02 Range (8.38-9.25)	8.90 Range (8.12-9.23)
Conductivity (µs/cm)	231	6650	8277	9591	> 10,000	> 10,000
Fish Length (cm.)			5.97 ± .49			
Fish Weight (gm.)			2.61 ± .66			
Number Fish/Dilution	5	5	5	5	5	5
Number Dilutions/Conc.	2	2	2	2	2	2
Volume of Dilutions (l.)	20	20	20	20	20	20
LT_{50} (hr.)				41.0	11.0 (8.52-14.2)	9.80 (6.81-14.11
LC_{50} (Conc. by Vol.)	29.9%					

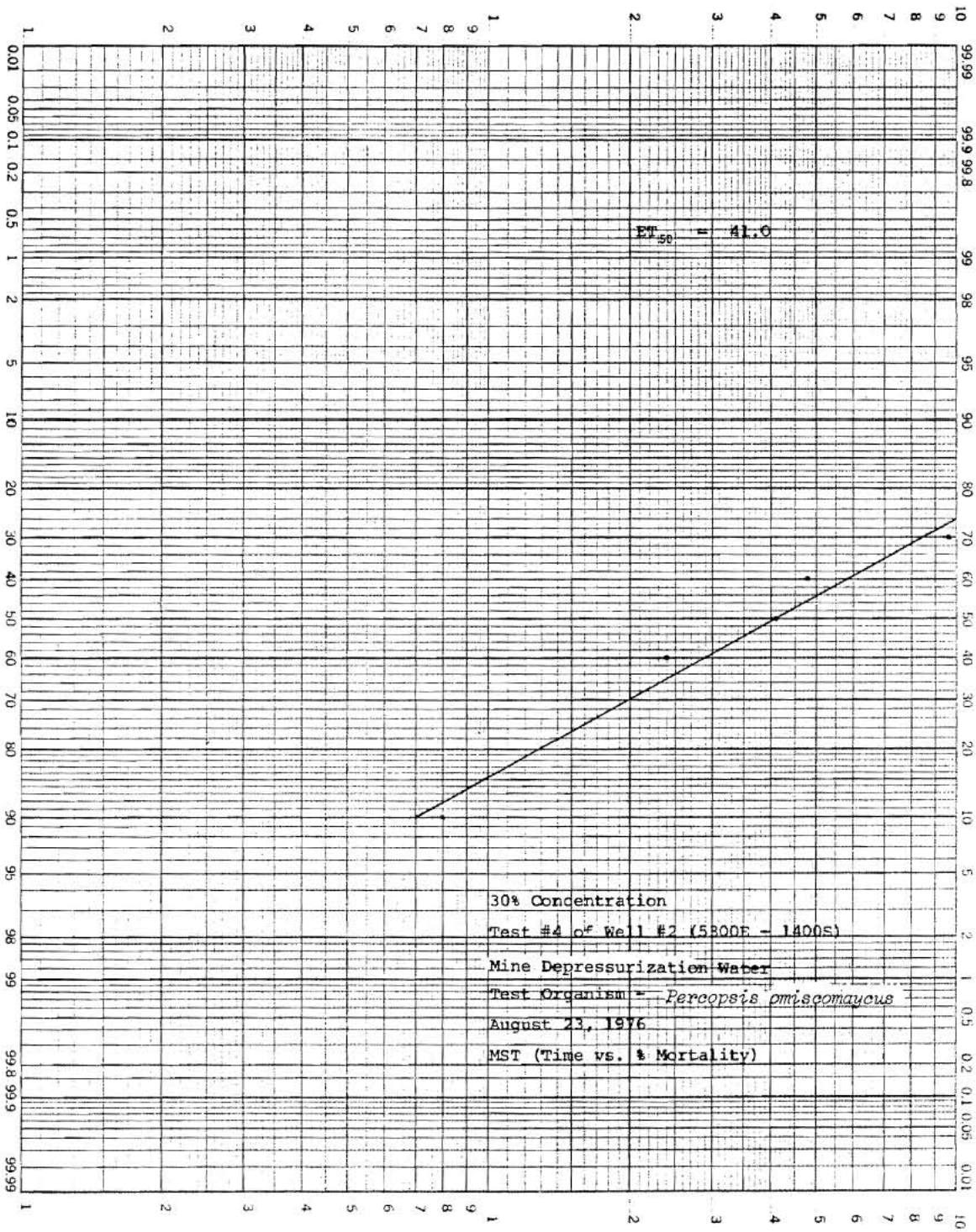
CUMULATIVE MORTALITY OF TROUT PERCH *(Percopsis omiscomaycus)* - Test #4, Well #2

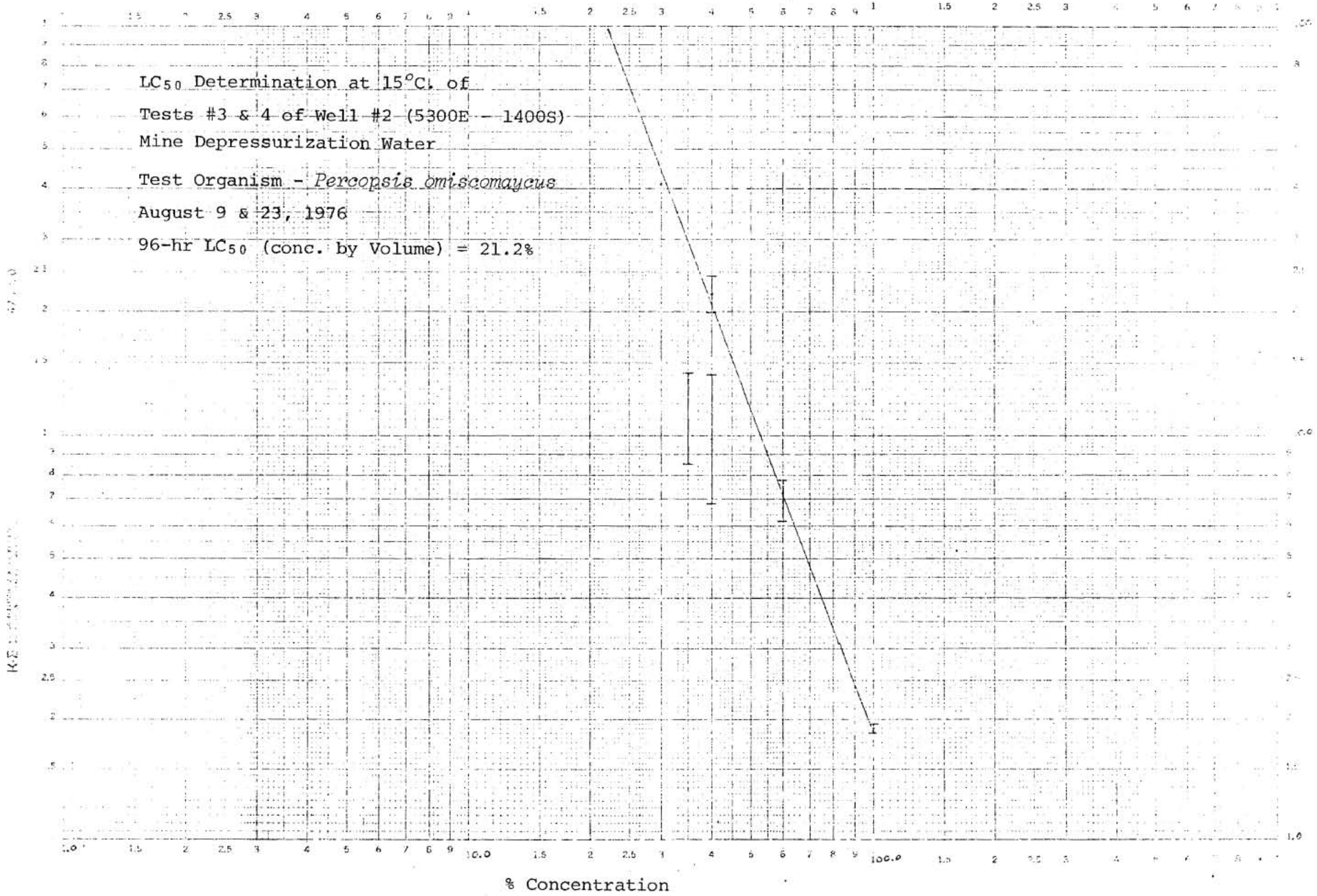
Concentration Mine Depressurization Water (% by volume)	TIME (Hours)																		Total % mortality (96 hrs)
	0.0	0.25	0.50	1.00	2.00	4.00	7.42	8.00	12.00	18.00	24.00	31.50	32.00	36.00	48.00	60.00	72.00	80.50	96.00	
Control																				
N = 10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
% mortality	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20																				
N = 10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% mortality	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25																				
N = 10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	
% mortality	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	10	10	10
30																				
N - 10	0	0	0	0	0	0	0	1	1	1	4	4	4	4	6	6	6	6	7	
% mortality	0	0	0	0	0	0	0	10	10	10	40	40	40	40	60	60	60	60	70	70
35																				
N = 10	0	0	0	0	0	0	2	3	7	7	9	9	10							
% mortality	0	0	0	0	0	0	20	30	70	70	90	90	100							100
40																				
N = 10	0	0	0	0	0	1	3	5	6	7	9	10								
% mortality	0	0	0	0	0	10	30	50	60	70	90	100								100




Time (Hours)
% Mortality
ET_{84} = 20.2
ET_{50} = 9.80 (6.81 - 14.11)
ET_{16} = 4.72
S = 2.065
FET_{50} = 1.44
40% Concentration
Test #4 of Well #2 (5300E - 1400S)
Mine Depressurization Water
Test Organism — *Percopsis omiscomaycus*
August 23, 1976
MST (Time vs. % Mortality)


Time (Hours)
% Mortality
ET_{84} = 18.2
ET_{50} = 11.0 (8.52 - 14.2)
ET_{16} = 6.6
S = 1.66
FET_{50} = 1.29
35% Concentration
Test #4 of Well #2 (5300E - 1400S)
Mine Depressurization Water
Test Organism - Percopsis omiscomaycus
August 23, 1976
MST (Time vs. % Mortality)


Time (Hours)
% Mortality
ET_{50} = 41.0
30% Concentration
Test #4 of Well #2 (5300E - 1400S)
Mine Depressurization Water
Test Organism - *Percopsis omiscomaycus*
August 23, 1976
MST (Time vs. % Mortality)


LC50 Determination at 15°C. of
Tests #3 & 4 of Well #2 (5300E – 1400S)
Mine Depressurization Water
Test Organism - Percopsis omiscomaycus
August 9 & 23, 1976
96-hr LC50 (conc. by Volume) = 21.2%
Time (Hours)
% Concentration

LETHAL CONCENTRATION DETERMINATION

WELL NO. 2

(5300E - 1400S)

2 Hrs.

Concentration	N	No. Dead	No. Alive	Accumulated Dead	Accumulated Alive	Total	Cumulative Mortality %
Control	10	0	10	0	82	82	0
20	10	0	10	0	72	72	0
25	10	0	10	0	62	62	0
30	10	0	10	0	52	52	0
35	10	0	10	0	42	42	0
40	10	0	10	0	32	32	0
60	10	0	10	0	22	22	0
80	10	0	10	0	12	12	0
100	10	8	2	8	2	10	80

LC_{50} = 92.5

LETHAL CONCENTRATION DETERMINATION

WELL NO. 2

(5300E - 1400S)

12 Hrs.

Concentration	N	No. Dead	No. Alive	Accumulated Dead	Accumulated Alive	Total	Cumulative Mortality %
Control	10	0	10	0	46	46	0
20	10	0	10	0	36	36	0
25	10	0	10	0	26	26	0
30	10	1	9	1	16	17	5.9
35	10	7	3	8	7	15	53.3
40	10	6	4	14	4	18	77.8
60	10	10	0	24	0	24	100
80	10	10	0	34	0	34	100
100	10	10	0	44	0	44	100

LC_{50} = 34.7 $\pm$ 5.6

LETHAL CONCENTRATION DETERMINATION

WELL NO. 2

(5300E - 1400S)

24 Hrs.

Concentration	N	No. Dead	No. Alive	Accumulated Dead	Accumulated Alive	Total	Cumulative Mortality %
Control	10	0	10	0	38	38	0
20	10	0	10	0	28	28	0
25	10	0	10	0	18	18	0
30	10	4	6	4	8	12	33.3
35	10	9	1	13	2	15	86.7
40	10	9	1	22	1	23	95.6
60	10	10	0	32	0	32	100
80	10	10	0	42	0	42	100
100	10	10	0	52	0	52	100

$LC_{50} = 31.6 \pm 5.0$

LETHAL CONCENTRATION DETERMINATION

WELL NO. 2

(5300E - 1400S)

48 Hrs. & 72 Hrs.

Concentration	N	No. Dead	No. Alive	Accumulated Dead	Accumulated Alive	Total	Cumulative Mortality %
Control	10	0	10	0	34	34	0
20	10	0	10	0	24	24	0
25	10	0	10	0	14	14	0
30	10	6	4	6	4	10	60
35	10	10	0	16	0	16	100
40	10	10	0	26	0	26	100
60	10	10	0	36	0	36	100
80	10	10	0	46	0	46	100
100	10	10	0	56	0	56	100

$LC_{50} = 29.2 \pm 4.9$

LETHAL CONCENTRATION DETERMINATION

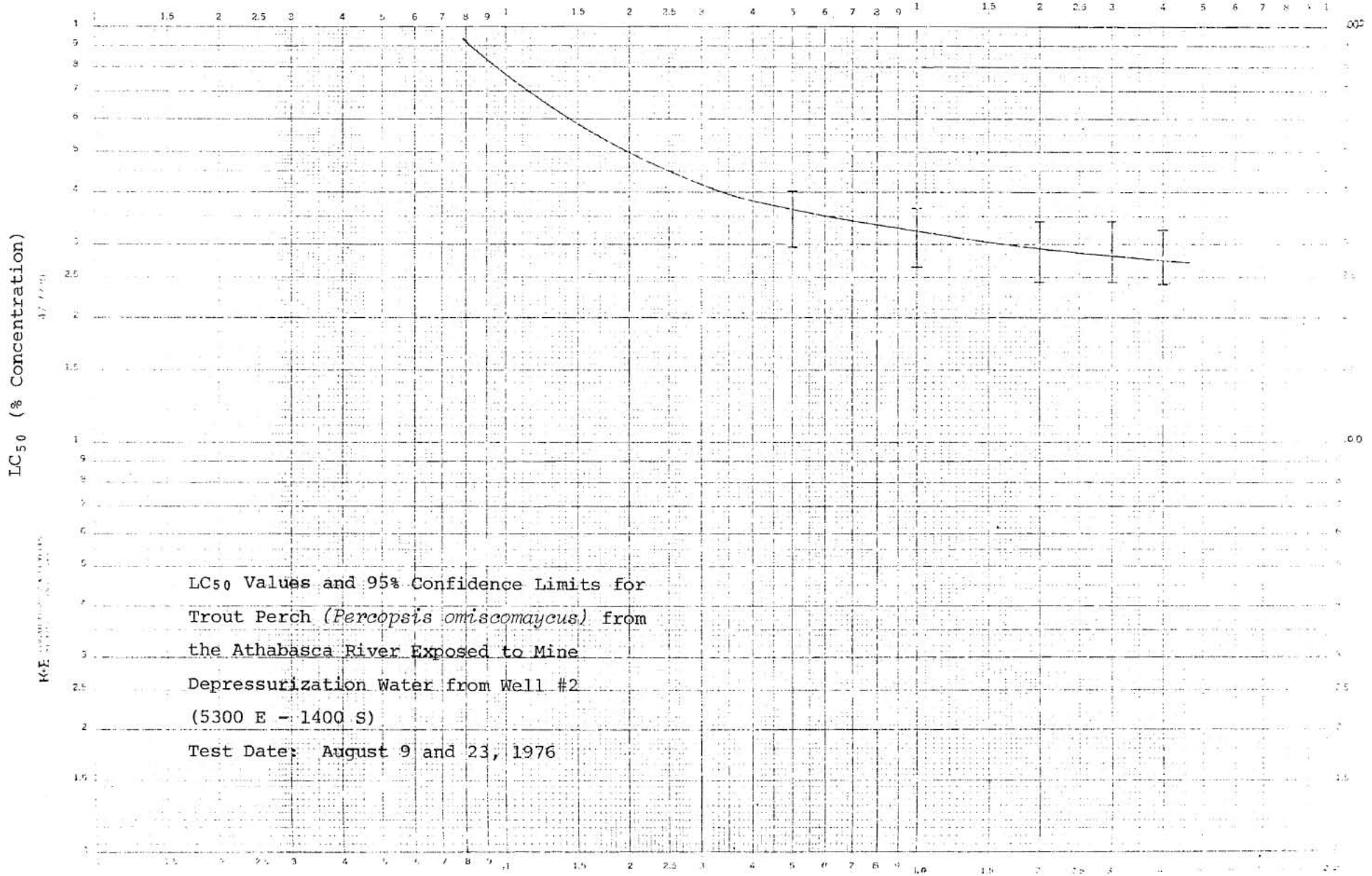
WELL NO. 2

(5300 E - 1400S)

96 Hrs.

Concentration	N	No. Dead	No. Alive	Accumulated Dead	Accumulated Alive	Total	Cumulative Mortality %
Control	10	0	10	0	32	32	0
20	10	0	10	0	22	22	0
25	10	1	9	1	12	13	7.7
30	10	7	3	8	3	11	72.7
35	10	10	0	18	0	18	100
40	10	10	0	28	0	28	100
60	10	10	0	38	0	38	100
80	10	10	0	48	0	48	100
100	10	10	0	58	0	58	100

$LC_{50} = 28.3 \pm 4.2$



LC_{50} Values and 95% Confidence Limits for Trout Perch *(Percopsis omiscomaycus)* from the Athabasca River Exposed to Mine Depressurization Water from Well #2 (5300 E - 1400 S)

Test Date: August 9 and 23, 1976

2.3 CHEMISTRY DATA (JUNE TO OCTOBER 1976)

Data presented here include a summary of chemistry analysis of mine depressurization water collected from Syncrude's Lease 17 and compared to analysis of Athabasca River water.

MINE DEPRESSURIZATION WATER

SYNCRUDE LEASE 17

CHEMISTRY DATA SITE #2 5300 E - 1400 S

(1) 96 hr. LC_{50} = 22.6%

M.S.T. (hrs.) 100% = 1.91 (1.86 - 1.95)
80% = 4.17
60% = 6.9 (6.16 - 7.73)
40% = 22.1 (19.95 - 24.49)

(2) 96 hr. LC_{50} = 29.9%

M.S.T. (hrs.) 40% = 9.80 (6.81 - 14.11)
35% = 11.0 (8.52 - 14.2)
30% = 41.0

	POLLUTION CONTROL LAB					CHEMEX LABS (ALTA) LTD.		SAMPLE DATES 1976							
PARAMETEPS	NAQUADAT CODE	DETECTION LIMIT	June 14	June 28	JULY 08	NAQUADAT CODE	DETECTION LIMIT	July 22	July 28	August 04	August 09 **	August 18	August 24 **	August 26***	August 26
Calcium	20105L	2.0	77	108	211	20103L	0.002	120	34.0	110.0	72.0	22.5	60.0	228	105.0
Magnesium	12102L	1.0	100	196	207	12102L	0.001	180	200	185	200	210	180	180.2	178
Sodium	11102L	0.1	5156	6563	7054	11102L	0.5	7000	7000	7250	6900	7900	7250	6900	7250
Potassium	19102L	0.1	36.9	47.7	37.6	19102L	0.5	56	44	43	45	51.5	65.0	60	61.0
Chloride	17203L	1.0	7692	9856	10000	17203L	0.5	9569	9400	10500	10500	11000	9650	9400	9650
Sulphate	16306L	10.0	34	78	10*	16306L	1.0	0.6	0.5	1.9	0.5*	1.4	3.1	39	1.6
Alkalinity T	10101L	5.0	2085	2825	2877	10101L	1.0	2782	4368	2772	2760	2690	3024	2868	2788
pH	10301L	0.0	8.8	7.0	7.4	10301L	0.0	7.1	7.0	7.1	7.3	7.6	7.6	6.9	7.3
Carbonate	06301L	5.0	134			06301L	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0.0
Bicarbonate	06201L	5.0	2270	3443	3507	06201L	1.0	3391.3	5324.6	3379.1	3364.4	3279.1	3686.3	3496.1	3398.6
Hardness T	10604L	5.0	605	1079	1377	10603L	1.0	1040.7	908.3	1036.3	1003.2	920.8	890.9	1311	995
Fluoride	09107L	0.05	0.78	0.65	0.72	09105L	0.1	0.61	0.64	0.48	0.48	0.58	0.52	-	0.56

CHEMISTRY DATA SITE # 2 5300 E - 1400 S

PARAMETERS	September					October		MEAN	RANGE		
	02	08	15	24	28	07	19		Low	-	High
Calcium	100.0	44.5	25.5	44	45	58	16	82.25	16	-	228
Magnesium	175	142	128	68	65	68	72	151.89	65	-	210
Sodium	7000	7000	6500	4550	4500	4525	4500	6377.66	4500	-	7900
Potassium	62.0	45	43	46	43	45	42	48.49	36.9	-	65
Chloride	10000	9750	8750	5400	5250	5400	5425	8732.86	5250	-	10500
Sulphate	1.1	0.5	2	0.5	3.1	0.5	0.5	9.93	0.05*	-	78
Alkalinity	2790	2788	2772	3075	3075	2950	3096	2910.28	2085	-	4368
pH	7.2	7.5	7.8	7.8	7.8	7.4	7.7	7.46	6.9	-	8.8
Carbonate	0.0	0	0	0	0	0	0	8.37	0.0	-	134
Bicarbonate	3401.0	3398.6	3379.1	3748.4	3748.4	3596.1	3774	3532.51	2270	-	5324
Hardness T	970.2	695.7	590.6	389.8	380	424.8	336.4	997.47	336.4	-	1377
Fluoride	0.58	0.66	0.53	0.8	0.69	0.5	0.81	0.62	0.48	-	0.81

SITE #2 5300E - 1400S (Continued)

PARAMETERS	POLLUTION CONTROL LAB		June			CHEMEX LABS (ALTA) LTD.		July		August					
	NAQUADAT CODE	DETECTION LIMIT	14	28	08	NAQUADAT CODE	DETECTION LIMIT	22	28	04	09**	18	24**	26***	26
Silica	14102L	0.5				14101L	0.02	4.2	3.6	2.8	2.7	2.9	2.6		2.5
Conductivity	02041L	0.2	24600	30800	29000	02041L	1.0	24000	40000	34000	32000	34000	34000	28000	33000
Odor	02001L	0.0	10	10		02001L	1.0	16	16	8	16	16	16		64
Color	02011L	1.0	98	98	97	02011L	1.0	5*	5*	5*	5*	5*	5*		5*
Color T_2	02011L	1.0	99	99	98										
Color T_3	02011L	1.0	97	97	96										
Tanin & Lignin	06551L	0.1	0.1*	0.5	0.5	06551L	0.1	1.80	1.60	0.45	0.40	0.90	0.25		0.85
T.R.	10471L	10.0	8810	19330	18138										
T.F.R.	10571L	10.0		18568	17602	10451L	1.0	18760	19240	17604	18608	18720	18870		18630
T.F.P.F.						10551L	1.0	18476	18520	17560	18168	18540	18100		18110
T.N.F.R.						10401L	1.0	4.4	6.0	9.2	3.6	6.4	12.8		4.8
T.N.F.R.F.						10510L	1.0	2.0	2.8	3.6	1.6	3.6	6.8		1.6
Turbidity	02073L	0.0	3	3		02073L	0.0	3.7	5.7	16.5	4.6	15.4	13.0		10.0
Surfactants	10701L	0.05	1.12	1.88	1.50	10701L	0.02	0.04	0.05	0.02*	0.02*	0.10	0.02*		0.02*
Humic Acids						00000L	2.0	2.0*	2.0*	1.0*	1.0*	1.0*	1.0*		1.0*
T.O.C.	06001L	2.0	348		294	06001L	1.0	20	10	20	50	10	10		20

CHEMISTRY DATA SITE # 2 5300 E - 1400 S

PARAMETERS	September					October		MEAN	RANGE		
	02	08	15	24	28	07	19		Low	-	High
Silica	2.6	2.6	2.9	2.5	2.6	2.6	2	3.81	2	-	18
Conductivity	33000	35000	33000	17700	17700	17100	17200	28561.11	17100	-	40000
Odor	32	8	32	8	4	16	32	19	4	-	64
Color	5*	5*	5*	5*	5*	5*	5*	21.35	5*	-	98
Color T								98.6	98	-	99
Color T_3								96.6	96	-	97
Tanin & Lignin	1.15	0.65	0.2	0.2	0.3	0.2	0.2*	0.6	0.1*	-	1.8
TR								15426	8810	-	19330
TFR	18480	18400	17180	11815	11545	11675	11590	16705.44	11545	-	19240
TFRF	17520	17700	16760	11535	11215	11240	11225	16047.79	11215	-	18540
TNFR	5.6	6	4.4	8.6	36	14	9.6	9.39	3.6	-	36
TNFRF	1.6	3.2	3.6	6.5	23.6	9.8	2	5.16	1.6	-	23.6
Turbidity	13.0							8.79	3	-	16.5
Surfactants	0.02*	0.02*	0.05	0.02*	0.02	0.02*	0.02*	0.29	0.02*	-	1.88
Humic Acids	1.0*	1.0*	1.0*	1.0*	1.0*	1.0*	1.0*	1.14*			
TOC	40	50	20	40	10	20	125	67.94	10	-	348

SITE #2 5300E - 1400S (Continued)

	POLLUTION CONTROL LAB					CHEMEX LABS (ALTA) LTD.									
PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	JUNE 14	28	JULY 08	NAQUADAT CODE	DETECTION LIMIT	JULY 22	28	AUGUST 04	09**	18	24**	26***	26
T.I.O.C.	06051L	2.0	538		545	06501L	0.5	750	810	680	700	550	660		720
Nitrite	07205L	0.1	0.1*		0.1*										
$NO_2 + NO_3$	07105L	0.1	0.1*	0.035	0.1*	07110L	0.01	0.1*	0.1*	0.02	0.1*	0.02	0.01		0.01*
NH_3	07555L	0.05		13.65	11.85	07506L	0.005	9.5	9.8	3.30	9.0	12.0	7.60		8.80
Nitrogen Tk	07003L	0.05	8.44	14.76	10.53	07013L	0.3	14.40	12.9	4.80	11.0	13.0	11.20		11.50
Phosplate T	15407L		0.74	0.54	0.46										
Phosphorus T	15001L	0.05		0.118		15406L	0.003	0.077	0.087	0.13	0.04	0.10	0.05		0.13
Phosphorus O	15256L					15256L	0.003	0.032	0.013	0.10	0.04	0.07	0.04		0.08
Phenol	06532L	0.001				06532L	0.002	0.090	0.008	0.001*	0.001*	0.003	0.024		0.001*
Oil & Grease	06521L	1.0	7.6	3.2		06521L	0.1	1.1	1.1	0.5	0.1*	0.7	5.0		0.1*
Sulphide	06101L	0.02				16101L	0.05	0.06	0.11	0.05*	0.05*	0.05*	0.05*		0.05*
Cyanide	06601L	0.002	0.01*	0.01*	0.01*	00000L	0.1	0.01*	0.01*	0.01*	0.01*	0.01*	0.01*		0.01*
Hydrocarbon T	06500L	0.001	0.001*	0.013	0.027	00000L	10.	84.6	216	0.1*	0.1*	0.3	4.7		0.1*
B.O.D.	08201L	0.01		6.0											
C.O.D.	08301L	5.0	118.1	140.8	84.6	08301L	5.0	80.6	961.8	85.0	180.0	63.7	30.0	1000	
Cadmium	48302L	0.001	0.014			48302L	0.001	0.021	0.023	0.023	0.024	0.025	0.048	0.001*	0.046

CHEMISTRY DATA SITE # 2 5300 E - 1400 S

PARAMETERS

	September				October		MEAN	RANGE
	02	08	15	24	28	07	19		Low - High
T.I.O.C.	750	730	660	720	820	720	725	692.38	538 - 820
Nitrite								0.1*	
NO_2 & NO_3	0.02	0.02	0.01*	0.01*	0.04		0.01*	0.027	0.01* - 0.04
NH_3	5.60	7.9	4.2	8.5	8	8.4	6.7	7.93	3.3 - 13.65
Nitrogen Tk	12.2	13.8	16	9.9	9.7	10.1	8.8	11.36	4.8 - 16
Phosphorus T	0.14	0.12	0.07	0.12	0.13	0.12	0.11	0.1	0.04 - 0.14
Phosphate T								0.58	0.46 - 0.74
Phosphorus O	0.11	0.03	0.04	0.05	0.07		0.08	0.06	0.013 - 0.11
Phenol	0.016	0.001*	0.001*	0.007	0.001*	0.001*	0.001*	0.01	0.001* - 0.09
Oil & Grease	4.0	4.5	0.5	0.2	1.3	1.1	0.6	1.98	0.1* - 7.6
Sulphide	0.05*	0.05*	0.05*	0.05*	0.05*	0.05*	0.05*	0.06	0.05* - 0.11
Cyanide	0.01*	0.01*	0.01*	0.01*	0.01*	0.01*	0.01*	0.01*	
Hydrocarbon T	0.4	4		0.1*	0.4	0.6		20.76	0.001* - 216
B.O.D.								6.0	
C.O.D.	190	352	452	336	376	502	56	294.62	30 - 1000
Cadmium	0.049	0.001*	0.001*	0.001*	0.001*	0.001*	0.001*	0.017	0.001* - 0.049

SITE #2 5300E - 1400S (Continued)

PARAMETERS	POLLUTION CONTROL LAB					CHEMEX LABS (ALTA) LTD.									
	NAQUADAT CODE	DETECTION LIMIT	JUNE 14	JUNE 28	JULY 08	NAQUADAT CODE	DETECTION LIMIT	JULY 22	JULY 28	AUGUST 04	AUGUST 09**	AUGUST 18	AUGUST 24**	AUGUST 26***	AUGUST 26
Chromium^{+6}	24101L	0.002	0.002*	0.002*	0.002*	24101L	0.003	0.007	0.001	0.022	0.019	0.013	0.007	0.005*	0.013
Copper	29305L	0.001				29306L	0.01	0.021	0.021	0.025	0.032	0.021	0.015	0.002	0.024
Iron	26302L	0.05	0.1	0.3	0.2	26304L	0.05	0.56	0.59	0.45	0.70	0.49	1.45	0.05	0.66
Lead	82302L	0.003				82302L	0.002	0.042	0.049	0.10	0.09	0.080	0.068	0.004*	0.142
Manganese	25004L	0.008				25004L	0.01	0.20	0.19	0.12	0.14	0.2	0.225	0.27	0.091
Silver	47303L	0.001				47301L	0.01	0.02	0.005	0.015	0.02	0.015	0.005		0.005
Zinc	30305L	0.001				30304L	0.01	0.012	0.016	0.048	0.086	0.019	0.067	0.016	0.018
Vanadium	23301L	0.05				23301L	0.05	0.05	0.04	0.001*	0.001*	0.001*	0.001*	0.001*	0.001*
Selenium	34102L	0.0002						0.0043	0.003	0.0033	0.0031	0.009	0.0005*	0.0005*	0.0005*
Mercury	80003L	0.0001	0.0001*	0.0001*	0.0001*			0.0004	0.0003	0.0006	0.0003	0.0013	0.0002*		
Arsenic	33104L	0.0002		0.0002*	0.0002*			0.005	0.017	0.005	0.005*	0.02	0.005*	0.0005*	0.005*
Nickel	28302L	0.001	0.004					0.178	0.170	0.156	0.160	0.173	0.187	0.002*	0.195
Aluminum	13005L	0.02						0.10	0.06	0.05	0.07	0.09	0.04	0.005*	0.06
Cobalt	27302L	0.001						0.150	0.140	0.116	0.130	0.15	0.165	5.11	0.145
Boron	05102L	0.1						1.60	3.18	0.92	0.52	7.08	2.20		4.22

CHEMISTRY DATA SITE # 2 5300 E - 1400 S

PARAMETERS	September					October		MEAN	RANGE	
	02	08	15	24	28	07	19		Low -	High
Chromium $^{+6}$	0.012	0.003*	0.003*	0.003*	0.003*	0.003*	0.003*	0.0079	0.002* -	0.019
Copper	0.023	0.001	0.003	0.007	0.004	0.014	0.001*	0.012	0.001* -	0.032
Iron	0.40	0.5	0.2	0.3	1.8	2.45	1.1	0.69	0.05 -	2.45
Lead	0.046	0.008	0.002*	0.002*	0.002*	0.002*	0.002*	0.04	0.002* -	0.142
Manganese	0.195	0.138	0.164	0.09	0.105	0.122	0.14	0.22	0.09 -	0.225
Silver	0.015	0.005*	0.005*	0.005	0.005*		0.005*	0.0099	0.005* -	0.02
Zinc	0.031	0.003	0.003	0.005	0.007	0.006	0.011	0.02	0.003 -	0.086
Vanadium	0.001*	0.001*	0.001*	0.001*	0.001*	0.001*	0.001*	0.007	0.001* -	0.05
Selenium	0.0005*	0.0009	0.0005*	0.0005*	0.0005*	0.0009	0.0005*	0.0019	0.0005* -	0.009
Mercury	0.0002*	0.0002*	0.0002*	0.0003	0.0007	0.0002*	0.0001*	0.0004	0.0001* -	0.0007
Arsenic	0.005*	0.005*	0.005*	0.001*	0.009	0.014	0.001*	0.006	0.0002* -	0.02
Nickel	0.191	0.002*	0.002*	0.002*	0.002*	0.002*	0.002*	0.089	0.002* -	0.195
Aluminum	0.06	0.12	0.14	0.07	0.44	0.29	0.17	0.12	0.005* -	0.44
Cobalt	0.165	0.002*	0.007	0.002*	0.002*	0.002*	0.002*	0.079	0.002* -	0.165
Boron	3.31	2.8	2.35	2.31	1.45	1.62	2.2	2.73	0.52 -	7.08

SITE #2 5300E - 1400S (Continued)

PARAMETERS	POLLUTION CONTROL LAB					CHEMEX LABS (ALTA) LTD.									
	NAQUADAT CODE	DETECTION LIMIT	JUNE 14	JUNE 28	JULY 08	NAQUADAT CODE	DETECTION LIMIT	JULY 22	JULY 28	AUGUST 04	AUGUST 09**	AUGUST 18	AUGUST 24**	AUGUST 26***	AUGUST 26
Pesticides	00000L														
T.D.S.	00205L	0.0	14348	18543	19245										
P.C.B.'s	00000L	0.0001		0.0001*	0.0001*										
Carbon T.	06006L	2.0	886		839										

Conductivity in microsiemens/cm

Turbidity in J.T.U.

Metals as Totals mg/l

Alkalinity and Hardness expressed as Calcium Carbonate

Nitrite, NO_2 + NO_3, NH_3 expressed as N

Phosphorus T expressed as PO_4

Phosphorus O expressed as P

pH in pH units

* less than

CHEMISTRY DATA SITE # 2 5300 E - 1400 S

PARAMETERS	September				October		MEAN	RANGE	
	02	08	15	24	28	07	19		Low - High
Pesticides									
TDS								17378.7	14348 - 19245
PCB's								0.0001*	
Carbon T								862.5	839 - 886

SUMMARY OF CHEMISTRY ANALYSIS OF

MINE DEPRESSURIZATION WATER COLLECTED FROM

SYNCRUDE'S LEASE 17 AND COMPARED TO ANALYSIS

OF ATHABASCA RIVER WATER

WELL #2 5300E - 1400S

PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	DATE OF BIOASSAY SAMPLE AUG.24/76	WELL PROFILE MEANS AND RANGES L - H	ATHABASCA RIVER AUG.24/76	RIVER PROFILE MEANS AND RANGES L - H
Calcium	20103L	0.002	60.0	82.25 16.0 - 228.0	34.0	31.35 17.5 - 40.0
Magnesium	12102L	0.001	180.0	151.89 65.0 - 210.0	7.4	6.57 4.5 - 10.0
Sodium	11102L	0.5	7250.0	6377.66 4500.0 - 7900.0	6.2	9.29 5.9 - 36.0
Potassium	19102L	0.5	65.0	48.49 36.9 - 65.0	1.1	0.91 0.4 - 1.5
Chloride	17203L	0.5	9650.0	8732.86 5250.0 - 10,500.0	1.6	6.11 1.0 - 51.0
Sulphate	16306L	1.0	3.1	9.93 0.05* - 78.0	15.2	13.8 0.5 - 41.0
Alkalinity T	10101L	1.0	3024.0	2910.28 2085.0 - 4368.0	104.0	86.69 66.8 - 129.0
pH	10301L	0	7.6	7.46 6.9 - 8.8	7.8	7.5 6.8 - 8.3
Carbonate	06301L	1.0	0.0	8.37 0.0 - 134.0	0.0	0.0
Bicarbonate	06201L	1.0	3686.3	3532.51 2270.0 - 5324.0	126.8	105.76 81.4- 158.0
Hardness T	10603L	0.1	890.9	997.47 336.4 - 1377.0	115.4	89.1 63.5 - 138.0
Conductivity	20401L	1.0	34000.0	28561.11 17100.0 - 40000.0	200.0	185.7 132.0 - 270.0
Surfactants	10701L	0.02	0.02*	0.29 0.02* - 1.88	0.02*	0.03 0.02* - 0.0
T.O.C.	06001L	1.0	10.0	67.94 10.0 - 348.0	19.5	25.82 10.5 - 70.0
T.I.O.C.	06051L	1.0	660.0	692.38 538.0 - 820.0	24.5	19.44 11.0 - 40.0
Phenol	06532L	0.002	0.024	0.01 0.001* - 0.09	0.022	0.005 0.001* - 0.022

WELL #2 5300E - 1400S (Continued)

PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	DATE OF BIOASSAY SAMPLE AUG.24/76	WELL PROFILE MEANS AND RANGES L - H	ATHABASCA RIVER AUG.24/76	RIVER PROFILE MEANS AND RANGES L - H
Oil & Grease	06521L	0.1	5.0	1.98 0.1* - 7.6	5.0	0.56 0.1* - 5.0
Sulphide	16101L	0.05	0.05*	0.06 0.05* - 0.11	0.05*	0.05*
Cyanide	00000L	0.1	0.01*	0.01*	0.01*	0.01*
Hydrocarbon T	00000L	1.0	4.7	20.76 0.001* - 216.0	2.0	0.9 0.001* - 2.0
C.O.D.	08301L	5.0	30.0	294.62 30.0 - 1000.0	43.0	86.83 37.0 - 267.0
Cadmium	48302L	0.001	0.048	0.017 0.001* - 0.049	0.001*	0.002 0.001* - 0.019
Chromium $^{+6}$	24101L	0.003	0.007	0.0079 0.002* - 0.019	0.008	0.004 0.002* - 0.018
Copper	29306L	0.01	0.015	0.012 0.001* - 0.032	0.011	0.019 0.002 - 0.059
Iron	26304L	0.05	1.45	0.69 0.05 - 2.45	9.8	7.26 0.9 - 63.0
Lead	82302L	0.002	0.068	0.04 0.002* - 0.142	0.002	0.0056 0.002* - 0.026
Manganese	25304L	0.01	0.225	0.22 0.09 - 0.225	0.32	0.24 0.056 - 1.7
Silver	47301L	0.01	0.005	0.0099 0.005* - 0.02	0.005*	0.005*
Zinc	30304L	0.01	0.067	0.02 0.003 - 0.086	0.036	0.053 0.014 - 0.069
Vanadium	23301L	0.02	0.001*	0.007 0.001* - 0.05	0.003	0.004 0.001* - 0.014
Selenium	34302L	0.00015	0.0005*	0.0019 0.0005* - 0.009	0.0005*	0.0012 0.0005* - 0.0018
Mercury	80011L	0.0002	0.0002*	0.0004 0.0001* - 0.0007	0.0002*	0.0067 0.0001* - 0.0044
Arsenic	33004L	0.001	0.005*	0.006 0.0002* - 0.02	0.005*	0.0065 0.0025* - 0.02
Nickel	28302L	0.002	0.187	0.089 0.002* - 0.195	0.022	0.014 0.002* - 0.08
Aluminum	13302L	0.5	0.04	0.12 0.005* - 0.44	2.95	2.1 0.43 - 10.6

WELL # 2 5300E - 1400S (Continued)

PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	DATE OF BIOASSAY SAMPLE AUG.24/76	WELL PROFILE MEANS AND RANGES L - H	ATHABASCA RIVER AUG.24/76	RIVER PROFILE MEANS AND RANGES L - H
Cobalt	27302L	0.002	0.165	0.079 0.002* - 0.165	0.006	0.005 0.002* - 0.043
Boron	05105L	0.05	2.2	2.73 0.52 - 7.08	0.02	0.2 0.01 - 1.51
Carbon T				862.5 839.0 - 886.0		44.5 41.0 - 48.0

Conductivity in microsiemens/cm

Turbidity in J.T.U.

Metals as Totals mg/l

Alkalinity and Hardness expressed as Calcium Carbonate

Nitrite, NO_2 + NO_3, NH expressed as N

Phosphorus T expressed as PO_4

Phosphorus O expressed as P

pH in pH units

* less than

Analysis by Chemex Labs (Alberta) Ltd.

2.4 TEST NO. 18 BIOASSAY DATA, 22 FEBRUARY 1977

Data presented here include:

1. cumulative mortality of Rainbow trout (*Salmo gairdneri*);
2. graphical determination of LC_{50} and MST's (Litchfield 1949); and
3. partial response determination of 96 hour LC_{50} (Litchfield and Wilcoxon 1949).

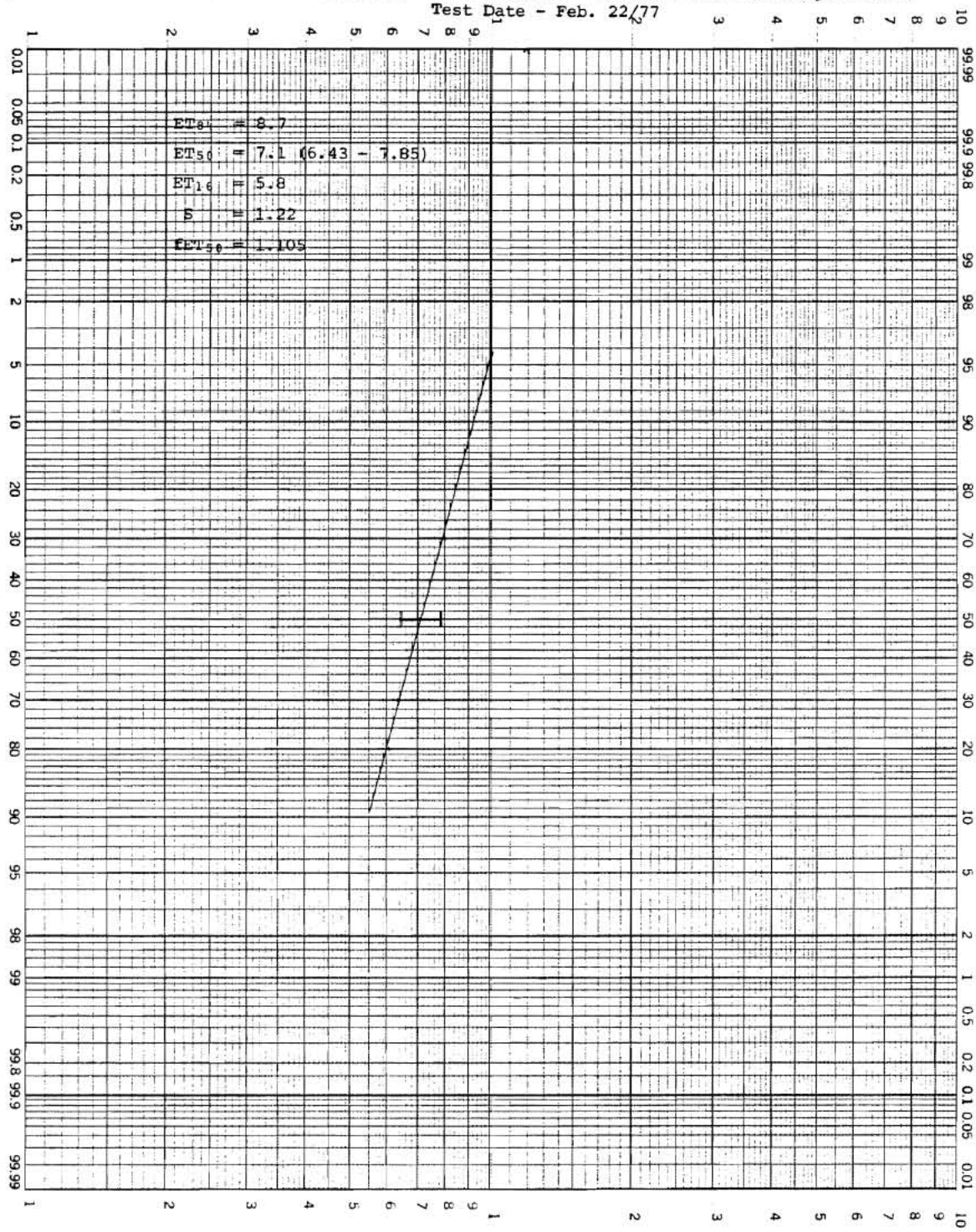
TEST #18 MINE DEPRESSURIZATION WATER SEMI-STATIC REPLACEMENT WELL #2 TEST DATE FEBRUARY 22, 1977

CONCENTRATIONS (MEAN & RANGE)

PARAMETERS	CONTROL 5 Readings	20% 5 Readings	40% 5 Readings	60% 5 Readings	80% 2 Readings	100% 2 Readings
Temperature (°C)	17.33 15.0 - 19.0	17.25 15.0 - 19.0	17.21 15.0 - 19.0	17.21 15.0 - 19.0	15.0	15.75 15.0 - 16.5
Dissolved Oxygen (mg/ℓ)	9.16 7.2 - 10.4	8.87 7.8 - 9.9	8.86 8.3 - 9.4	8.75 7.9 - 9.6	7.3 6.7 - 7.9	9.1 8.8 - 9.4
pH	7.67 7.38 - 7.90	7.99 7.31 - 8.56	7.93 7.29 - 8.53	7.94 7.24 - 8.51	7.21 7.18 - 7.23	8.04 7.55 - 8.53
Conducitivity (µs/cm)	159.58 150 - 170	3750 3500 - 3900	6916.67 6500 - 7500	10166.67 9500 - 11000	11500	15500 15000 - 16000
Salinity (ppt Cl)	0.0	2.5	4.5	7.0	8.5	10.0
Fish Length (cm)		TOTAL 6.115 ± .50				
Fish Weight (gm)		TOTAL 2.46 ± .77				
Loading Density (gm/ℓ)		TOTAL .06				
Number Fish/Dilution	10	10	10	10	10	10
Number Dilutions/Conc	1	1	1	1	1	1
Volume of Dilutions (ℓ)	40	40	40	40	40	40
LT_{50} (Hr.)			34.2 (30.67 - 38.13)	30.5	0.69 (0.62 - 0.77)	7.1 (6.43 - 7.85)
LC_{50} (Conc by Vol)	20% < LC_{50} < 40%					

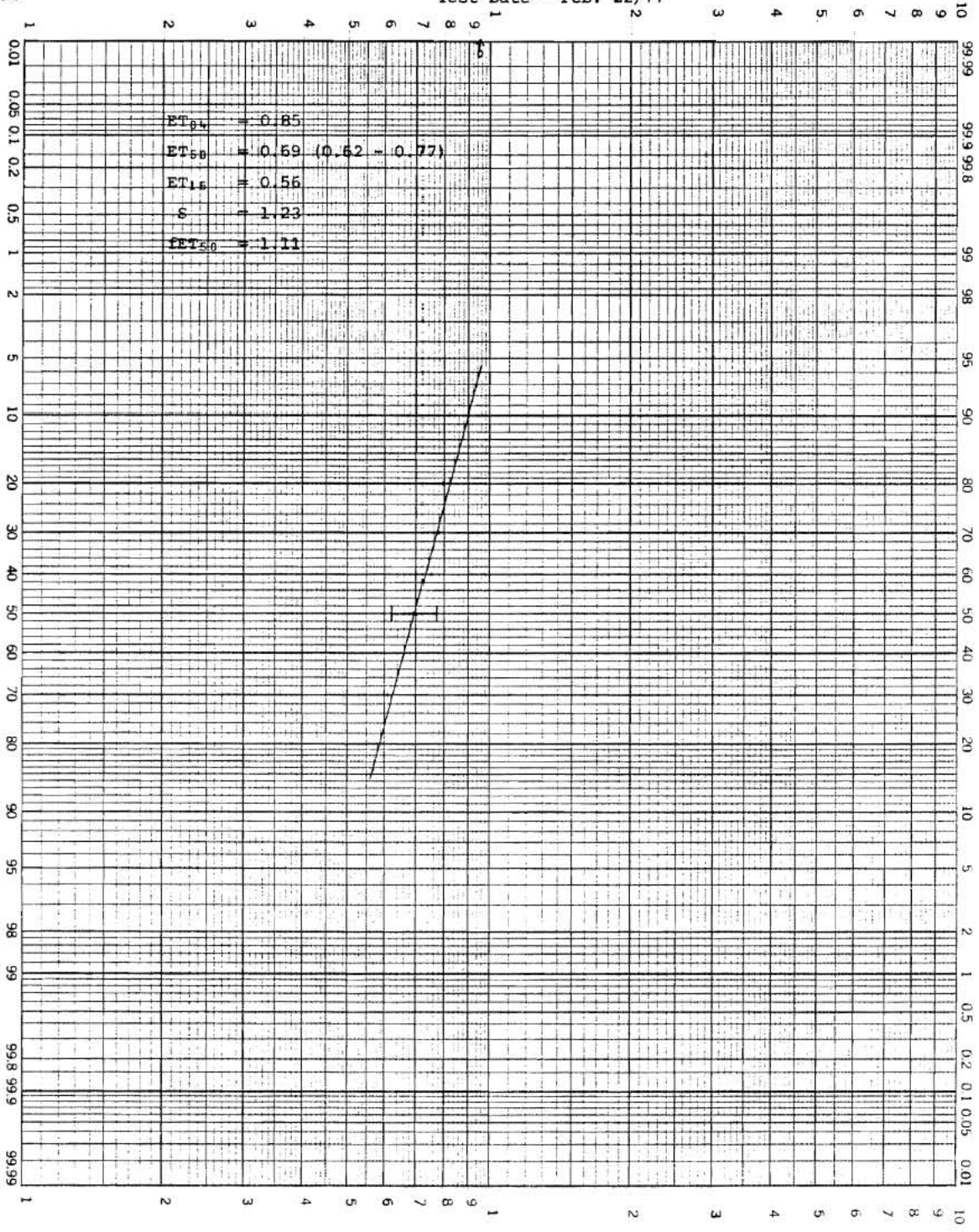
96 hr. LC_{50} Mine Depressurization Water Test #18 Well #2 5300 E - 1400S
Test Organism - Rainbow Trout (*Salmo gairdneri*)
Test Date - Feb. 22/77
96 hr. LC_{50} = 20% < LC_{50} < 40%
% CONCENTRATION (By Volume)
TIME (Hrs.)

100% Concentration Mine Depressurization Water Test #18 Well #2 5300E - 1400S
MST (Time vs. Mortality) Test Organism - Rainbow Trout *(Salmo gairdneri)*
Test Date - Feb. 22/77

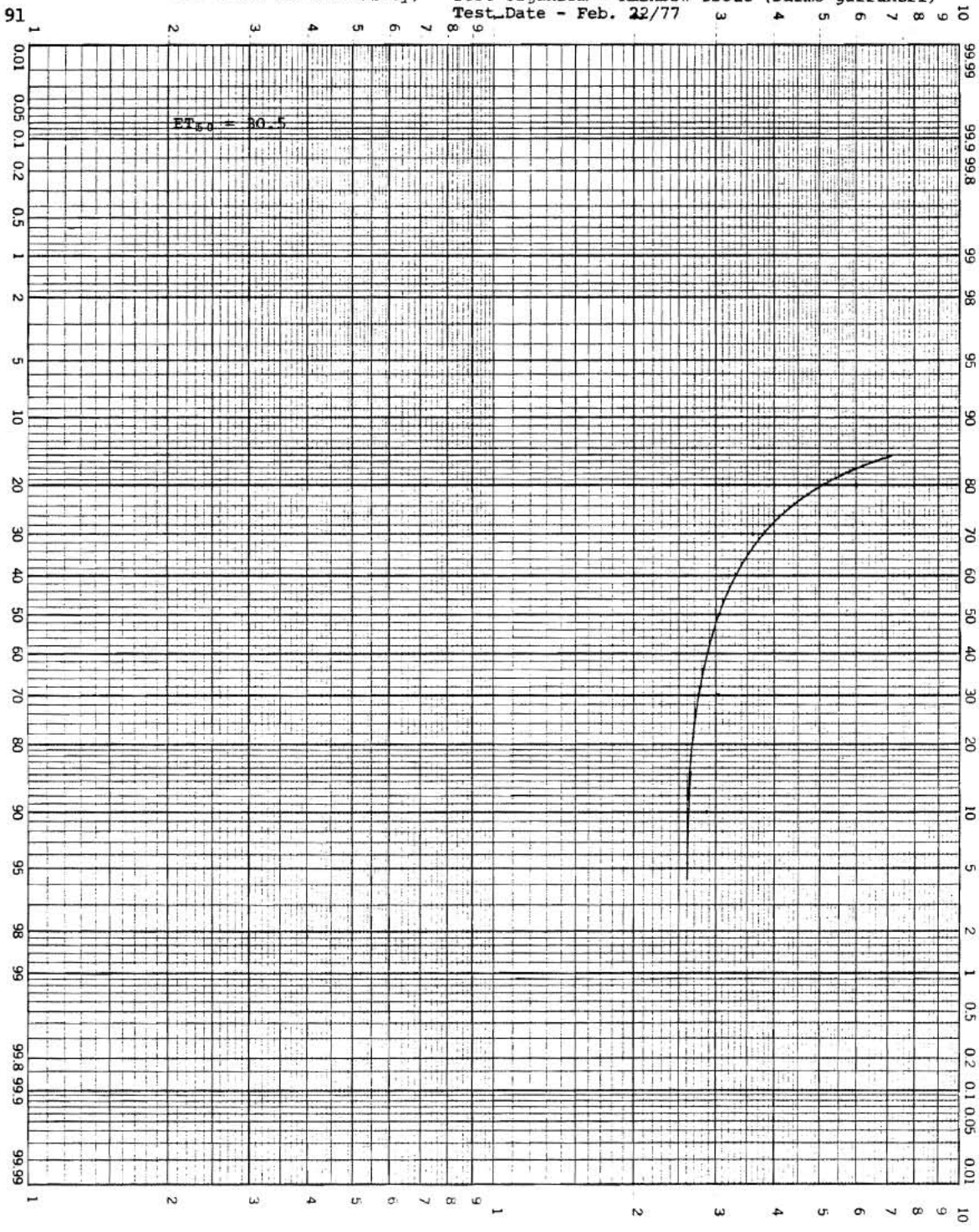


80% Concentration Mine Depressurization Water Test #18 Well #2 5300E - 1400S
MST (Time vs. Mortality) Test Organism - Rainbow Trout *(Salmo gairdneri)*
Test Date - Feb. 22/77

90

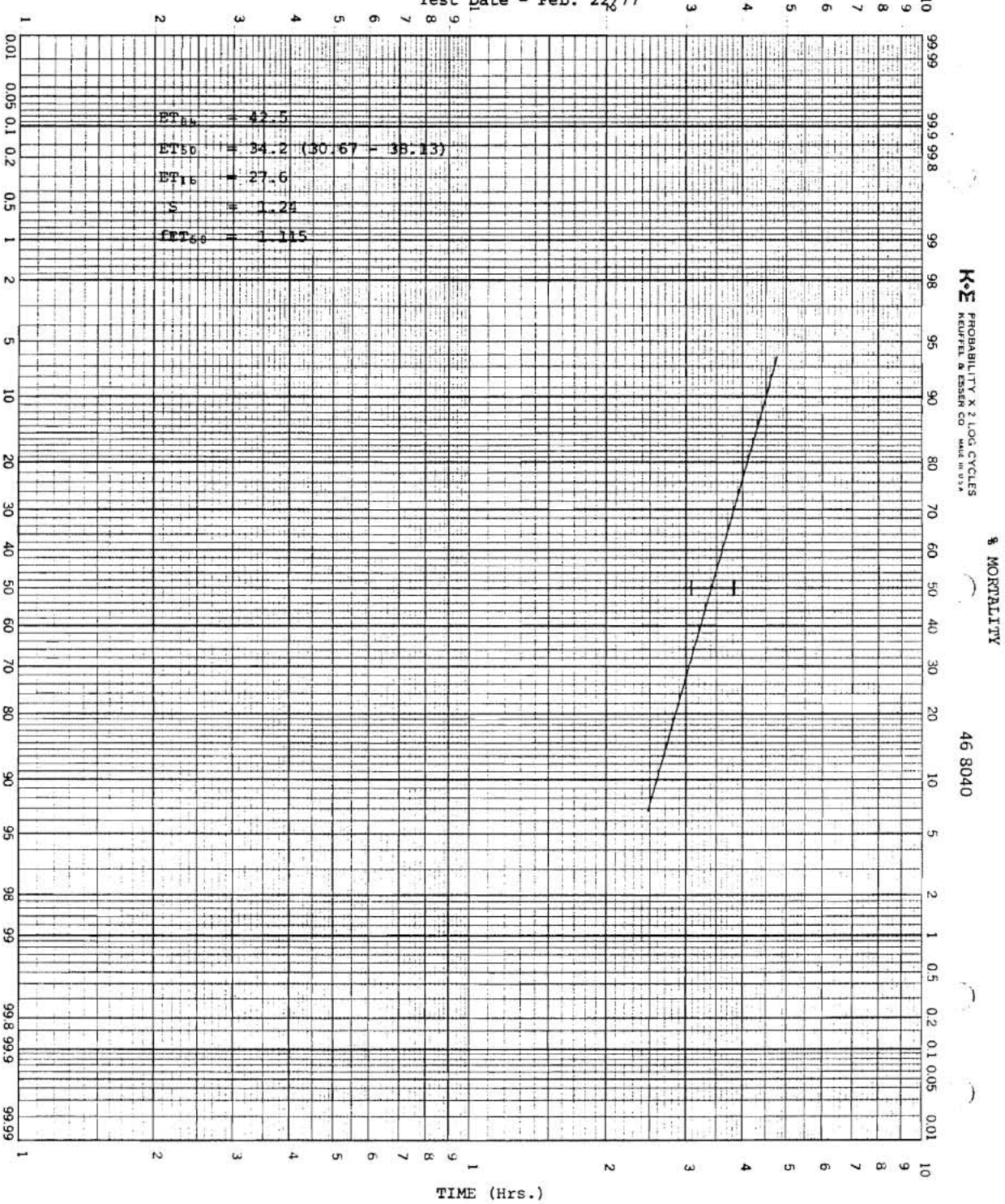


60% Concentration Mine Depressurization Water Test #18 Well #2 5300E - 1400S
MST (Time vs. Mortality) Test Organism - Rainbow Trout *(Salmo gairdneri)*
Test Date - Feb. 22/77



92

40% Concentration Mine Depressurization Water Test #18 Well #2 5300E - 1400S
MST (Time vs. Mortality) Test Organism - Rainbow Trout *(Salmo gairdneri)*
Test Date - Feb. 22/77



MINE DEPRESSURIZATION WATER TEST #18 WELL #2 5300E - 1400S

TEST ORGANISM - RAINBOW TROUT *(Salmo gairdneri)*

TEST DATE - FEB. 22/77

PARTIAL RESPONSE DETERMINATION OF 96-hr. LC_{50} (LITCHFIELD & WILCOXON)

Calculations

% Concentrations	% Mortality Observed	% Expected	Corrected	Observed minus Expected	$(Chi)^2$ (Nomograph #1)
20	0	22.1	6.5	15.6	0.40
40	60	60.0		0	0
60	80	80.0		0	0
80	100	89.5	96.5	7.0	0.06
					0.46

Number of Concentration plotted = k = 4

Average number of fish/concentration = 10

$(Chi)^2 = 0.46 \times 10 = 4.6$

Degrees of freedom, n = k - 2 = 2

$(Chi)^2$ from Table 2 for n of 2 = 5.99 4.6 is less than 5.99, therefore, the data are not significantly heterogenous.

$ED_{84} = 57.0$ $ED_{50} = 37.5$ $ED_{16} = 25.0$

$$S = \frac{ED_{84}/ED_{50} + ED_{50}/ED_{16}}{2} = \frac{1.52 + 1.5 = 1.51}{2}$$

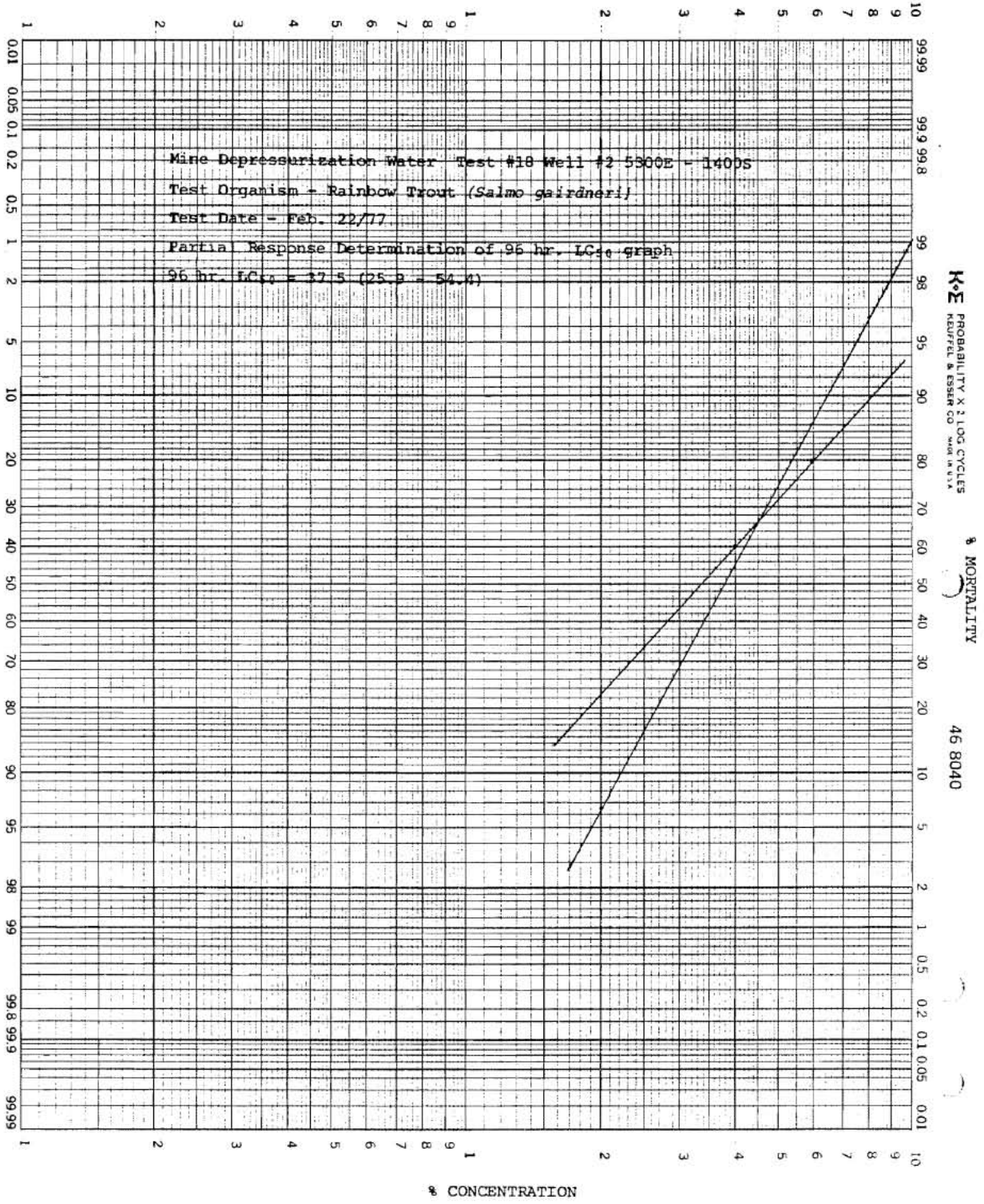
$N^1 = 10$

$f_{ED_{50}} = S^{2.77/\sqrt{N^1}} = S^{\text{exponent}}$

$= S^{2.77/3.16} = S^{0.876}$

= 1.45 from Nomograph 2

96 hr. LC_{50} with 95% Confidence Limits = 37.5 (25.9 - 54.4)


Mine Depressurization Water Test #18 Well #2 5300E - 1400S
Test Organism - Rainbow Trout (Salmo gairdneri)
Test Date - Feb. 22/77
Partial Response Determination of 96 hr. LC50 graph
96 hr. LC50 = 37.5 (25.9 - 54.4)
% MORTALITY
% CONCENTRATION
K•E PROBABILITY X 2 LOG CYCLES
KEUFFEL & ESSER CO MADE IN U.S.A.
46 8040

2.5 CHEMISTRY DATA (FEBRUARY 1977)

Data presented here include summary of chemistry analysis of mine depressurization water collected from Syncrude's Lease 17 and compared to analysis of City of Edmonton treated water.

MINE DEPRESSURIZATION WATER

SYNCRUDE LEASE 17

96 hr. LC_{50} = 20 <LC_{50}< 40 (Sprague)

M.S.T. = Conc. 100% = 7.1 (6.43 - 7.85)

M.S.T. (hrs.) 80% = 0.69 (0.62 - 0.77)

60% = 30.5

40 = 34.2 (30.67 - 38.13)

CHEMISTRY DATA SITE #2

5300E - 1400S

PARAMETERS	POLLUTION CONTROL LAB NAQUADAT CODE	DETECTION LIMIT	Feb. 9	Feb. 22**	MEAN	RANGES Low - High
Calcium	20105L	2.0	67.0	72.0	69.5	67.0 - 72.0
Magnesium	12102L	1.0	85.0	77.0	81.5	77.0 - 85.0
Sodium	11102L	0.1	4571.0	5200.0	4885.5	4571.0 - 5200.0
Potassium	19102L	0.1	33.8	31.5	32.65	31.5 - 33.8
Chloride	17203L	1.0	6000.0	6714.0	6357.0	6000.0 - 6714.0
Sulphate	16306L	10.0	23.0	10.0*	16.5	10.0* - 23.0
Alkalinity	10101L	5.0	3181.0	3151.0	3166.0	3151.0 - 3181.0
pH	10301L	0.0	7.5	7.2	7.35	7.2 - 7.5
Bicarbonate	06201L	5.0	3877.0	3841.0	3859.0	3841.0 - 3877.0
Hardness T	10604L	5.0	519.0	496.0	507.5	496.0 - 519.0
Fluroide	09107L	0.05	0.67	0.77	0.72	0.67 - 0.77
Silica	14102L	0.5	5.4	5.3	5.35	5.3 - 5.4
Conductivity	02041L	0.2	20500.0	20000.00	20250.0	20000.0 - 20500.0
Odor	02001L	0.0	1.0	1.0	1.0	

SITE #2

POLLUTION CONTROL LAB

PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	SAMPLE DATES 1977 Feb. 9	Feb. 22**	MEAN	RANGES Low - High
Color	02011L	1.0	100	100	100	-
Color T_2	02011L	1.0	99	100	99.5	99 - 100
Color T_3	02011L	1.0	98	100	99.0	98 - 100
Tanin & Lignin	06551L	0.1	0.5	0.3	0.4	0.3 - 00.5
T.R.	10471L	10.0	12644.	15566.	14105.	12644. - 15566.
T.F.R.	10571L	10.0	12400.	12348.	12374.	12348. - 12400.
T.F.R.F.						-
T.N.F.R.						-
T.N.F.R.F.						-
Turbidity	02073L	0.0	4.0	2.0	3.0	2.0 - 4.0
Surfactants	10701L	0.05	1.56	1.60	1.58	1.56 - 1.60
Humic Acids						-
T.O.C.	06001L	2.0	7.0		7.0	-
T.I.O.C.	06051L	2.0	308.0		308.0	-
Nitrite	07205L	0.1	0.1*	0.1*	0.1*	-
NO_2 & NO_3	07105L	0.1	0.1*	0.5	0.3	0.1* - 0.5
NH_3	07555L	0.05	8.88	7.84	8.36	7.84 - 8.88
Nitrogen Tk	07003L	0.05	17.25	8.04	12.65	8.04 - 17.25
Phosphorus T	15001L	0.05	0.12	0.25	0.19	0.12 - 0.25
Phosphate T	15407L					-
Phosphorus O	15256L					-
Phenol	06532L	0.001	0.013	0.064	0.039	0.013 - 0.064

SITE #2

POLLUTION CONTROL LAB

PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	SAMPLE DATES 1977 Feb. 9	Feb. 22**	MEAN	RANGES Low - High
Oil & Grease	06521L	1.0	9.2	4.6	6.9	4.6 - 9.2
Sulphide	06101L	0.02	0.02*	0.02*	0.02*	
Cyanide	06601L	0.002	0.03		0.03	
Hydrocarbon T.	06500L	0.001				
B.O.D.	08201L	0.01	1.3		1.3	
C.O.D.	08301L	5.0	79.2	232.2	155.7	79.2 - 232.2
Cadmium	48302L	0.001	0.001*	0.001*	0.001*	
Chromium^{+6}	24101L	0.002	0.002*	0.002*	0.002*	
Copper	29305L	0.001	0.001*	0.001*	0.001*	
Iron	26302L	0.05	0.42	0.25	0.34	0.25 - 0.42
Lead	82302L	0.003	0.003*	0.003*	0.003*	
Manganese	25004L	0.008	0.194	0.178	0.186	0.178 - 0.194
Silver	47303L	0.001	0.001*	0.001*	0.001*	
Zinc	30305L	0.001	0.014	0.002	0.008	0.002 - 0.014
Vanadium	23301L	0.05				
Selenium	34102L	0.0002		0.0002*	0.0002*	
Mercury	80003L	0.0001	0.0001*	0.0001*	0.0001*	
Arsenic	33104L	0.0002	0.0002*	0.0002*	0.0002*	
Nickel	28302L	0.001	0.001*	0.001*	0.001*	
Aluminum	13005L	0.02				
Cobalt	27302L	0.001	0.001*	0.001*	0.001*	
Boron	05102L	0.1				

SITE #2

PARAMETERS	POLLUTION CONTROL LAB NAQUADAT CODE	DETECTION LIMIT	SAMPLE DATES 1977 Feb. 9	Feb. 22**	MEAN	RANGES Low - High
Pesticides	00000L					
T.D.S.	00205L	0.0	12690.	13998.	13344.	12690. - 13998.
P.C.B.'s	00000L	0.0001				
Carbon T.	06006L	2.0	315.0		315.0	

Conductivity in microsiemens/cm

Turbidity in J.T.U.

Metals as Totals mg/l

Alkalinity and Hardness expressed as Calcium Carbonate

Nitrite, NO_2 & NO_3, NH_3 expressed as N

Phosphorus T expressed as PO_4

Phosphorus O expressed as P

pH in pH units

* less than

** sample taken for bioassay

SUMMARY OF CHEMISTRY ANALYSIS

OF MINE DEPRESSURIZATION WATER COLLECTED FROM

SYNCRUDE'S LEASE 17 AND COMPARED TO ANALYSIS

OF CITY OF EDMONTON TREATED WATER

WELL #2 5300E - 1400S

PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	DATE OF BIOASSAY FEB.22/76	WELL PROFILE MEANS & RANGES L - H	TREATED WATER FEB.22/76	TREATED WATER PROFILE MEANS & RANGES L - H
Calcium	20105L	2.0	72.0	69.5 67.0 - 72.0	23.0	22.5 22.0 - 23.0
Magnesium	12102L	1.0	77.0	81.0 77.0 - 85.0	9.0	10.5 9.0 - 12.0
Sodium	11103L	0.1	5200.0	4885.5 4571.0 - 5200.0	237.0	65.0 4.0 - 237.0
Potassium	19103L	0.1	31.5	32.65 31.5 - 33.8	4.5	1.75 0.8 - 4.5
Chloride	17203L	1.0	6714.0	6357.0 6000.0 - 6714.0	7.0	2.8 0.1* - 7.0
Sulphate	16306L	10.0	10.0*	16.5 10.0* - 23.0	505.0	164.25 46.0 - 505.0
Alkalinity T	10101L	5.0	3151.0	3166.0 3151.0 - 3181.0	60.0	56.25 46.0 - 66.0
pH	10301L	0	7.2	7.35 7.2 - 7.5	8.3	8.18 8.1 - 8.3
Carbonate	06301L	5.0				
Bicarbonate	06201L	5.0	3841.0	3859.0 3841.0 - 3877.0	73.0	68.25 56.0 - 80.0
Hardness T	10604L	5.0	496.0	507.5 496.0 - 519.0	96.0	100.5 96.0 - 108.0
Conductivity	02041L	0	20000	20250 20000 - 20500	260	217 188 - 260
Surfactants	10701L	0.05	1.60	1.58 1.56 - 1.60	0.005*	0.07 0.005* - 0.13
T.O.C.	06001L	2.0		7.0		
T.I.O.C.	06051L	2.0		308.0		
Phenol	06532L	0.001	0.064	0.039 0.013 - 0.064	0.001*	0.001*

WELL #2 5300E - 1400S (Continued)

PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	DATE OF BIOASSAY FEB.22/77	WELL PROFILE MEANS & RANGES L - H	TREATED WATER FEB.22/77	TREATED WATER PROFILE MEANS & RANGES L - H
Oil & Grease	06521L	0.02	4.6	6.9 4.6 - 9.2		2.1
Sulphide	16101L	0.02	0.02*	0.02*		
Cyanide	06601L	0.002		0.03		
Hydrocarbon T	06500L	0.001				
C.O.D.	08301L	5.0	232.2	155.7 79.2 - 232.2	6.4	5.47 5.0* - 6.4
Cadmium	48302L	0.001	0.001*	0.001*	0.001*	0.001*
Chromium $^{+6}$	24101L	0.002	0.002*	0.002*	0.002*	0.002*
Copper	29305L	0.001	0.001*	0.001*	0.001*	0.001*
Iron	26302L	0.05	0.25	0.34 0.25 - 0.42	0.80	0.27 0.06 - 0.80
Lead	82302L	0.003	0.003*	0.003*	0.003*	0.003*
Manganese	25304L	0.008	0.178	0.186 0.178 - 0.194	0.008*	0.008*
Silver	47303L	0.001	0.001*	0.001*		
Zinc	30305L	0.001	0.002	0.008 0.002 - 0.014	0.002	0.005 0.002 - 0.007
Vanadium	04303L	0.01				
Selenium	34102L	0.0002	0.0002*	0.0002*		
Mercury	80011L	0.0001	0.0001*	0.0001*		0.0001*
Arsenic	33104L	0.0002	0.0002*	0.0002*		
Nickel	28302L	0.001	0.001*	0.001*	0.001*	0.001*
Aluminum						
Cobalt	27302L	0.001	0.001*	0.001*	0.001*	0.001*
Boron						
Carbon T.	06006L	2.0		315.		

WELL #2 5300E - 1400S (Continued)

Conductivity in microsiemens/cm
Turbidity in J.T.U.
Metals as Totals mg/l
Alkalinity and Hardness expressed as Calcium Carbonate
Nitrite, NO_2 + NO_3, NH_3 expressed as N
Phosphorus T expressed as PO_4
Phosphorus O expressed as P
pH in pH units
* less than

Analysis by Department of Environment, Pollution Control Division Laboratory.

3. SUMMARY OF SAMPLING AND TESTING OF WELL NO. 3
4800 E - 14600 S

Well No. 3
4800E - 14600S

Date of Bioassays: A. (1) August 28, 1976 (Terminated after 48 hours)
(2) August 31, 1976

Type of Bioassays: A. (1) 96 hr. Semi Static Replacement
(2) 96 hr. Semi Static Replacement

Type of Fish: A. (1) Trout Perch *(Percopsis omiscomaycus)*
(2) Trout Perch *(Percopsis omiscomaycus)*

Dilution Water: A. (1) Athabasca River Water
(2) Athabasca River Water

Mean Survival Times: A. (1) N/A
(2) 100% = 2.0
80% = 1.74
60% = 2.69 (1.51 - 4.79)
40% = 70.0

96 hr. LC_{50}(%): = 40.05 (Sprague)
= 31.3 (23.0 - 39.6) (Reed & Muench)

3.1 TEST NO. 5 BIOASSAY DATA, 28 AUGUST 1976

Data presented here include cumulative mortality of Trout-perch (*Percopsis omiscomayais*).

TEST # 5 MINE DEPRESSURIZATION WATER SEMI-STATIC REPLACEMENT OF WELL # 3 TEST DATE August 28/76

CONCENTRATIONS (MEAN & RANGE)

PARAMETERS	CONTROL 5 Readings	20% 5 Readings	40% 5 Readings	60% 2 Readings	80% 2 readings	100% 2 readings
Temperature (°C)	13.6 ± .64	13.6 ± .64	13.6 ± .64	12.5 Range (12.0-13.0)	12.2 Range (12.0-12.5)	12.0 No Range
Dissolved Oxygen (mg/l)	9.9 ± .05	10.0 ± .05	9.8 ± .07	10.1 Range (10.0-10.2	10.0 Range (9.9-10.2)	10.0 No Range
pH	8.21 ± .02	8.85 ± .13	8.61 ± .09	9.03 No Range	9.01 Range (8.98-9.03)	8.56 Range (8.56-8.57)
Conductivity (µs/cm)	201	5929	> 10,000	> 10,000	> 10,000	> 10,000
Fish Length (cm.)			5.79 ± .59			
Fish Weight (gm.)			2.44 ± .75			
Number Fish/Dilution	5	5	5	5	5	5
Number Dilutions/Conc.	2	2	2	2	2	2
Volume of Dilutions (1.)	20	20	20	20	20	20
LT_{50} (hrs.)						
LC_{50} (Conc. by Vol.)	TERMINATED					

CUMULATIVE MORTALITY OF TROUT PERCH *(Percopsis omiscomaycus)*

TEST #5 - WELL #3

Concentration Mine Depressurization Water (% by volume)	Time (Hours) 0.0	0.25	0.50	1.00	2.00	3.00	4.00	5.75	8.00	12.00	14.58	24.00	36.00	48.00	Total % Mortality (48 hrs)
Control															
N = 10	0	0	0	0	0	0	0	0	0	1	1	2	2	3	
% mortality	0	0	0	0	0	0	0	0	0	10	10	20	20	30	30
20															
N - 10	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
% mortality	0	0	0	0	0	0	0	0	0	10	10	10	10	10	10
40															
N = 10	0	0	0	0	0	0	0	0	0	0	1	3	3	3	
% mortality	0	0	0	0	0	0	0	0	0	0	10	30	30	30	30
60															
N = 10	0	0	0	1	2	2	5	10							
% mortality	0	0	0	10	20	20	50	100							100
80															
N = 10	0	0	0	0	8	9	10								
% mortality	0	0	0	0	80	90	100								100
100															
N = 10	0	0	0	0	8	10									
% mortality	0	0	0	0	80	100									100

Test #5 is not significant due to large mortality in Control, therefore terminated after 48 hours.

3.2 TEST NO. 6 BIOASSAY DATA 30 AUGUST 1976

Data presented here include:

1. cumulative mortality of Trout-perch (*Percopsis omiscomaycus*);
2. graphical determination of LC_{50} and MST's (Litchfield 1949); and
3. lethal concentration determination (Woolf 1968).

TEST # 6 MINE DEPRESSURIZATION WATER SEMI STATIC REPLACEMENT OF WELL # 3 TEST DATE AUGUST 30/76

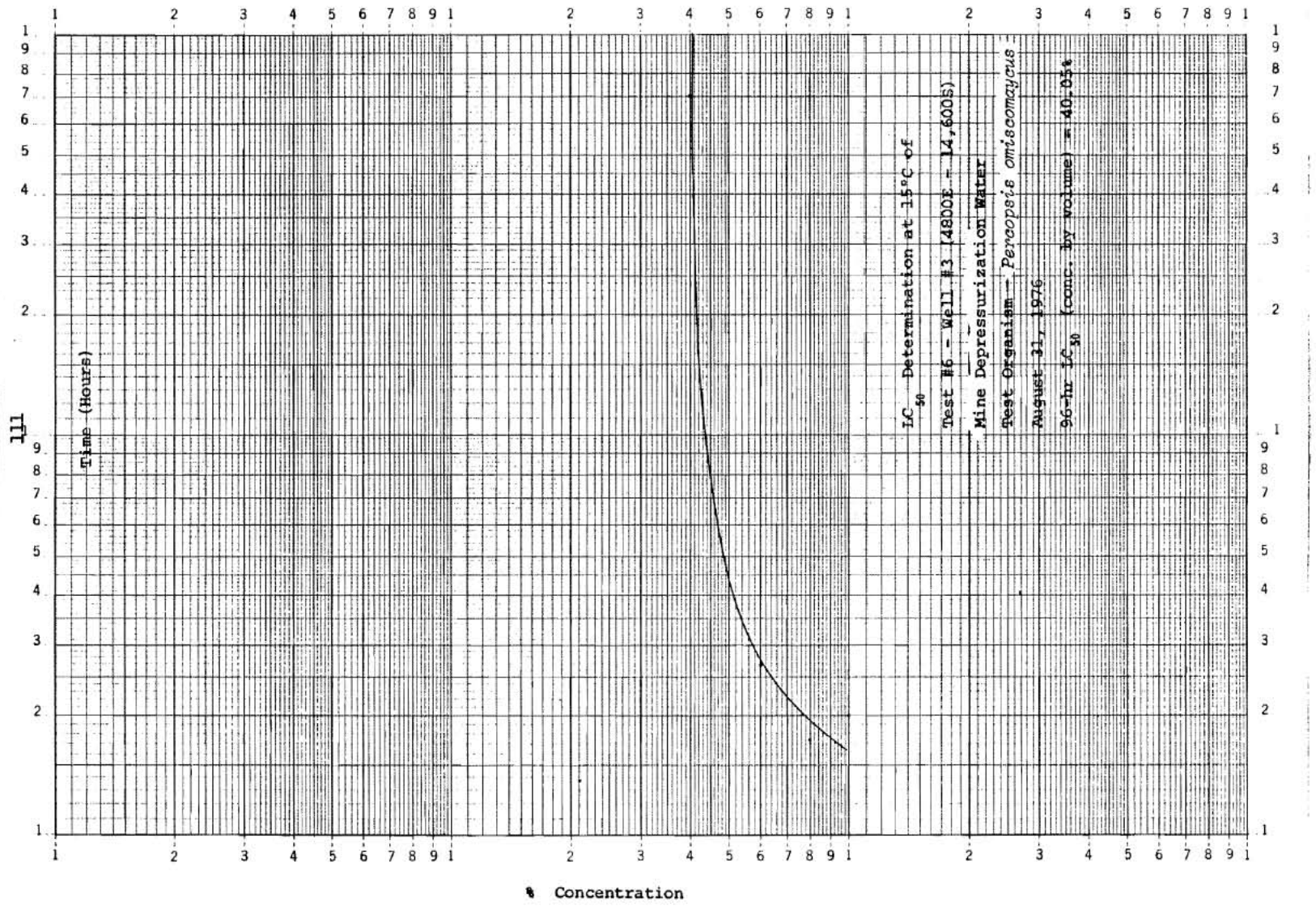
CONCENTRATIONS (MEAN & RANGE)

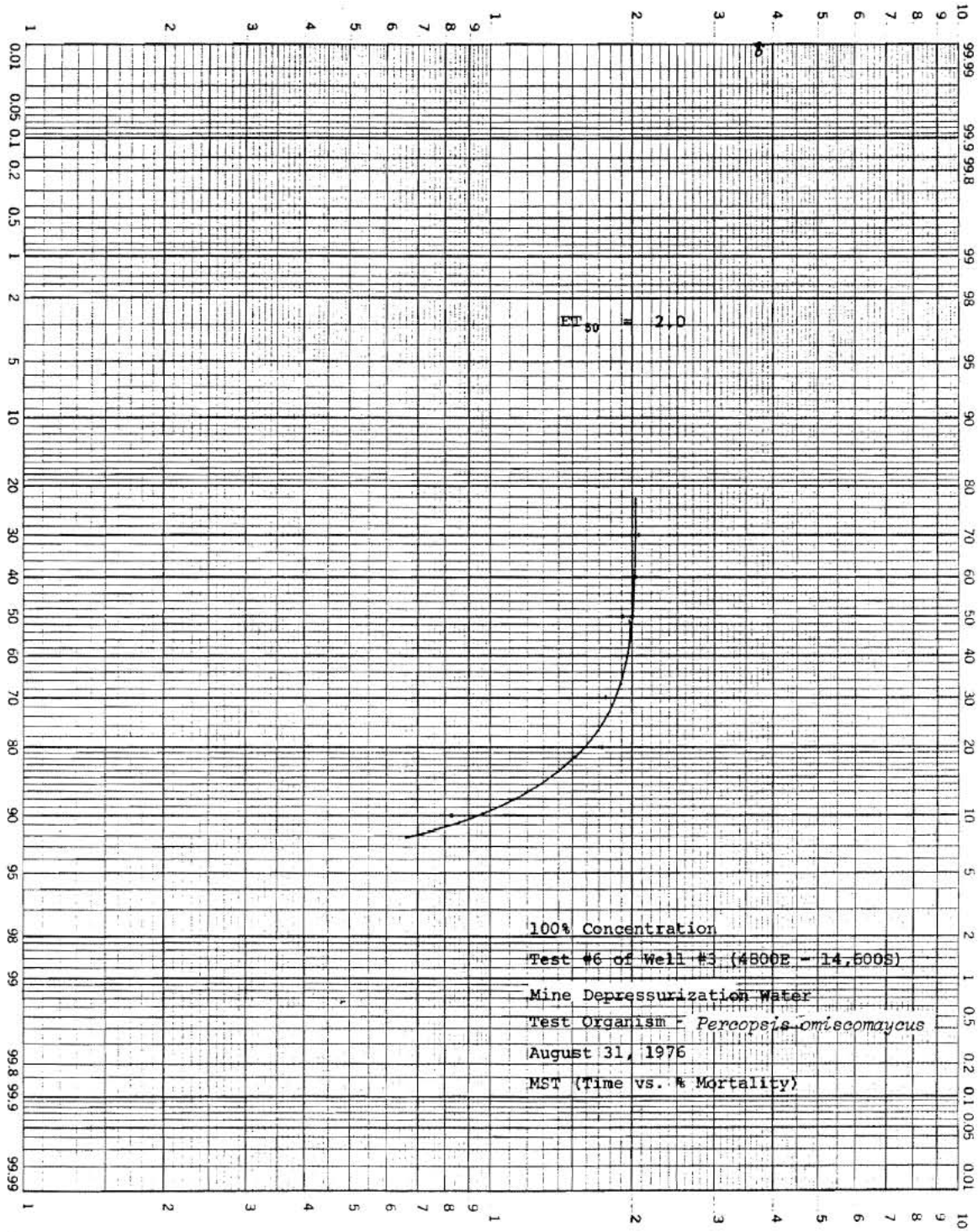
PARAMETERS	CONTROL 5 readings	20% 5 readings	40% 5 readings	60% 2 readings	80% 2 readings	100% 2 readings
Temperature (°C)	14.7 ± .17	14.7 ± .17	14.7 ± 17	14.5 No Range	14.5 No Range	14.5 No Range
Dissolved Oxygen (mg/l)	9.8 ± .09	9.8 ± .08	9.6 ± .12	10.1 Range (10.0-10.2)	10.2 Range (10.1-10.4)	10.2 No Range
pH	8.11 ±.00	8.61 ± .24	8.48 ± .18	8.58 Range (8.56-8.61)	8.83 Range (8.77-8.89)	8.40 Range (8.31-8.50)
Conductivity (µs/cm)	162	6017	> 10,000	> 10,000	> 10,000	> 10,000
Fish Length (cm.)			5.9 ± .32			
Fish Weight (gm.)			2.0 ± .39			
Number Fish/Dilution	5	5	5	5	5	5
Number Dilutions/Conc.	2	2	2	2	2	2
Volume of Dilutions (l)	20	20	20	20	20	20
LT_{50} (Hrs.)			70.0	2.69 (1.51-4.79)	1.74	2.0
LC_{50} (Conc. by Vol.)	40.05%					

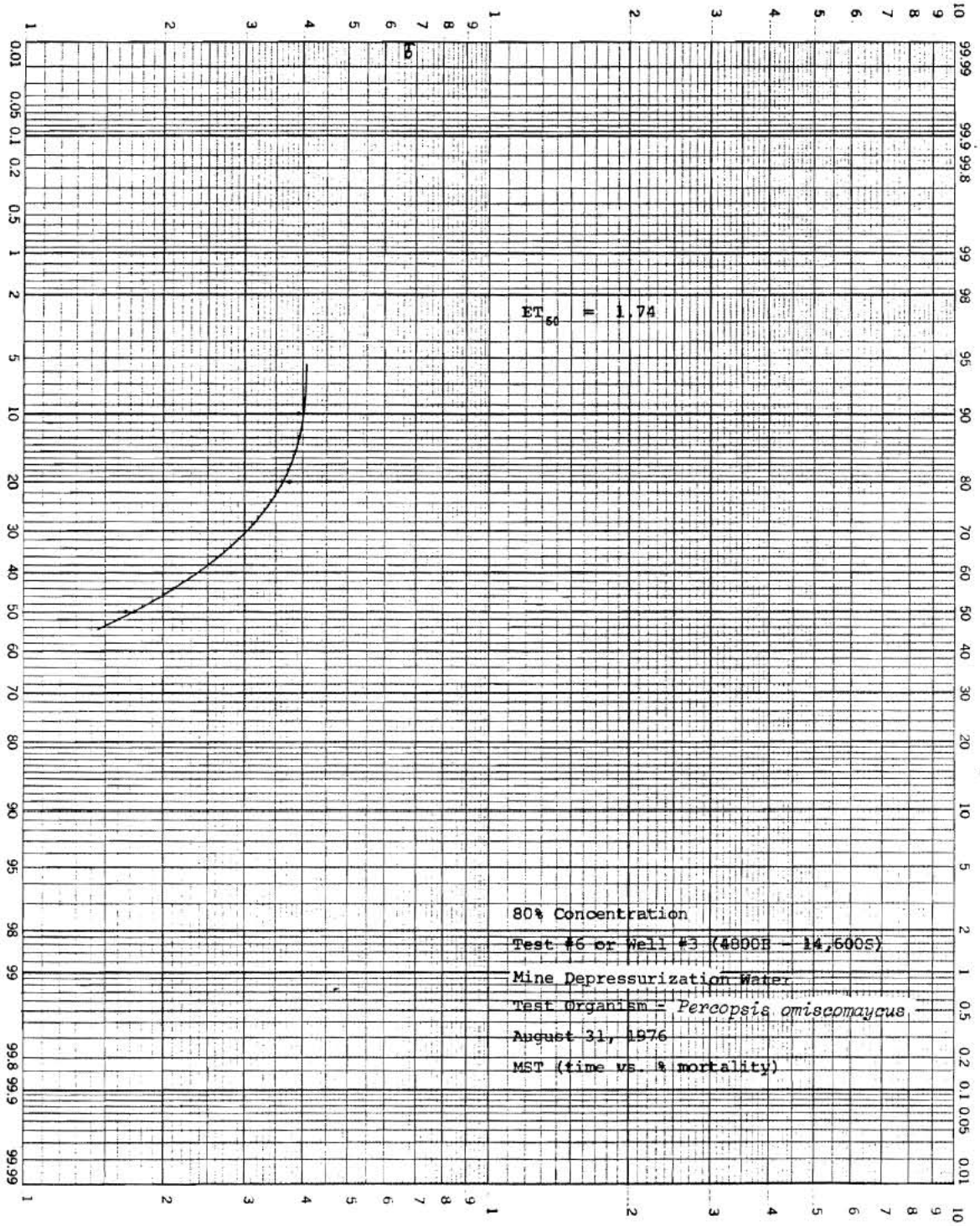
CUMULATIVE MORTALITY OF TROUT PERCH *(Percopsis omiscomaycus)*

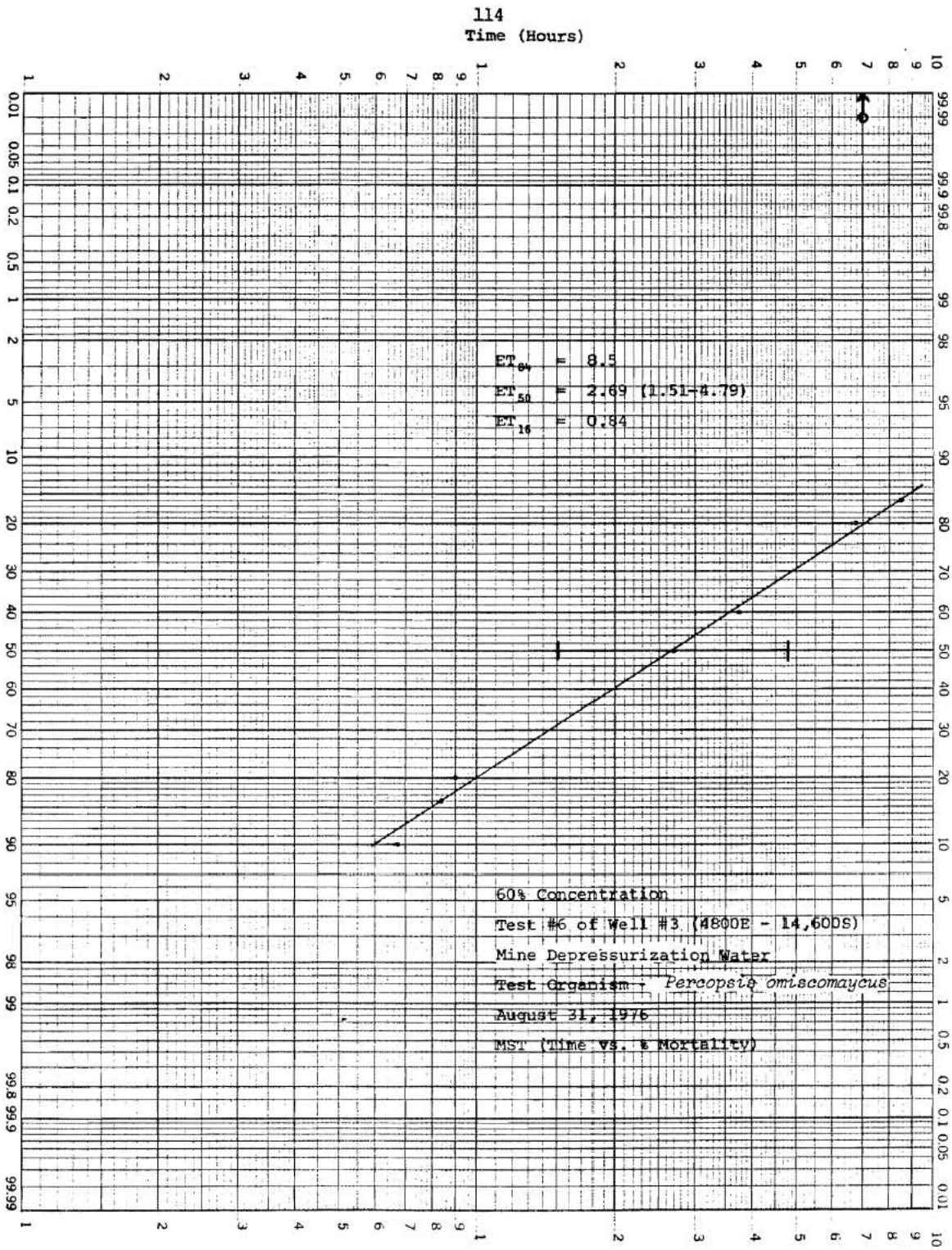
TEST #6 - WELL 3

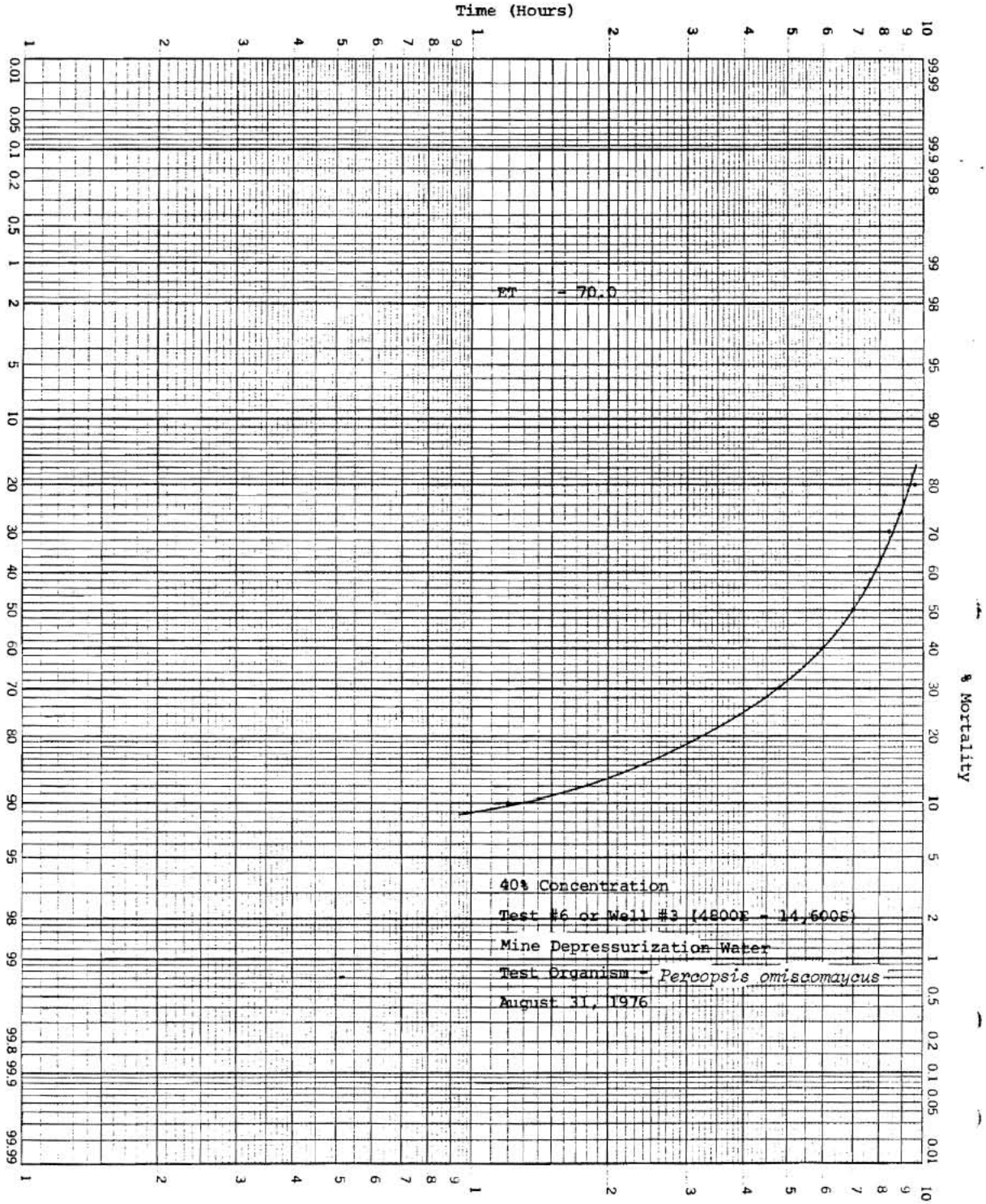
Concentration Mine Depressurization Water (% by volume)	TIME (Hrs.)																										Total % mortality (96 hrs.)
	0.0	0.25	0.50	0.83	1.00	1.66	1.73	1.76	1.90	1.91	2.03	2.06	3.75	3.91	4.00	6.75	8.00	12.00	18.00	24.00	36.00	48.00	60.00	72.00	84.00	96.00	
Control																											
N = 10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
% mortality	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20																											
N = 10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	
% mortality	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	10	10	10	10	10
40																											
N = 10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	3	4	6	7	8	
% mortality	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	10	10	10	30	40	60	70	80	80
60																											
N = 10	0	0	0	0	0	1	1	1	2	2	2	2	6	6	6	8	10										
% mortality	0	0	0	0	0	10	10	10	20	20	20	20	60	60	60	80	100										100
80																											
N = 10	0	0	0	0	0	5	5	5	5	5	5	5	8	9	9	10											
% mortality	0	0	0	0	0	50	50	50	50	50	50	50	80	90	90	100											100
100																											
N = 10	0	0	0	1	1	1	2	3	3	5	6	7	10														
% mortality	0	0	0	10	10	10	20	30	30	50	60	70	100														100




Time (Hours)
% Mortality
ET_{50} = 2.0
100% Concentration
Test #6 of Well #3 (4800E - 14,500S)
Mine Depressurization Water
Test Organism - *Percopsis omiscomaycus*
August 31, 1976
MST (Time vs. % Mortality)


ET_{50} = 1.74
80% Concentration
Test #6 or Well #3 (4000B - 14,600S)
Mine Depressurization Water
Test Organism - *Percopsis omiscomaycus*
August 31, 1976
MST (time vs. % mortality)
% Mortality


114
Time (Hours)
% Mortality
ET_{84} = 8.5
ET_{50} = 2.69 (1.51-4.79)
ET_{16} = 0.84
60% Concentration
Test #6 of Well #3 (4800E - 14,600S)
Mine Depressurization Water
Test Organism : Percopsis omiscomaycus
August 31, 1976
MST (Time vs. % Mortality)


Time (Hours)
% Mortality
ET = 70.0
40% Concentration
Test #6 or Well #3 (4800E - 14,600S)
Mine Depressurization Water
Test Organism - Percopsis omiscomaycus
August 31, 1976

LETHAL CONCENTRATION DETERMINATION

WELL NO. 3

(4800E - 14,600S)

2 Hrs.

Concentration	N	No. Dead	No. Alive	Accumulated Dead	Accumulated Alive	Total	Cumulative Mortality %
Control	10	0	10	0	47	47	0
20	10	0	10	0	37	37	0
40	10	0	10	0	27	27	0
60	10	2	8	2	17	19	10.5
80	10	5	5	7	9	16	43.8
100	10	6	4	13	4	17	76.4

LC_{50} = 83.8

LETHAL CONCENTRATION DETERMINATION

WELL NO. 3

(4800E - 14,600S)

12 Hrs.

Concentration	N	No. Dead	No. Alive	Accumulated Dead	Accumulated Alive	Total	Cumulative Mortality %
Control	10	0	10	0	29	29	0
20	10	0	10	0	19	19	0
40	10	1	9	1	9	10	10
60	10	10	0	11	0	11	100
80	10	10	0	21	0	21	100
100	10	10	0	31	0	31	100

LC_{50} = 48.9 $\pm$ 8.1

LETHAL CONCENTRATION DETERMINATION

WELL NO. 3

(4800E - 14,600S)

24 Hrs.

Concentration	N	No. Dead	No. Alive	Accumulated Dead	Accumulated Alive	Total	Cumulative Mortality %
Control	10	0	10	0	29	29	0
20	10	0	10	0	19	19	0
40	10	1	9	1	9	10	10
60	10	10	0	11	0	11	100
80	10	10	0	21	0	21	100
100	10	10	0	31	0	31	100

$LC_{50} = 48.9 \pm 8.1$

LETHAL CONCENTRATION DETERMINATION

WELL NO. 3

(4800E - 14,600S)

48 Hrs.

Concentration	N	No. Dead	No. Alive	Accumulated Dead	Accumulated Alive	Total	Cumulative Mortality %
Control	10	0	10	0	26	26	0
20	10	1	9	1	16	17	5.9
40	10	3	7	4	7	11	36.4
60	10	10	0	14	0	14	100
80	10	10	0	24	0	24	100
100	10	10	0	34	0	34	100

$LC_{50} = 44.3 \pm 10.1$

LETHAL CONCENTRATION DETERMINATION

WELL NO. 3

(4800E - 14,600S)

72 Hrs.

Concentration	N	No. Dead	No. Alive	Accumulated Dead	Accumulated Alive	Total	Cumulative Mortality %
Control	10	0	0	0	25	25	0
20	10	1	9	1	15	16	63
40	10	4	6	5	6	11	45.5
60	10	10	0	15	0	15	100
80	10	10	0	25	0	25	100
100	10	10	0	35	0	35	100

$LC_{50} = 41.7 \pm 10.4$

LETHAL CONCENTRATION DETERMINATION

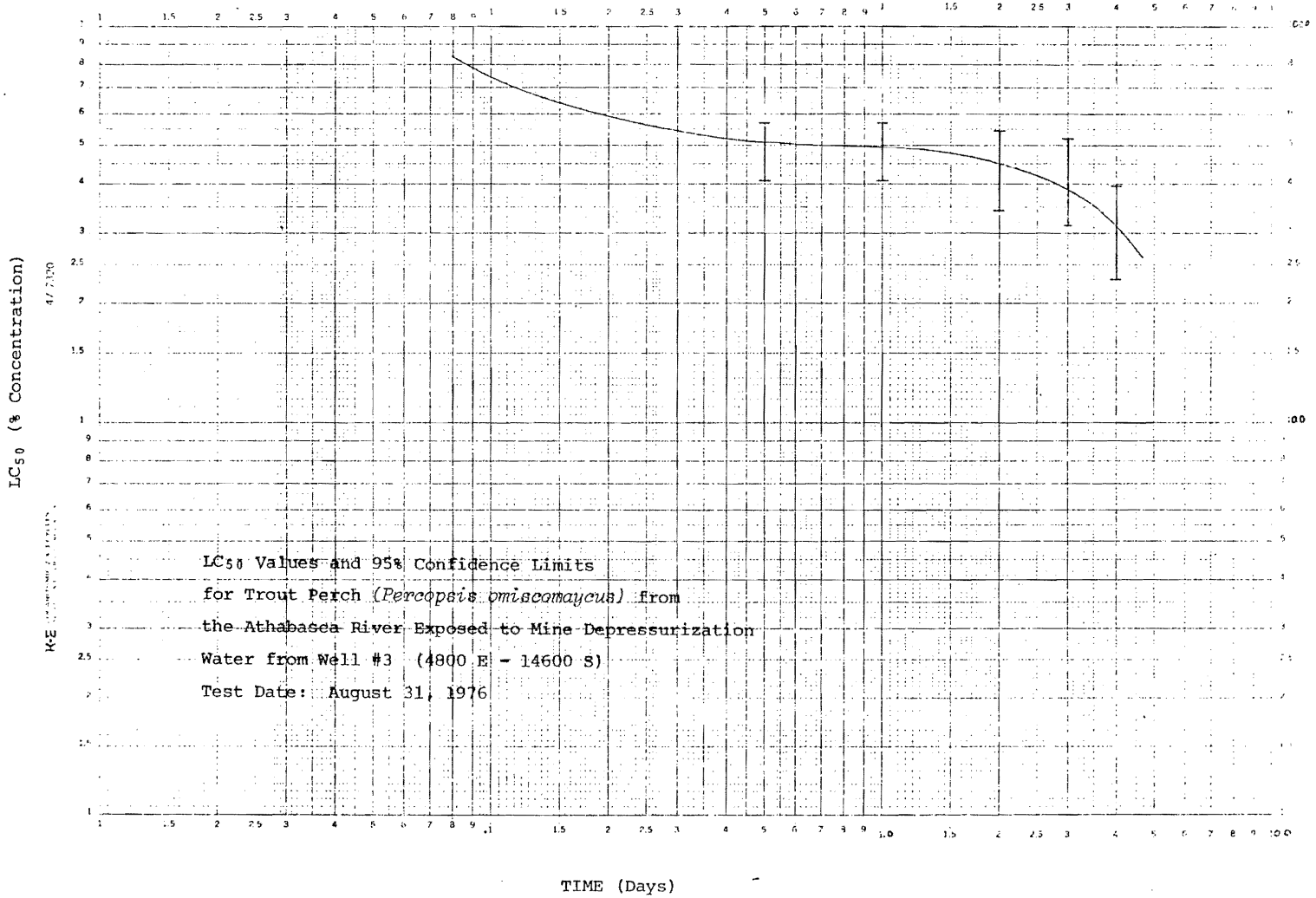
WELL NO. 3

(4800E - 14,600S)

96 Hrs.

Concentration	N	No. Dead	No. Alive	Accumulated Dead	Accumulated Alive	Total	Cumulative Mortality %
Control	10	0	10	0	21	21	0
20	10	1	9	1	11	12	8.3
40	10	8	2	9	2	11	81.8
60	10	10	0	19	0	19	100
80	10	10	0	29	0	29	100
100	10	10	0	39	0	39	100

$LC_{50} = 31.3 \pm 8.3$


LC50 (% Concentration)
TIME (Days)
LC50 Values and 95% Confidence Limits
for Trout Perch (Percopsis omiscomaycus) from
the Athabasca River Exposed to Mine Depressurization
Water from Well #3 (4800 E - 14600 S)
Test Date: August 31, 1976

3.3 CHEMISTRY DATA (JUNE TO OCTOBER 1976)

Data presented here include summary of chemistry analysis of mine depressurization water collected from Syncrude's Lease 17 and compared to analysis of Athabasca River water.

96 hr. LC_{50} = 40.05

M.S.T. (hrs.) 100% = 2.0

80% = 1.74

60% = 2.69 (1.51 - 4.79

40% = 70.0

MINE DEPRESSURIZATION WATER

SYNCRUDE LEASE 17

CHEMISTRY DATA SITE #3 4800E - 14600S

	POLLUTION CONTROL LAB		SAMPLE DATES 1976			CHEMEX LABS (ALTA) LTD.								
PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	JUNE 14	JUNE 28	JULY 08	NAQUADAT CODE	DETECTION LIMIT	JULY 22	JULY 28	AUGUST 04	AUGUST 18	AUGUST 26***	AUGUST 27	AUGUST 30**
Calcium	20105L	2.0	63	1.0*	160	20103L	0.002	100	11.0	95.0	46.0	40	72.0	73.0
Magnesium	12102L	1.0	154	188	220	12102L	0.001	140	160	140	150	142.6	142	142
Sodium	11102L	0.1	5781	5625	5982	11102L	0.5	6000	6500	5900	6500	6100	6500	6500
Potassium	19102L	0.1	45.4	58.7	37.6	19102L	0.5	50	41	41	46	50	58	57
Chloride	17203L	1.0	9958	0877	8415	17203L	0.5	9217	8000	8750	8800	7800	8750	8750
Sulphate	16306L	10.0	33	59	26	16306L	1.0	0.3	0.2	21.0	1.9	35	0.6	1.1
Alkalinity T	10101L	5.0	2796	2526	2773	10101L	1.0	1990	4356	2660	2620	2807	2776	2714
pH	10301L	0.0	7.3	8.7	7.5	10301L	0.0	7.2	7.1	7.7	7.8	7.1	7.2	7.5
Carbonate	06301L	5.0		38		06301L	1.0	0.0	0.0	0.0	0.0	0	0.0	0.0
Bicarbonate	06201L	5.0	3408	3003	3381	06201L	1.0	2425.8	5310	3242.5	3193.8	3421.7	3383.9	3308.4
Hardness T	10604L	5.0	789	595		10603L	1.0	826.1	686.2	813.6	732.4	687	764.4	766.9
Fluoride	09107L	0.05	0.72	0.75	0.72	09105L	0.1	0.61	0.58	0.52	0.72	-	0.63	0.75

* less than

CHEMISTRY DATA SITE # 3 4800 E - 14600 S

PARAMETERS	September					October		MEAN	RANGE
	02	08	15	24	28	07	19		Low - High
Calcium	83.0	42.5	35.5	52	85	100	28	63.94	1.0* - 160
Magnesium	144	119	108	128	130	129	135	145.39	108 - 220
Sodium	6500	6250	5750	5925	5875	6000	6250	6114	5625 - 6500
Potassium	56	42	40	61	64	62	55	50.86	37.6 - 64
Chloride	8750	8750	7600	8200	8750	7950	8500	8541	7600 - 9958
Sulphate	0.6	1.2	0.5	1.4	0.5	5	0.5	11.05	0.2 - 59
Alkalinity T	2742	2724	2728	2650	2675	2675	2700	2759.53	1990 - 4356
pH	7.3	7.5	7.9	7.8	7.9	7.6	7.7	7.58	7.1 - 8.7
Carbonate	0.0	0	0	0	0	0	0	2.53	0.0 - 38
Bicarbonate	3342.5	3320.6	3325.4	3230.4	3260.8	3260.8	3291.3	3359.41	2425.8 - 5310
Hardness T	800.1	596	533.3	656.8	747.5	780.8	625.7	712.53	533.3 - 826.1
Fluoride	0.63	0.74	0.71	0.59	0.57	0.77	0.74	0.67	0.52 - 0.77

CHEMISTRY DATA SITE #3 4800E - 14600S

	POLLUTION CONTROL LAB		SAMPLE DATES 1976			CHEMEX LABS (ALTA) LTD.								
PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	JUNE 14	JUNE 28	JULY 08	NAQUADAT CODE	DETECTION LIMIT	JULY 22	JULY 28	AUGUST 04	AUGUST 18	AUGUST 26***	AUGUST 27	AUGUST 30**
Silica	14102L	0.5				14101L	0.02	5.4	4.2	2.8	3.6	16	3.2	2.8
Conductivity	02041L	0.2	24900	25800	25500	02041L	1.0	30000	45000	25000	23000	24300	30000	30000
Odor	02001L	0.0	100	10		02001L	1.0	8	16	8	8		16	16
Color	02011L	1.0	98	98	97	02011L	1.0	5*	5*	5*	5*		5*	5*
Color T_2	02011L	1.0	99	99	98									
Color T_3	02011L	1.0	97	97	96									
Tanin & Lignin	06551L	0.1	0.2	0.3	0.3	06551L	0.1	2.0	1.60	1.30	1.25		0.40	0.80
T.R.	10471L	10.0	16250	16064	15840									
T.F.R.	10571L	10.0		14612	15386	10451L	1.0	15880	16660	15524	15780		16410	16350
T.F.R.F.						10551L	1.0	15820	15780	15468	15756		15840	15920
T.N.F.R.						10401L	1.0	9.2	28.4	46.0	45.6		98	24.8
T.N.F.R.F.						10510L	1.0	4.8	24.0	39.6	23.7		93	20.8
Turbidity	02073L	0.0	8	7		02073L	0.0	18.0	6.5	56.7	20.0		51.0	13.0
Surfactants	10701L	0.05	1.26	1.20	1.36	10701L	0.02	0.08	0.02*	0.02*	0.02*		0.02*	0.03
Humic Acids						00000L	2.0	2.0*	2.0*	1.0*	1.0*		1.0*	1.0*
T.O.C.	06001L	2.0	223	181	291	06001L	1.0	20	10	40	30		310	60

* less than

CHEMISTRY DATA SITE #3 4800 E - 14600S

PARAMETERS	September 02	September 08	September 15	September 24	September 28	October 07	October 19	MEAN	RANGE Low - High
Silica	3.4	3.3	3	3.6	3.1	3.3	2.7	4.32	2.7 - 16
Conductivity	30000	33000	30000	27000	27000	26500	25800	28988.24	24300 - 45000
Odor	32	8	8	4	4	2	8	16.53	2 - 100
Color	5*	5*	5*	5*	5*	5*	5*	22.38	5* - 98
Color T								98.67	98 - 99
Color T_3								96.67	96 - 97
Tanin & Lignin	1.15	0.6	0.55	1.1	0.2	1	0.35	0.82	0.2 - 2.0
TR								16084.67	15840 - 16250
TFR	16380	16260	15000	16240	16275	16405	14645	15853.8	14612 - 16660
TFRF	15840	15480	14640	15655	15830	15825	14195	15542.23	14195 - 15920
TNFR	36	6	97.2	11.2	20.8	16	19.2	35.26	6 - 98
TNFRF	26	5.6	90.4	4.4	13.2	9.2	10.8	28.12	4.4 - 93
Turbidity	28.0							23.13	6.5 - 56.7
Surfactants	0.02*	0.02*	0.02*	0.02*	0.02*	0.02*	0.02*	0.26	0.02* - 1.36
Humic Acids	1.0*	1.0*	1.0*	1.0*	1.0*	1.0*	1.0*	1.16*	
TOC	1.0*	80	50	30	10*	10*	50	87.25	1.0* - 310

CHEMISTRY DATA SITE #3 4800E - 14600S

	POLLUTION CONTROL LAB		SAMPLE DATES 1976			CHEMEX LABS (ALTA) LTD.								
PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	JUNE 14	JUNE 28	JULY 08	NAQUADAT CODE	DETECTION LIMIT	JULY 22	JULY 28	AUGUST 04	AUGUST 18	AUGUST 26***	AUGUST 27	AUGUST 30**
T.I.O.C.	06051L	2.0	308	569	523	06501L	0.5	740	780	660	690		410	700
Nitrite	07205L	0.1	0.1*		0.1*									
$NO_2 + NO_3$	07105L	0.1	0.1	0.096	0.1*	07110L	0.01	0.07	0.01	0.11	0.09		0.02	0.03
NH_3	07555L	0.05		10.06	11.06	07506L	0.005	7.8	5.90	4.80	3.30		6.60	4.20
Nitrogen Tk	07003L	0.05	12.10	12.17	10	07013L	0.3	18.3	6.62	5.30	6.60		12.0	11.5
Phosplate T	15407L				-									
Phosphorus T	15001L	0.05		0.068		15406L	0.003	0.10	0.115	0.13	0.16		0.17	0.14
Phosphorus O	15256L					15256L	0.003	0.025	0.01	0.13	0.13		0.03	0.04
Phenol	06532L	0.001				06532L	0.002	0.001	0.001*	0.001*	0.009		0.001*	0.009
Oil & Grease	06521L	1.0	6.1	4.7		06521L	0.1	0.9	1.3	0.1*	0.3		3.0	3.0
Sulphide	06101L	0.02		0.02*		16101L	0.05	0.05*	0.06	0.05*	0.05*		0.05*	0.05*
Cyanide	06601L	0.002	0.01*	0.01*	0.01*	00000L	0.1	0.01*	0.01*	0.01*	0.01*		0.01*	0.01*
Hydrocarbon T	06500L	0.001	0.001*	0.001*	0.36	00000L	10.	324	13.2	0.1*	0.7		1.5	5.7
B.O.D.	08201L	0.01		2.0										
C.O.D.	08301L	5.0	113.3	133.4	72.7	08301L	5.0	51.6	1282	85.8	164		10.0	144.0

* less than

PARAMETERS

CHEMISTRY DATA SITE # 3 4800 E - 14600S

	September		September			October		MEAN	RANGE	
	02	08	15	24	28	07	19		Low -	High
TIOC	680	680	730	660	720	720	450	626.25	308 -	780
Nitrite								0.1*		
NO_2 & NO_3	0.05	0.42	0.01	0.02	0.01*	0.02	0.01	0.073	0.01* -	0.42
NH_3	5.60	5.7	5.5	11	10.8	11.2	10.1	7.6	3.3 -	11.2
Nitrogen Tk	8.90	16	13.8	13.8	19.1	14.7	12	12.06	5.3 -	19.1
Phosphorus T	0.16	0.11	0.12	0.1	0.25	0.25	0.35	0.16	0.068 -	0.35
Phosphate T										
Phosphorus O	0.08	0.03	0.02	0.02	0.19	0.04	0.05	0.06	0.01 -	0.19
Phenol	0.02	0.001*	0.001*	0.001*	0.001*	0.001*	0.001*	0.004	0.001*-	0.02
Oil & Grease	2.5	2.5	3	1.1	1	1	0.8	2.08	0.1* -	6.1
Sulphide	0.05*	0.05*	0.05*	0.05*	0.05*	0.05*	0.05*	0.048	0.02* -	0.06
Cyanide	0.01*	0.01*	0.01*	0.01*	0.01*	0.01*	0.01*	0.01*		
Hydrocarbon T	2.3	0.7		0.3	0.3	0.1*		24.24	0.001*-	324
BOD								2.0		
COD	90.0	418	80	121	840	136	338	254.99	10 -	1282

CHEMISTRY DATA SITE #3 4800E - 14600S

	POLLUTION CONTROL LAB		SAMPLE DATES 1976			CHEMEX LABS (ALTA) LTD.								
PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	JUNE 14	JUNE 28	JULY 80	NAQUADAT CODE	DETECTION LIMIT	JULY 22	JULY 28	AUGUST 04	AUGUST 18	AUGUST 26***	AUGUST 27	AUGUST 30**
Cadmium	48302L	0.001	0.021	0.002*		48302L	0.001	0.02	0.021	0.02	0.019	0.001*	0.045	0.053
Chromium^{+6}	24101L	0.002	0.002*	0.002*		24101L	0.003	0.007	0.036	0.02	0.004	0.015	0.009	0.016
Copper	29305L	0.001				29306L	0.01	0.026	0.018	0.026	0.025	0.003	0.015	0.027
Iron	26302L	0.05	0.9	0.7	1.8	26304L	0.05	1.10	0.92	1.05	1.10	0.04	2.0	1.0
Lead	82302L	0.003				82302L	0.002	0.039	0.033	0.096	0.068	0.004*	0.054	0.068
Manganese	25004L	0.008				25004L	0.01	0.19	1.20	0.11	0.185	0.2	0.205	0.175
Silver	47303L	0.001				47301L	0.01	0.01	0.015	0.005*	0.015	-	0.01	0.015
Zinc	30305L	0.001				30304L	0.01	0.007	0.007	0.059	0.028	0.006	0.044	0.044
Vanadium	23310L	0.05				23301L	0.05	0.05	0.02	0.001*	0.002	0.001*	0.001	0.003
Selenium	34102L	0.0002						0.0035	0.002*	0.0037	0.002*	0.0005*	0.0005	0.0008
Mercury	80003L	0.0001	0.0001*	0.0001*	0.0001*			0.0004	0.0016	0.0007	0.0016	-	0.0008	0.0006
Arsenic	33104L	0.0002		0.0002*	0.0005*			0.005*	0.005*	0.005*	0.005*	0.005*	0.005*	0.007
Nickel	13005L	0.02	0.004					0.152	0.32	0.134	0.14	0.002	0.169	0.145
Cobalt	27302L	0.001						0.15	0.17	0.06	0.2	0.005*	0.59	0.14

* less than

PARAMETERS

CHEMISTRY DATA SITE # 3 4800 E - 14600S

	September		September			October		MEAN	RANGE	
	02	08	15	24	28	07	19		Low -	High
Cadmium	0.043	0.001*	0.001*	0.001*	0.001*	0.001*	0.001*	0.016	0.001* -	0.053
Chromium $^{+6}$	0.005	0.003*	0.003*	0.003*	0.003*	0.003*	0.003*	0.008	0.002* -	0.036
Copper	0.011	0.03	0.003	0.012	0.013	0.014	0.011	0.016	0.003 -	0.03
Iron	0.9	0.74	3.65	0.78	1.02	0.98	0.85	1.15	0.04 -	3.65
Lead	0.106	0.023	0.002*	0.002*	0.003	0.005	0.006	0.036	0.002* -	0.106
Manganese	0.17	0.152	0.175	0.13	0.141	0.14	0.18	0.24	0.11 -	1.2
Silver	0.015	0.03	0.01	0.005*	0.01		0.005*	0.02	0.005* -	0.03
Zinc	0.031	0.039	0.007	0.015	0.003	0.028	0.019	0.02	0.003 -	0.059
Vanadium	0.001*	0.001*	0.001*	0.001*	0.001*	0.001	0.001*	0.006	0.001* -	0.05
Selenium	0.0005*	0.0005*	0.0008	0.002	0.0005*	0.0018	0.0005*	0.0014	0.0005* -	0.0037
Mercury	0.0002*	0.0002	0.004	0.0002	0.0003	0.0002*	0.0003	0.0003	0.0001* -	0.004
Arsenic	0.005*	0.005*	0.005*	0.004	0.004	0.014	0.007	0.0047	0.0002* -	0.014
Nickel	0.173	0.002*	0.002*	0.002*	0.002*	0.002*	0.004	0.084	0.002* -	0.32
Aluminum	0.1	0.14	0.54	0.07	0.13	0.05	0.17	0.18	0.005* -	0.059
Cobalt	0.125	0.002*	0.002*	0.002*	0.004	0.002*	0.002*	0.063	0.002* -	0.13

CHEMISTRY DATA SITE #3 4800E - 14600S

	POLLUTION CONTROL LAB		SAMPLE DATES 1976			CHEMEX LABS (ALTA) LTD.								
PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	JUNE 14	JUNE 28	JULY 08	NAQUADAT CODE	DETECTION LIMIT	JULY 22	28	AUGUST 04	18	26***	27	30**
Boron	05102L	0.1						0.80	0.95	2.08	3.94	4.95	2.63	2.54
Pesticides	00000L											-		
T.D.S.	00205L	0.0	17712	15481	16504							15869.72		
P.C.B.'s	00000L	0.0001		0.0001*	0.0001*									
Carbon T	06006L	2.0	531	750	814									

Conductivity in microsiemens/cm

Turbidity in J.T.U.

Metals as Totals mg/l

Alkalinity and Hardness expressed as Calcium Carbonate

Nitrite, NO_2 + NO_3, NH_3 expressed as N

Phosphorus T expressed as PO_4

Phosphorus O expressed as P

pH in pH units

* less than

PARAMETERS

CHEMISTRY DATA SITE # 3 4800 E - 14600S

	September		September			October		MEAN	RANGE		
	02	03	15	24	28	07	19		Low	-	High
Boron	1.63	1.83	2.9	2.97	2.22	1.07	3.21	2.41	0.8	-	4.95
Pesticides											
TDS								16391.55	15481	-	17712
PCB's								0.0001*			
Carbon T.								698.33	531	-	814

*** sample analysed by M. Korchinski, Water Quality Branch, Western Region

SUMMARY OF CHEMISTRY ANALYSIS OF

MINE DEPRESSURIZATION WATER COLLECTED FROM

SYNCRUDE'S LEASE 17 AND COMPARED TO ANALYSIS

OF ATHABASCA RIVER WATER

WELL #3 4800E - 14600S

PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	DATE OF BIOASSAY SAMPLE AUG.30/76	WELL PROFILE MEANS AND RANGES L - H	ATHABASCA RIVER AUG.30/76	RIVER PROFILE MEANS AND RANGES L - H
Calcium	20103L	0.002	73.0	63.94 1.0* - 160.0	21.0	31.35 17.5 - 40.0
Magnesium	12102L	0.001	142.0	145.39 108.0 - 220.0	5.7	6.57 4.5 - 10.0
Sodium	11102L	0.5	6500.0	6114.0 5625.0 - 6500.0	7.4	9.29 5.9 - 36.0
Potassium	19102L	0.5	57.0	50.86 37.6 - 64.0	1.5	0.91 0.4 - 1.5
Chloride	17203L	0.5	8750.0	8541.0 7600.0 - 9958.0	1.4	6.11 1.0 - 51.0
Sulphate	16306L	1.0	1.1	11.05 0.2 - 59.0	11.0	13.8 0.5 - 41.0
Alkalinity T	10101L	1.0	2714.0	2759.53 1990.0 - 4356.0	86.6	86.69 66.8 - 129.0
pH	10301L	0	7.5	7.58 7.1 - 8.7	7.6	7.5 6.8 - 8.3
Carbonate	06301L	1.0	0.0	2.53 0.0 - 38.0	0.0	0.0
Bicarbonate	06201L	1.0	3308.4	3359.41 2425.8 - 5310.0	105.6	105.76 81.4 - 158.0
Hardness T	10603L	0.1	766.9	712.53 533.3 - 826.1	75.9	89.1 63.5 - 138.0
Conductivity	20401L	1.0	30000.0	28988.24 24300 - 45000	200.0	185.7 132.0 - 270.0
Surfactants	10701L	0.02	0.03	0.26 0.02* - 1.36	0.02*	0.03 0.02* - 0.09
T.O.C.	06001L	1.0	60.0	87.25 1.0* - 310.0	57.0	25.82 10.5 - 70.0
T.I.O.C.	06051L	1.0	700.0	626.25 308.0 - 780.0	23.0	19.44 11.0 - 40.0
Phenol	06532L	0.002	0.009	0.004 0.001* - 0.02	0.001*	0.005 0.001* - 0.022

WELL #3 4800E - 14600S (Continued)

PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	DATE OF BIOASSAY SAMPLE AUG.30/76	WELL PROFILE MEANS AND RANGES L - H	ATHABASCA RIVER AUG.30/76	RIVER PROFILE MEANS AND RANGES L - H
Oil & Grease	06521L	0.1	3.0	2.08 0.1* - 6.1	0.1*	0.56 0.1* - 5.0
Sulphide	16101L	0.05	0.05*	0.048 0.02* - 0.06	0.05*	0.05*
Cyanide	00000L	0.1	0.01*	0.01*	0.01*	0.01*
Hydrocarbon T	00000L	1.0	5.7	24.24 0.001* - 324.0	0.1*	0.9 0.001* - 2.0
C.O.D.	08301L	5.0	144.0	254.99 10.0 - 1282.0	267.0	86.83 37.0 - 267.0
Cadmium	48302L	0.001	0.053	0.016 0.001* - 0.053	0.001*	0.002 0.001* - 0.019
Chromium $^{+6}$	24101L	0.003	0.016	0.008 0.002* - 0.036	0.018	0.004 0.002* - 0.018
Copper	29306L	0.01	0.027	0.016 0.003 - 0.03	0.059	0.019 0.002 - 0.059
Iron	26304L	0.05	1.0	1.15 0.04 - 3.65	63.0	7.26 0.9 - 63.0
Lead	82302L	0.002	0.068	0.036 0.002* - 0.106	0.019	0.0056 0.002* - 0.026
Manganese	25304L	0.01	0.175	0.24 0.11 - 1.2	1.7	0.24 0.056 - 1.7
Silver	47301L	0.01	0.015	0.02 0.005* - 0.03	0.005*	0.005*
Zinc	30304L	0.01	0.044	0.02 0.003 - 0.059	0.331	0.053 0.014 - 0.069
Vanadium	23301L	0.02	0.003	0.006 0.001* - 0.05	0.001*	0.004 0.001* - 0.014
Selenium	34302L	0.00015	0.0008	0.0014 0.0005* - 0.0037	0.0005*	0.0012 0.0005* - 0.0018
Mercury	80011L	0.0002	0.0006	0.0003 0.0001* - 0.004	0.0002*	0.0067 0.0001* - 0.0044
Arsenic	33004L	0.001	0.007	0.0047 0.0002* - 0.014	0.015	0.0065 0.0025* - 0.02
Nickel	28302L	0.002	0.145	0.084 0.002* - 0.32	0.071	0.014 0.002* - 0.08
Aluminum	13302L	0.5	0.14	0.18 0.005* - 0.59	10.6	2.1 0.43 - 10.6

WELL #3 4800E - 14600S (Continued)

PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	DATE OF BIOASSAY SAMPLE AUG.30/76	WELL PROFILE MEANS AND RANGES L - H	ATHABASCA RIVER AUG.30/76	RIVER PROFILE MEANS AND RANGES L - H
Cobalt	27302L	0.002	0.125	0.063 0.002* - 0.13	0.043	0.005 0.002* - 0.043
Boron	05105L	0.05	2.54	2.11 0.8 - 4.95	1.51	0.2 0.01 - 1.51
Carbon T				698.33 531.0 - 814.0		44.5 41.0 - 48.0

Conductivity in microsiemens/cm

Turbidity in J.T.U.

Metals as Totals mg/l

Alkalinity and Hardness expressed as Calcium Carbonate

Nitrite, NO_2 + NO_3, NH expressed as N

Phosphorus T expressed as PO_4

Phosphorus O expressed as P

pH in pH units

* less than

Analysis by Chemex Labs (Alberta) Ltd.

4. SUMMARY OF SAMPLING AND TESTING OF WELL NO. 4

4900 E - 15700 S

Well No. 4

4900E - 15700S

Date of Bioassays: A. (1) October 8, 1976 (Terminated after 24 hrs.)
(2) October 12, 1976

B. (1) February 12, 1977 (Collected Dec. 15/76)
(2) February 12, 1977

Type of Bioassays: A. (1) 96 hr. Semi Static Replacement
(2) 144 hr. Semi Static Replacement

B. (1) 96 hr. Semi Static Replacement
(2) 96 hr. Semi Static Replacement

Type of Fish: A. (1) Trout Perch *(Percopsis omiscomaycus)*
(2) Trout Perch *(Percopsis omiscomaycus)*

B. (1) Rainbow Trout *(Salmo gairdneri)*
(2) Rainbow Trout *(Salmo gairdneri)*

Dilution Water: A. (1) Athabasca River Water
(2) Athabasca River Water

B. (1) City of Edmonton Treated Water
(2) City of Edmonton Treated Water

Mean Survival Times: A. (1) N/A
(2) 100% = 2.19 (2.07 - 2.31)
80% = 2.45
60% = 14.0 (12.35 - 15.88)
40% = 110 (27.36 - 442.2)

B. (1) 100% = 37.10
80% = 44.5 (41.78 - 47.39)
(2) 100% = 1.9 (1.62 - 2.22)
80% = 2.44

Well No. 4

96 hr. LC_{50}(%): A. (2) = 41.0 (Sprague)
= 37.4 (24.5 - 50.3) (Reed & Muench)

B. (1) = $80 < LC_{50} < 100$ (Sprague)
(2) = $60 < LC_{50} < 80$ (Sprague)
= 64.3 (59.2 - 69.4) (Reed & Muench)

4.1 TEST NO. 10 BIOASSAY DATA, 8 OCTOBER 1976

Data presented here include cumulative mortality of Trout-perch (*Percopsis omiscomaycus*).

TEST # 10 MINE DEPRESSURIZATION WATER SEMI STATIC REPLACEMENT OF WELL # 4 TEST DATE OCTOBER 8/76

CONCENTRATIONS (MEAN & RANGE)

PARAMETERS	CONTROL 4 readings	20% 4 readings	25% 4 readings	40% 4 readings	60% 4 readings	80% 2 readings	100% 2 readings
Temperature (°C)	13 ± 1.16 Range (12.0-14.5)	12.88 ± 1.4 Range (12.0-14.5	12.8 ± .99 Range (12.0-14.0)	12.95 ± 1.24 Range (12.0-14.5)	12.75 ± 1.08 Range (11.5-14.0)	12.75 ± 3.13 Range (11.5-14.0)	11.5
Dissolved O_2 (mg/l)	9.93 ± .26 Range (9.4-10.5)	10.08 ± .33 Range (9.4-10.6)	9.88 ± .40 Range (9.3-10.6)	10.0 ± .27 Range (9.4-10.6)	9.9 ± .55 Range (9.2-10.8)	10.5 ± .18 Range (10.2-10.8)	10.61 ± .005 (10.6-10.7) Range
pH	8.23 ± .004 Range (8.16-8.30)	8.55 ± .22 Range (7.84-8.80)	8.0 ± .05 Range (7.74-8.30)	8.13 ± .13 Range (7.70-8.51)	8.29 ± .14 Range (7.76-8.62)	8.5 ± .006 Range (8.49-8.60)	8.575 ± .007 (8.57-8.58) Range
Conductivity (µs/cm)	221.25	6187	7225	> 10,000	> 10,000	> 10,000	> 10,000
Fish Length (cm)			4.86 ± .93				
Fish Weight (gm)			1.22 ± .55				
Number Fish/Dilution	8	8	11	5	9	8	7
Number Dilutions/Conc.	1	1	1	1	1	1	1
Volume of Dilutions (l)	20	20	20	20	20	20	20
LT_{50} (Hr.)							
LC_{50} (Conc. by Vol.)	TERMINATED						

CUMULATIVE MORTALITY OF TROUT PERCH *(Percopsis omiscomaycus)*

TEST # 10 - WELL 4

Concentration Mine Depressurization Water (% by volume)	0.0	0.25	0.50	0.58	0.66	1.00	1.08	1.73	1.81	1.85	2.00	2.60	3.88	4.00	4.16	4.23	8.00	12.00	18.00	23.75	24.00	25.16	Total % Mortality 25.16
Control																							
N = 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
% mortality	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20																							
N = 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	
% mortality	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12.50	12.50	12.50	12.50	12.50	12.50	12.50
25																							
N = 11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
% mortality	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40																							
N = 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
% mortality	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
60																							
N = 9	0	0	0	0	0	0	0	0	0	1	1	1	2	2	2	2	2	4	5	6	8	9	
% mortality	0	0	0	0	0	0	0	0	0	11.11	11.11	11.11	22.22	22.22	22.22	22.22	22.22	44.44	55.55	66.66	88.88	100.00	100.00
80																							
N = 8	0	0	0	0	0	0	0	1	1	1	2	3	4	4	5	6	8						
% mortality	0	0	0	0	0	0	0	12.50	12.50	12.50	25.00	37.50	50.00	50.00	52.50	75.00	100.00						100.00
100																							
N = 7	0	0	0	1	2	2	3	6	7														
% mortality	0	0	0	14.28	28.57	28.57	42.10	85.71	100.0														100.00

4.2 TEST NO. 12 BIOASSAY DATA, 12 OCTOBER 1976

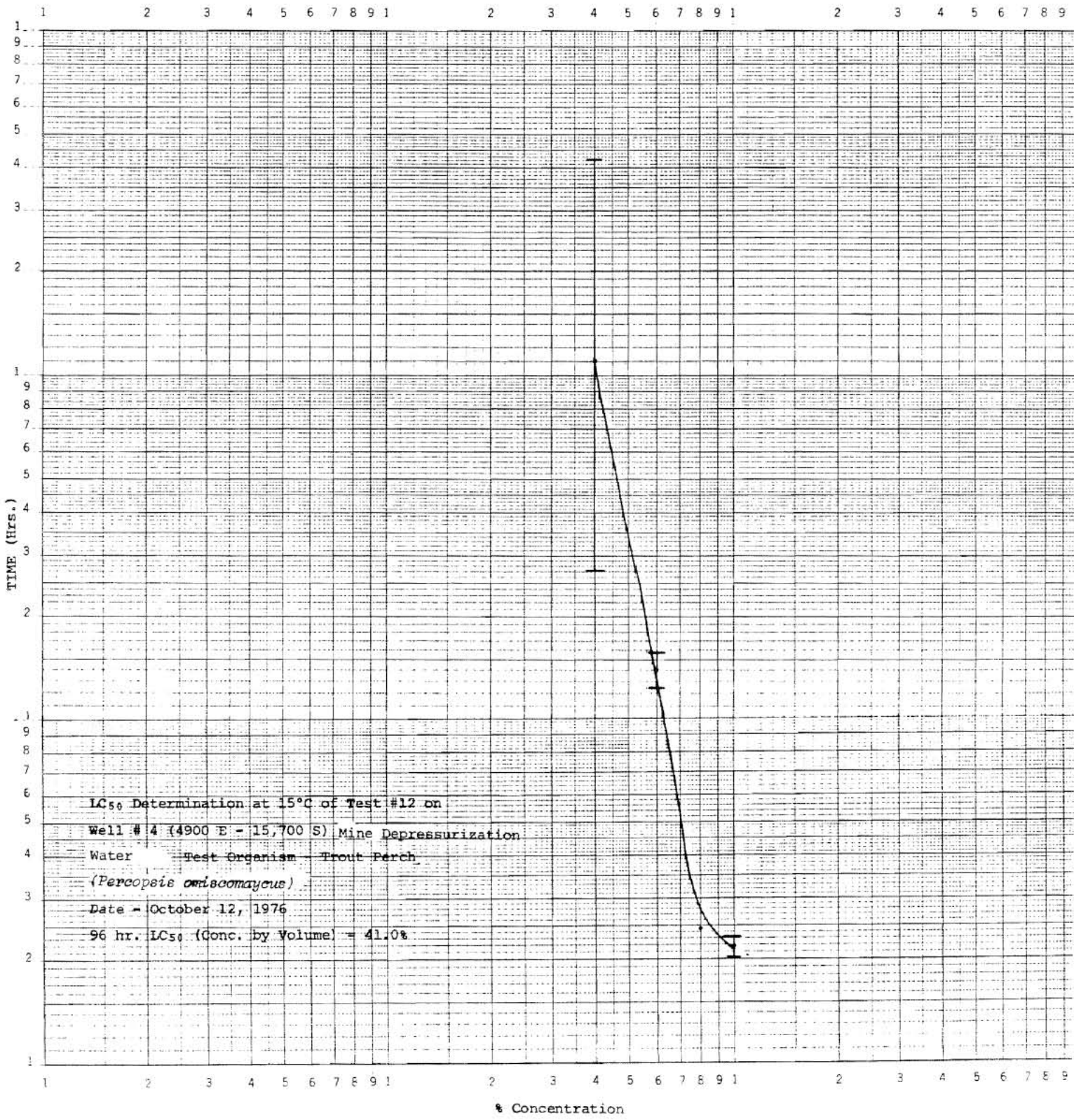
Data presented here include:

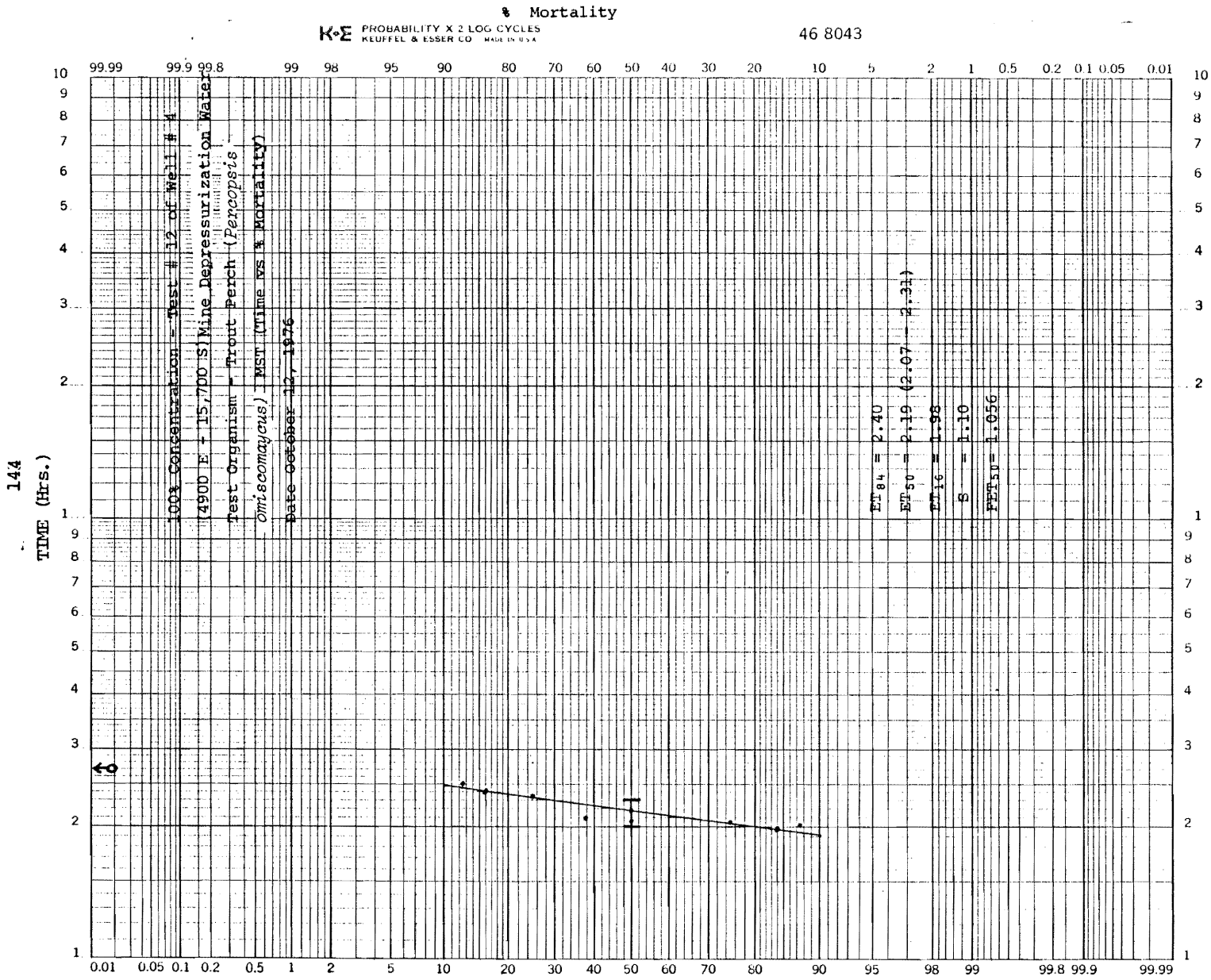
1. cumulative mortality of Trout-perch (*Percopsis omiscomaycus*);
2. graphical determination of LC_{50} and MST's (Litchfield 1949); and
3. lethal concentration determination (Woolf 1968).

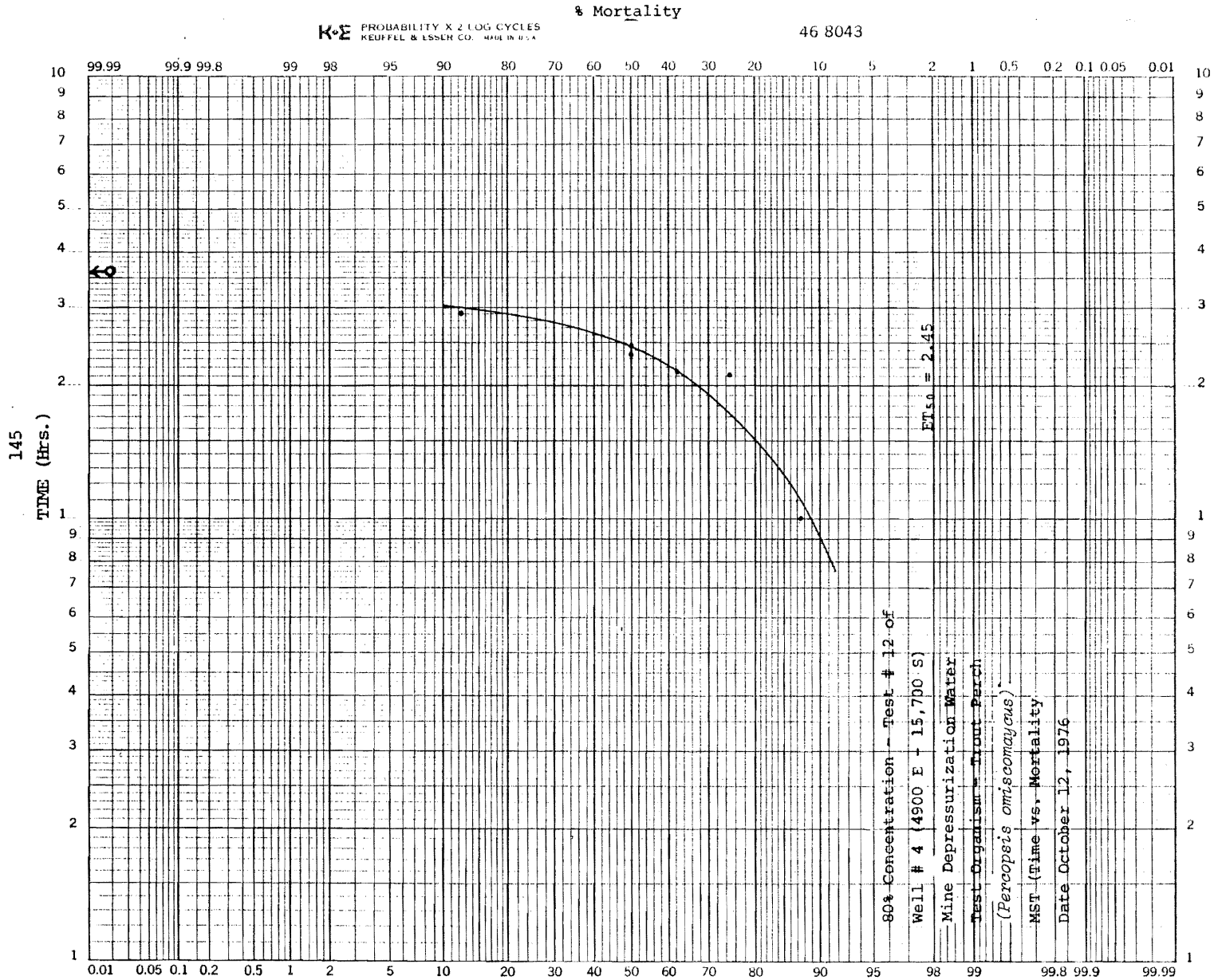
TEST # 12 MINE DEPRESSURIZATION WATER SEMI STATIC REPLACEMENT OF WELL # 4 TEST DATE OCTOBER 12/76

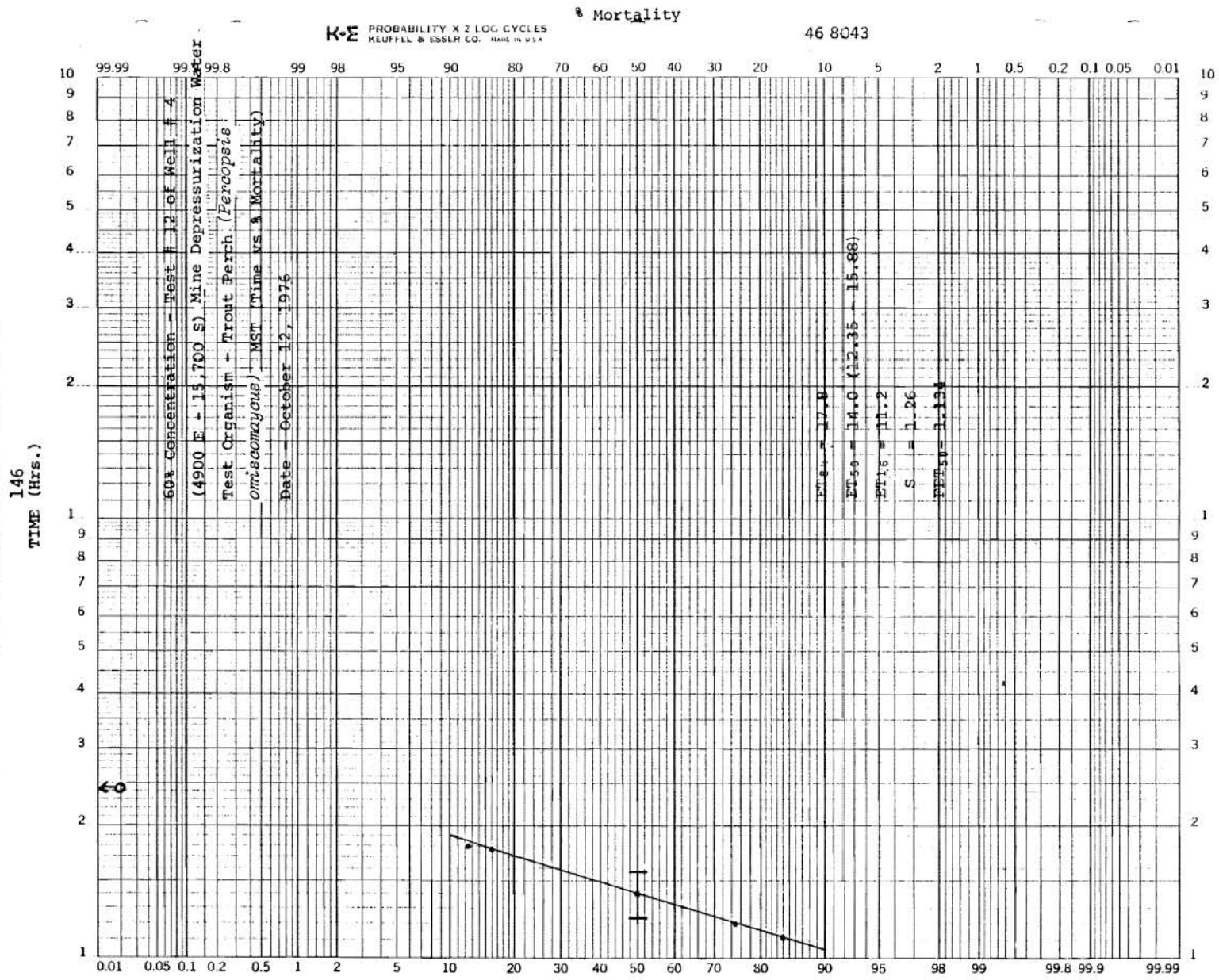
CONCENTRATIONS (MEAN & RANGE)

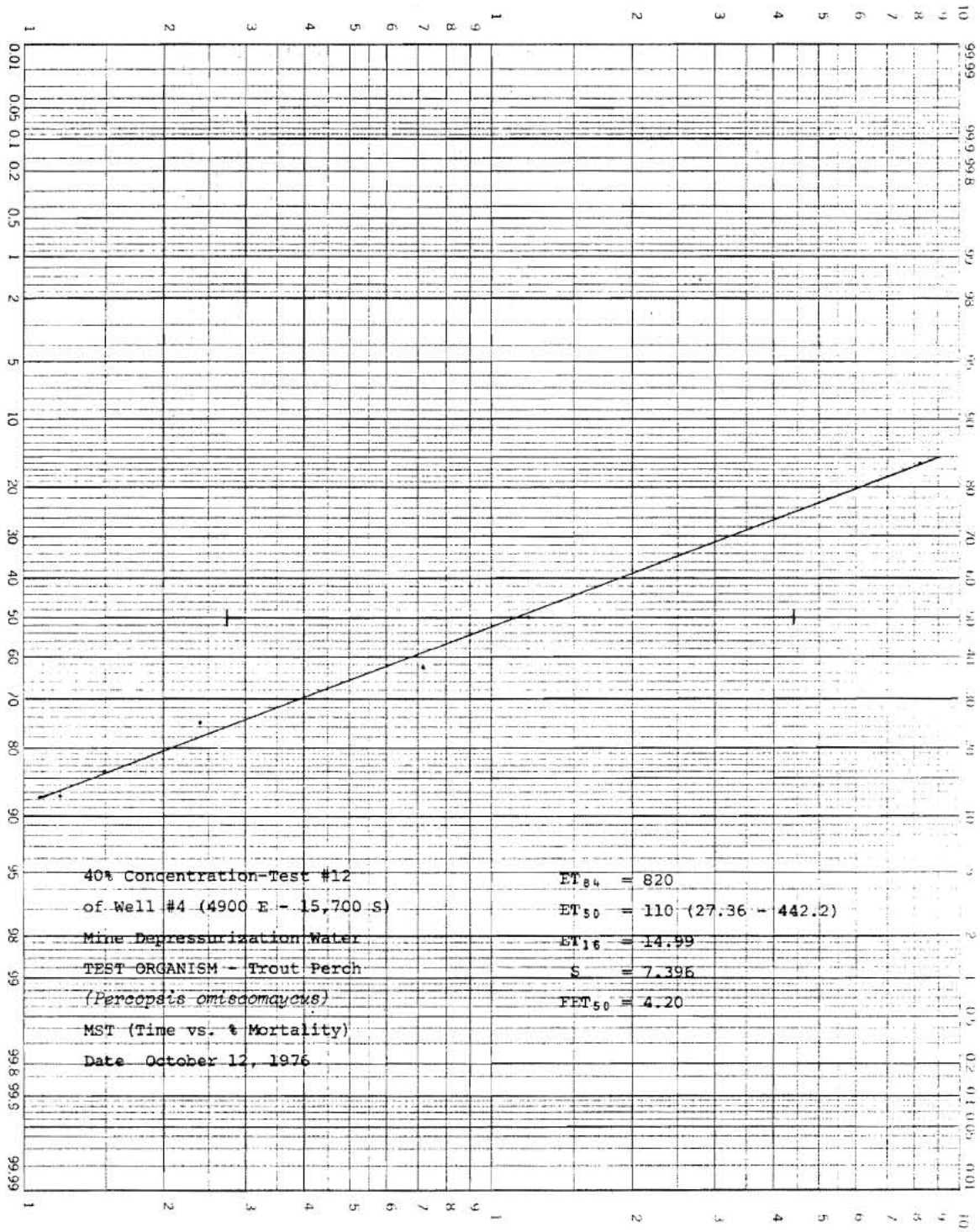
PARAMETERS	CONTROL 5 readings	20% 5 readings	40% 5 readings	60% 4 readings	80% 2 readings	100% 2 readings
Temperature (°C)	14.0 ± .41	13.7 ± .31	13.4 ± .28	13.4 Range (13.0-13.5)	13.5 No Range	13.5 No Range
Dissolved Oxygen (mg/l)	10.2 ± .09	10.1 ± .12	9.8 ± .44	10.0 (2 readings) Range (9.7-10.4	10.4 No Range	10.3 Range (10.3-10.4)
pH	8.10 ± .00	8.31 ± .16	8.30 ± .21	8.50 Range (7.79-8.78)	8.87 Range (8.87-8.88)	8.79 Range (8.79-8.80)
Conductivity (µs/cm)	187	4147	7645	> 10,000	> 10,000	> 10,000
Fish Length (cm.)			5.3 ± 1.12			
Fish Weight (gm.)			1.58 ± .94			
Number Fish/Dilution	8	8	8	8	8	8
Number Dilutions/Conc.	1	1	1	1	1	1
Volume of Dilutions (1.)	20	20	20	20	20	20
LT_{50} (Hrs.)			110 (27.36-442.2)	14.0 (12.35-15.88)	2.45	2.19 (2.07-2.31)
LC_{50} (Conc. by Vol.)	41.0%					


TIME (Hrs.)
% Concentration
LC50 Determination at 15°C of Test #12 on
Well # 4 (4900 E - 15,700 S) Mine Depressurization
Water Test Organism - Trout Perch
(Percopsis omiscomaycus)
Date - October 12, 1976
96 hr. LC50 (Conc. by Volume) = 41.0%


% Mortality
K&E PROBABILITY X 2 LOG CYCLES
KEUFFEL & ESSER CO MADE IN U.S.A.
46 8043
144
TIME (Hrs.)
100% Concentration - Test # 12 of Well # 4
(4900 E - 15,700 S) Mine Depressurization Water
Test Organism - Trout Perch (Percopsis
Omiscomaycus) MST (Time vs % Mortality)
Date October 12, 1976
ET84 = 2.40
ET50 = 2.19 (2.07 - 2.31)
ET16 = 1.98
S = 1.10
PET50 = 1.056


% Mortality
K&E PROBABILITY X 2 LOG CYCLES
KEUFFEL & ESSER CO. MADE IN U.S.A.
46 8043
99.99 99.9 99.8 99 98 95 90 80 70 60 50 40 30 20 10 5 2 1 0.5 0.2 0.1 0.05 0.01
0.01 0.05 0.1 0.2 0.5 1 2 5 10 20 30 40 50 60 70 80 90 95 98 99 99.8 99.9 99.99
145
TIME (Hrs.)
80% Concentration - Test # 12 of
Well # 4 (4900 E + 15,700 S)
Mine Depressurization Water
Test Organism = Trout Perch
(Percopsis omiscomaycus)
MST (Time vs. Mortality
Date October 12, 1976
ET50 = 2.45


% Mortality
K•E PROBABILITY X 2 LOG CYCLES
KEUFFEL & ESSER CO.
46 8043
146
TIME (Hrs.)
60% Concentration - Test # 12 of Well # 4
(4900 E - 15,700 S) Mine Depressurization Water
Test Organism - Trout Perch (Percopsis omiscomaycus) MST Time vs % Mortality)
Date - October 12, 1976
ET84 = 17.8
ET50 = 14.0 (12.35 - 15.88)
ET16 = 11.2
S = 1.26
ETM50 = 3.134
99.99 99.9 99.8 99 98 95 90 80 70 60 50 40 30 20 10 5 2 1 0.5 0.2 0.1 0.05 0.01
0.01 0.05 0.1 0.2 0.5 1 2 5 10 20 30 40 50 60 70 80 90 95 98 99 99.8 99.9 99.99


TIME (hrs.)
40% Concentration-Test #12
of Well #4 (4900 E - 15,700 S)
Mine Depressurization Water
TEST ORGANISM - Trout Perch
(Percopsis omiscomaycus)
MST (Time vs. % Mortality)
Date October 12, 1976
ET84 = 820
ET50 = 110 (27.36 - 442.2)
ET16 = 14.99
S = 7.396
FET50 = 4.20

LETHAL CONCENTRATION DETERMINATION

WELL NO. 4

(4900E - 15,700S)

2.5 Hrs.

Concentration	N	No. Dead	No. Alive	Accumulated Dead	Accumulated Alive	Total	Cumulative Mortality %
Control	10	0	8	0	37	37	0
20	8	0	8	0	29	29	0
40	8	0	8	0	21	21	0
60	8	0	8	0	13	13	0
80	8	4	4	4	5	9	44
100	8	7	1	11	1	12	91.7

$LC_{50} = 82.5 \pm 12.0$

LETHAL CONCENTRATION DETERMINATION

WELL NO. 4

(4900E - 15,700S)

12 Hrs.

Concentration	N	No. Dead	No. Alive	Accumulated Dead	Accumulated Alive	Total	Cumulative Mortality %
Control	8	0	8	0	28	28	0
20	8	1	7	1	20	21	4.8
40	8	1	7	2	13	15	13.3
60	8	2	6	4	6	10	40
80	8	8	0	12	0	12	100
100	8	8	0	20	0	20	100

$LC_{50} = 63.3 \pm 12.0$

LETHAL CONCENTRATION DETERMINATION

WELL NO. 4

(4900E - 15,700S)

24 Hrs.

Concentration	N	No. Dead	No. Alive	Accumulated Dead	Accumulated Alive	Total	Cumulative Mortality %
Control	8	0	8	0	22	22	0
20	8	1	7	1	14	15	67
40	8	2	6	3	7	10	30
60	8	7	1	10	1	11	90.9
80	8	8	0	18	0	18	100
100	8	8	0	26	0	26	100

$LC_{50} = 46.6 \pm 11.0$

LETHAL CONCENTRATION DETERMINATION

WELL NO. 4

(4900E - 15,700S)

48 and 60 Hrs.

Concentration	N	No. Dead	No. Alive	Accumulated Dead	Accumulated Alive	Total	Cumulative Mortality %
Control	8	0	8	0	21	21	0
20	8	1	7	1	13	14	7.1
40	8	2	6	3	6	9	33
60	8	8	0	11	0	11	100
80	8	8	0	19	0	19	100
100	8	8	0	27	0	27	100

$LC_{50} = 45 \pm 10.9$

LETHAL CONCENTRATION DETERMINATION

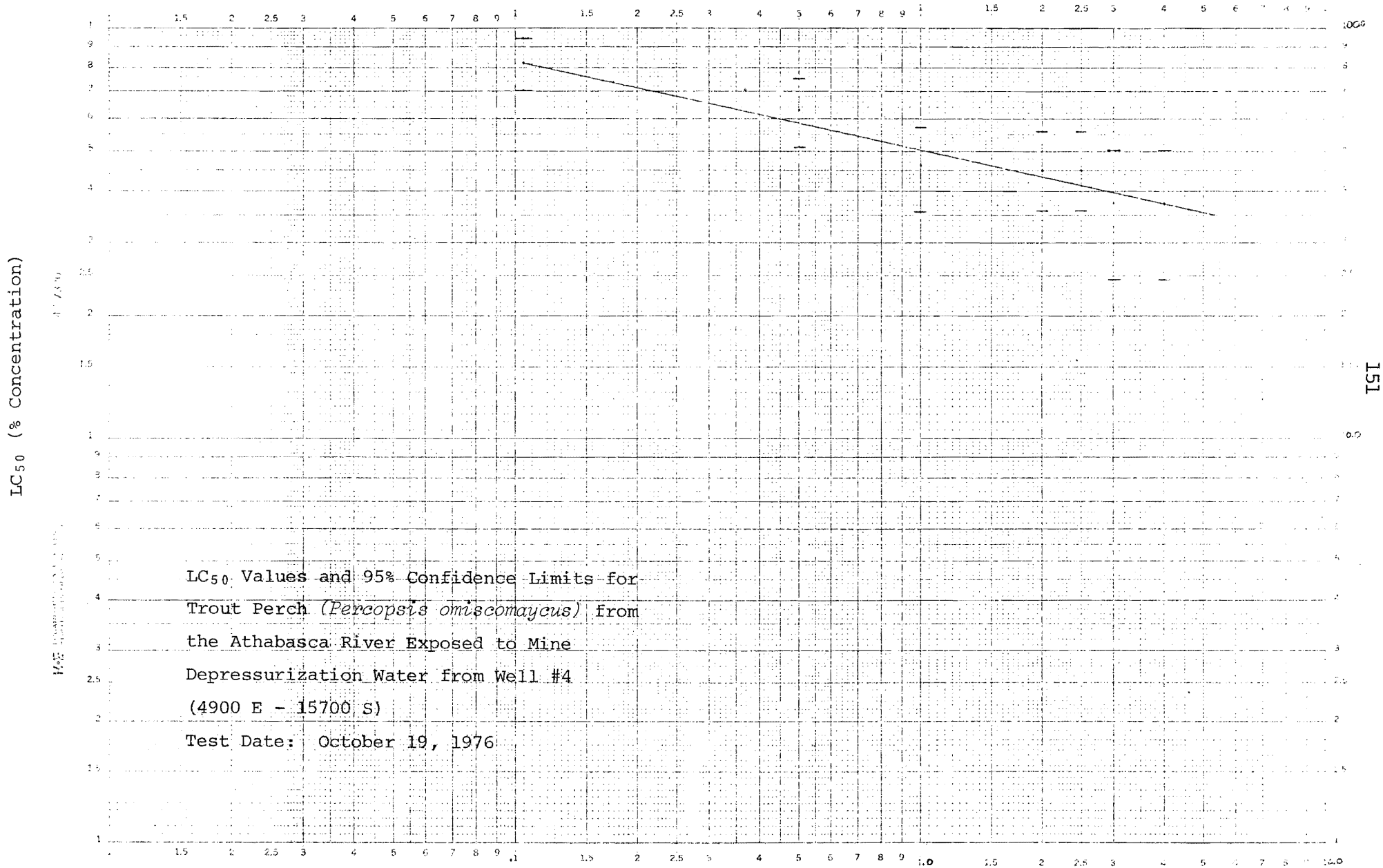
WELL NO. 4

(4900E - 15,700S)

72 and 96 Hrs.

Concentration	N	No. Dead	No. Alive	Accumulated Dead	Accumulated Alive	Total	Cumulative Mortality %
Control	8	2	6	2	18	20	10
20	8	1	7	3	12	15	20
40	8	3	5	6	5	11	54.5
60	8	8	0	14	0	14	100
80	8	8	0	22	0	22	100
100	8	8	0	30	0	30	100

$LC_{50} = 37.4 \pm 12.9$



LC_{50} Values and 95% Confidence Limits for Trout Perch *(Percopsis omiscomaycus)* from the Athabasca River Exposed to Mine Depressurization Water from Well #4 (4900 E - 15700 S)

Test Date: October 19, 1976

4.3 CHEMISTRY DATA (JUNE TO OCTOBER 1976)

Data presented here include summary of chemistry analysis of mine depressurization water collected from Syncrude's Lease 17 and compared to analysis of Athabasca River water.

96 hr. LC_{50} = 41.0%

M.S.T. (hrs.) 100% = 2.19 (2.07 - 2.31)
80% = 2.45
60% = 14.0 (12.35 - 15.88)
40% = 110 ((27.36 - 442.2)

MINE DEPRESSURIZATION WATER

SYNCRUDE LEASE 17

CHEMISTRY DATA SITE #4 4900E - 15700S

	POLLUTION CONTROL LAB SAMPLE DATES 1976					CHEMEX LABS (ALTA) LTD.					
PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	JUNE 14	JUNE 28	JULY 08	NAQUADAT CODE	DETECTION LIMIT	JULY 28	AUGUST 04	AUGUST 18	SEPTEMBER 02
Calcium	20105L	2.0	121	1.0*	107	20103L	0.002	19	100	3636	77
Magnesium	12102L	1.0	150	223	253	12102L	0.001	150	170	200	157
Sodium	11102L	0.1	5875	5938	6339	11102L	0.5	5500	6400	7000	6500
Potassium	19102L	0.1	44.6	60	37.6	19102L	0.5	37	40	46	56
Chloride	17203L	1.0	8929	8974	9024	17203L	0.5	6950	9000	9600	9000
Sulphate	16306L	10.	34	65	17	16306L	1.0	3.2	0.5	2.4	1.6
Alkalinity T	10101L	5.0	2689	2414	2702	10101L	1.0	1964	2628	2620	2660
pH	10301L	0.0	7.5	9.0	7.5	10301L	0.0	7.6	7.3	7.6	7.2
Carbonate	06301L	5.0		219		06301L	1.0	0.0	0.0	0.0	0.0
Nicarbonate	06201L	5.0	3278	2499	3293	06201L	1.0	2394.1	3203.5	3193.8	3242.5
Hardness T	10604L	5.0	921	632	1309	10603L	1.0	665	949.6	913.3	838.6
Fluoride	09107L	0.05	0.69	0.72	0.72	09105L	0.1	0.72	0.58	0.7	0.72

* less than

CHEMISTRY DATA SITE # 4 4900 E - 15700 S

PARAMETERS	September					October			MEAN	RANGE	
,	08	15	24	28	30	07**	12	19		Low -	High
Calcium	40	40	102	45	110	110	55	106	71.27	1.0* -	121
Magnesium	128	120	140	87	88	138	82	150	149.07	82 -	253
Sodium	6250	6250	6175	4300	5000	6125	4175	6250	5871.8	4175 -	7000
Potassium	42.5	51.5	61	40	55	62	40	55	47.88	37 -	62
Chloride	8750	8500	9000	5500	6000	8200	5050	8800	8085.13	5050 -	9600
Sulphate	0.5	1.8	0.5	1	0.5	0.5	0.5	0.5	8.63	0.5 -	65
Alkalinity	2640	2668	2625	2450	2075	2575	2425	2630	2517.67	1964 -	2702
pH	7.6	7.7	7.8	8.2	8.5	7.5	7.9	7.7	7.77	7.2 -	9.0
Carbonate	0	0	0	0	150	0	0	0	28.38	0.0 -	219
Bicarbonate	3218.2	3253.3	3199.9	2986.6	2224.7	3138.9	2956.1	3206	3019.17	2224.7 -	3293
Hardness T	626.9	593.9	831.1	470.5	637	842.8	474.9	882.2	772.52	626.9 -	1309
Fluoride	0.77	0.68	0.5	0.9	0.8	0.69	0.88	0.81	0.72	0.5 -	0.88

CHEMISTRY DATA SITE #4 4900E - 15700S

	POLLUTION CONTROL LAB		SAMPLE DATES 1976			CHEMEX LABS (ALTA) LTD.					
PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	JUNE 14	JUNE 28	JULY 08	NAQUADAT CODE	DETECTION LIMIT	JULY 28	AUGUST 04	AUGUST 18	SEPTEMBER 02
Silica	14102L	0.5				14101L	0.02	4.3	2.9	3.3	2.8
Conductivity	02041L	0.2	26300	27700	27000	02041L	1.0	30000	28000	48000	31000
Odor	02001L	0.0	10	100		02001L	1.0	16	8	32	2
Color	02011L	1.0	98	98	97	02011L	1.0	5*	5*	5*	5*
Color T_2	02011L	1.0	99	99	98						
Color T_3	02011L	1.0	97	97	96						
Tanin & Lignin	06551L	0.1	0.1*	0.4	0.4	06551L	0.1	1.30	0.7	1.0	1.0
T.R.	10471L	10.0	16610	17236	15978						
T.F.R.	10571L	10.0		16420	16446	10451L	1.0	16020	16888	16564	16990
T.F.R.F.						10551L	1.0	15000	16480	16184	16450
T.N.F.R.						10401L	1.0	171.2	44.4	159	27
T.N.F.R.F.						10510L	1.0	153.2	39.6	143	19
Turbidity	02073L	0.0	9	9		02073L	0.0	84	47.0	120	23
Surfactants	10701L	0.05	1.74	1.30	1.32	10701L	0.02	0.04	0.02*	0.02*	0.02*
Humic Acids						00000L	2.0	2.0*	1.0*	1.0*	1.0*
T.O.C.	06001L	2.0	611	212	297	06001L	1.0	15	40	20	50

* less than

CHEMISTRY DATA SITE # 4 4900 E - 15700 S

PARAMETERS	September					October			MEAN	RANGE	
	08	15	24	28	30	07**	12	19		Low	High
Silica	3	3.1	3.4	3.9	4.4	3.3	4.2	2.9	3.46	2.8	4.4
Conductivity	32000	32000	27500	17200	19500	27500	17000	30500	28080	17200	48000
Odor	8	32	4	4	2	2	16	8	17.43	2	100
Color	5*	5*	5*	5*	5*	5*	5*	5*	23.53	5*	98
Color T									98.66	98	99
Color T_3									96.66	96	97
Tanin & Lignin	0.45	0.9	1	0.65	0.25	0.2	0.2	0.5	0.6	0.1*	1.3
TR									16608	15978	17236
TFR	16500	16300	16975	11355	12935	16890	11000	16440	15551.64	11000	16990
TFRF	16120	15880	16370	10865	12535	16310	10470	15995	14888.25	10470	16480
TNFR	20	5.6	18	436	15.2	4.4	8.8	13.2	76.9	4.4	436
TNFRF	15.6	3.6	11.2	394	11.6	0.4	4.4	5.2	66.73	0.4	394
Turbidity									48.67	9	120
Surfactants	0.02*	0.02*	0.02*	0.02*	0.02*	0.02*	0.02	0.02*	0.31	0.02*	1.74
Humic Acids	1.0*	1.0*	1.0*	1.0*	1.0*	1.0*	1.0*	1.0*	1.08*		
TOC	30	50	20	35	25	10	20	50	99	10	611

CHEMISTRY DATA SITE #4 4900E - 15700S

	POLLUTION CONTROL LAB		SAMPLE DATES 1976			CHEMEX LABS (ALTA) LTD.					
PARAMETERS	NAQUADAT CODE	DDECTIO LIMIT	JUNE 14	JUNE 28	JULY 08	NAQUADAT CODE	DETECTION LIMIT	JULY 28	AUGUST 04	AUGUST 18	SEPTEMBER 02
T.I.O.C.	06051L	2.0	519	575	517	06501L	0.5	760	620	700	700
Nitrite	07205L	0.1	0.1*		0.1*						
$NO_2 + NO_3$	07105L	0.1	0.1*	0.061	0.1*	07110L	0.01	0.03	0.04	0.01*	0.02
NH_3	07555L	0.05		11.03	11.48	07506L	0.005	6.8	8.2	10.50	4.2
Nitrogen Tk	07003L	0.05	12.11	11.97	10.53	07013L	0.3	14.4	8.6	12.0	12.2
Phosplate T	15407L			0.64	0.51						
Phosphorus T	15001L	0.05	1.74			15406L	0.003	0.015	0.21	0.13	0.16
Phosphorus O	15256L			0.113		15256L	0.003	0.010	0.09	0.04	0.05
Phenol	06532L	0.001				06532L	0.002	0.003	0.001*	0.009	0.004
Oil & Grease	06521L	1.0	6.8	6.9		06521L	0.1	0.3	0.6	1.8	2.5
Sulphide	06101L	0.02		0.02*		16101L	0.05	0.09	0.05*	0.05*	0.05*
Cyanide	06601L	0.002	0.01*	0.01*	0.01*	00000L	0.1	0.01*	0.01*	0.01*	0.01*
Hydrocarbon T	06500L	0.001		0.013	0.78	00000L	10.	5.0*	0.1*	1.3	0.1*
B.O.D.	08201L	0.01		2.0							
C.O.D.	08301L	5.0	102.7	163.8	72.7	08301L	5.0	36.3	90.3	60.0	260.0

* less than

CHEMISTRY DATA SITE # 4 4900 E - 15700 S

PARAMETERS	September					October			MEAN	RANGE	
	08	15	24	28	30	07**	12	19		Low -	High
TIOC	700	730	660	350	350	520	640	450	586.07	586.07 -	760
Nitrite									0.1*		
NO_2 & NO_3	0.03	0.01	0.02	0.01*	0.01	0.01*	0.01*	0.02	0.03	0.01* -	0.061
NH_3	7.7	7.9	11	8.4	7.6	11	8.2	10	8.86	4.2 -	11.48
Nitrogen Tk	17	14	14.6	22.9	9.4	14.3	10.6	11.5	13.08	8.6 -	22.9
Phosphorus T	0.1	0.07	0.15	0.13	0.06	0.13	0.06	0.34	0.25	0.06 -	1.74
Phosphate T									0.58	0.51 -	0.64
Phosphorus O	0.03	0.02	0.12	0.05	0.04	0.04	0.02	0.04	0.05	0.01 -	0.113
Phenol	0.001*	0.001*	0.012	0.001*	0.006	0.001*	0.001*	0.001	0.003	0.001* -	0.012
Oil & Grease	4.5	5	0.8	0.8	0.3	1	1.6	0.8	2.41	0.3 -	6.9
Sulphide	0.05*	0.05*	0.05*	0.05*	0.05*	0.05*	0.05*	0.05*	0.05	0.02* -	0.09
Cyanide	0.01*	0.01*	0.01*	0.01*	0.01*	0.01*	0.01*	0.01*	0.01*		
Hydrocarbon T	5.9	6.5	0.6	0.2	0.1*	0.5			1.17	0.1* -	6.5
BOD									2.0		
COD	64	680	690	420	387	72	489	79	244.45	36.3 -	690

CHEMISTRY DATA SITE #4 4900E - 15700S

	POLLUTION CONTROL LAB		SAMPLE DATES 1976			CHEMEX LABS (ALTA) LTD.					
PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	JUNE 14	JUNE 28	JULY 08	NAQUADAT CODE	DETECTION LIMIT	JULY 28	AUGUST 04	AUGUST 18	SEPTEMBER 02
Cadmium	48302L	0.001	0.026			48302L	0.001	0.016	0.021	0.021	0.051
Chromium^{+6}	24101L	0.002	0.002*	0.002*	0.002*	24101L	0.003	0.005	0.019	0.013	0.009
Copper	29305L	0.001				29306L	0.01	0.017	0.024	0.021	0.014
Iron	26302L	0.05	0.9	1.0	3.0	26304L	0.05	2.05	1.0	0.96	0.65
Lead	82302L	0.003				82302L	0.002	0.045	0.093	0.083	0.137
Manganese	25004L	0.008				25004L	0.01	0.220	0.12	0.17	0.18
Silver	47303L	0.001				47301L	0.01	0.02	0.005*	0.005*	0.01
Zinc	30305L	0.001				30304L	0.01	0.21	0.041	0.019	0.043
Vanadium	23301L	0.05				23301L	0.05	0.01*	0.001*	0.001*	0.005
Selenium	34102L	0.0002						0.0028	0.0021	0.0035	0.0011
Mercury	80003L	0.0001	0.0001*	0.0001*	0.0001*			0.0003	0.0004	0.0007	0.0005
Arsenic	33104L	0.0002		0.0002*	0.0002*			0.02	0.005*	0.005*	0.005*
Nickel	28302L	0.001	0.006					0.135	0.147	0.146	0.165
Aluminum	13005L	0.02						0.38	0.18	0.21	0.1
Cobalt	27302L	0.001						0.115	0.107	0.103	0.135

* less than

CHEMISTRY DATA SITE # 4 4900 E - 15700 S

PARAMETERS	September					October			MEAN	RANGE	
	08	15	24	28	30	07**	12	19		Low -	High
Cadmium	0.001*	0.001*	0.001*	0.001*	0.001*	0.001*	0.001*	0.001*	0.011	0.11 -	0.051
Chromium $^{+6}$	0.003*	0.003*	0.003*	0.003*	0.003*	0.003	0.003*	0.003*	0.005	0.002* -	0.019
Copper	0.025	0.005	0.016	0.01	0.021	0.016	0.011	0.002	0.015	0.002 -	0.025
Iron	0.83	0.21	0.59	4.75	0.65	0.72	0.61	0.8	1.25	0.21 -	4.75
Lead	0.008	0.002*	0.002*	0.002*	0.002*	0.007	0.002*	0.002*	0.032	0.002* -	0.137
Manganese	0.16	0.175	0.138	0.15	0.065	0.145	0.071	0.2	0.15	0.065 -	0.22
Silver	0.02	0.015	0.02	0.01	0.005		0.005*	0.005*	0.011	0.005* -	0.02
Zinc	0.025	0.016	0.011	0.032	0.008	0.014	0.008	0.018	0.021	0.008 -	0.043
Vanadium	0.001*	0.001*	0.001*	0.001*	0.001*	0.001*	0.001*	0.001*	0.002	0.001* -	0.005
Selenium	0.0006	0.0005	0.0005*	0.0009	0.0018	0.0005*	0.0005*	0.0005*	0.0013	0.0005*-	0.0035
Mercury	0.0029	0.0072	0.0003	0.0007*		0.0002*	0.0002*	0.0011	0.001	0.0001*-	0.0072
Arsenic	0.005*	0.005*	0.001	0.001*	0.006	0.006	0.001*	0.001*	0.004	0.0002*-	0.02
Nickel	0.002*	0.002*	0.002*	0.002*	0.002*	0.002*	0.002*	0.002*	0.047	0.002* -	0.165
Aluminum	0.03	0.09	0.1	2	0.09	0.12	0.15	0.09	0.296	0.03 -	2
Cobalt	0.002*	0.002*	0.004	0.002*	0.002*	0.002*	0.002*	0.002*	0.042	0.002* -	0.135

CHEMISTRY DATA SITE #4 4900E - 15700S

PARAMETERS	POLLUTION CONTROL LAB NAQUADAT CODE	DETECTION LIMIT	SAMPLE DATES 1976 JUNE 14	JUNE 28	JULY 08	CHEMEX LABS (ALTA) LTD. NAQUADAT CODE	DETECTION LIMIT	JULY 28	AUGUST 04	AUGUST 18	SEPTEMBER 02
Boron	05102L	0.1						0.76	2.67	3.61	3.61
Pesticides	00000L										
T.D.S.	00205L	0.0	16767	16639	17400						
P.C.B.'s	00000L	0.0001		0.0001*	0.0001*						
Carbon T	06006L	2.0	1130	787	814						

Conductivity in microsiemens/cm

Turbidity in J.T.U.

Metals as Totals mg/ℓ

Alkalinity and Hardness expressed as Calcium Carbonate

Nitrite, NO_2 + NO_3, NH_3 expressed as N

Phosphorus T expressed as PO_4

Phosphorus O expressed as P

pH in pH units

* less than

CHEMISTRY DATA SITE # 4 4900 E - 15700 S

PARAMETERS	September					October			MEAN	RANGE		
	08	15	24	28	30	07**	12	19		Low	-	High
Boron	3.08	3.46	2.14	2.76	2.3	1.83	2.36	1.99	2.55	0.76	-	3.46
Pesticides												
TDS									16935.3	16639	-	17400
PCB's									0.0001*			
Carbon T									910.34	787	-	1130

SUMMARY OF CHEMISTRY ANALYSIS OF

MINE DEPRESSURIZATION WATER COLLECTED FROM

SYNCRUDE'S LEASE 17 AND COMPARED TO ANALYSIS

OF ATHABASCA RIVER WATER

WELL #4 4900E - 15700S

PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	DATE OF BIOASSAY SAMPLE OCT.12/76	WELL PROFILE MEANS AND RANGES L - H	ATHABASCA RIVER OCT.6/76	RIVER PROFILE MEANS AND RANGES L - H
Calcium	20103L	0.002	55.0	71.27 1.0* - 121.0	22.5	31.35 17.5 - 40.0
Magnesium	12102L	0.001	82.0	149.07 82.0 - 253.0	6.2	6.57 4.5 - 10.0
Sodium	11102L	0.5	4175.0	5871.8 4175.0 - 7000.0	9.6	9.29 5.9 - 36.0
Potassium	19102L	0.5	40.0	47.88 37.0 - 62.0	0.5	0.91 0.4 - 1.5
Chloride	17203L	0.5	5050.0	8085.13 5050.0 - 9600.0	2.6	6.11 1.0 - 51.0
Sulphate	16306L	1.0	0.5	8.63 0.5 - 65.0	14.1	13.8 0.5 - 41.0
Alkalinity T	10101L	1.0	2425.0	2517.67 1964.0 - 2702.0	76.0	86.69 66.8 - 129.0
pH	10301L	0	7.9	7.77 7.2 - 9.0	7.2	7.5 6.8 - 8.3
Carbonate	06301L	1.0	0.0	23.38 0.0 - 219.0	0.0.	0.0
Bicarbonate	06201L	1.0	2956.1	3019.17 2224.7 - 3923.0	9.26	105.76 81.4 - 158.0
Hardness T	10603L	0.1	474.9	772.52 626.9 - 1309.0	81.7	89.1 63.5 - 138.0
Conductivity	20401L	1.0	17000.0	28080.0 17000.0 - 48000.0	182.0	185.7 132.0 - 270.0
Surfactants	10701L	0.02	0.02	0.31 0.02* - 1.74	0.02*	0.03 0.02* - 0.09
T.O.C.	06001L	1.0	20.0	99.0 10.0 - 611.0	23.0	25.82 10.5 - 80.0
T.I.O.C.	06051L	1.0	640.0	586.07 350.0 - 760.0	17.0	19.44 11.0 - 40.0
Phenol	06532L	0.002	0.001*	0.003 0.001* - 0.012	0.006	0.005 0.001* - 0.022

WELL #4 4900E - 15700S (Continued)

PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	DATE OF BIOASSAY SAMPLE OCT.12/76	WELL PROFILE MEANS AND RANGES L - H	ATHABASCA RIVER OCT.6/76	RIVER PROFILE MEANS AND RANGES L - H
Oil & Grease	06521L	0.1	1.6	2.41 0.3 - 6.9	0.7	0.56 0.1* - 5.0
Sulphide	16101L	0.05	0.05*	0.05 0.02* - 0.09	0.05*	0.05*
Cyanide	00000L	0.1	0.01*	0.01*	0.01*	0.01*
Hydrocarbon T	00000L	1.0		1.17 0.1* - 6.5	0.1*	0.9 0.001* - 2.0
C.O.D.	08301L	5.0	489.0	244.45 36.3 - 690.0	37.0	86.83 37.0 - 267.0
Cadmium	48302L	0.001	0.001*	0.011 0.001* - 0.051	0.001*	0.002 0.001* - 0.019
Chromium $^{+6}$	24101L	0.003	0.003*	0.005 0.002* - 0.019	0.003*	0.004 0.002* - 0.018
Copper	29306L	0.01	0.011	0.015 0.002 - 0.025	0.008	0.019 0.002 - 0.059
Iron	26304L	0.05	0.61	1.25 0.21 - 4.75	2.15	7.26 0.9 - 63.0
Lead	82302L	0.002	0.002*	0.032 0.002* - 0.137	0.004	0.0056 0.002* - 0.026
Manganese	25304L	0.01	0.071	0.15 0.065 - 0.22	0.056	0.24 0.056 - 1.7
Silver	47301L	0.01	0.005*	0.011 0.005* - 0.02		0.005*
Zinc	30304L	0.01	0.008	0.021 0.008 - 0.043	0.016	0.053 0.014 - 0.069
Vanadium	23301L	0.02	0.001*	0.002 0.001* - 0.005	0.001*	0.004 0.001* - 0.014
Selenium	34302L	0.00015	0.0005*	0.0013 0.0005* - 0.0035	0.0013	0.0012 0.0005* - 0.0018
Mercury	80011L	0.0002	0.0002*	0.001 0.0001* - 0.0072	0.0002*	0.0067 0.0001* - 0.0044
Arsenic	33004L	0.001	0.001*	0.004 0.0002* - 0.02	0.004	0.0065 0.0025* - 0.02
Nickel	28302L	0.002	0.002*	0.047 0.002* - 0.165	0.002*	0.014 0.002* - 0.08
Aluminum	13302L	0.5	0.15	0.296 0.03 - 2.0	0.58	2.1 0.43 - 10-6

WELL #4 4900E - 15700S (Continued)

PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	DATE OF BIOASSAY SAMPLE OCT.12/76	WELL PROFILE MEANS AND RANGES L - H	ATHABASCA RIVER OCT.6/76	RIVER PROFILE MEANS AND RANGES L - H
Cobalt	27302L	0.002	0.002*	0.042 0.002* - 0.135	0.002*	0.005 0.002* - 0.043
Boron	05105L	0.05	2.36	2.55 0.76 - 3.46	0.45	0.2 0.01 - 1.51
Carbon T				910.34 787.0 - 1130.0		44.5 41.0 - 48.0

Conductivity in microsiemens/cm

Turbidity in J.T.U.

Metals as Totals mg/l

Alkalinity and Hardness expressed as Calcium Carbonate

Nitrite, NO_2 + NO_3, NH expressed as N

Phosphorus T expressed as PO_4

Phosphorus O expressed as P

pH in pH units

* less than

Analysis by Chemex Labs (Alberta) Ltd.

4.4 TEST NO. 13 BIOASSAY DATA, 12 FEBRUARY 1977

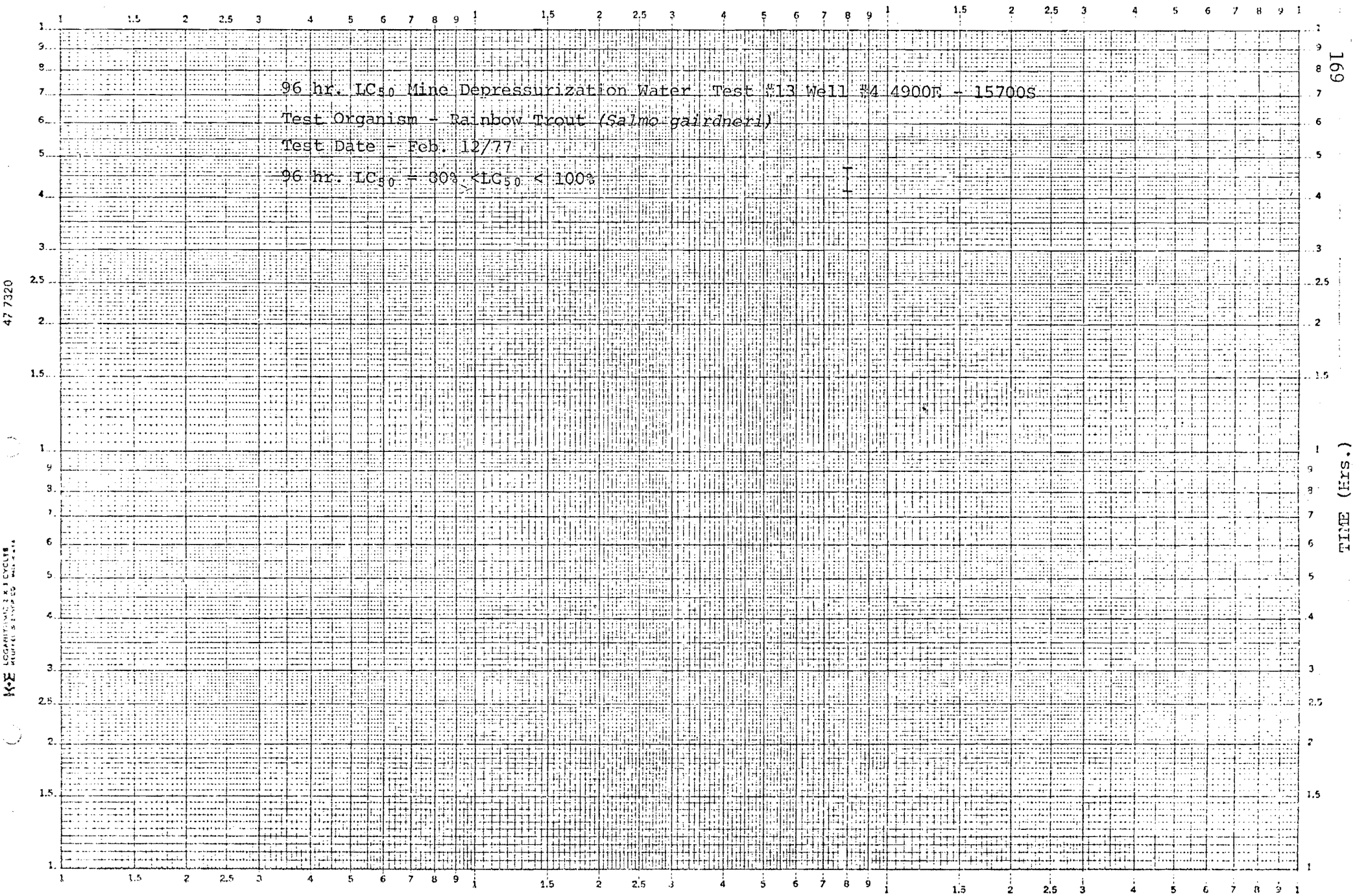
Data presented here includes:

1. cumulative mortality of Rainbow trout (*Salmo gairdneri*); and
2. graphical determination of LC_{50} and MST's (Litchfield 1949).

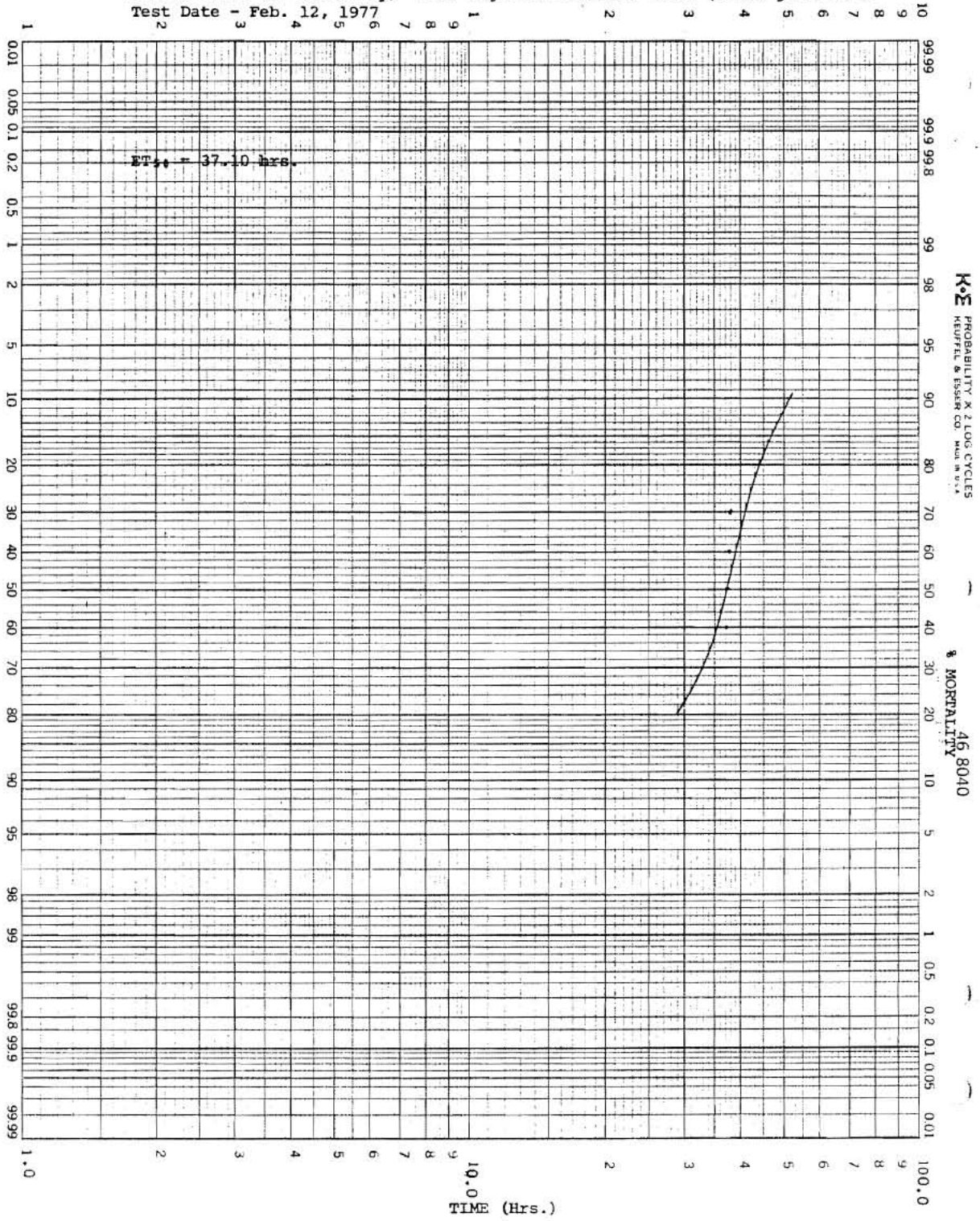
TEST #13 MINE DEPRESSURIZATION WATER SEMI-STATIC REPLACEMENT WELL #4 (STORAGE) TEST DATE FEBRUARY 12, 1977

CONCENTRATIONS (MEAN & RANGE)

PARAMETERS	CONTROL 5 Readings	20% 5 Readings	40% 5 Readings	60% 5 Readings	80% 5 Readings	100% 5 Readings
Temperature (°C)	19.38 15.0 - 25.0	19.38 15.0 - 25.0	19.38 15.0 - 25.0	19.38 15.0 - 25.0	19.33 15.0 - 25.0	19.38 15.0 - 25.0
Dissolved Oxygen (mg/ℓ)	8.76 6.8 - 10.2	8.46 6.6 - 9.9	8.70 7.3 - 10.0	8.50 6.5 - 9.8	8.60 6.3 - 10.0	8.75 6.2 - 10.2
pH	7.63 7.47 - 7.76	8.06 7.60 - 8.45	8.24 7.67 - 8.69	8.17 7.70 - 8.58	8.25 7.57 - 8.69	8.32 7.69 - 8.77
Conductivity (µs/cm)	186.25 165 - 200	2341.67 800 - 3400	5478.33 4790 - 6000	7366.67 6500 - 11000	11750.0 10000 - 14500	12383.33 9000 - 18000
Salinity (ppt Cl)	0	2	3.7	6.8	8.0	10.2
Fish Length (cm)		TOTAL 5.19 ± .24				
Fish Weight (gm)		TOTAL 1.38 ± 1.29				
Loading Density (gm/ℓ)		TOTAL 0.035				
Number Fish/Dilution	9	10	10	10	9	10
Number Dilutions/Conc.	1	1	1	1	1	1
Volume of Dilutions (ℓ)	40	40	40	40	40	40
LT_{50} (Hr.)					44.5 41.78 - 47.39	37.10
LC_{50} (Conc. by Vol.)	80% < LC_{50} < 100%					


96 hr. LC_{50} Mine Depressurization Water Test #13 Well #4 4900E - 15700S
Test Organism - Rainbow Trout *(Salmo gairdneri)*
Test Date - Feb. 12/77
96 hr. LC_{50} = 80% <LC_{50} < 100%
% CONCENTRATION (by Volume)
TIME (HRS.)
47 7320

100% Concentration Mine Depressurization Water Test #13 Well #4 4900 E - 15700 S
M.S.T. (Time vs. Mortality) Test Organism -Rainbow Trout *(Salmo gairdneri)*
Test Date - Feb. 12, 1977

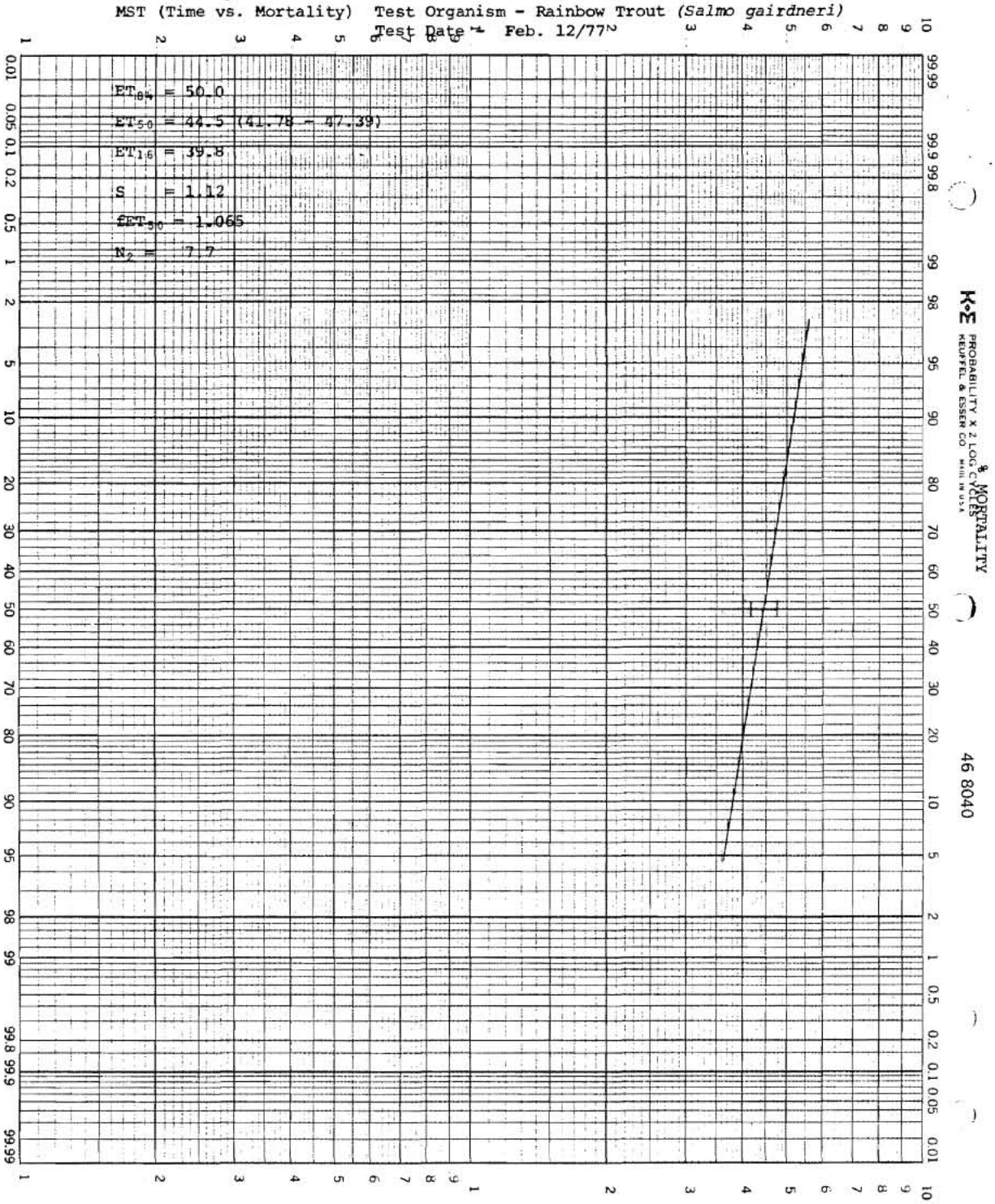


171

80% Mine Depressurization Water Test #13 Well #4 4900E - 15700S

MST (Time vs. Mortality) Test Organism - Rainbow Trout *(Salmo gairdneri)*

Test Date - Feb. 12/77



4.5 TEST NO. 14 BIOASSAY DATA, 12 FEBRUARY 1977

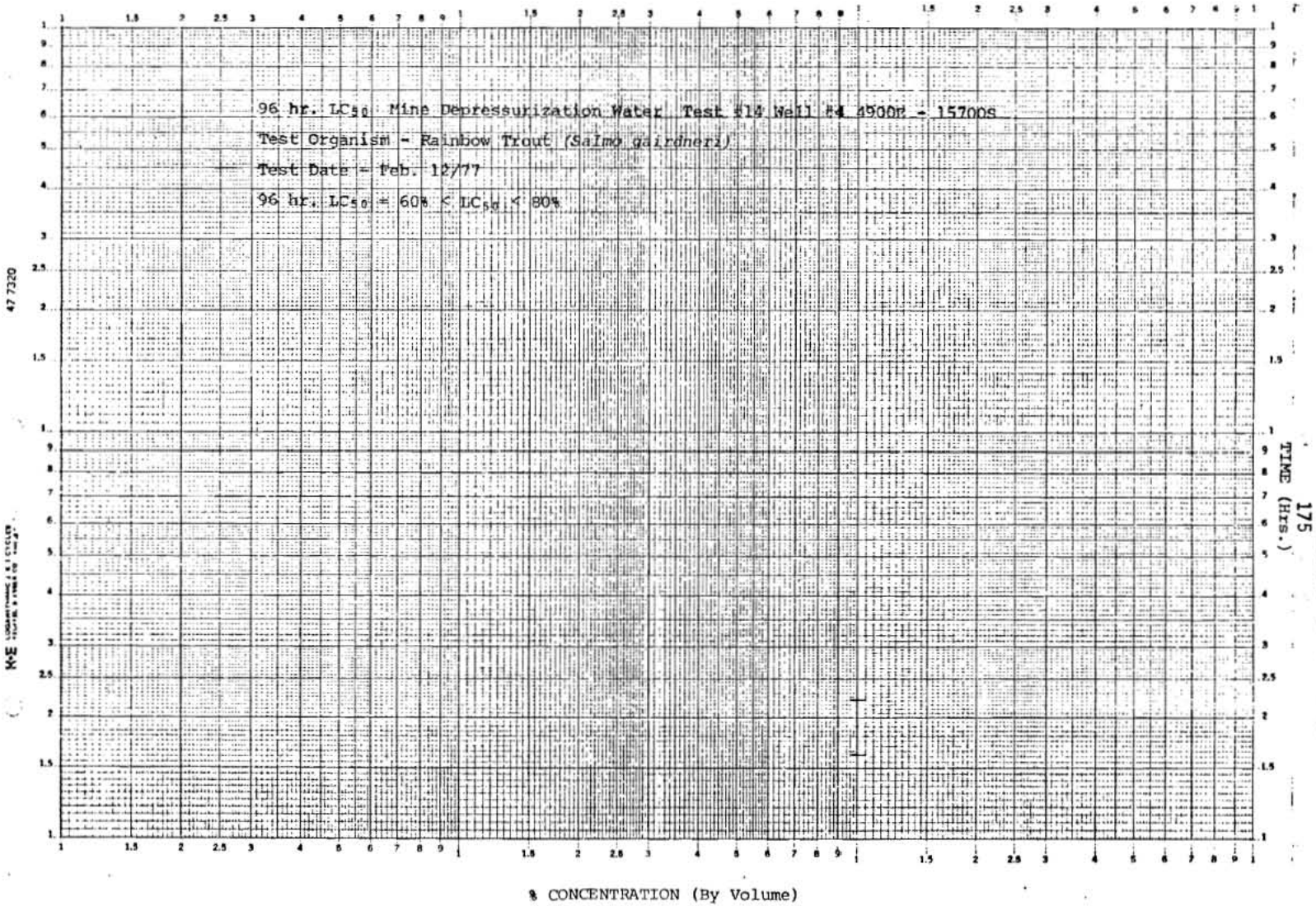
Data presented here include:

1. cumulative mortality of Rainbow trout (*Salmo gairdner*); and
2. graphical determination of LC_{50} and MST's (Litchfield 1949).

TEST #14 MINE DEPRESSURIZATION WATER SEMI-STATIC REPLACEMENT WELL #4 (FRESH) TEST DATE FEBRUARY 12, 1977

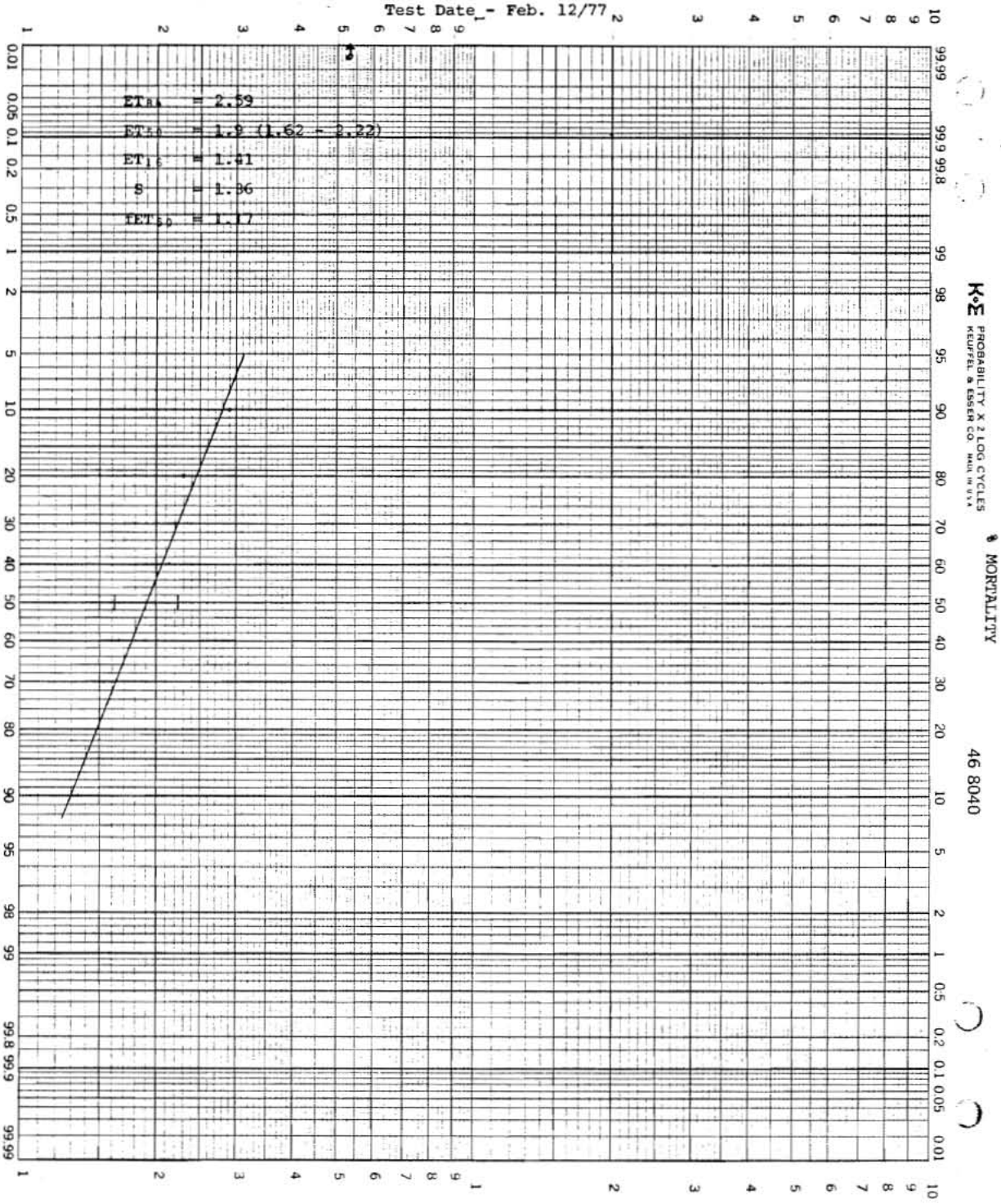
CONCENTRATIONS (MEAN & RANGE)

PARAMETERS	CONTROL 5 Readings	20% 5 Readings	40% 5 Readings	60% 5 Readings	80% 2 Readings	100% 2 Readings
Temperature °C	19.33 15 - 25	19.38 15 - 25	19.38 15 - 25	19.38 15 - 25	18.5 15 - 22	18.5 15 - 22
Dissolved Oxygen (mg/ℓ)	8.57 6.2 - 10.2	8.7 6.6 - 9.8	8.73 7.1 - 10.0	8.55 6.2 - 10.1	8.35 8.3 - 8.4	8.25 8.0 - 8.5
pH	7.63 7.52 - 7.85	8.18 7.64 - 8.63	8.22 7.61 - 8.76	8.24 7.46 - 8.69	7.82 7.60 - 8.03	8.03 7.57 - 8.49
Conductivity (µs/cm)	190 165 - 210	4579.17 2900 - 5000	8916.67 7500 - 9500	12976 12000 - 14000	16250 16000 - 16500	20000 19000 - 21000
Salinity (ppt Cl)	0	3.0	5.5	9.0	12.5	15.0
Fish Length (cm)		TOTAL	5.18 ± .69			
Fish Weight (gm)		TOTAL	1.66 ± 1.67			
Loading Density (gm/ℓ)		TOTAL	0.042			
Number Fish/Dilution	10	10	10	10	10	10
Number Dilutions/Conc	1	1	1	1	1	1
Volume of Dilutions (ℓ)	40	40	40	40	40	40
LT_{50} (Hr.)					2.44	1.9 (1.62 - 2.22)
LC_{50} (Conc. by Vol.)	60% < LC_{50} < 80%					

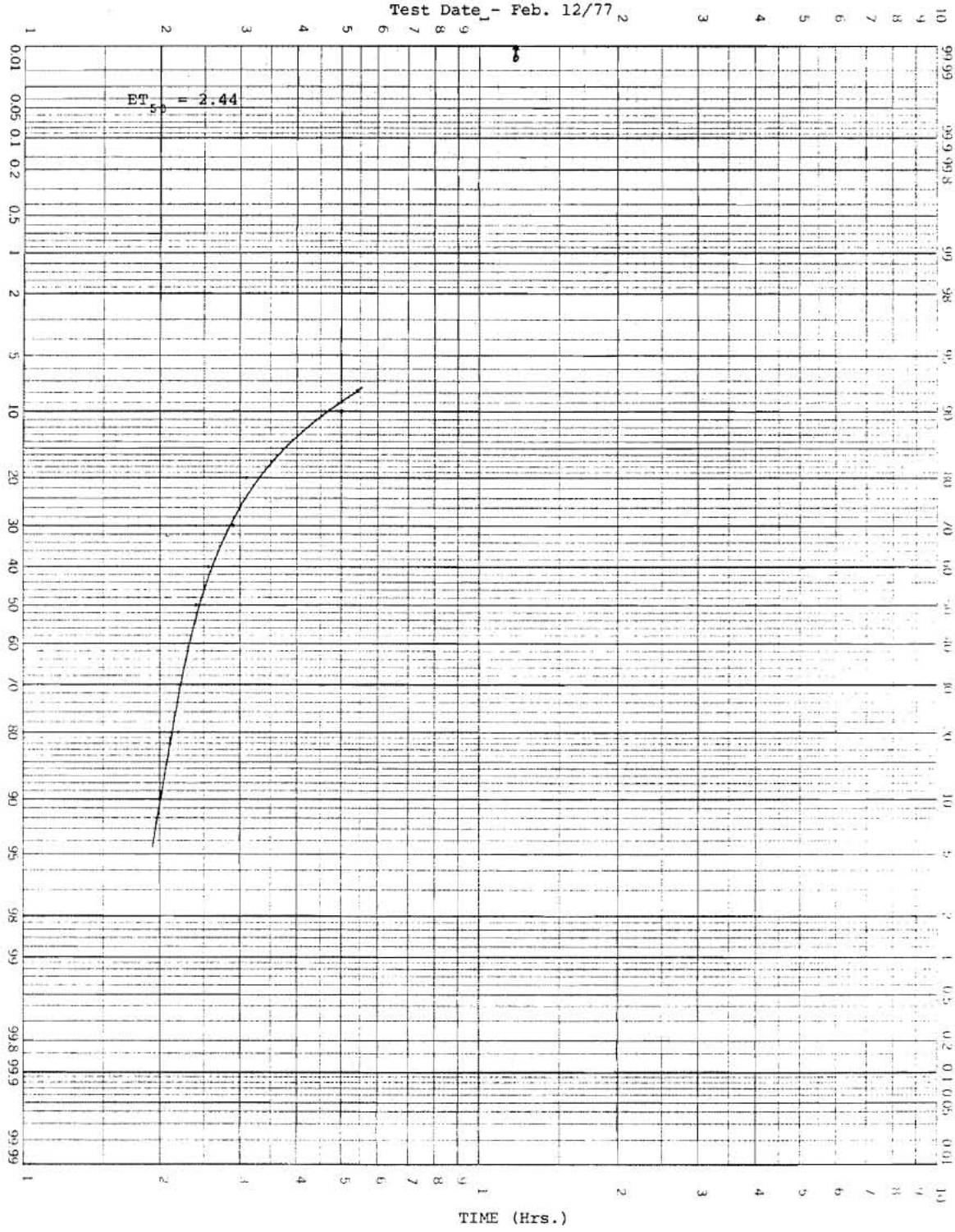

96 hr. LC_{50} Mine Depressurization Water Test #14 Well #4 4900S - 1570OS
Test Organism - Rainbow Trout *(Salmo gairdneri)*
Test Date - Feb. 12/77
96 hr. LC_{50} = 60% < LC_{50} < 80%
TIME (Hrs.)
% CONCENTRATION (By Volume)

176

100% Concentration Mine Depressurization Water Test #14 Well #4 4900E - 15700S
MST (Time vs. Mortality) Test Organism - Rainbow Trout *(Salmo gairdneri)*
Test Date - Feb. 12/77



80% Concentration Mine Depressurization Water Test #14 Well #4 4900E - 15700S
MST (Time vs. Mortality) Test Organism - Rainbow Trout *(Salmo gairdneri)*
Test Date - Feb. 12/77



4.6 CHEMISTRY DATA (FEBRUARY 1977)

Data presented here include summary of chemistry analysis of mine depressurization water collected from Syncrude's Lease 17 and compared to analysis of City of Edmonton treated water.

MINE DEPRESSURIZATION WATER

96 hr. LC_{50} = (1) 80 <LC_{50}< 100 (Sprague)

(2) 40 <LC_{50}< 60 (Sprague)

M.S.T. = Conc. (1) 100% = 37.10

M.S.T. (hrs.) 80% = 44.5 (41.78 - 47.39)

(2) 100% = 1.9 (1.62 - 2.22)

80% = 2.44

SYNCRUDE LEASE 17

CHEMISTRY DATA SITE #4

4900E - 15700S

POLLUTION CONTROL LAB

PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	SAMPLE DATES 1977 Feb. 9	Feb. 12**	Feb. 12***	MEAN	RANGES Low - High
Calcium	20105L	2.0	115.0	107.0	57.0	93.0	57.0 - 115.0
Magnesium	12102L	1.0	133.0	130.0	69.0	110.67	69.0 - 133.0
Sodium	11102L	0.1	5500.0	5521.0	3333.0	4784.67	3333.0 - 5521.0
Potassium	19102L	0.1	40.0	39.2	22.6	33.93	22.6 - 40.0
Chloride	17203L	1.0	8000.0	7857.0	4357.0	6738.0	4357.0 - 8000.0
Sulphate	16306L	10.0	20.0	10.0*	18.0	16.0	10.0* - 20.0
Alkalinity	10101L	5.0	2836.0	2695.0	1724.0	2418.33	1724.0 - 2836.0
pH	10301L	0.0	7.5	8.1	8.1	7.9	7.5 - 8.1
Carbonate	06301L	5.0					-
Bicarbonate	06201L	5.0	3458.0	3285.0	2102.0	2948.33	2102.0 - 3458.0
Hardness T	10604L	5.0	837.0	806.0	425.0	689.33	425.0 - 837.0
Fluoride	09107L	0.05	0.67	0.65	0.45	0.59	0.45 - 0.65
Silica	14102L	0.5	5.3	5.3	2.9	4.5	2.9 - 5.3
Conductivity	02041L	0.2	25250.	24500.	15250.	21666.67	15250. - 25250.
Odor	02001L	0.0	1.0	1.0		1.0	

SITE #4

POLLUTION CONTROL LAB

PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	SAMPLE DATES 1977 Feb. 9	Feb. 12**	Feb. 12***	MEAN	RANGES Low - High
Color	02011L	1.0	100	100	100	100	
Color T_2	02011L	1.0	99	99	99	99	
Color T_3	02011L	1.0	98	98	98	98	
Tanin & Lignin	06551L	0.1	0.5	0.4	0.5	0.45	0.4 - 0.5
T.R.	10471L	10.0	15752	15672	9474	13632.67	9474 - 15752
T.F.R.	10571L	10.0	15380	15280	9242	13300.67	9242 - 15380
T.F.R.F.							
T.N.F.R.							
T.N.F.R.F.							
Turbidity	02073L	0.0	6.0	6.0	6.0	6.0	
Surfactants	10701L	0.05	2.63	1.39	1.0	1.67	1.0 - 2.63
Humic Acids							
T.O.C.	06001L	2.0	17.0	177.0	34.0	76.0	17.0 - 177.0
T.I.O.C.	06051L	2.0	733.0	339.0	196.0	422.67	196.0 - 733.0
Nitrite	07205L	0.1	0.1*	0.1*	0.1*	0.1*	
NO_2 & NO_3	07105L	0.1	0.1*	0.1*	0.1*	0.1*	
NH_3	07555L	0.05	9.57	10.52	6.41	8.83	6.41 - 10.52
Nitrogen Tk	07003L	0.05	18.13	18.41	17.77	18.10	17.77 - 18.41
Phosphorus T	15001L	0.05	0.09	0.09	0.08	0.087	0.08 - 0.09
Phosphate T	15407L						
Phosphorus O	15256L	0.05					
Phenol	06532L	0.001	0.006			0.006	

SITE #4

POLLUTION CONTROL LAB

PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	SAMPLE DATES 1977 Feb. 9	Feb. 12**	Feb. 12***	MEAN	RANGES Low - High
Oil & Grease	06521L	1.0	3.5			3.5	
Sulphide	06101L	0.02	0.02*			0.02*	
Cyanide	06601L	0.002	0.04	0.02	0.02	0.027	0.02 - 0.04
Hydrocarbon T	06500L	0.001					
B.O.D.	08201L	0.01	1.0*			1.0*	
C.O.D.	08301L	5.0	70.4	35.2	68.6	58.07	35.2 - 70.4
Cadmium	48302L	0.001	0.001*	0.001*	0.001*	0.001*	
Chromium^{+6}	24101L	0.002	0.002*	0.002*	0.002*	0.002*	
Copper	29305L	0.001	0.001*	0.002	0.001*	0.0013	0.001* - 0.002
Iron	26302L	0.05	0.71	0.56	0.48	0.58	0.48 - 0.71
Lead	26302L	0.003	0.003*	0.003*	0.003*	0.003*	
Manganese	25004L	0.008	0.205	0.210	0.087	0.167	0.087 - 0.210
Silver	47303L	0.001	0.001*	0.001*	0.001*	0.001*	
Zinc	30305L	0.001	0.014	0.064	0.005	0.028	0.005 - 0.064
Vanadium	23301L	0.05		0.01*	0.01*	0.01*	
Selenium	34102L	0.0002					
Mercury	80003L	0.0001	0.0001*	0.0001*	0.0001*	0.001*	
Arsenic	33104L	0.0002	0.0002*	0.0002*	0.0002*	0.0002*	
Nickel	28302L	0.001	0.001*	0.001*	0.001*	0.001*	
Aluminum	13005L	0.02					
Cobalt	27302L	0.001	0.001*	0.001*	0.001*	0.001*	
Boron	05102L	0.1					

SITE #4

PARAMETERS	POLLUTION CONTROL LAB NAQUADAT CODE	DETECTION LIMIT	SAMPLE DATES 1977 Feb. 9	Feb. 12**	Feb. 12***	MEAN	RANGES Low - High
Pesticides	00000L						
T.D.S.	00205L	0.0	15511	15282	8897.0	13230.0	8897 - 15511
P.C.B.'s	00000L	0.0001					
Carbon T	06006L	2.0	750.0	516.0	230.0	498.67	230.0 - 750.0

Conductivity in microsiemens/cm

Turbidity in J.T.U.

Metals as Totals mg/ℓ

Alkalinity and Hardness expressed as Calcium Carbonate

Nitrite, NO_2 & NO_3, NH_3 expressed as N

Phosphorus P expressed as PO_4

Phosphorus O expressed as P

* less than

** sample taken for bioassay

*** sample collected December 15, 1976
stored frozen

SUMMARY OF CHEMISTRY ANALYSIS OF

MINE DEPRESSURIZATION WATER COLLECTED FROM

SYNCRUDE'S LEASE 17 AND COMPARED TO ANALYSIS

OF CITY OF EDMONTON TREATED WATER

WELL #4 4900E - 15700S (COLLECTED DEC. 15/76)

PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	DATE OF BIOASSAY FEB.12/77	WELL PROFILE MEANS & RANGES L - H	TREATED WATER FEB.12/77	TREATED WATER PROFILE MEANS & RANGES L - H
Calcium	20105L	2.0	57.0	93.0 57.0 - 115.0	22.0	22.5 22.0 - 23.0
Magnesium	12102L	1.0	69.0	110.67 69.0 - 133.0	11.0	10.5 9.0 - 12.0
Sodium	11103L	0.1	3333.0	4784.67 3333.0 - 5521.0	13.0	65.0 4.0 - 237.0
Potassium	19103L	0.1	22.6	33.93 22.6 - 40.0	0.9	1.75 0.8 - 4.5
Chloride	17203L	1.0	4357.0	6738.0 4357.0 - 8000.0	4.0	2.8 0.1* - 7.0
Sulphate	16306L	10.0	18.0	16.0 10.0* - 20.0	49.0	164.25 46.0 - 505.0
Alkalinity T	10101L	5.0	1724.0	2418.33 1724.0 - 2836.0	66.0	56.25 46.0 - 66.0
pH	10301L	0	8.1	7.9 7.5 - 8.1	8.2	8.18 8.1 - 8.3
Carbonate	06301L	5.0				
Bicarbonate	06201L	5.0	2102.0	2948.33 2102.0 - 3458.0	80.0	68.25 56.0 - 80.0
Hardness T	10604L	5.0	425.0	689.33 425.0 - 837.0	102.0	100.5 96.0 - 108.0
Conductivity	02041L	0	15250.0	21666.67 15250.0 - 25250.0	220.0	217.0 188.0 - 260.0
Surfactants	10701L	0.05	1.0	1.67 1.0 - 2.63	0.13	0.07 0.05* - 0.13
T.O.C.	06001L	2.0	34.0	76.0 17.0 - 177.0		
T.I.O.C.	06051L	2.0	196.0	422.67 196.0 - 733.0		
Phenol	06532L	0.001		0.006		0.001*

WELL #4 4900E - 15700S (Continued)

PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	DATE OF BIOASSAY FEB.12/77	WELL PROFILE MEANS & RANGES L - H	TREATED WATER FEB.12/77	TREATED WATER PROFILE MEANS & RANGES L - H
Oil & Grease	06521L	0.02		3.5		2.1
Sulphide	16101L	0.02		0.02*		
Cyanide	06601L	0.002	0.02	0.027 0.02 - 0.04		
Hydrocarbon T	06500L	0.001				
C.O.D.	08301L	5.0	68.6	58.07 35.2 - 70.4		5.47
Cadmium	48302L	0.001	0.001*	0.001*		0.001*
Chromium^{+6}	24101L	0.002	0.002*	0.002*		0.002*
Copper	29305L	0.001	0.001*	0.0013 0.001* - 0.002		0.001*
Iron	26302L	0.05	0.48	0.58 0.48 - 0.71		0.27 0.06 - 0.80
Lead	82302L	0.003	0.003*	0.003*		0.003*
Manganes	25304L	0.008	0.087	0.167 0.087 - 0.210		0.008*
Silver	47303L	0.001	0.001*	0.001*		
Zinc	30305L	0.001	0.005	0.028 0.005 - 0.064	0.007	0.005 0.002 - 0.007
Vanadium	04303L	0.01	0.01*	0.01*		
Selenium	34102L	0.0002				
Mercury	80011L	0.0001	0.0001*	0.0001*		0.0001*
Arsenic	33104L	0.0002	0.0002*	0.0002*		
Nickel	28302L	0.001	0.001*	0.001*		0.001*
Aluminum						
Cobalt	27302L	0.001	0.001*	0.001*		0.001*
Boron						
Carbon T.	06006L	2.0	230.0	498.67 230.0 - 750.0		

WELL #4 4900E - 15700S (Continued)

Conductivity in microsiemens/cm
Turbidity in J.T.U.
Metals as Totals mg/l
Alkalinity and Hardness expressed as Calcium Carbonate
Nitrite, NO_2 + NO_3, NH_3 expressed as N
Phosphorus T expressed as PO_4
Phosphorus O expressed as P
pH in pH units
* less than

Analysis by Department of Environment, Pollution Control Division Laboratory.

SUMMARY OF CHEMISTRY ANALYSIS OF

MINE DEPRESSURIZATION WATER COLLECTED FROM

SYNCRUDE'S LEASE 17 AND COMPARED TO ANALYSIS

OF CITY OF EDMONTON TREATED WATER

WELL #4 4900E - 15700S

PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	DATE OF BIOASSAY FEB.12/77	WELL PROFILE MEANS & RANGES L - H	TREATED WATER FEB.12/77	TREATED WATER PROFILE MEANS & RANGES L - H
Calcium	20105L	2.0	107.0	93.0 57.0 - 115.0	22.0	22.5 22.0 - 23.0
Magnesium	12102L	1.0	130.0	110.67 69.0 - 133.0	11.0	10.5 9.0 - 12.0
Sodium	11103L	0.1	5521.0	4784.67 3333.0 - 5521.0	13.0	65.0 4.0 - 237.0
Potassium	19103L	0.1	39.2	33.93 22.6 - 40.0	0.9	1.75 0.8 - 4.5
Chloride	17203L	1.0	7857.0	6738.0 4357.0 - 8000.0	4.0	2.8 0.1* - 7.0
Sulphate	16306L	10.0	10.0*	16.0 10.0* - 20.0	49.0	164.25 46.0 - 505.0
Alkalinity T	10101L	5.0	2695.0	2418.0 1724.0 - 2836.0	66.0	56.25 46.0 - 66.0
pH	10301L	0	8.1	7.9 7.5 - 8.1	8.2	8.18 8.1 - 8.3
Carbonate	06301L	5.0				
Bicarbonate	06201L	5.0	3285.0	2948.33 2102.0 - 3458.0	80.0	68.25 56.0 - 80.0
Hardness T	10604L	5.0	806.0	689.33 425.0 - 837.0	102.0	100.5 96.0 - 108.0
Conductivity	02041L	0	24500.0	21666.67 15250.0 - 25250.0	220.0	217.0 188.0 - 260.0
Surfactants	10701L	0.05	1.39	1.67 1.0 - 2.63	0.13	0.07 0.05* - 0.13
T.O.C.	06001L	2.0	177.0	76.0 17.0 - 177.0		
T.I.O.C.	06051L	2.0	339.0	422.67 196.0 - 733.0		
Phenol	06532L	0.001		0.006		0.001*

WELL #4 4900E - 15700S (Continued)

PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	DATE OF BIOASSAY FEB.12/77	WELL PROFILE MEANS & RANGES L - H	TREATED WATER FEB.12/77	TREATED WATER PROFILE MEANS & RANGES L - H
Oil & Grease	06521L	0.02		3.5		2.1
Sulphide	16101L	0.02		0.02*		
Cyanide	06601L	0.002	0.02	0.027 0.02 - 0.04		
Hydrocarbon T	06500L	0.001				
C.O.D.	08301L	5.0	35.2	58.27 35.2 - 70.4		5.47 5.0* - 6.4
Cadmium	48302L	0.001	0.001*	0.001*		0.001*
Chromium^{+6}	24101L	0.002	0.002*	0.002*		0.002*
Copper	29305L	0.001	0.002	0.0013 0.001* - 0.002		0.001*
Iron	26302L	0.05	0.56	0.58 0.48 - 0.71		0.27 0.06 - 0.80
Lead	82302L	0.003	0.003*	0.003*		0.003*
Manganese	25304L	0.008	0.210	0.167 0.87 - 0.210		0.008*
Silver	47303L	0.001	0.001*	0.001*		
Zinc	30305L	0.001	0.064	0.028 0.005 - 0.064	0.007	0.005 0.002 - 0.007
Vanadium	04303L	0.01	0.01*	0.01*		
Selenium	34102L	0.0002				
Mercury	80011L	0.0001	0.0001*	0.0001*		0.0001*
Arsenic	33104L	0.0002	0.0002*	0.0002*		
Nickel	28302L	0.001	0.001*	0.001*		0.001*
Aluminum						
Cobalt	27302L	0.001	0.001*	0.001*		0.001*
Boron						
Carbon T.	06006L	2.0	516.0	498.67 230.0 - 750.0		

WELL #4 4900E - 15700S (Continued)

Conductivity in microsiemens/cm
Turbidity in J.T.U.
Metals as Totals mg/l
Alkalinity and Hardness expressed as Calcium Carbonate
Nitrite, NO_2 + NO_3, NH_3 expressed as N
Phosphorus T expressed as PO_4
Phosphorus O expressed as P
pH in pH units
* less than

Analysis by Department of Environment, Pollution Control Division Laboratory.

5. SUMMARY OF SAMPLING AND TESTING OF WELL NO. 5 5300 E - 14400 S.

Well No. 5

5300E - 14400S

Date of Bioassays: A. October 8, 1976

B. (1) March 1, 1977 (Collected Dec. 15/76)
(2) March 1, 1977

Type of Bioassays: A. 96 hr. Semi Static Replacement

B. (1) 96 hr. Semi Static Replacement
(2) 96 hr. Semi Static Replacement

Type of Fish: A. (1) Trout Perch *(Percopsis omiscomaycus)*

B. (1) Rainbow Trout *(Salmo gairdneri)*
(2) Rainbow Trout *(Salmo gairdneri)*

Dilution Water: A. (1) Athabasca River Water

B. (1) City of Edmonton Treated Water
(2) City of Edmonton Treated Water

Mean Survival Times: A. 100% = 2.50 (2.08 - 3.00)
80% = 2.32 (2.07 - 2.59)
60% = 24.0 (23.67 - 24.34)
40% = 21.2 (18.43 - 24.38)
25% = 59.0

B. (1) No Readings
(2) 100% = 3.59
80% = 7.6
60% = 9.3

. . . /2

Well No. 5

96 hr. LC_{50}(%): A. (1) = 20.5 (Sprague)
= 24.4 (16.8 - 32.0) (Reed & Muench)

B. (2) = 60% (Sprague)
= 61.9 (51.8 - 73.9) (Litchfield & Wilcoxen)
= 65.6 (54.9 - 76.3) (Reed & Muench)

5.2 TEST NO. 11 BIOASSAY DATA, 8 OCTOBER 1976

Data presented here include:

1. cumulative mortality of Trout-perch (*Percopsis miscomaycus*);
2. graphical determination of LC_{50} and MST's (Litchfield 1949); and
3. lethal concentration determination (Woolf 1968).

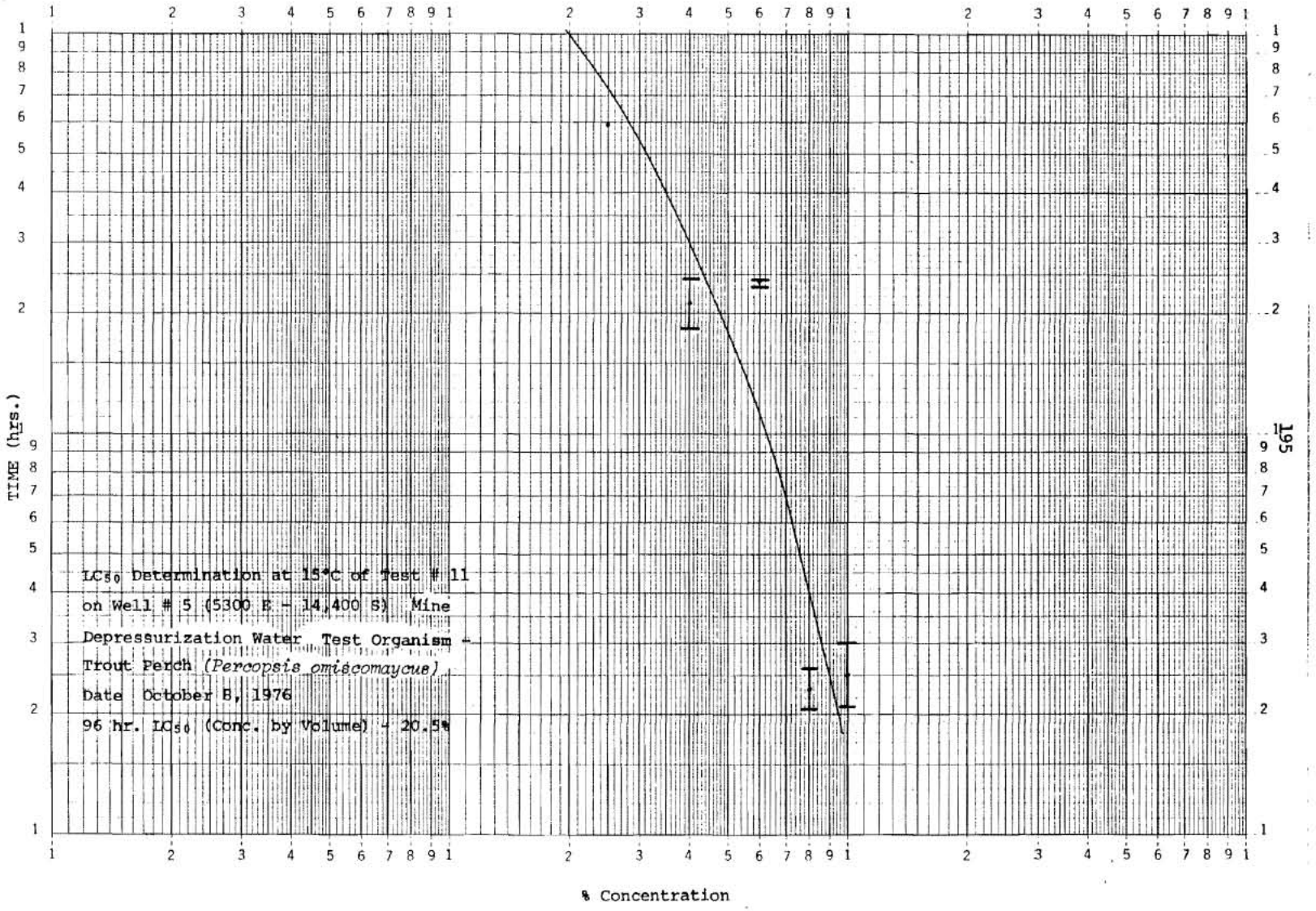
TEST # 11

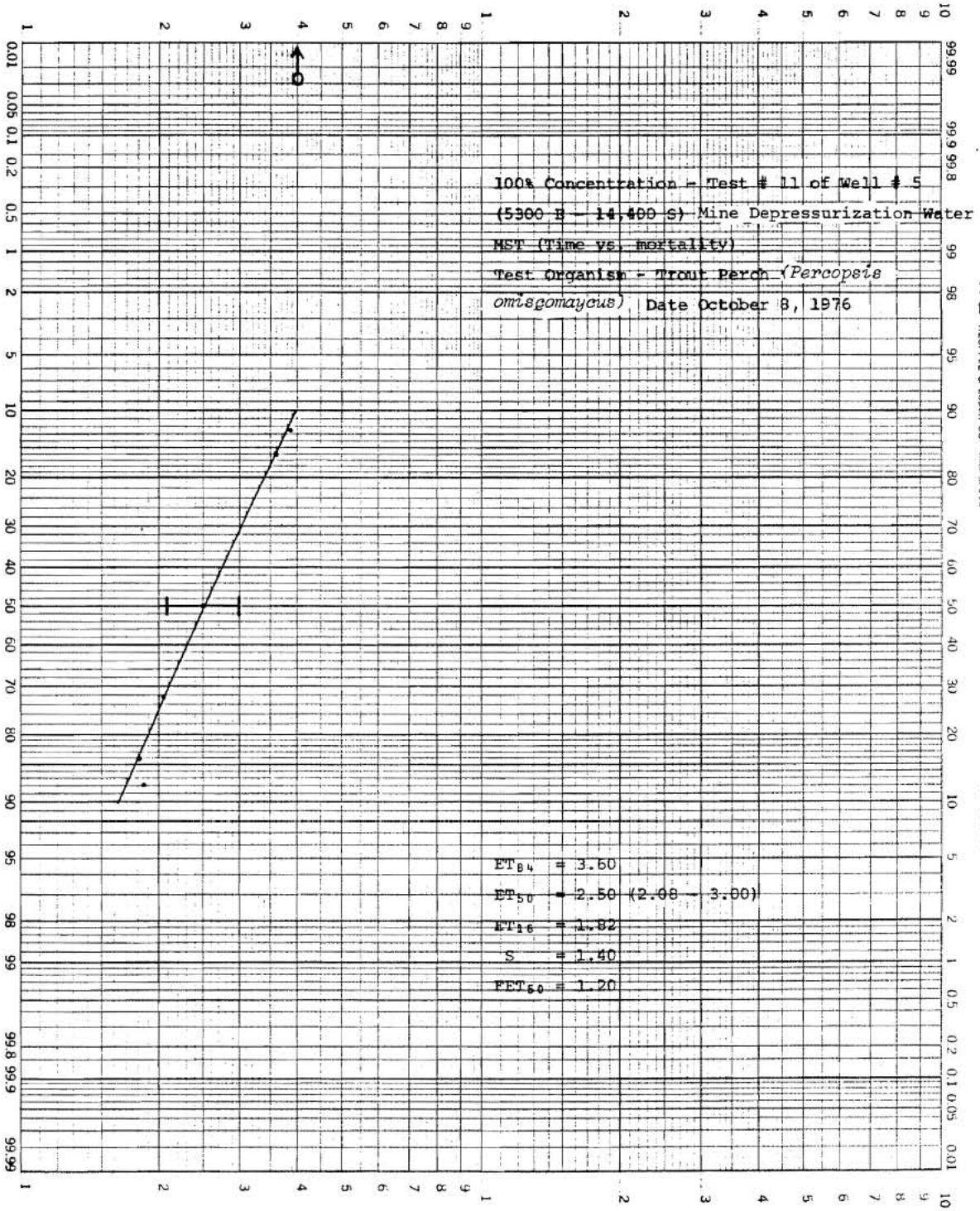
MINE DEPRESSURIZATION WATER SEMI STATIC REPLACEMENT OF WELL # 5

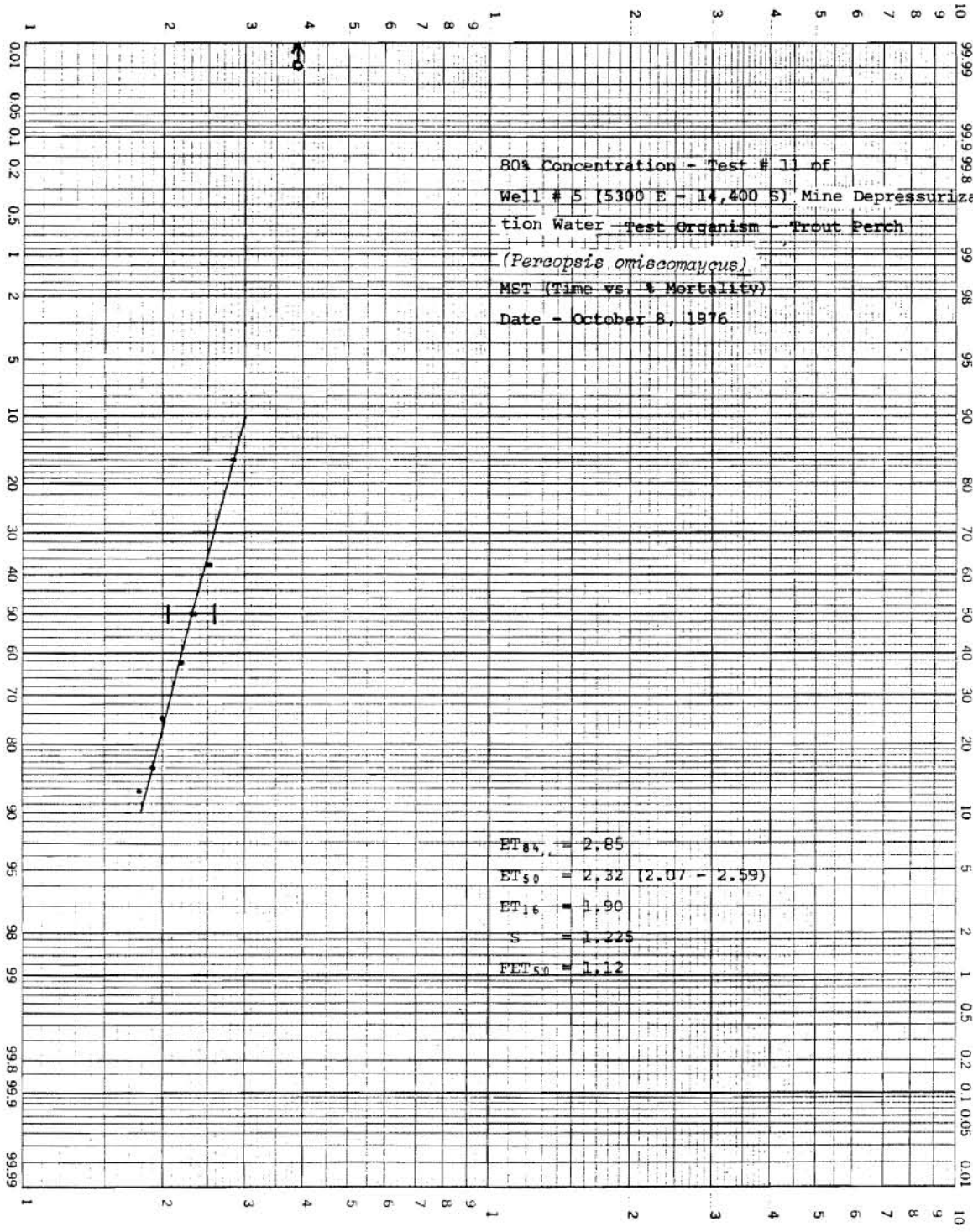
TEST DATE OCTOBER 8, 1976

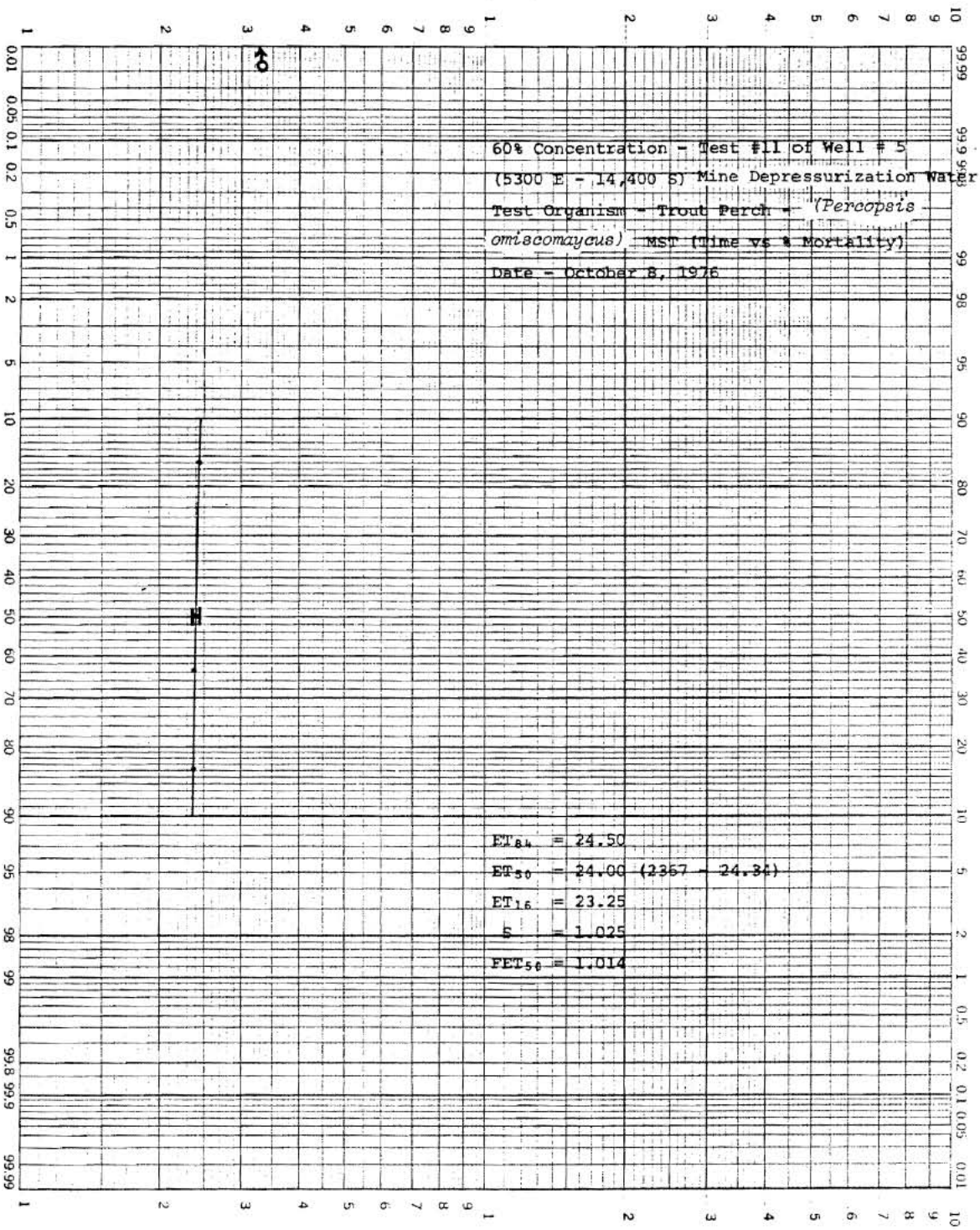
CONCENTRATION (MEAN & RANGE)

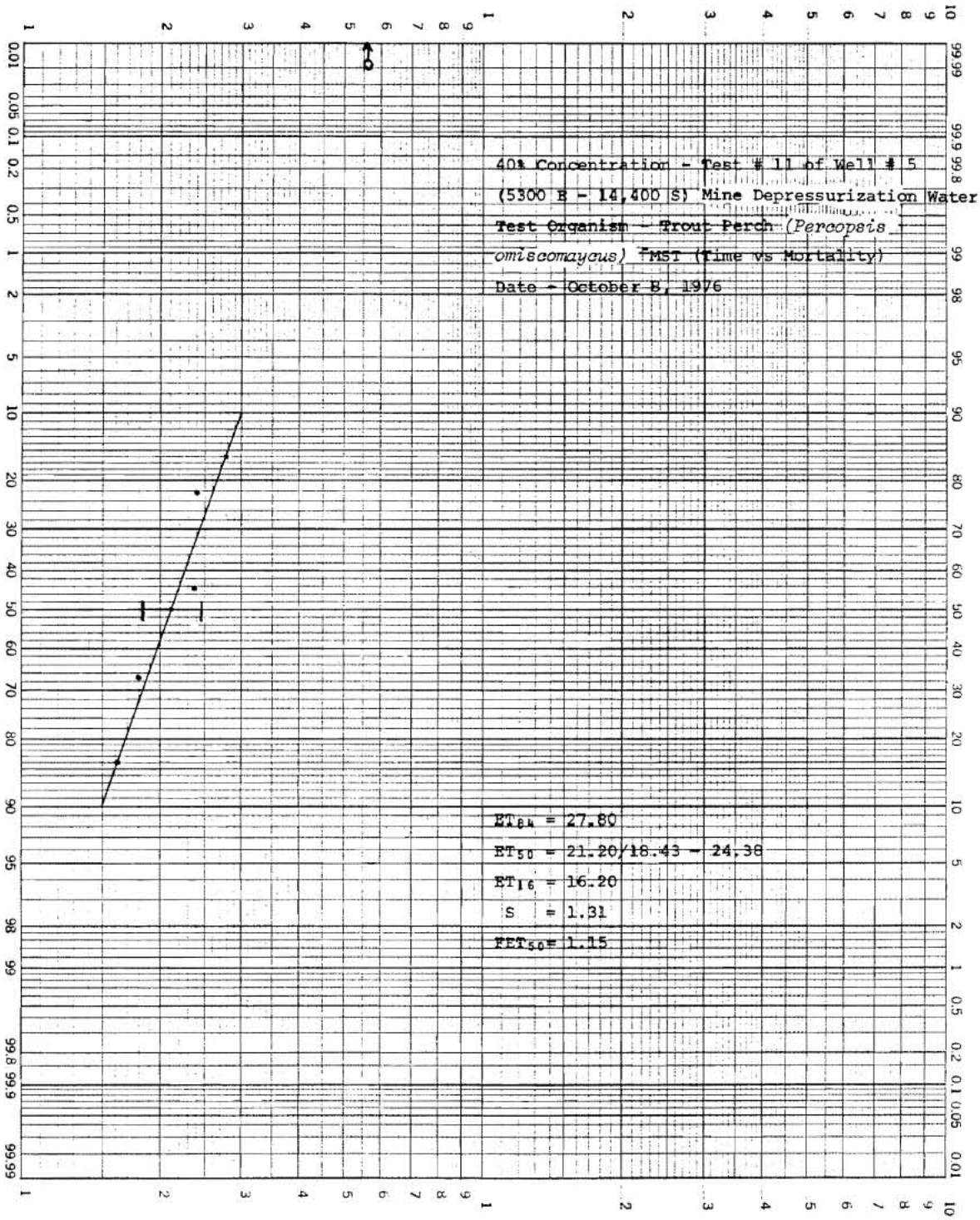
PARAMETERS	CONTROL 5 readings	20% 5 readings	25% 5 readings	40% 5 readings	60% 5 readings	80% 2 readings	100% 2 readings
Temperature (°C)	13.7 ± .66	13.7 ± .52	13.5 ± .52	13.6 ± .91	13.4 Range (12.5-14.5)	12.5 Range (12.5-13.0)	12.5 Range (12.5-13.0)
Dissolved Oxygen (mg/l)	9.9 ± .09	9.9 ± .16	10.0 ± .13	10.0 ± .18	10.0 Range (9.4-10.6	10.4 Range (10.3-10.6)	10.5 Range (10.4-10.6)
pH	8.25 ± .01	8.45 ± .29	8.54 ± .29	8.57 ± .29	8.18 Range (7.64-8.59	8.64 Range (8.62-8.66	8.07 Range (8.00-8.15)
Conductivity (µs/cm)	213	5904	7121	9950 (8 readings) Range (9950-710,000)	> 10,000	> 10,000	> 10,000
Fish Length (cm.)			4.4 + .72				
Fish Weight (gm.)			.95 ± .33				
Number Fish/Dilution	8	8	7	9	8	8	8
Number Dilutions/Conc.	1	1	1	1	1	1	1
Volume of Dilutions (1.)	20	20	20	20	20	20	20
LT_{50} (Hrs.)			59.0	21.2 (18.43-24.38)	24.0 (23.67-24.34)	2.32 (2.07-2.59)	2.50 (2.08-3.00)
LC_{50} (Conc. by Vol.)	20.5%						

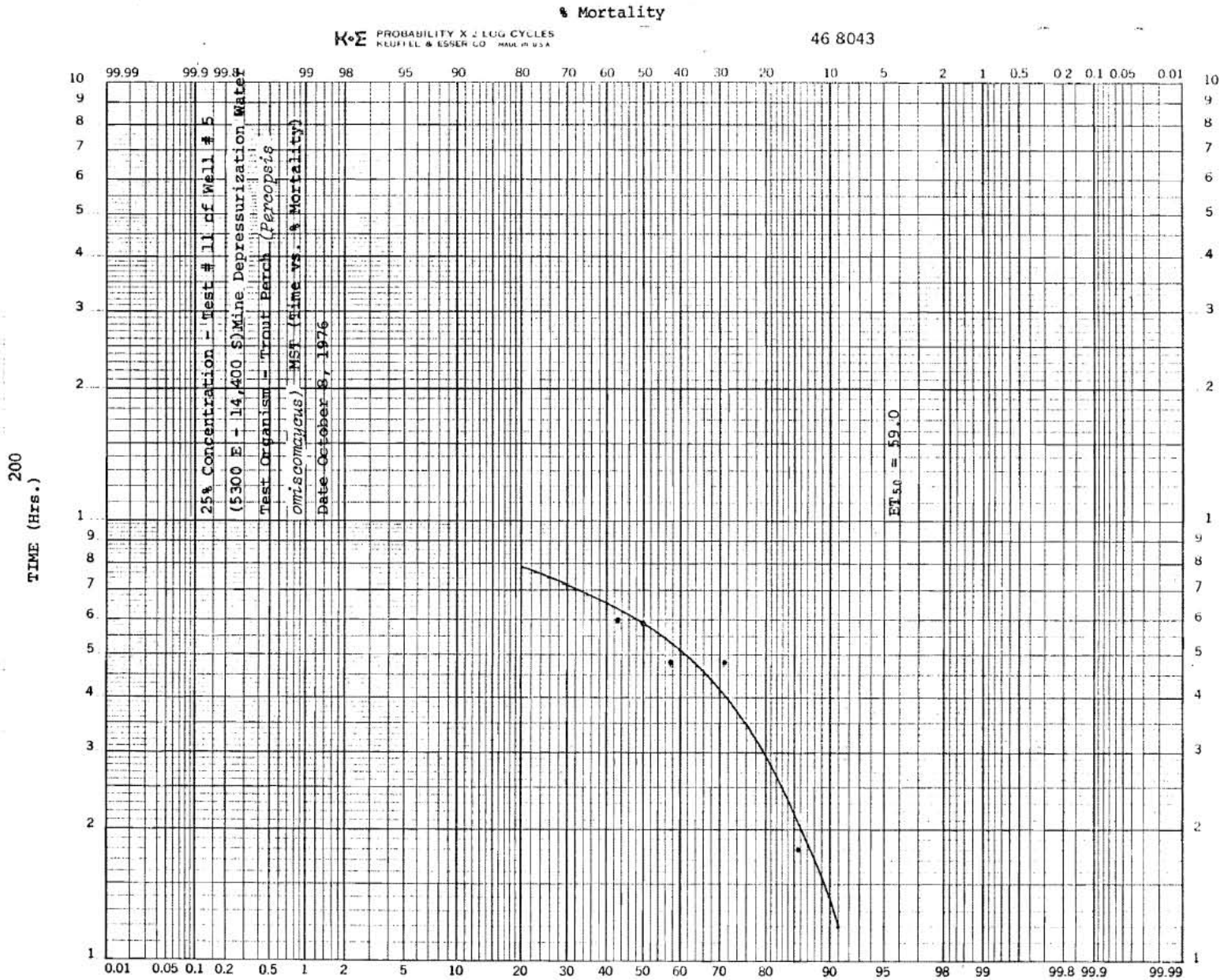



TIME (Hrs.)
% Mortality
100% Concentration - Test # 11 of Well # 5
(5300 B - 14,400 S) Mine Depressurization Water
MST (Time vs. mortality)
Test Organism - Trout Perch (Percopsis omiscomaycus) Date October 8, 1976
ET84 = 3.50
ET50 = 2.50 (2.08 - 3.00)
ET16 = 1.82
S = 1.40
FET50 = 1.20
K+E PROBABILITY X 2 LOG CYCLES KEUFFEL & ESSER CO. MADE IN U.S.A.
46 8043


TIME (Hrs.)
80% Concentration - Test # 11 of
Well # 5 (5300 E - 14,400 S) Mine Depressurization Water - Test Organism - Trout Perch
(Percopsis omiscomaycus)
MST (Time vs. % Mortality)
Date - October 8, 1976
$ET_{84.1}$ = 2.85
ET_{50} = 2.32 (2.07 - 2.59)
ET_{16} = 1.90
S = 1.225
FET_{50} = 1.12
% Mortality
PROBABILITY X 2 LOG CYCLES
KEUFFEL & ESSER CO. MADE IN U.S.A.
46 8043


TIME (Hrs.)
% Mortality
60% Concentration - Test #11 of Well # 5
(5300 E - 14,400 S) Mine Depressurization Water
Test Organism - Trout Perch - (Percopsis
omiscomaycus) MST (Time vs % Mortality)
Date - October 8, 1976
ET_{84} = 24.50
ET_{50} = 24.00 (2357 - 24.34)
ET_{16} = 23.25
S = 1.025
FET_{50} = 1.014
K&E PROBABILITY X 2 LOG CYCLES
KEUFFEL & ESSER CO.
46 8043


TIME (Hrs.)
% Mortality
40% Concentration - Test # 11 of Well # 5
(5300 E - 14,400 S) Mine Depressurization Water
Test Organism - Trout Perch (Percopsis omiscomaycus)
MST (Time vs Mortality)
Date - October 8, 1976
ET84 = 27.80
ET50 = 21.20/18.43 - 24.38
ET16 = 16.20
S = 1.31
FET50 = 1.15
K+E PROBABILITY X 2 LOG CYCLES KEUFFEL & ESSER CO. MADE IN U.S.A.
46 8043


% Mortality
K&E PROBABILITY X 3 LOG CYCLES
KEUFFEL & ESSER CO MADE IN U.S.A.
46 8043
99.99 99.9 99.8 99 98 95 90 80 70 60 50 40 30 20 10 5 2 1 0.5 0.2 0.1 0.05 0.01
10 9 8 7 6 5 4 3 2 1
0.01 0.05 0.1 0.2 0.5 1 2 5 10 20 30 40 50 60 70 80 90 95 98 99 99.8 99.9 99.99
25% Concentration - Test # 11 of Well # 5
(5300 E - 14,400 S)Mine Depressurization Water
Test Organism - Trout Perch (Percopsis omiscomaycus) MST (Time vs. % Mortality)
Date October 8, 1976
ET50 = 59.0
200
TIME (Hrs.)

LETHAL CONCENTRATION DETERMINATION

WELL NO. 5

(5300E - 14,400S)

2.5 Hrs.

Concentration	N	No. Dead	No. Alive	Accumulated Dead	Accumulated Alive	Total	Cumulative Mortality %
Control	8	0	8	0	48	48	0
20	8	0	8	0	40	40	0
25	7	0	7	0	32	32	0
40	9	0	9	0	25	25	0
60	8	0	8	0	16	16	0
80	8	4	4	4	8	12	33
100	8	4	4	8	4	12	66.7

LC_{50} = 90.1%

LETHAL CONCENTRATION DETERMINATION

WELL NO. 5

(5300E--14;400S)

12 Hrs.

Concentration	N	No. Dead	No. Alive	Accumulated Dead	Accumulated Alive	Total	Cumulative Mortality %
Control	8	0	8	0	40	40	0
20	8	0	8	0	32	32	0
25	7	0	7	0	24	24	0
40	9	0	9	0	17	17	0
60	8	0	8	0	8	8	0
80	8	8	0	8	0	8	100
100	8	8	0	16	0	16	100

LC_{50} = 70 $\pm$ 4.1

LETHAL CONCENTRATION DETERMINATION

WELL NO. 5

(5300E - 14,400S)

24 Hrs.

Concentration	N	No. Dead	No. Alive	Accumulated Dead	Accumulated Alive	Total	Cumulative Mortality %
Control	8	0	8	0	28	28	0
20	8	0	8	0	20	20	0
25	7	1	6	1	12	13	7.7
40	9	7	2	8	6	14	57.1
60	8	4	4	12	4	16	75
80	8	8	0	20	0	20	100
100	8	8	0	28	0	28	100

$LC_{50} = 37.8 \pm 13.7$

LETHAL CONCENTRATION DETERMINATION

WELL NO. 5

(5300E - 14,400S)

48 Hrs.

Concentration	N	No. Dead	No. Alive	Accumulated Dead	Accumulated Alive	Total	Cumulative Mortality %
Control	8	0	8	0	24	24	0
20	8	0	8	0	16	16	0
25	7	1	6	1	8	9	11.1
40	9	7	2	8	2	10	80
60	8	8	0	16	0	16	100
80	8	8	0	24	0	24	100
100	8	8	0	32	0	32	100

$LC_{50} = 33.5 \pm 4.2$

LETHAL CONCENTRATION DETERMINATION

WELL NO. 5

(5300E - 14,400S)

72 Hrs.

Concentration	N	No. Dead	No. Alive	Accumulated Dead	Accumulated Alive	Total	Cumulative Mortality %
Control	8	0	8	0	23	23	0
20	8	0	8	0	15	15	0
25	7	2	5	2	7	9	22.2
40	9	7	2	9	2	10	90
60	8	8	0	17	0	17	100
80	8	8	0	25	0	25	100
100	8	8	0	33	0	33	100

$LC_{50} = 31.2 \pm 7.5$

LETHAL CONCENTRATION DETERMINATION

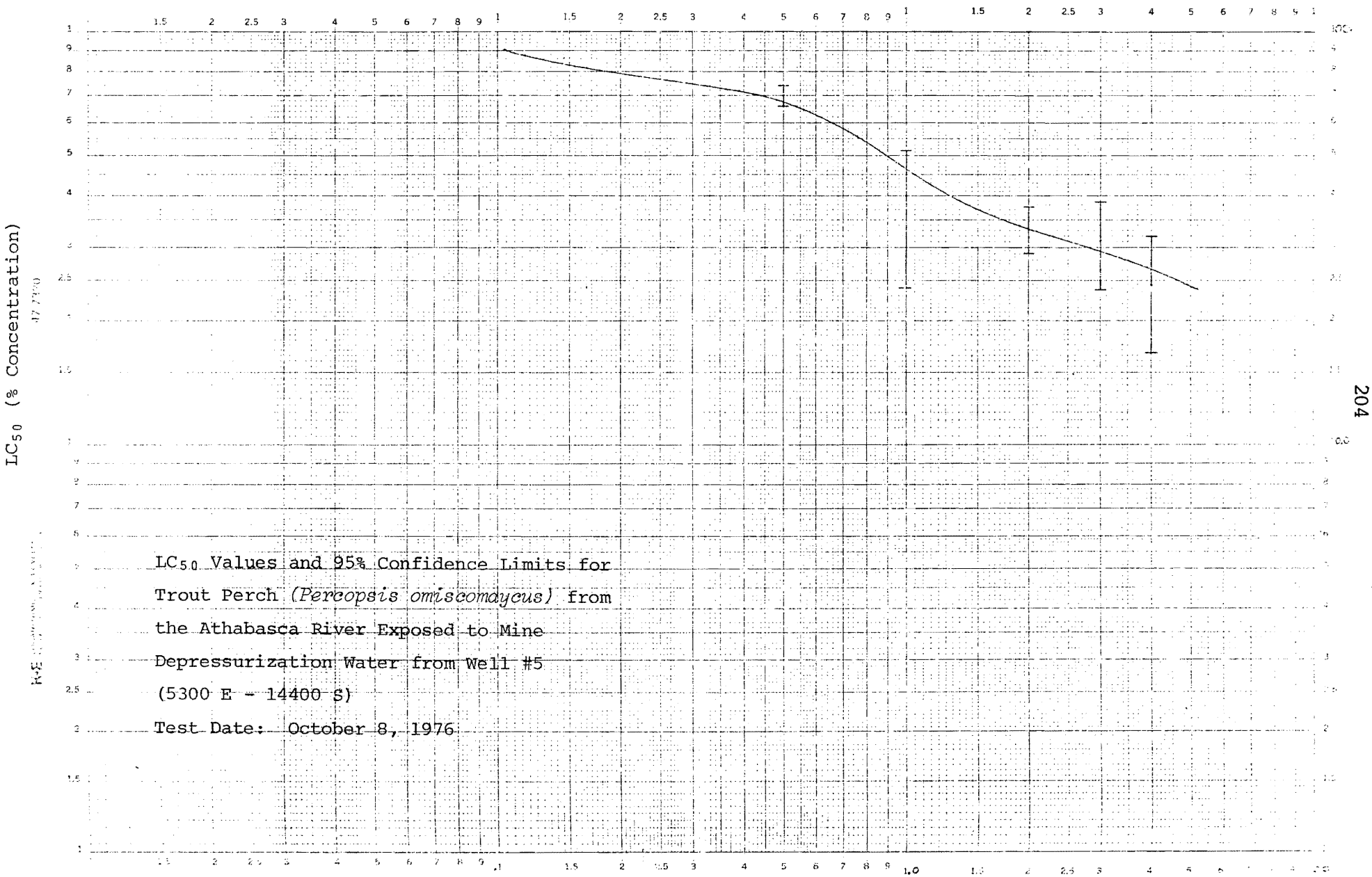
WELL NO. 5

(5300E - 14,400S)

96 Hrs.

Concentration	N	No. Dead	No. Alive	Accumulated Dead	Accumulated Alive	Total	Cumulative Mortality %
Control	8	0	8	0	19	19	0
20	8	0	8	0	11	11	0
25	7	4	3	4	3	7	57.1
40	9	9	0	13	0	13	100
60	8	8	0	21	0	21	100
80	8	8	0	29	0	29	100
100	8	8	0	37	0	37	100

$LC_{50} = 24.4 \pm 7.6$



LC_{50} Values and 95% Confidence Limits for Trout Perch *(Percopsis omiscomaycus)* from the Athabasca River Exposed to Mine Depressurization Water from Well #5 (5300 E - 14400 S)

Test Date: October 8, 1976

5.2 CHEMISTRY DATA (JUNE TO OCTOBER 1976)

Data presented here include summary of chemistry analysis of mine depressurization water collected from Syncrude's Lease 17 and compared to analysis of Athabasca River water.

96 hr. LC_{50} = 20.5%

M.S.T. (hrs.) 100% = 2.50 (2.08 - 3.00)

80% = 2.32 (2.07 - 2.59)

60% = 24.0 (23.67 - 24.34)

40% = 21.2 (18.43 - 24.38)

25% = 59.0

MINE DEPRESSURIZATION WATER

SYNCRUDE LEASE 17

CHEMISTRY DATA SITE #5 5300E - 14600S

	POLLUTION CONTROL LAB		SAMPLE DATES 1976			CHEMEX LABS (ALTA) LTD.						
PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	JUNE 14	JUNE 28	JULY 08	NAQUADAT CODE	DETECTION LIMIT	JULY 28	AUGUST 04	18	26	26***
Calcium	20105L	2.0	30	73	237	20103L	0.002	10	43	44	81	198
Magnesium	12102L	1.0	164	139	158	12102L	0.001	140	55	105	210	99
Sodium	11102L	0.1	5320	6948	4583	11102L	0.5	5750	2150	4050	5625	5200
Potassium	19102L	0.1	45.4	37.8	28.2	19102L	0.5	40	19	32	50	50
Chloride	17203L	1.0	8721	8276	5532	17203L	0.5	7200	2550	4800	7125	6500
Sulphate	16306L	10.0	29	55	17	16306L	1.0	0.6	0.4	1.4	0.6	30
Alkalinity T	10101L	5.0	2492	2525	2477	10101L	1.0	4452	1524	2070	2572	2643
pH	10301L	0.0	8.9	8.3	7.3	10301L	0.0	7.1	7.4	8.1	7.2	6.9
Carbonate	06301L	5.0	219			06301L	1.0	0.0	0.0	0.0	0.0	0
Bicarbonate	06201L	5.0	2593	3077	3019	06201L	1.0	5427	1857.8	2523.3	3135.3	3221.8
Hardness T	10604L	5.0	750	757	1241	10603L	1.0	601.4	333.8	542.2	696.3	902
Fluoride	09107L	0.05	0.72	0.80	0.70	09105L	0.1	0.70	0.66	0.70	0.58	
Silica	14102L	0.5				14101L	0.02	4.0	8.4	6.0	3.5	16

CHEMISTRY DATA SITE 5 5300 E - 14600 S

PARAMETERS

		September	October	MEAN	RANGE		
	02	15	07**		Low	-	High
Calcium	86	57	91	86.36	10	-	237
Magnesium	127	77.5	122	126.95	55	-	164
Sodium	5750	3900	5750	5002.36	2150	-	6948
Potassium	52	29.5	61	40.45	19	-	61
Chloride	7750	5100	8250	6527.64	2250	-	8721
Sulphate	1.1	2	0.5	12.51	0.4	-	55.0
Alkalinity	2630	2096	2700	2602.82	1524	-	4452
pH	7.3	7.6	7.5	7.6	6.9	-	8.9
Carbonate	0.0	0	0	27.38	0.0	-	219.0
Bicarbonate	3206	2555	3291.3	3082.41	1857.8	-	5427
Hardness T	737.6	461.4	729.5	704.75	333.8	-	1241
Fluoride	0.70	0.71	0.66	0.69	0.58	-	0.80
Silica	3.1	5.9	3.2	6.26	3.1	-	16

CHEMISTRY DATA SITE #5 5300E - 14600S

	POLLUTION CONTROL LAB		SAMPLE DATES 1976			CHEMEX LABS (ALTA) LTD.						
PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	JUNE 14	JUNE 28	JULY 08	NAQUADAT CODE	DETECTION LIMIT	JULY 28	AUGUST 04	18	26	26***
Conductivity	02041L	0.2	26500	23000	20500	14101L	0.02	30000	9400	16000	25000	21500
Odor	02001L	0.0	10	100		02001L	1.0	16	16	16	32	
Color	02011L	1.0	98	98	97	02011L	1.0	5*	30	5	5*	
Color T_2	02011L	1.0	99	99	98							
Color T^3	02011L	1.0	97	97	96							
Tanin & Lignin	06551L	0.1	0.3	0.5	0.3	06551L	0.1	1.70	1.15	1.10	0.90	
T.R.	10471L	10.0	16070	14984	12810							
T.F.R.	10571L	10.0		14488	12388	10451L	1.0	15040	5768	10000	13910	
T.F.R.F.						10551L	1.0	13480	5376	9728	13200	
T.N.F.R.						10401L	1.0	7.6	320	233	166	
T.N.F.R.F.						10510L	1.0	6.4	284	209	147	
Turbidity	02073L	0.0		11		02073L	0.0	4.0	298	112	90	
Surfactants	10701L	0.05	1.2	1.25	1.02	10701L	0.02	0.21	0.02*	0.02*	0.02*	
Humic Acids						00000L	2.0	2.0*	2.5	1.0*	1.0*	
T.O.C.	06001L	2.0	286	216	297	06001L	1.0	10	30	70	30	

* less than

CHEMISTRY DATA SITE 5 5300 E - 14600 S

PARAMETERS

	September		October	MEAN	RANGE		
	02	15	07**		Low	-	High
Conductivity	28000	15600	26000	21945.55	9400	-	30000
Odor	32	16	32	30	10	-	100
Color	5*	15	5*	36.26	5*	-	98
Color T				98.67	98	-	99
Color T_3				96.67	96	-	97
Tanin & Lignin	0.90	0.85	0.95	0.87	0.3	-	1.70
TR				14621.3	12810	-	16070
TFR	14660	10200	15970	12491.55	5768	-	15970
TFRF	14230	9760	15440	11604.86	5376	-	15440
TNFR	127	382	15.2	178.69	7.6	-	382
TNFRF	110	351	6.4	159.11	6.4	-	351
Turbidity	74			98.17	4.0	-	298
Surfactants	0.04	0.02*	0.02*	0.38	0.02*	-	1.25
Humic Acids	1.0*	1.0*	1.0*	1.36	1.0*	-	2.5
TOC	30	40	16	102.5	10	-	297

CHEMISTRY DATA SITE #5 5300E - 14600S

PARAMETERS	POLLUTION CONTROL LAB NAQUADAT CODE	DETECTION LIMIT	SAMPLE DATES 1976 JUNE 14	JUNE 28	JULY 08	CHEMEX LABS (ALTA) LTD. NAQUADAT CODE	DETECTION LIMIT	JULY 28	AUGUST 04	18	26	26***
T.I.O.C.	06051L	2.0	525	562	458	06501L	0.5	790	410	540	700	
Nitrite	07205L	0.1	0.1*		0.1*							
$NO_2 + NO_3$	07105L	0.1	0.1*	0.052	0.1*	07110L	0.01	0.1	0.03	0.01	0.04	
NH_3	07555L	0.05		10.19	9.36	07506L	0.005	6.7	3.70	6.70	6.60	
Nitrogen Tk	07003L	0.05	14.28	12.07	8.86	07013L	0.3	16.2	6.60	7.40	10.00	
Phosplate T	15407L							0.005*	0.37	0.18	0.22	
Phosphorus T	15001L	0.05	0.81	0.79	0.58	15406L	0.003					
Phosphorus	15256L			0.242		15256L	0.003	0.005*	0.05	0.09	0.08	
Phenol	06532L	0.001				06532L	0.002	0.003	0.001*	0.011	0.001*	
Oil & Grease	06521L	1.0	10.0	5.1		06521L	0.1	0.7	36.3	3.2	7.5	
Sulphide	06101L	0.02		0.02*		16101L	0.05	0.6	0.05*	0.05*	0.05*	
Cyanide	06601L	0.002	0.01*	0.01*	0.01*	00000L	0.1	0.01*	0.01*	0.01*	0.01*	
Hydrocarbon T	06500L	0.001		0.009	0.29	00000L	10	7.2	60.7	28.8	0.6	
B.O.D.	08201L	0.01		2.0								
C.O.D.	08301L	5.0	117.1	154.6	81.0	08301L	5.0	27.3	56.7	160	388	

* less than

CHEMISTRY DATA SITE 5 5300 E - 14600 S

PARAMETERS

	September		October	MEAN	RANGE		
	02	15	07**		Low	-	High
TIOC	740	340	490	555	340	-	790
Nitrite				0.1*			
NO_2 & NO_3	0.20	0.01*	0.01	0.056	0.01*	-	0.052
NH_3	2.20	6.7	10.7	6.98	2.20	-	10.7
Nitrogen Tk	10.00	15	14.9	11.53	6.6	-	16.2
Phosphorus T	0.26	0.12	0.12	0.18	0.005*	-	0.37
Phosphate T				0.73	0.58	-	0.81
Phosphorus O	0.17	0.02	0.03	0.08	0.005*	-	0.242
Phenol	0.001*	0.001*	0.01	0.004	0.001*	-	0.011
Oil & Grease	3.5	2	0.9	7.69	0.7	-	36.3
Sulphide	0.05*	0.05*	0.05*	0.048	0.02*	-	0.06
Cyanide	0.01*	0.01*	0.01*	0.01*			
Hydrocarbon T	2.8		0.8	12.62	0.009	-	60.7
BOD				2.0			
COD	30	165	340	151.97	27.3	-	388

CHEMISTRY DATA SITE #5 5300E - 14600S

	POLLUTION CONTROL LAB		SAMPLE DATES 1976			CHEMEX LABS (ALTA) LTD.						
PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	JUNE 14	JUNE 28	JULY 08	NAQUADAT CODE	DETECTION LIMIT	JULY 28	AUGUST 04	18	26	26***
Cadmium	48302L	0.001	0.013			48302L	0.001	0.02	0.005	0.011	0.041	0.001*
Chromium^{+6}	24101L	0.002	0.002*	0.002*	0.002*	24101L	0.003	0.08	0.014	0.011	0.01	0.015*
Copper	29305L	0.001				29306L	0.01	0.019	0.023	0.017	0.019	0.002
Iron	26302L	0.05	13	1.0	3.3	26304L	0.05	1.05	4.45	3.20	2.30	0.04*
Lead	82302L	0.003				82302L	0.002	0.04	0.046	0.052	0.041	0.004*
Manganese	25004L	0.008				25004L	0.01	0.18	0.21	0.21	0.215	0.20
Silver	47303L	0.001				47301L	0.01	0.01	0.005*	0.005*	0.01	
Zinc	30305L	0.001				30304L	0.01	0.02	0.055	0.02	0.032	0.017
vanadium	23301L	0.05				23301L	0.05	0.01*	0.001*	0.001*	0.001*	0.001*
Selenium	34102L	0.0002						0.002	0.0018	0.004	0.0005*	0.0005*
Mercury	80003L	0.0001	0.0001*	0.0001*	0.0001*			0.0003	0.0006	0.0036	0.0003	
Arsenic	33104L	0.0002		0.0002*	0.0009			0.005*	0.005*	0.012	0.005*	0.005*
Nickel	28302L	0.001	0.004					0.14	0.046	0.079	0.164	0.002
Aluminum	13005L	0.02						0.15	2.30	0.50	0.70	0.005*
Cobalt	27302L	0.001						0.115	0.035	0.068	0.005	0.002*

* less than

CHEMISTRY DATA SITE 5 5300 E - 14600 S

PARAMETERS

	September		October	MEAN	RANGE	
	02	15	07**		Low -	High
Cadmium	0.041	0.001*	0.001*	0.015	0.001* -	0.041
Chromium^{+6}	0.007	0.003*	0.003	0.014	0.015* -	0.08
Copper	0.018	0.001	0.006	0.013	0.001 -	0.023
Iron	2.10	4.75	0.69	3.26	0.04* -	4.75
Lead	0.054	0.002*	0.002*	0.03	0.002* -	0.054
Manganese	0.096	0.27	0.15	0.19	0.096 -	0.27
Silver	0.015	0.02		0.01	0.005* -	0.02
Zinc	0.036	0.014	0.001*	0.025	0.001* -	0.055
Vanadium	0.001*	0.001*	0.001*	0.0021*		
Selenium	0.0026	0.0005*	0.0005*	0.0015	0.0005* -	0.004
Mercury	0.0009	0.0029	0.0002*	0.0009	0.0001* -	0.0029
Arsenic	0.005*	0.005*	0.001	0.004	0.0002* -	0.012
Nickel	0.158	0.002*	0.002*	0.067	0.0002* -	0.164
Aluminum	0.25	1.5	0.1	0.64	0.005* -	2.30
Cobalt	0.110	0.002*	0.002*	0.056	0.002* -	0.115

CHEMISTRY DATA SITE #5 5300E - 14600S

	POLLUTION CONTROL LAB		SAMPLE DATES 1976			CHEMEX LABS (ALTA) LTD.						
PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	JUNE 14	JUNE 28	JULY 08	NAQUADAT CODE	DETECTION LIMIT	JULY 28	AUGUST 04	18	26	26***
Boron	05102L	0.1						0.42	1.07	6.30	4.22	4.64
Pesticides	00000L											
T.D.S.	00205L	0.0	15805	17044	12042							
P.C.B.'s	00000L	0.0001			0.0001* 0.0001*							13680.1
Carbon T.	06006L	2.0	811	778	750							

Conductivity in microsiemens/cm

Turbidity in J.T.U.

Metals as Totals mg/ℓ

Alkalinity and Hardness expressed as Calcium Carbonate

Nitrite, NO_2 + NO_3, NH_3 expressed as N

Phosphorus T expressed as PO_4

Phosphorus O expressed as P

pH in pH units

* less than

CHEMISTRY DATA SITE 5 5300 E - 14600 S

PARAMETERS

	September		October	MEAN	RANGE		
	02	15	07**		Low	-	High
Boron	1.47	2.63	0.98	2.72	0.48	-	6.30
Pesticides							
TDS				14642.78	12042	-	17044
PCB's				0.0001*			
Carbon T				779.67	750	-	811

SUMMARY OF CHEMISTRY ANALYSIS OF

MINE DEPRESSURIZATION WATER COLLECTED FROM

SYNCRUDE'S LEASE 17 AND COMPARED TO ANALYSIS

OF ATHABASCA RIVER WATER

WELL #5 5300E - 14400S

PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	DATE OF BIOASSAY SAMPLE OCT.7/76	WELL PROFILE MEANS AND RANGES L - H	ATHABASCA RIVER OCT.6/76	RIVER PROFILE MEANS AND RANGES L - H
Calcium	20103L	0.002	91.0	86.36 10.0 - 237.0	22.5	31.35 17.5 - 40.0
Magnesium	12102L	0.001	122.0	126.95 55.0 - 164.0	6.2	6.57 4.5 - 10.0
Sodium	11102L	0.5	5750.0	5002.36 2150.0 - 6948.0	9.6	9.29 5.9 - 36.0
Potassium	19102L	0.5	61.0	40.45 19.0 - 61.0	0.5	0.91 0.4 - 1.5
Chloride	17203L	0.5	8250.0	6527.64 2250.0 - 8721.0	2.6	6.11 1.0 - 51.0
Sulphate	16306L	1.0	0.5	12.51 0.4 - 55.0	14.1	13.8 0.5 - 41.0
Alkalinity T	10101L	1.0	2700.0	2602.82 1524.0 - 4452.0	76.0	86.69 66.8 - 129.0
pH	10301L	0	7.5	7.6 6.9 - 8.9	7.2	7.5 6.8 - 8.3
Carbonate	06301L	1.0	0.0	27.38 0.0 - 219.0	0.0	0.0
Bicarbonate	06201L	1.0	3291.3	3082.41 1857.8 - 5427.0	92.6	105.76 81.4 - 158.0
Hardness T	10603L	0.1	729.5	704.75 333.8 - 1241.0	81.7	89.1 63.5 - 138.0
Conductivity	20401L	1.0	26000.0	21945.55 9400.0 - 30000.0	182.0	185.7 132.0 - 270.0
Surfactants	10701L	0.02	0.02*	0.38 0.02* - 1.25	0.02	0.03 0.02* - 0.09
T.O.C.	06001L	1.0	16.0	102.5 10.0 - 297.0	23.0	25.82 10.5 - 70.0
T.I.O.C.	06051L	1.0	490.0	555.0 340.0 - 790.0	17.0	19.44 11.0 - 40.0
Phenol	06532L	0.002	0.01	0.004 0.001* - 0.011	0.006	0.005 0.001* - 0.02

WELL #5 5300E - 14400S (Continued)

PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	DATE OF BIOASSAY SAMPLE OCT.7/76	WELL PROFILE MEANS AND RANGES L - H	ATHABASCA RIVER OCT.6/76	RIVER PROFILE MEANS AND RANGES L - H
Oil & Grease	06521L	0.1	0.9	7.69 0.7 - 36.3	0.7	0.56 0.1* - 5.0
Sulphide	16101L	0.05	0.05*	0.048 0.02* - 0.06	0.05*	0.05*
Cyanide	00000L	0.1	0.01*	0.01*	0.01*	0.01*
Hydrocarbon T	00000L	1.0	0.8	12.62 0.009 - 60.7	0.1*	0.9 0.001* - 2.0
C.O.D.	08301L	5.0	340.0	151.97 27.3 - 388.0	37.0	86.83 37.0 - 2670.0
Cadmium	48302L	0.001	0.001*	0.015 0.001* - 0.041	0.001*	0.002 0.001* - 0.01
Chromium $^{+6}$	24101L	0.003	0.003	0.014 0.015* - 0.08	0.003*	0.004 0.002* - 0.01
Copper	29306L	0.01	0.006	0.013 0.001 - 0.023	0.008	0.019 0.002 - 0.05
Iron	26304L	0.05	0.69	3.26 0.04* - 4.75	2.15	7.26 0.9 - 63.0
Lead	82302L	0.002	0.002*	0.03 0.002* - 0.054	0.004	0.0056 0.002* - 0.026
Manganese	25304L	0.01	0.15	0.19 0.096 - 0.27	0.056	0.24 0.056 - 1.7
Silver	47301L	0.01		0.01 0.005* - 0.02		0.005*
Zinc	30304L	0.01	0.001*	0.025 0.001* - 0.055	0.016	0.053 0.014 - 0.069
Vanadium	23301L	0.02	0.001*	0.0021*	0.001*	0.004 0.001* - 0.014
Selenium	34302L	0.00015	0.0005*	0.0015 0.0005* - 0.004	0.0013	0.0012 0.0005* - 0.0018
Mercury	80011L	0.0002	0.0002*	0.0009 0.0001* - 0.0029	0.0002*	0.0067 0.0001* - 0.0044
Arsenic	33004L	0.001	0.001	0.004 0.0002* - 0.012	0.004	0.0065 0.0025* - 0.02
Nickel	28302L	0.002	0.002*	0.067 0.0002* - 0.164	0.002*	0.014 0.002* - 0.08
Aluminum	13302L	0.5	0.1	0.64 0.005* - 2.30	0.58	2.1 0.43 - 10.6

WELL #5 5300E - 14400S (Continued)

PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	DATE OF BIOASSAY SAMPLE OCT.7/76	WELL PROFILE MEANS AND RANGES L - H	ATHABASCA RIVER OCT.6/76	RIVER PROFILE MEANS AND RANGES L - H
Cobalt	27302L	0.002	0.002*	0.56 0.002* - 0.115	0.002*	0.005 0.002* - 0.043
Boron	05105L	0.05	0.98	2.72 0.48 - 6.30	0.45	0.2 0.01 - 1.51
Carbon T				779.67 750.0 - 811.0		44.5 41.0 - 48.0

Conductivity in microsiemens/cm

Turbidity in J.T.U.

Metals as Totals mg/l

Alkalinity and Hardness expressed as Calcium Carbonate

Nitrite, NO_2 + NO_3, NH expressed as N

Phosphorus T expressed as PO_4

Phosphorus O expressed as P

pH in pH units

* less than

Analysis by Chemex Labs (Alberta) Ltd.

5.3 TEST NO. 20 BIOASSAY DATA, 1 MARCH 1977

Data presented here include cumulative mortality of Rainbow trout (*Salmo gairdneri*).

TEST #20 MINE DEPRESSURIZATION WATER SEMI-STATIC REPLACEMENT WELL #5 (STORAGE) TEST DATE MARCH 1, 1977

CONCENTRATIONS (MEAN & RANGE)

PARAMETERS	CONTROL 5 Readings	20% 5 Readings	40% 5 Readings	60% 5 Readings	80% 5 Readings	100% 5 Readings
Temperature (°C)	17.17 15.5 - 18.0	17.16 16.0 - 18.0	16.25 15.0 - 18.0	17.38 16.0 - 18.0	16.5 16.0 - 17.0	17.5 16.0 - 18.0
Dissolved Oxygen (mg/ℓ)	9.1 7.9 - 10.3	9.4 8.6 - 10.2	8.6 5.7 - 10.0	9.0 8.2 - 10	9.1 8.8 - 9.8	8.7 7.2 - 9.7
pH	7.42 7.27 - 7.68	8.13 7.57 - 8.52	8.15 7.55 - 8.45	8.25 7.52 - 8.52	8.47 8.42 - 8.51	8.23 7.59 - 8.66
Conductivity (µs/cm)	151.67 140 - 160	2208.33 1600 - 2950	4808.33 3300 - 6000	6941.67 4800 - 9000	8666.67 8000 - 9000	11500 11000 - 13000
Salinity (ppt Cl)	0.0	1.0	4.0	3.0	6.0	8.0
Fish Length (cm)			TOTAL 6.9 ± .71			
Fish Weight (gm)			TOTAL 3.4 ± 1.45			
Loading Density (gm/ℓ)			TOTAL 0.085			
Number Fish/Dilution	9	10	10	10	10	10
Number Dilutions/Conc	1	1	1	1	1	1
Volume of Dilutions (ℓ)	40	40	40	40	40	40
LT_{50} (hr)						
LC_{50} (Conc by Vol)	NO CALCULATION					

CUMULATIVE MORTALITY OF RAINBOW TROUT *(Salmo gairdneri)*

Test #20 Well #5 5300E - 14400S

Concentration Mine Depressurization Water (% by volume)	Time (Hrs.) 0.0	.25	.50	1.00	2.00	4.00	8.00	12.00	18.00	23.50	24.0	25.0	28.50	36.0	48.0	60.0	72.0	84.0	96.0	Total % Mortality 96 hours
Control																				
N = 9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
% Mortality	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
20%																				
N = 10	0	0	0	0	0	0	0	0	0	3	3	3	3	3	3	3	3	3	3	
% Mortality	0	0	0	0	0	0	0	0	0	30	30	30	30	30	30	30	30	30	30	30
40%																				
N = 10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
% Mortality	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
60%																				
N = 10	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	2	2	2	2	
% Mortality	0	0	0	0	0	0	0	0	0	0	0	0	0	20	20	20	20	20	20	20
80%																				
N = 10	0	0	0	0	0	0	0	0	0	0	0	0	10							
% Mortality	0	0	0	0	0	0	0	0	0	0	0	0	100							100* due to mistake during 90% replacement of solution
100%																				
N = 10	0	0	0	0	0	0	0	0	0	0	0	0	1	3	3	3	3	3	3	
% Mortality	0	0	0	0	0	0	0	0	0	0	0	0	10	30	30	30	30	30	30	30

5.4 TEST NO. 21 BIOASSAY DATA, 1 MARCH 1977

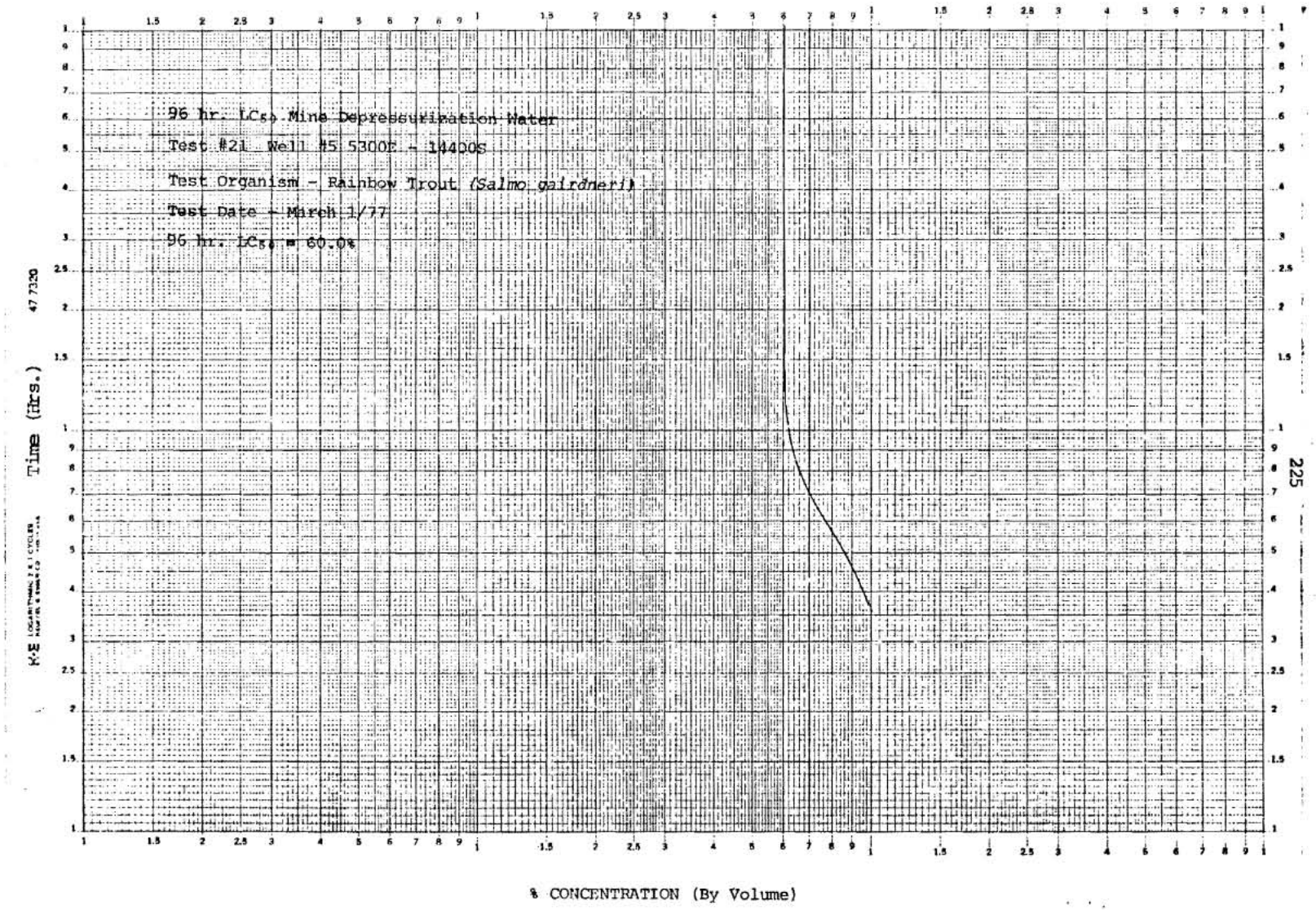
Data presented here include:

1. cumulative mortality of Rainbow trout (*Salmo gairdneri*);
2. graphical determination of LC_{50} and MST's (Litchfield 1949); and
3. partial response determination of 96-hour LC_{50} (Litchfield and Wilcoxon 1949).

TEST #21 MINE DEPRESSURIZATION WATER SEMI-STATIC REPLACEMENT WELL #5 (FRESH) TEST DATE MARCH 1, 1977

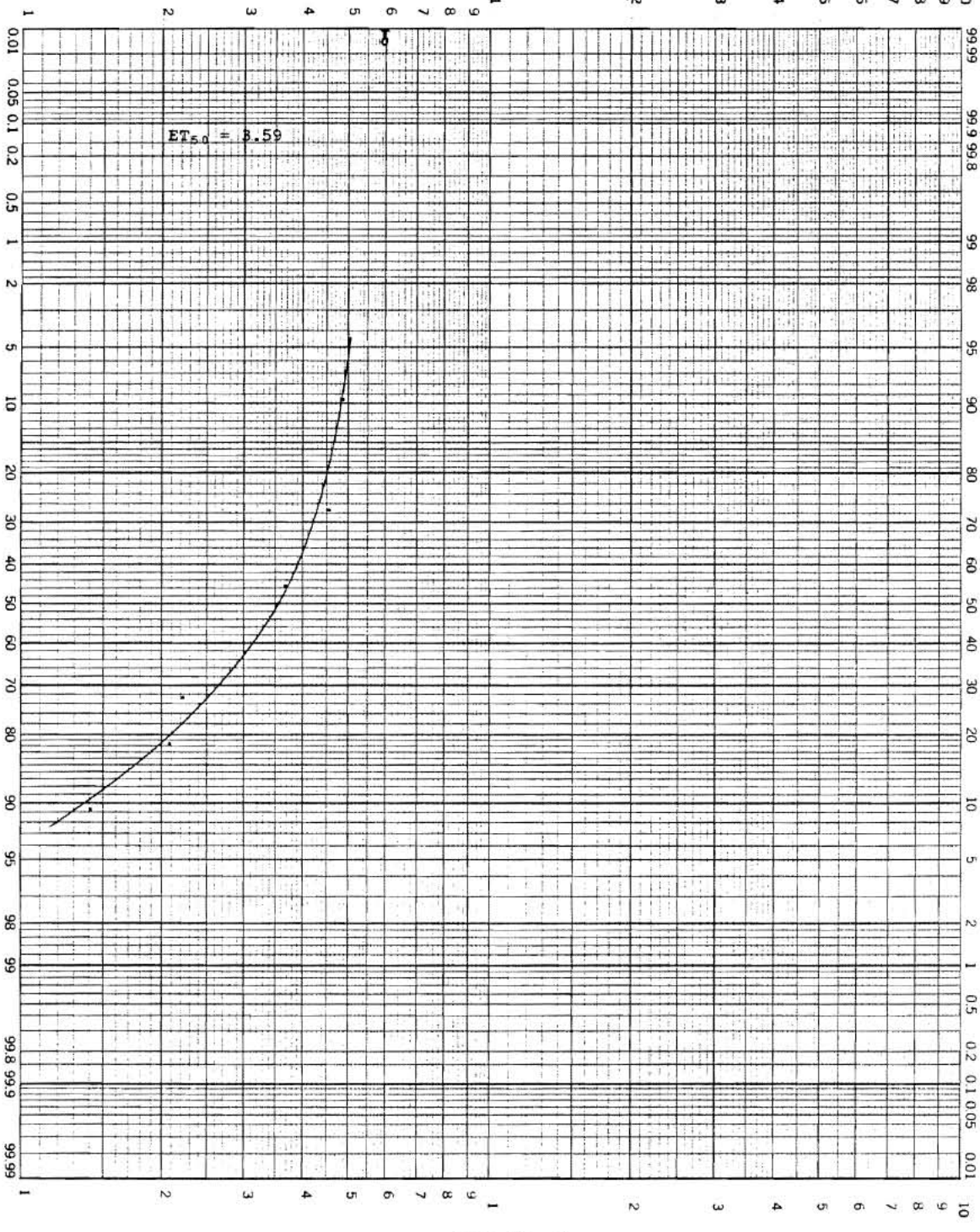
CONCENTRATIONS (MEAN & RANGE)

PARAMETERS	CONTROL 5 Readings	20% 5 Readings	40% 5 Readings	60% 5 Readings	80% 5 Readings	100% 2 Readings
Temperature (°C)	16.9 14.0 - 18.0	17.0 14.0 - 18.0	17.2 14.0 - 18.0	17.2 14.0 - 18.0	17.3 13.0 - 19.0	13.0 11.0 - 15.0
Dissolved Oxygen (mg/ℓ)	9.5 9.1 - 10.4	9.1 8.8 - 10.2	9.1 8.5 - 10.0	8.9 7.8 - 9.4	8.7 7.0 - 9.5	8.35 8.3 - 8.4
pH	7.48 7.40 - 7.57	8.06 7.60 - 8.46	8.09 7.47 - 8.51	8.06 7.37 - 8.47	7.99 7.38 - 8.39	7.42 7.26 - 7.57
Conductivity (µs/cm)	153.8 140 - 160	3883.33 3350 - 4400	8250 7500 - 9000	12125 11000 - 13000	15791.67 14500 - 16500	16000 15000 - 17000
Salinity (ppt Cl)	0.0	2.0	5.0	8.0	10.0	11.0
Fish Length (cm)			TOTAL 6.56 ± 1.1			
Fish Weight (gm)			TOTAL 3.02 ± 1.04			
Loading Density (gm/ℓ)			TOTAL 0.075			
Number Fish/Dilution	9	11	11	11	11	11
Number Dilutions/Conc	1	1	1	1	1	1
Volume of Dilutions (ℓ)	40	40	40	40	40	40
LT_{50} (Hr.)				9.3	7.6	3.59
LC_{50} (Conc by Vol)	60.0%					

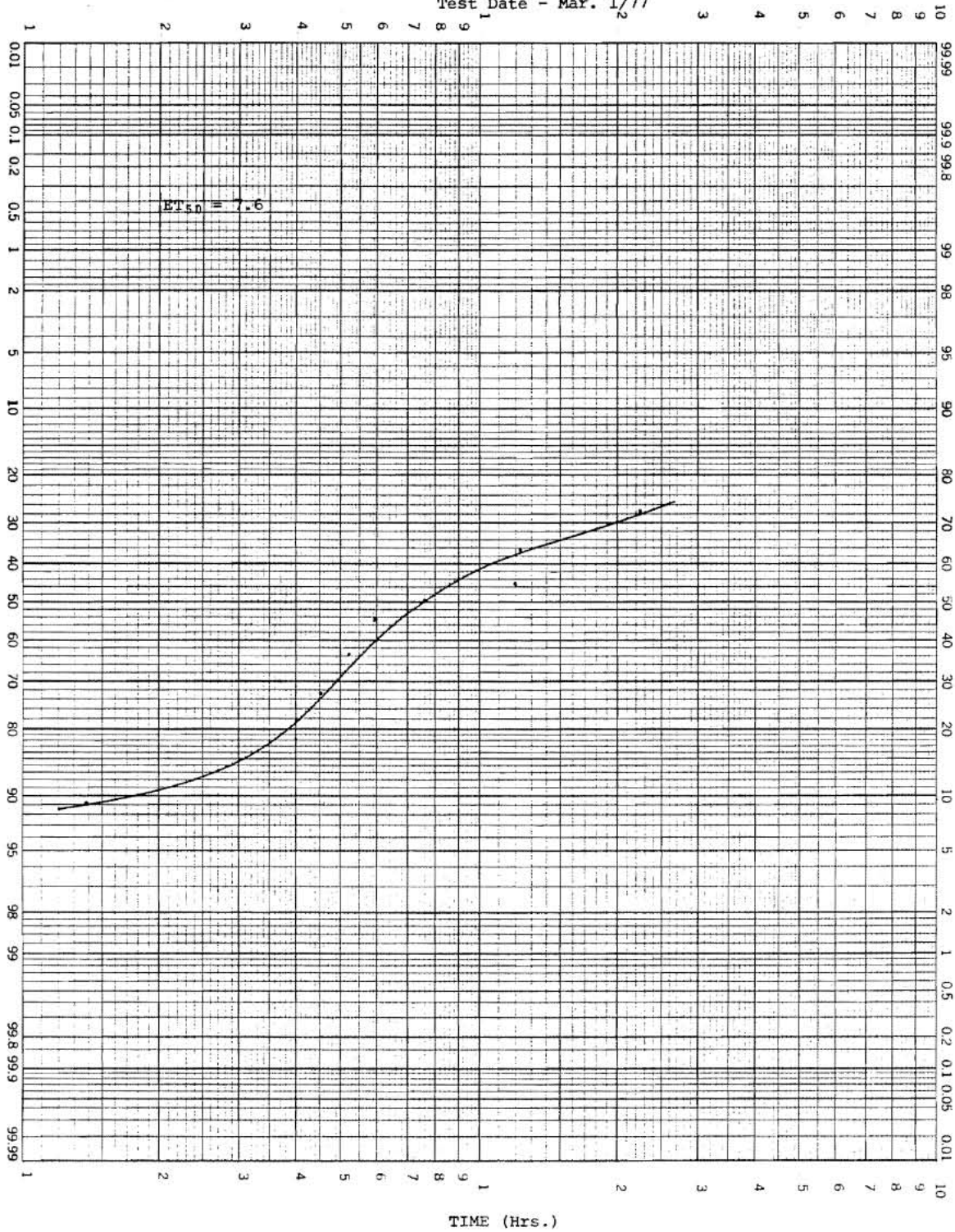

96 hr. LC_{50} Mine Depressurization Water
Test #21 Well #5 5300E - 14400S
Test Organism - Rainbow Trout (*Salmo gairdneri*)
Test Date - March 1/77
96 hr. LC_{50} = 60.0%
Time (Hrs.)
% CONCENTRATION (By Volume)
225

226

100% Concentration Mine Depressurization Water Test #21 Well #5 5300E - 14400S
MST (Time vs. Mortality) Test Organism - Rainbow Trout *(Salmo gairdneri)*
Test Date - Mar. 1/77

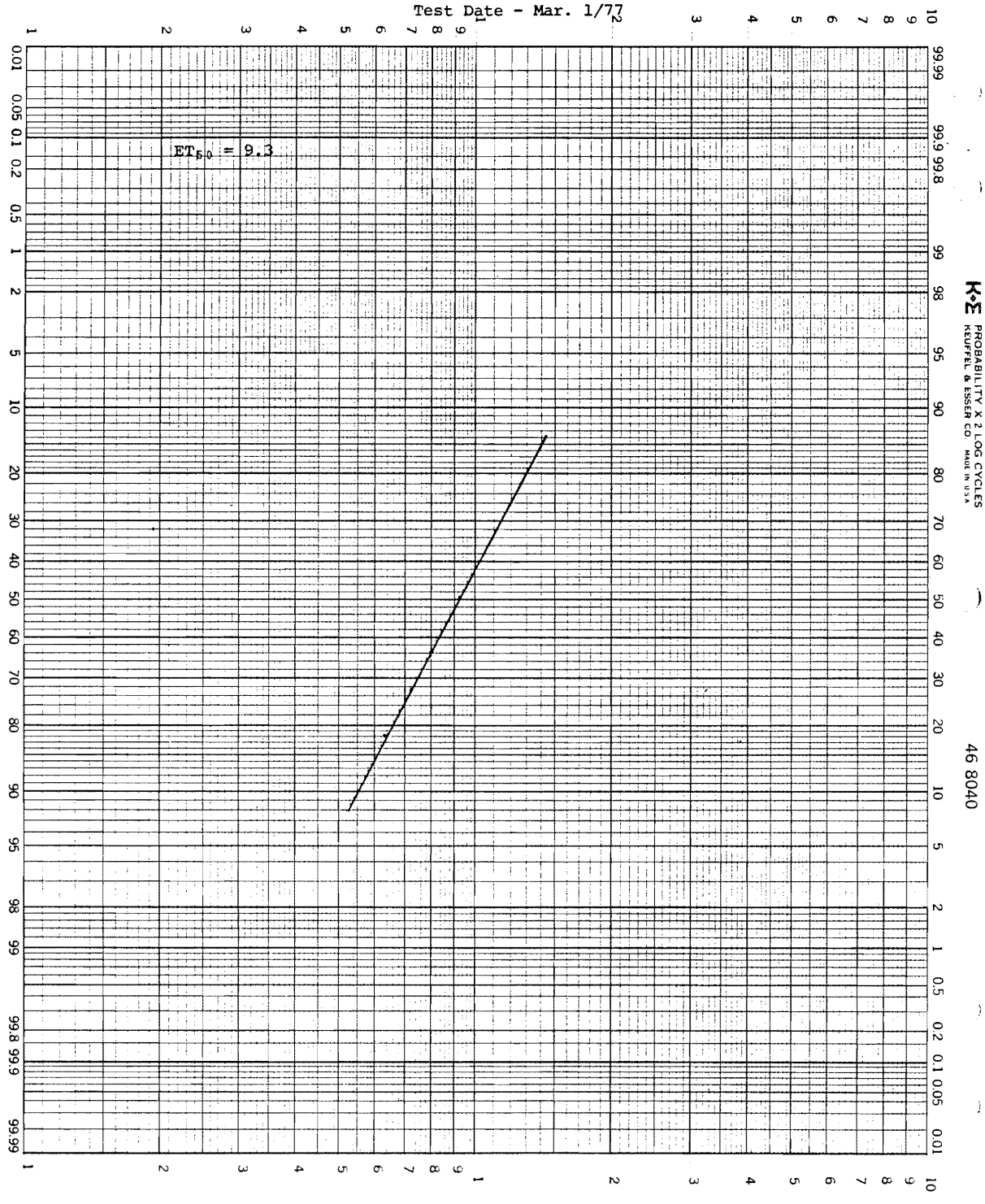


80% Concentration Mine Depressurization Water Test #21 Well #5 5300 - 14400S
MST (Time vs. Mortality) Test Organism - Rainbow Trout (*Salmo gairdneri*)
Test Date - Mar. 1/77



228

60% Concentration Mine Depressurization Water Test #21 Well #5 5300E - 14400S
MST (Time vs. Mortality) Test Organism - Rainbow Trout *(Salmo gairdneri)*
Test Date - Mar. 1/77



MINE DEPRESSURIZATION WATER TEST #21 WELL #5 5300E - 1440S

TEST ORGANISM - RAINBOW TROUT *(Salmo gairdneri)*

TEST DATE - MARCH 1/77

PARTIAL RESPONSE DETERMINATION OF 96 hr. LC_{50} (LITCHFIELD & WILCOXON)

Calculations

% Concentration	% Mortality Observed	% Expected	Corrected	Observed minus Expected	$(Chi)^2$ (Nomograph 1)
20	0	0.05	0.3	0.25	0.128
40	9.09	8.4		0.69	- (off scale)
60	36.36	40.0		3.64	0.0056
80	72.72	71.0		1.72	0.0013
100	100.0	88.0	96.2	3.8	0.014
					0.0337

Number of Concentrations plotted = k = 5

Average number of fish/concentration = 11

$(Chi)^2 = 0.0337 \times 11 = 0.37$

Degrees of freedom, n = k - 2 = 3

$(Chi)^2$ from Table 2 for n of 3 = 7.82 0.37 is less than 7.82, therefore, the data are not significantly heterogeneous.

$ED_{84} = 83.0$ $ED_{50} = 61.9$ $ED_{16} = 45.5$

$$S = \frac{ED_{84}/ED_{50} + ED_{50}/ED_{16}}{2} = \frac{1.34 + 1.36 = 1.35}{2}$$

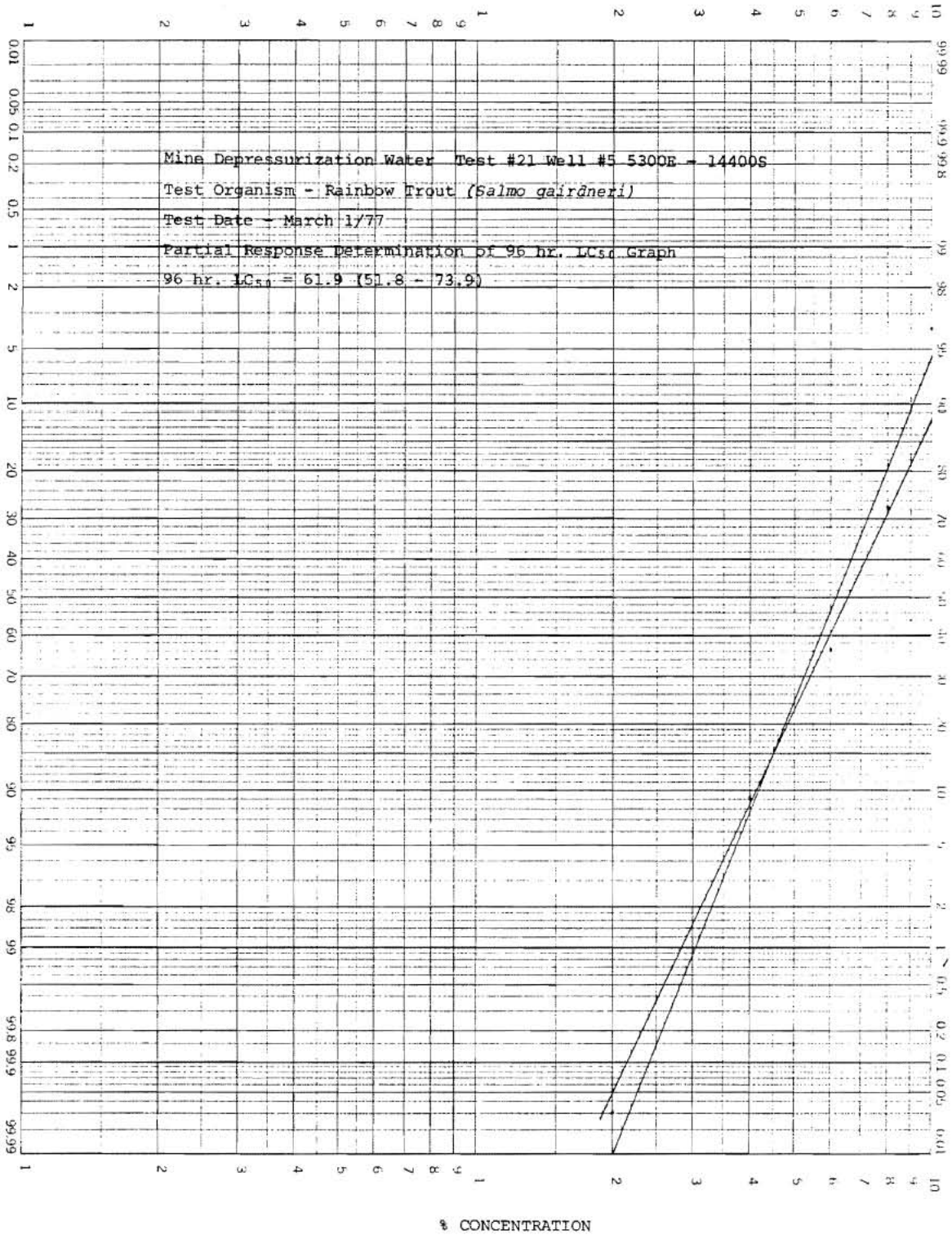
$N^1 = 22$

$f_{ED_{50}} = S^{2.77/\sqrt{N^1}} = S^{\text{exponent}}$

$= S^{2.77/4.69} = S^{.59}$

= 1.195 from Nomograph 2

96 hr. LC_{50} with 95% Confidence Limits = 61.9 (51.8 - 73.9)


Mine Depressurization Water Test #21 Well #5 5300E - 14400S
Test Organism - Rainbow Trout (Salmo gairdneri)
Test Date - March 1/77
Partial Response Determination of 96 hr. LC50 Graph
96 hr. LC50 = 61.9 (51.8 - 73.9)
% MORTALITY
% CONCENTRATION
46 8040

5.5 CHEMISTRY DATA (FEBRUARY TO MARCH 1977)

Data presented here include summary of chemistry analysis of mine depressurization water collected from Syncrude's Lease 17 and compared to analysis of City of Edmonton treated water.

MINE DEPRESSURIZATION WATER

SYNCRUDE LEASE 17

CHEMISTRY DATA SITE #5

5300E - 14400S

96 hr. LC_{50} (2) = 60.0% (Sprague)

M.S.T. = Conc. (2) 100% = 3.59

M.S.T. (hrs.) 80% = 7.6

60% = 9.3

	POLLUTION CONTROL LAB						
PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	SAMPLE DATES 1977 Feb. 9	March 1**	March 1***	MEAN	RANGES Low - High
Calcium	20105L	2.0	104.0	103.0	80.0	95167	80.0 - 104.0
Magnesium	12102L	1.0	129.0	117.0	91.0	112.33	91.0 - 129.0
Sodium	11102L	0.1	5214.0	5673.0	4583.0	5156.67	4583.0 - 5673.0
Potassium	19102L	0.1	41.5	54.6	41.5	45.87	41.5 - 54.6
Chloride	17203L	1.0	7192.0	6692.0	5333.0	6405.67	5333.0 - 7192.0
Sulphate	16306L	10.0	10.0*	17.0	10.0*	22.33	10.0* - 47.0
Alkalinity	10101L	5.0	2642.0	2880.0	2384.0	2635.33	2384.0 - 2888.0
pH	10301L	0.0	7.9	7.3	7.5	7.57	7.3 - 7.9
Carbonate	06301L	5.0					
Bicarbonate	06201L	5.0	3221.0	3511.0	2906.0	3212.67	2906.0 - 3511.0
Hardness T	10604L	5.0	788.0	740.0	577.0	701.67	577.0 - 788.0
Fluoride	09107L	0.05	0.67	0.56	0.47	0.57	0.47 - 0.67
Silica	14102L	0.5	5.4	5.4	3.9	4.9	3.9 - 5.4
Conductivity	02041L	0.2	24250	25000	20000	23083.33	20000 - 25000
Odor	02001L	0.0	1.0	1.0	1.0	1.0	

SITE # 5

POLLUTION CONTROL LAB

PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	SAMPLE DATES 1977 Feb. 9	March 1**	March 1***	MEAN	RANGES Low - High
Color	02011L	1.0	100	100	100	100	
Color T_2	02011L	1.0	99	100	100	99.67	99 - 100
Color T_3	02011L	1.0	98	99	99	98.67	98 - 99
Tanin & Lignin	06551L	0.1	0.5	0.5	0.4	0.47	0.4 - 0.5
T.R.	10471L	10.0	15056	15060	13552	14440.67	13552 - 15060
T.F.R.	10571L	10.0	14712	14754	13206	14224.0	13206 - 14754
T.F.R.F.							
T.N.F.R.							
T.N.F.R.F.							
Turbidity	02073L	0.0	8.0	3.0	4.0	5.0	3.0 - 8.0
Surfactants	10701L	0.05	1.39	0.64	0.58	0.87	0.58 - 1.39
Humic Acids							
T.O.C.	06001L	2.0	30.0			30.0	
T.I.O.C.	06051L	2.0	275.0			275.0	
Nitrite	07205L	0.1	0.1*	0.1*	0.1*	0.1*	
NO_2 & NO_3	07105L	0.05	0.1*	0.1*	0.1*	0.1*	
NH_3	07555L	0.05	11.17	11.78	9.79	10.77	9.36 - 11.78
Nitrogen Tk	07003L	0.05	18.73	11.82	9.79	13.45	9.79 - 18.73
Phosphorus T	15001L	0.05	0.08	0.25	0.17	0.17	0.08 - 0.25
Phosphate T	15407L						
Phosphorus O	15256L						
Phenol	06532L	0.001	0.003	0.006	0.002	0.0037	0.002- 0.006

SITE #5

POLLUTION CONTROL LAB

PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	SAMPLE DATES 1977 Feb. 9	March 1**	March 1***	MEAN	RANGES Low - High
Oil & Grease	06521L	1.0	6.3	8.1	1.5	5.3	1.5 - 8.1
Sulphide	06101L	0.02	0.02*	0.02*	0.02*	0.02*	
Cyanide	06601L	0.002	0.03			0.03	
Hydrocarbon T	06500L	0.001					
B.O.D.	08201L	0.01	1.3	8.5	8.2	6.0	1.3 - 8.5
C.O.D.	08301L	5.0	56.3	96.8	88.0	80.37	56.3 - 96.8
Cadmium	48302L	0.001	0.001*	0.001*	0.001*	0.001*	
Chromium^{+6}	24101L	0.002	0.002*	0.002*	0.002*	0.002*	
Copper	29305L	0.001	0.001*	0.022	0.001*	0.008	0.001* - 0.022
Iron	26302L	0.05	0.74	0.31	0.30	0.45	0.30 - 0.74
Lead	82302L	0.003	0.003*	0.003*	0.003*	0.003*	
Manganese	25004L	0.008	0.231	0.205	0.152	0.096	0.52 - 0.231
Silver	47303L	0.001	0.001*			0.001*	
Zinc	30305L	0.001	0.015	0.014	0.006	0.0117	0.006 - 0.015
Vanadium	23301L	0.05					
Selenium	34102L	0.0002		0.0002*	0.0002*	0.0002*	
Mercury	80003L	0.0001	0.0001*	0.0001*	0.0001*	0.0001*	
Arsenic	33104L	0.0002	0.0002*	0.0002*	0.0002*	0.0002*	
Nickel	28302L	0.001	0.001*	0.001*	0.005	0.002	0.001* - 0.005
Aluminum	13005L	0.02					
Cobalt	27302L	0.001	0.001*	0.001*	0.001*	0.001*	
Boron	05102L	0.1					

SITE #5

PARAMETERS	POLLUTION CONTROL LAB NAQUADAT CODE	DETECTION LIMIT	SAMPLE DATES 1977 Feb. 9	March 1**	March 1***	MEAN	RANGES Low - High
Pesticides	00000L						
T.D.S.	00205L	0.0	14276	14416	11571	13421	11571 - 14416
P.C.B.'s	00000L	0.0001					
Carbon T	06006L	2.0	305.0			305.0	

Conductivity in microsiemens/cm

Turbidity in J.T.U.

Metals as Totals mg/l

Alkalinity and Hardness expressed as Calcium Carbonate

Nitrite, NO_2 & NO_3, NH_3 expressed as N

Phosphorus T expressed as PO_4

Phosphorus O expressed as P

pH in pH units

* less than

** sample taken for bioassay

*** sample collected December 15, 1976
and stored frozen

SUMMARY OF CHEMISTRY ANALYSIS OF

MINE DEPRESSURIZATION WATER COLLECTED FROM

SYNCRUDE'S LEASE 17 AND COMPARED TO ANALYSIS

OF CITY OF EDMONTON TREATED WATER

WELL #5 5300E - 14400S (COLLECTED DEC. 15/76)

PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	DATE OF BIOASSAY MAR.01/77	WELL PROFILE MEANS AND RANGES L - H	TREATED WATER MAR.01/77	TREATED WATER PROFILE MEANS AND RANGES L - H
Calcium	20105L	2.0	80.0	95.67 80.0 - 104.0	22.0	22.5 22.0 - 23.0
Magnesium	12102L	1.0	91.0	112.33 91.0 - 129.0	10.0	10.5 9.0 - 12.0
Sodium	11103L	0.1	4583.0	5156.67 4583.0 - 5673.0	6.0	65.0 4.0 - 237.0
Potassium	19103L	0.1	41.5	45.87 41.5 - 54.6	0.8	1.75 0.8 - 4.5
Chloride	17203L	1.0	5333.0	6405.67 5333.0 - 7192.0	0.1*	2.8 0.1* - 7.0
Sulphate	16306L	10.0	10.0*	22.33 10.0* - 47.0	46.0	164.25 46.0 - 505.0
Alkalinity T	10101L	5.0	2384.0	2635.0 2384.0 - 2880.0	46.0	56.25 46.0 - 66.0
pH	10301L	0	7.5	7.57 7.3 - 7.9	8.1	8.18 8.1 - 8.3
Carbonate	06301L	5.0				
Bicarbonate	06201L	5.0	2906.0	3212.57 2906.0 - 3511.0	56.0	68.25 56.0 - 80.0
Hardness T	10604L	5.0	577.0	701.67 577.0 - 788.0	96.0	100.5 96.0 - 108.0
Conductivity	02041L	0	20000.0	23083.33 20000.0 - 25000.0	188.0	217.0 188.0 - 260.0
Surfactants	10701L	0.05	0.58	0.87 0.58 - 1.39	0.05*	0.07 0.05* - 0.13
T.O.C.	06001L	2.0		30.0		
T.I.O.C.	06051L	2.0		275.0		
Phenol	06532L	0.001	0.002	0.0037 0.002 - 0.006	0.001*	0.001*

WELL #5 5300E - 14400S (Continued)

PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	DATE OF BIOASSAY MAR.01/77	WELL PROFILE MEANS AND RANGES L - H	TREATED WATER MAR.01/77	TREATED WATER PROFILE MEANS AND RANGES L - H
Oil & Grease	06521L	0.02	1.5	5.3 1.5 - 8.1		2.1
Sulphide	16101L	0.02	0.02*	0.02*		
Cyanide	06601L	0.002		0.03		
Hydrocarbon T	06500L	0.001				
C.O.D.	08301L	5.0	88.0	80.37 56.3 - 96.8	5.0*	5.47 5.0* - 6.4
Cadmium	48302L	0.001	0.001*	0.001*		0.001*
Chromium^{+6}	24101L	0.002	0.002*	0.002*	0.002*	0.002*
Copper	29305L	0.001	0.001*	0.008 0.001* - 0.022	0.001*	0.001*
Iron	26302L	0.05	0.30	0.45 0.30 - 0.74	0.80	0.27 0.06 - 0.80
Lead	82302L	0.003	0.003*	0.003*	0.003*	0.003*
Manganese	25304L	0.008	0.152	0.196 0.152 - 0.231	0.008*	0.008*
Silver	47303L	0.001		0.001*		
Zinc	30305L	0.001	0.006	0.0117 0.006 - 0.015		0.005 0.002 - 0.007
Vanadium	04303L	0.01				
Selenium	34102L	0.0002	0.0002*	0.0002*		
Mercury	80011L	0.0001	0.0001*	0.0001*		0.0001*
Arsenic	33104L	0.0002	0.0002*	0.0002*		
Nickel	28302L	0.001	0.005	0.002 0.001* - 0.005		0.001*
Aluminum						
Cobalt	27302L	0.001	0.001*	0.001*		0.001*
Boron						
Carbon T.	06006L	2.0		305.0		

WELL #5 5300E - 14400S (Continued)

Conductivity in microsiemens/cm
Turbidity in J.T.U.
Metals as Totals mg/l
Alkalinity and Hardness expressed as Calcium Carbonate
Nitrite, NO_2 + NO_3, NH_3 expressed as N
Phosphorus T expressed as PO_4
Phosphorus O expressed as P
pH in pH units
* less than

Analysis by Department of Environment, Pollution Control Division Laboratory.

SUMMARY OF CHEMISTRY ANALYSIS OF

MINE DEPRESSURIZATION WATER COLLECTED FROM

SYNCRUDE'S LEASE 17 AND COMPARED TO ANALYSIS

OF CITY OF EDMONTON TREATED WATER

WELL #5 5300E - 14400S

PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	DATE OF BIOASSAY MAR.01/77	WELL PROFILE MEANS AND RANGES L - H	TREATED WATER MAR.01/77	TREATED WATER PROFILE MEANS AND RANGES L - H
Calcium	20105L	2.0	103.0	95.67 80.0 - 104.0	22.0	22.5 22.0 - 23.0
Magnesium	12102L	1.0	117.0	112.33 91.0 - 129.0	10.0	10.5 9.0 - 12.0
Sodium	11103L	0.1	5673.0	5156.67 4583.0 - 5673.0	6.0	65.0 4.0 - 237.0
Potassium	19103L	0.1	54.6	45.87 41.5 - 54.6	0.8	1.75 0.8 - 4.5
Chloride	17203L	1.0	6692.0	6405.67 5333.0 - 7192.0	0.1*	2.8 0.1* - 7.0
Sulphate	16306L	10.0	47.0	22.33 10.0* - 47.0	46.0	164.25 46.0 - 505.0
Alkalinity T	10101L	5.0	2880.0	2635.33 2384.0 - 2880.0	46.0	56.25 46.0 - 66.0
pH	10301L	0	7.3	7.57 7.3 - 7.9	8.1	8.18 8.1 - 8.3
Carbonate	06301L	5.0				
Bicarbonate	06201L	5.0	3511.0	3212.67 2906.0 - 3511.0	56.0	68.25 56.0 - 80.0
Hardness T	10604L	5.0	740.0	701.67 577.0 - 788.0	96.0	100.5 96.0 - 108.0
Conductivity	02041L	0	25000.0	23083.0 20000.0 - 25000.0	188.0	217.0 188.0 - 260.0
Surfactants	10701L	0.05	0.64	0.87 0.58 - 1.39	0.05*	0.07 0.05* - 0.13
T.O.C.	06001L	2.0		30.0		
T.I.O.C.	06051L	2.0		275.0		
Phenol	06532L	0.001	0.006	0.0037 0.002 - 0.006	0.001*	0.001*

WELL #5 5300E - 14400S (Continued)

PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	DATE OF BIOASSAY MAR.01/77	WELL PROFILE MEANS AND RANGES L - H	TREATED WATER MAR.01/77	TREATED WATER PROFILE MEANS AND RANGES L - H
Oil & Grease	06521L	0.02	8.1	5.3 1.5 - 8.1		2.1
Sulphide	16101L	0.02	0.02*	0.02*		
Cyanide	06601L	0.002		0.03		
Hydrocarbon T	06500L	0.001				
C.O.D.	08301L	5.0	96.8	80.37 56.3 - 96.8	5.0*	5.47 5.0* - 6.4
Cadmium	48302L	0.001	0.001*	0.001*		0.001*
Chromium^{+6}	24101L	0.002	0.002*	0.002*	0.002*	0.002*
Copper	29305L	0.001	0.022	0.008 0.001* - 0.022	0.001*	0.001*
Iron	26302L	0.05	0.31	0.45 0.30 - 0.74	0.80	0.27 0.06 - 0.80
Lead	82302L	0.003	0.003*	0.003*	0.003*	0.003*
Manganese	25304L	0.008	0.205	0.196 0.152 - 0.231	0.008*	0.008*
Silver	47303L	0.001		0.001*		
Zinc	30305L	0.001	0.014	0.0117 0.006 - 0.015		0.005 0.002 - 0.007
Vanadium	04303L	0.01				
Selenium	34102L	0.0002	0.0002*	0.0002*		
Mercury	80011L	0.0001	0.0001*	0.0001*		0.0001*
Arsenic	33104L	0.0002	0.0002*	0.0002*		
Nickel	28302L	0.001	0.001*	0.002 0.001* - 0.005		
Aluminum						
Cobalt	27302L	0.001	0.001*	0.001*		0.001*
Boron						
Carbon T.	06006L	2.0		305.0		

WELL #5 5300E - 14400S (Continued)

Conductivity in microsiemens/cm
Turbidity in J.T.U.
Metals as Totals mg/l
Alkalinity and Hardness expressed as Calcium Carbonate
Nitrite, NO_2 + NO_3, NH_3 expressed as N
Phosphorus T expressed as PO_4
Phosphorus O expressed as P
pH in pH units
* less than

Analysis by Department of Environment, Pollution Control Division Laboratory.

6. SUMMARY OF SAMPLING AND TESTING OF COMPOSITE SAMPLES OF ALL FIVE WELLS

Composite Samples

Date of Bioassays:	A.	(1)	July 19, 1976
		(2)	July 27, 1976
		(3)	September 15, 1976
		(4)	September 25, 1976
	B.	(1)	February 12, 1977
		(2)	February 12, 1977
		(3)	February 22, 1977
		(4)	March 22, 1977
Type of Bioassays:	A.	(1)	10 day Static
		(2)	10 day Static
		(3)	96 hr. Semi Static Replacement
		(4)	96 hr. Semi Static Replacement
	B.	(1)	96 hr. Continuous Flow
		(2)	96 hr. Semi Static Replacement
		(3)	96 hr. Continuous Flow
		(4)	96 hr. Continuous Flow
Type of Fish:	A.	(1)	Trout Perch *(Percopsis omiscomaycus)*
		(2)	Trout Perch *(Percopsis omiscomaycus)*
		(3)	Trout Perch *(Percopsis omiscomaycus)*
		(4)	Trout Perch *(Percopsis omiscomaycus)*
	B.	(1)	Rainbow Trout *(Salmo gairdneri)*
		(2)	Rainbow Trout *(Salmo gairdneri)*
		(3)	Rainbow Trout *(Salmo gairdneri)*
		(4)	Rainbow Trout *(Salmo gairdneri)*

. . . /2

Composite Samples

Dilution Water:
- A. (1) Athabasca River Water
- (2) Athabasca River Water
- (3) Athabasca River Water
- (4) Athabasca River Water
- B. (1) City of Edmonton Treated Water
- (2) City of Edmonton Treated Water
- (3) City of Edmonton Treated Water
- (4) City of Edmonton Treated Water

Mean Survival Times:
- A. (1) 100% = 2.49 (2.41 - 2.56)
  40% = 14.2 (9.66 - 20.87)
- (2) 100% = 3.5 (3.09 - 3.97)
  80% = 8.99 (7.50 - 10.77)
  40% = 96.0 (79.3 - 116.2)
- (3) 100% = 1.03 (0.89 - 1.19)
  80% = 3.25 (2.62 - 4.03)
  60% = 2.86 (2.25 - 3.63)
  40% = 4.78
- (4) 35% = 13.6 (7.31 - 25.3)
- B. (1) 100% = 1.41 (1.15 - 1.72)
  80% = 2.35
  60% = 3.30
- (2) 100% = 0.759 (0.6 - 0.9)
  80% = 2.0 (1.8 - 2.2)
- (3) 100% = 5.69 (5.03 - 6.44)
  80% = 18.0 (7.44 - 43.56)
- (4) 100% = 2.03 (1.83 - 2.24)
  80% = 2.20
  60% = 2.50 (2.33 - 2.69)
  40% = 4.20 (3.59 - 4.91)
  20% = 7.81 (6.59 - 9.25)

. . . /3

Composite Samples

96 hr. LC_{50}(%): A. (1) = $20 < LC_{50} < 40$ (Sprague)
= 45.0 (38.0 - 59.2) (Reed & Muench)
(2) = 40.0 (Sprague)
(3) = 35.0 (Sprague)
= 32.0 (28.1 - 35.9) (Reed & Muench)
(4) = $30 < LC_{50} < 35$ (Sprague)

B. (1) = 52.5 (Sprague)
= 55.2 (50.1 - 60.0) (Reed & Muench)
(2) = $60\% < LC_{50} < 80\%$ (Sprague)
= 68.6 (64.2 - 73.0) (Reed & Muench)
(3) = $80 < LC_{50} < 100$ (Sprague)
= 80 (74.9 - 85.1) (Reed & Muench)
(4) = 15.2% (Sprague)
= 11.1 (3.7 - 18.5) (Reed & Muench)

6.1 TEST NO. 1 BIOASSAY DATA, 19 July 1976

Data presented here include:

1. cumulative mortality of Trout-perch (*Percopsis omiscomaycus*); and
2. graphical determination of LC_{50} and MST's (Litchfield 1949).

TEST # 1

MINE DEPRESSURIZATION WATER COMPOSITE STATIC BIOASSAY

TEST DATE JULY 19/76

CONCENTRATIONS (MEAN & RANGE)

PARAMETER	CONTROL 5 Readings	20% 5 Readings	40% 5 Readings	60% 4 Readings	80% 2 Readings	100% 2 Readings
Temperature (°C)	15.39 ± .18	15.39 ± .11	15.3 ± .32 Range (14.5-16.0)	15 Range (14.5-15.5)	15.25 Range (15.0-15.5)	15 No Range
Dissolved Oxygen (mg/l)	9.11 ± .43	9.03 ± .76	8.92 ± .49 Range (7.9 - 9.5)	9.1 Range (8.6- 9.6)	8.25 Range (7.5 - 9.0)	9.25 Range (8.7 - 9.8)
pH	8.00 ± .06	8.82 ± .21	8.84 ± .11 Range (8.35- 9.10)	8.74 Range (8.30-8.91)	8.32 Range (7.88- 8.55)	8.32 Range (8.26- 8.39)
Conductivity (µs/cm)	240	5761	> 10,000	> 10,000	> 10,000	> 10,000
Fish Length (cm.)		TOTAL	5.75 ± .23			
Fish Weight (gm.)		TOTAL	2.15 ± .32			
Number Fish/Dilution	5	5	5	5	5	5
Number Dilutions/Conc.	1	1	1	1	1	1
Volume of Dilutions (l)	20	20	20	20	20	20
LT_{50} (hr.)			14.2 (9.66-20.87)			2.49 (2.41-2.56)
LC_{50} (Conc. by Vol.)	BETWEEN 20% and 40%					

LC_{50} Determination at 15°C of Test #1 of Composite Mine Depressurization Water

K&E LOGARITHMIC • 2 X 3 CYCLES KEUFFEL & ESSER CO. MADE IN U.S.A.

46 7320

Test Organism - Trout Perch *(Percopsis omiscomaycus)*

Date - July 19, 1976

96 Hr. LC_{50} (Conc. by Vol.) = between 20% & 40%

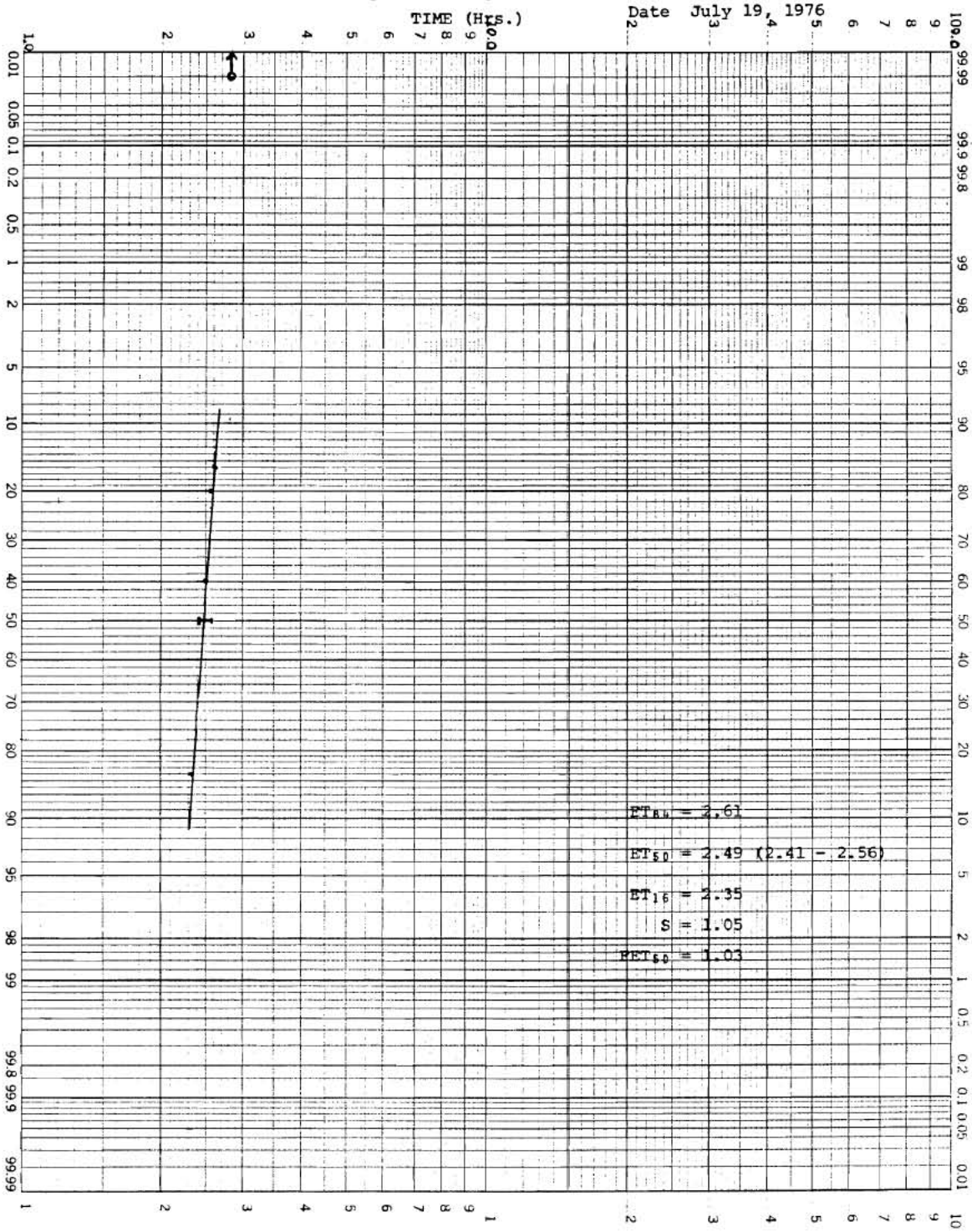
TIME

% Concentration

/250 100% Conc. Test # 1 of Composite Mine Depressurization Water

MST (Time vs % Mortality) Test organism Trout Perch *(Percopsis omiscomaycus)*

Date July 19, 1976



K&E PROBABILITY X 2 LOG CYCLES KEUFFEL & ESSER CO. MADE IN U.S.A.

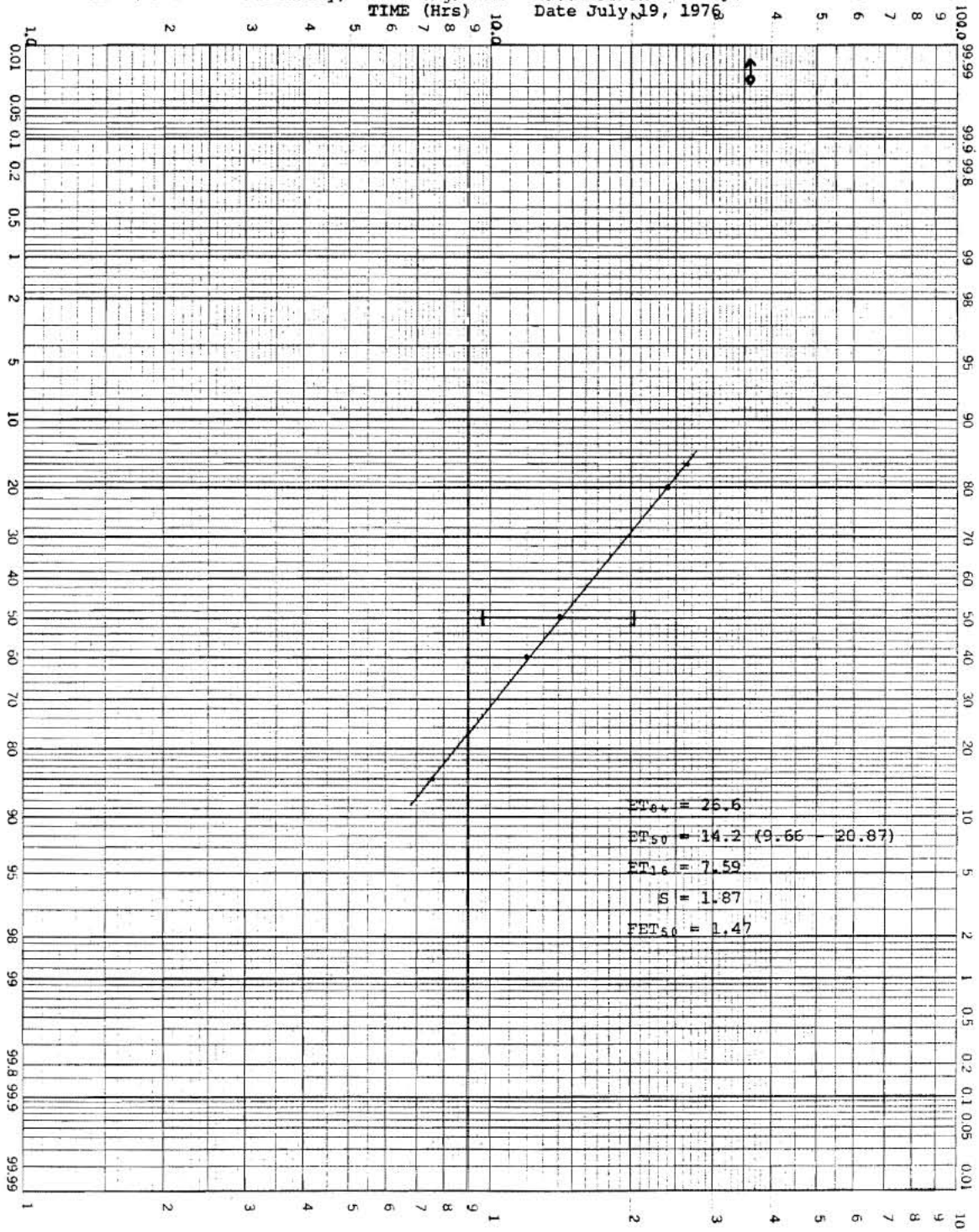
46 8043

251

40% Conc. Test #1 of Composite Mine Depressurization Water

MST (Time vs % Mortality) Test Organism - Trout Perch *(Percopsis omiscomaycus)*

TIME (Hrs) Date July 19, 1976



6.2 TEST NO. 2 BIOASSAY DATA, 27 JULY 1976

Data presented here include:

1. cumulative mortality of Trout-perch (*Percopsis omiscomaycus*);
2. graphical determination of LC_{50} and MST's (Litchfield 1949); and
3. lethal concentration determination (Woolf 1968).

TEST #2

MINE DEPRESSURIZATION WATER COMPOSITE STATIC BIOASSAY

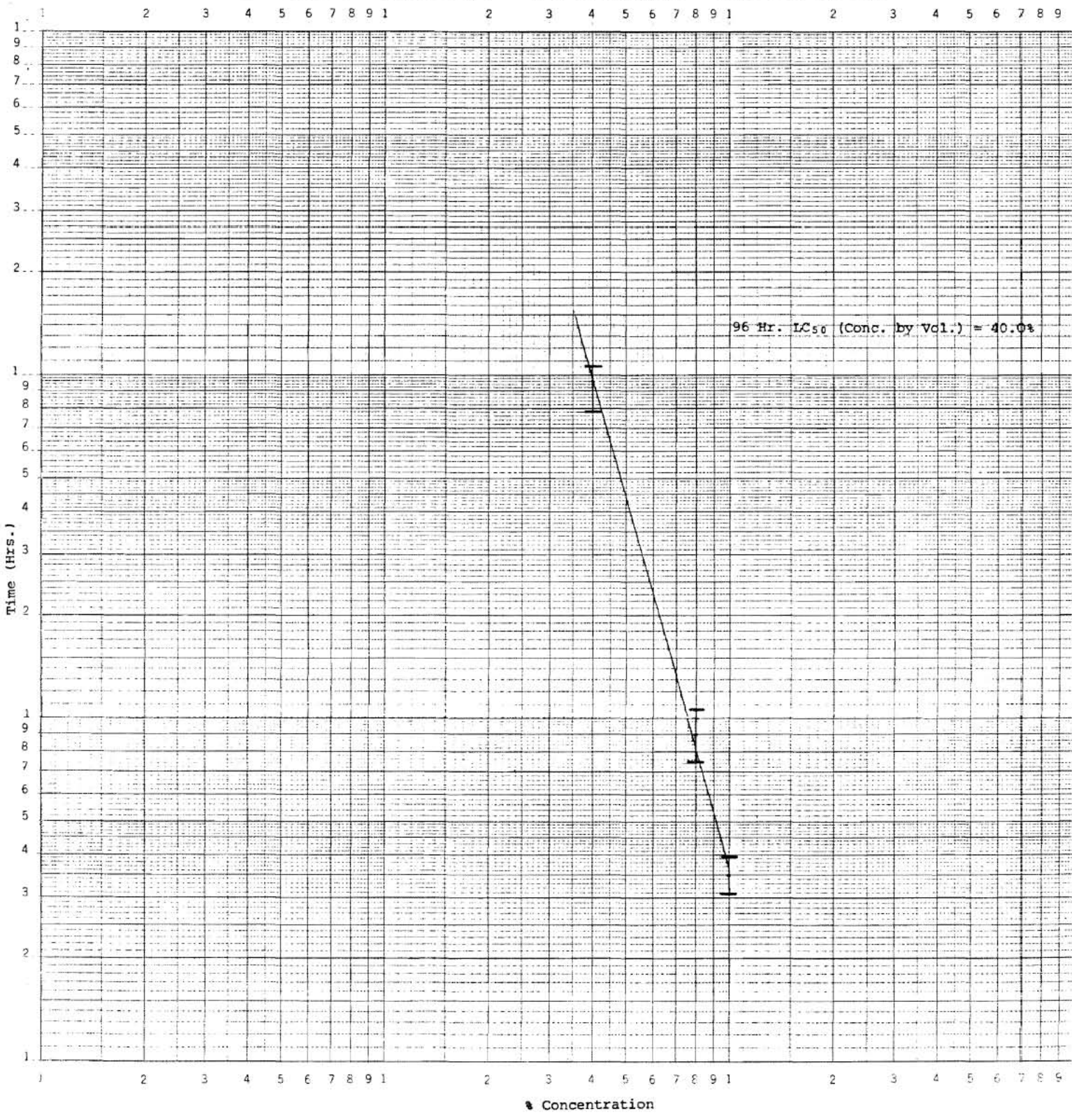
TEST DATE JULY 27/76

CONCENTRATIONS (MEAN & RANGE)

PARAMETER	CONTROL 5 Readings	20% 5 Readings	40% 5 Readings	60% 4 Readings	80% 2 Readings	100% 2 Readings
Temperature (°C)	14.8 ± .13	14.8 ± .19	14.8 ± .18	14.4 Range (13.0-15.5)	13.75 Range (13.0-14.5)	13.5 Range (13.0-14.0)
Dissolved Oxygen (mg/l)	9.59 ± .35	9.59 ± .18	9.47 ± .09	9.43 Range (8.7 - 9.9)	8.4 Range (7.5- 9.3)	7.7 Range (6.5- 8.9)
pH	8.33 ± .04	9.03 ± .07	8.87 ± .09	8.49 Range (7.86- 8.88)	8.13 Range (7.71-8.55)	8.00 Range (7.70-8.31)
Conductivity (µs/cm	226	5674	> 10,000	> 10,000	> 10,000	> 10,000
Fish Length (cm.)			6.0 ± .30			
Fish Weight (gm.)			2.5 ± .44			
Number Fish/Dilution	5	5	5	5	5	5
Number Dilutions/Conc.	1	1	1	1	1	1
Volume of Dilutions (l.)	20	20	20	20	20	20
LT_{50} (hr.)	-	-	96 (79.3 -116.2)	-	8.99 (7.50-10.77)	3.5 (3.09-3.97)
LC_{50} (Conc. by Vol.)	40.0%					

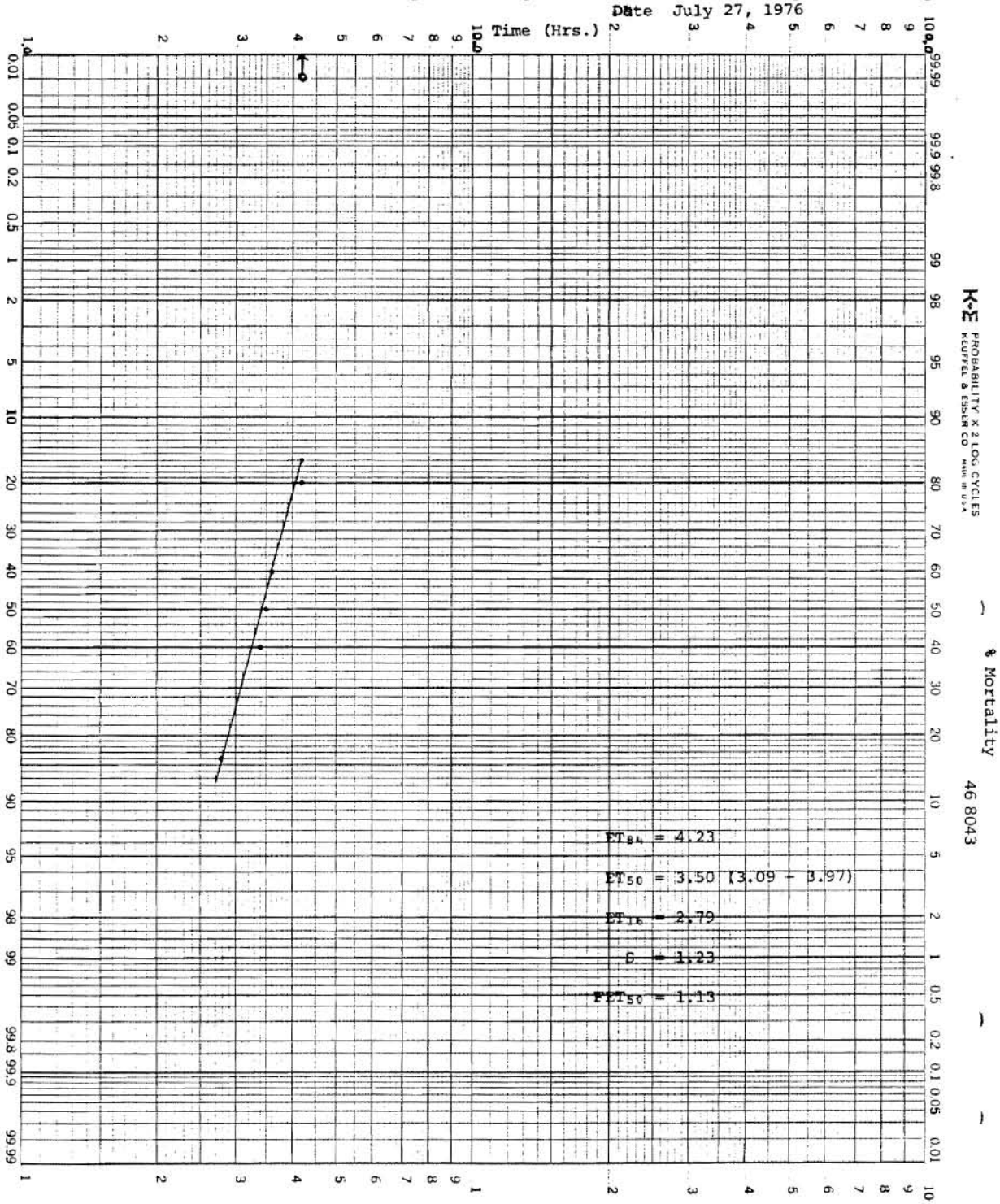
LC_{50} Determination at 15° of Test #2 of Composite Mine Depressurization Water 46 7320

Test Organism - Trout Perch *(Percopsis omiscomaycus)* Date July 27, 1976



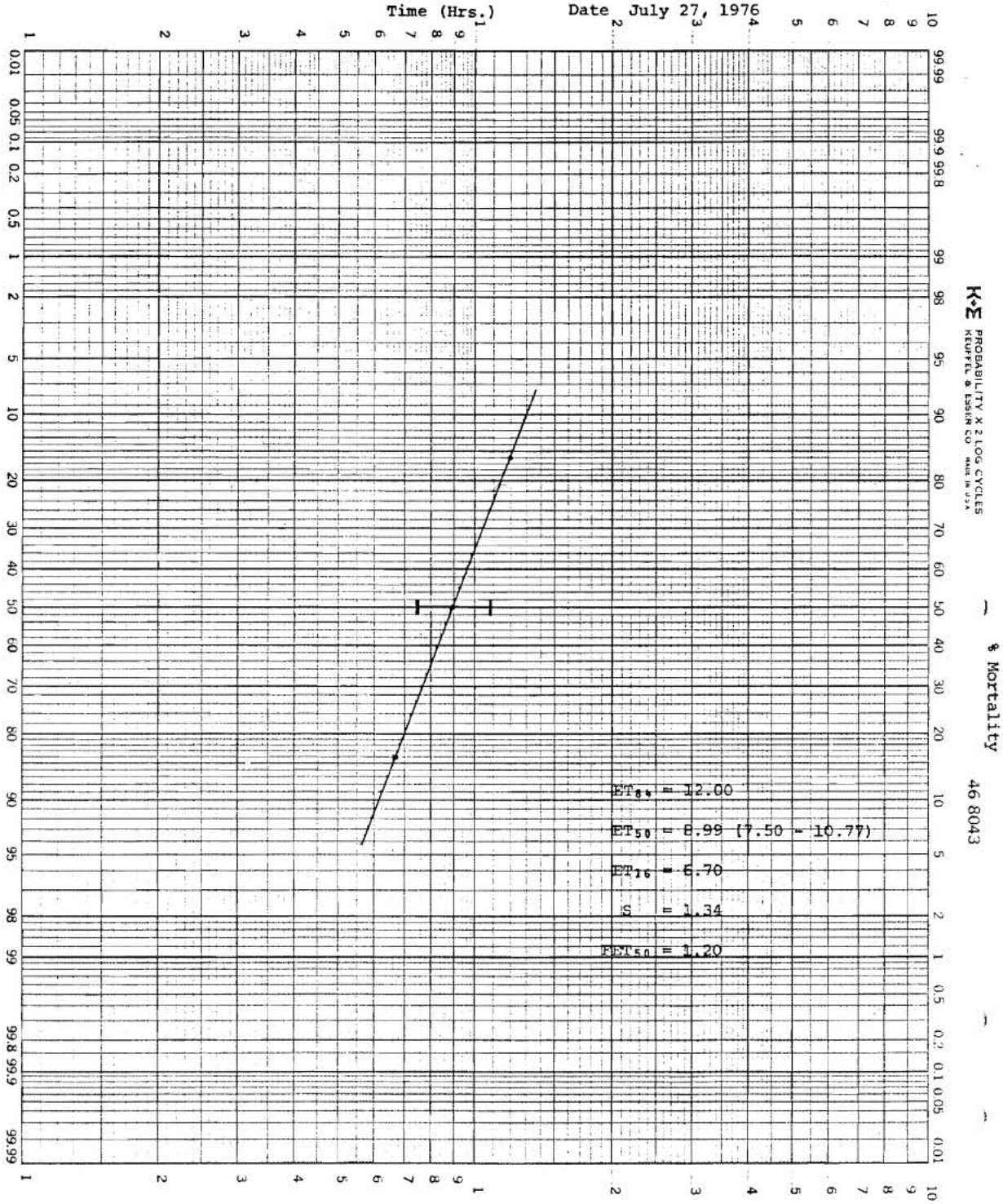
256

100% Conc. Test #2 Composite Mine Depressurization Water
MST (Time vs % Mortality) Test Organism - Trout Perch *(Percopsis omiscomaycus)*
Date July 27, 1976



257

80% Conc. by Volume Test # 2 Composite Mine Depressurization Water
MST (Time vs % Mortality) Test Organism - Trout Perch *(Percopsis omiscomaycus)*
Time (Hrs.) Date July 27, 1976

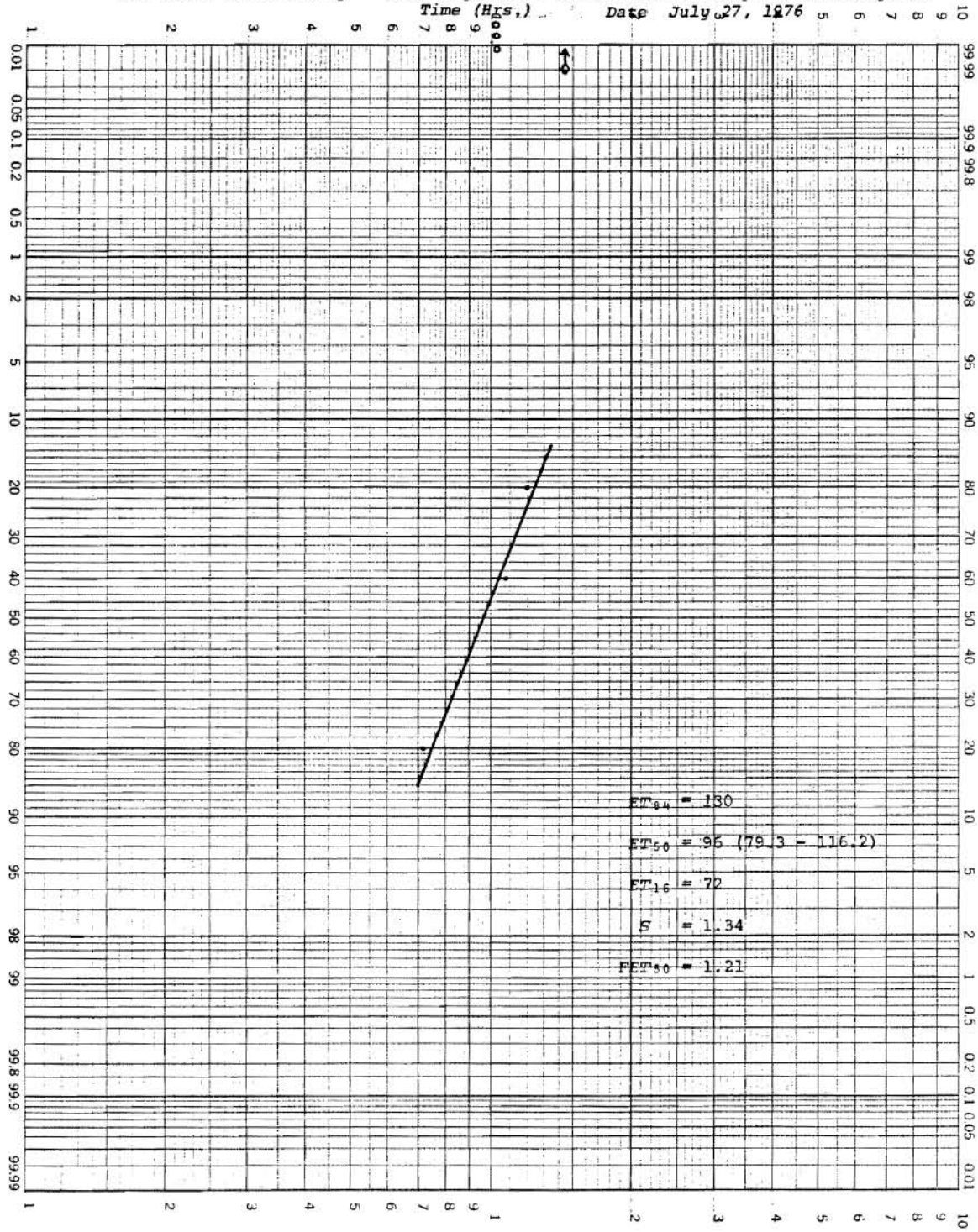


258

40% Conc. Test # 2 Composite Mine Depressurization Water

MST (Time vs mortality Test Organism - Trout Perch *(Percopsis omiscomaycus)*

Time (Hrs.) Date July 27, 1976



LETHAL CONCENTRATION DETERMINATION

COMPOSITE

12 Hrs.

Concentration	N	No. Dead	No. Alive	Accumulated Dead	Accumulated Alive	Total	Cumulative Mortality %
Control	5	0	5	0	20	20	0
20	5	0	5	0	15	15	0
40	5	0	5	0	10	10	0
60	5	0	5	0	5	5	0
80	5	5	0	5	0	5	100%
100	5	5	0	10	0	10	100%

$LC_{50} = 70 \pm 10.1$

LETHAL CONCENTRATION DETERMINATION

COMPOSITE

24 Hrs.

Concentration	N	No. Dead	No. Alive	Accumulated Dead	Accumulated Alive	Total	Cumulative Mortality %
Control	5	0	5	0	17	17	0
20	5	0	5	0	12	12	0
40	5	0	5	0	7	7	0
60	5	3	2	3	2	5	60
80	5	5	0	8	0	8	100
100	5	5	0	13	0	13	100

$LC_{50}=56.7 \pm 14.0$

LETHAL CONCENTRATION DETERMINATION

COMPOSITE

48 Hrs.

Concentration	N	No. Dead	No. Alive	Accumulated Dead	Accumulated Alive	Total	Cumulative Mortality %
Control	5	0	5	0	14	14	
20	5	1	4	1	9	10	10
40	5	0	5	1	5	6	16.7
60	5	5	0	6	0	6	100
80	5	5	0	11	0	11	100
100	5	5	0	16	0	16	100

LC_{50}=48.0 $\pm$ 11.0

LETHAL CONCENTRATION DETERMINATION

COMPOSITE

72 Hrs.

Concentration	N	No. Dead	No. Alive	Accumulated Dead	Accumulated Alive	Total	Cumulative Mortality %
Control	5	0	5	0	13	13	0
20	5	1	4	1	8	9	11.1
40	5	1	4	2	4	6	33.3
60	5	5	0	7	0	7	100
80	5	5	0	12	0	12	100
100	5	5	0	17	0	17	100

LC_{50} = 45 $\pm$ 14.2

LETHAL CONCENTRATION DETERMINATION

COMPOSITE

96 Hrs.

Concentration	N	No. Dead	No. Alive	Accumulated Dead	Accumulated Alive	Total	Cumulative Mortality %
Control	5	0	5	0	13	13	0
20	5	1	4	1	8	9	11.1
40	5	1	4	2	4	6	33.3
60	5	5	0	7	0	7	100
80	5	5	0	12	0	12	100
100	5	5	0	17	0	17	100

$LC_{50} = 45 \pm 14.2$

LETHAL CONCENTRATION DETERMINATION

COMPOSITE

120 Hrs.

Concentration	N	No. Dead	No. Alive	Accumulated Dead	Accumulated Alive	Total	Cumulative Mortality %
Control	5	0	5	0	10	10	0
20	5	1	4	1	5	6	16.7
40	5	4	1	5	1	6	83.3
60	5	5	0	10	0	10	100
80	5	5	0	15	0	15	100
100	5	5	0	20	0	20	100

$LC_{50} = 30 \pm 12.3$

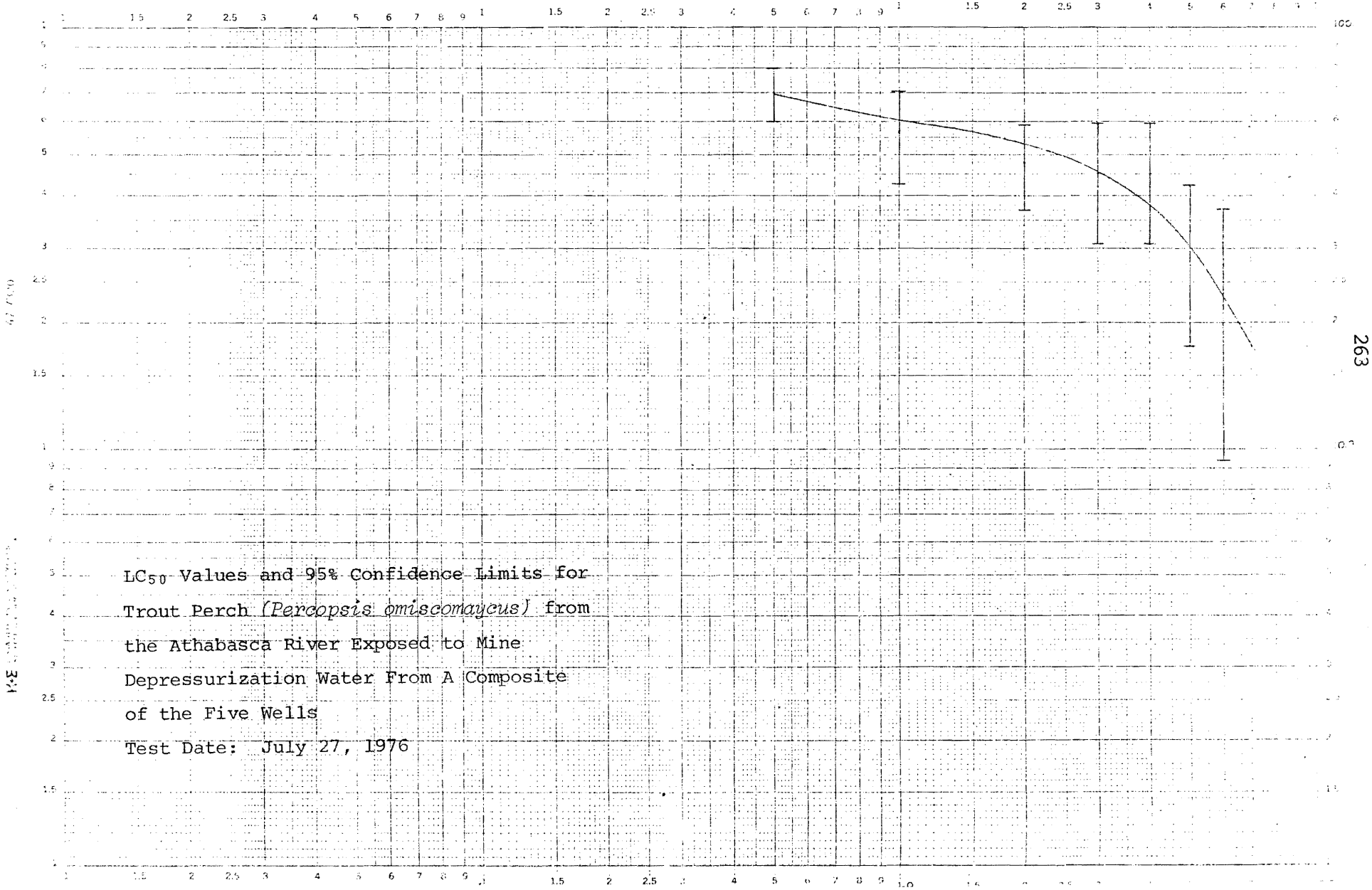
LETHAL CONCENTRATION DETERMINATION

COMPOSITE

144 Hrs.

Concentration	N	No. Dead	No. Alive	Accumulated Dead	Accumulated Alive	Total	Cumulative Mortality %
Control	5	0	5	0	8	8	0
20	5	2	3	2	3	5	40
40	5	5	0	7	0	7	100
60	5	5	0	12	0	12	100
80	5	5	0	17	0	17	100
100	5	5	0	22	0	22	100

$LC_{50} = 23.3 \pm 13.9$



LC_{50} Values and 95% Confidence Limits for Trout Perch *(Percopsis omiscomaycus)* from the Athabasca River Exposed to Mine Depressurization Water From A Composite of the Five Wells

Test Date: July 27, 1976

6.3 TEST NO. 7 BIOASSAY Data, 20 SEPTEMBER 1976

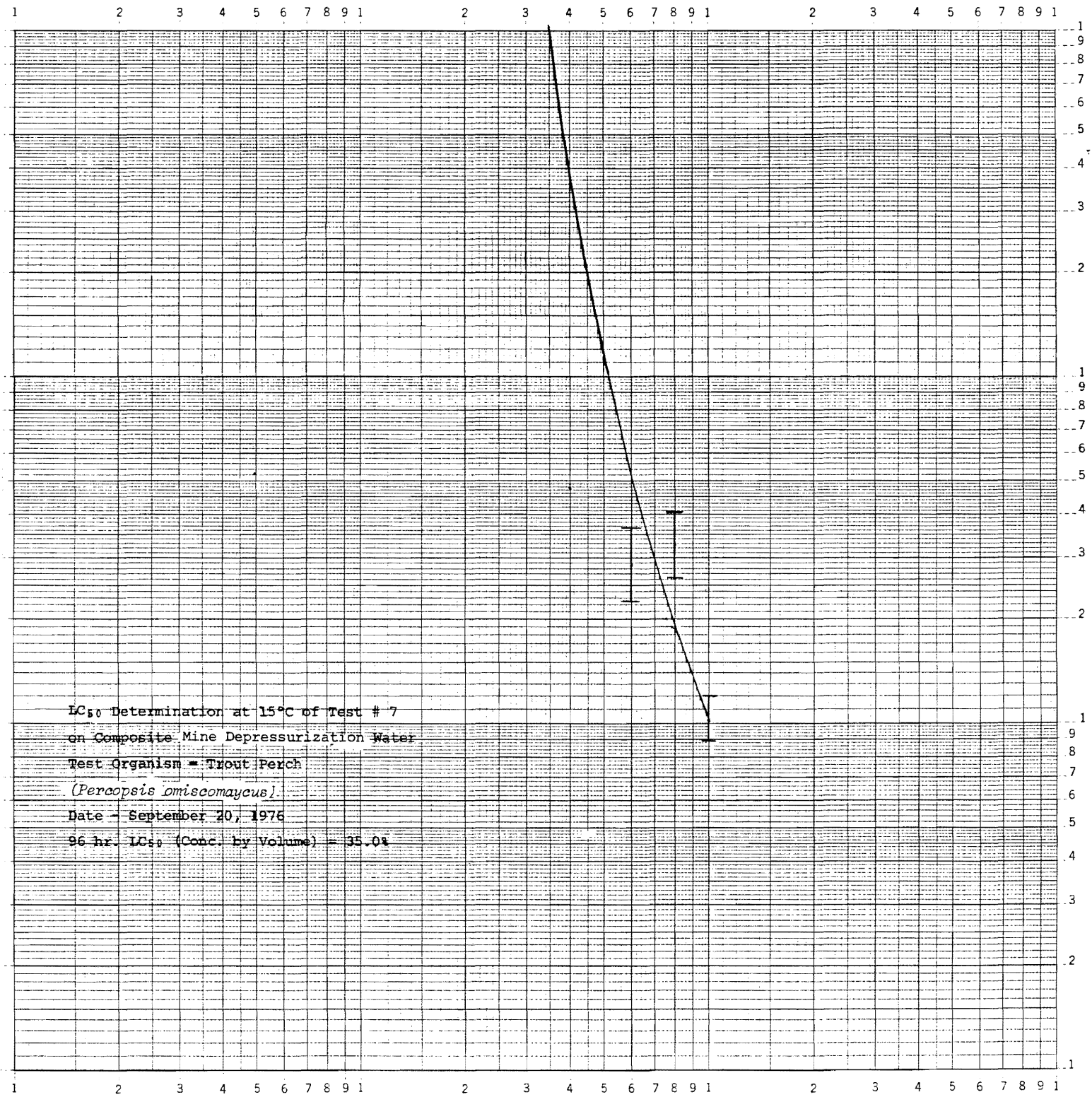
Data presented here include:

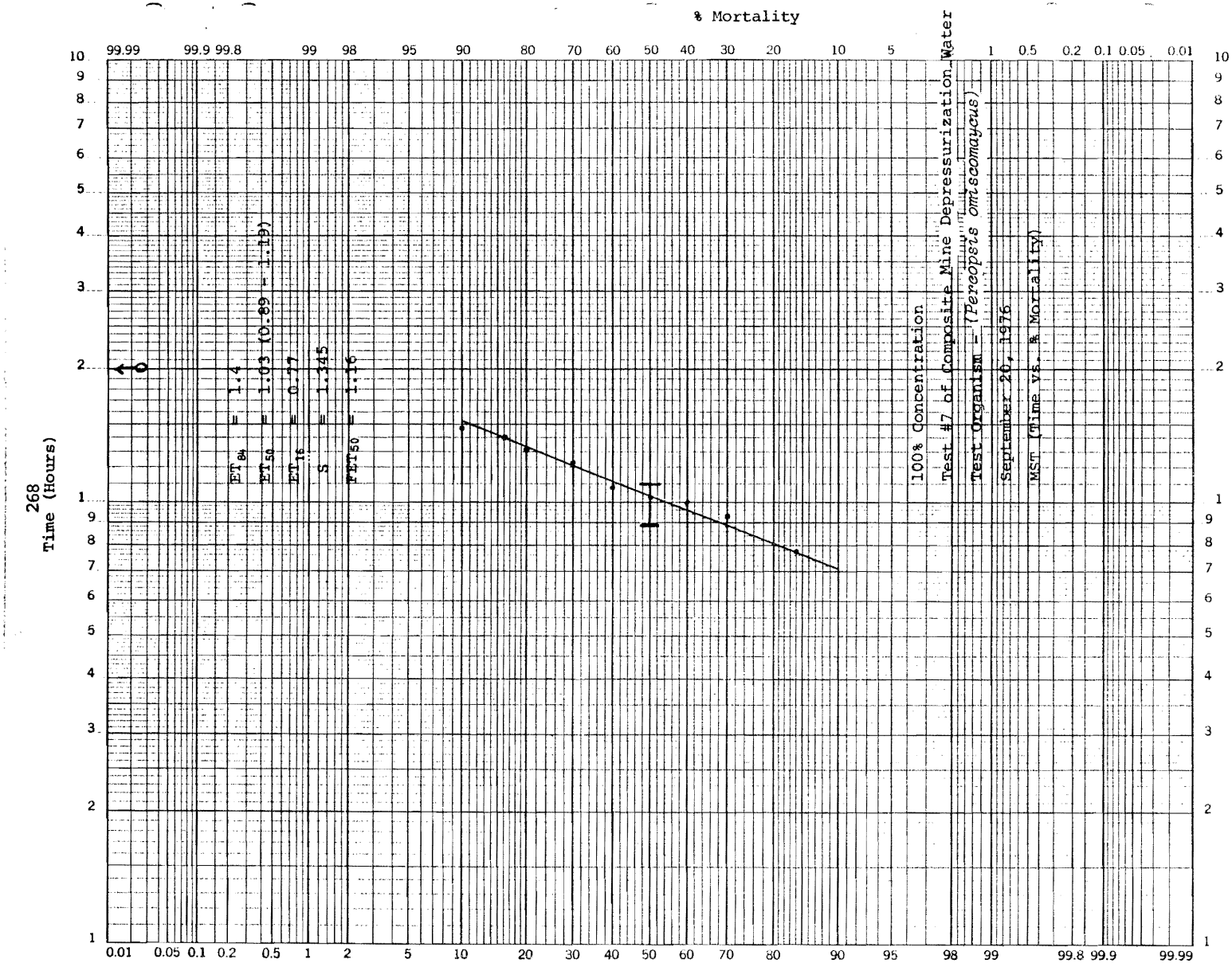
1. cumulative mortality of Trout-perch (*Percopsis omiscomaycus*);
2. graphical determination of LC_{50} and MST's (Litchfield 1949); and
3. lethal concentration determination (Woolf 1968).

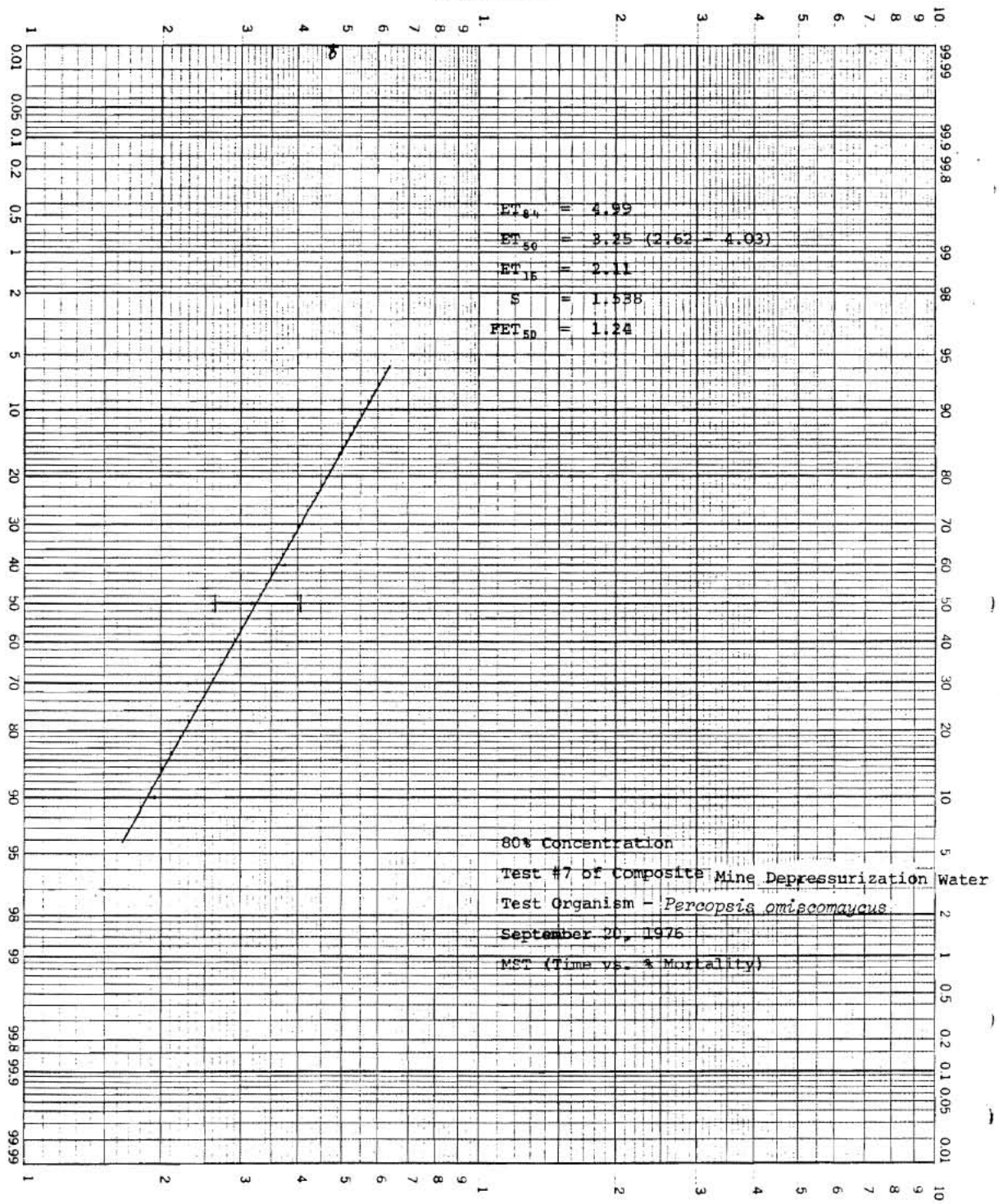
TEST # 7 COMPOSITE MINE DEPRESSURIZATION WATER SEMI STATIC REPLACEMENT TEST DATE SEPTEMBER 20/76

CONCENTRATIONS (MEAN & RANGE)

PARAMETERS	CONTROL 5 readings	20% 5 readings	40% 5 readings	60% 2 readings	80% 2 readings	100% 2 readings
Temperature (°C)	13.8 ± 1.21	13.8 ± 1.28	13.9 ± .56	14.0 No Range	14.0 No Range	14.0 No Range
Dissolved Oxygen (mg/l)	9.9 ± .11	9.8 ± .11	9.8 ± .16	9.6 No Range	9.5 Range (9.5-9.6)	9.5 Range (9.5-9.6)
pH	8.25 ± .00	8.69 ± .15	8.81 ± .14	8.91 Range (8.88-8.94)	8.57 No Range	8.66 Range (8.65-8.67)
Conductivity (µs/cm)	186	5329	9793	> 10,000	> 10,000	> 10,000
Fish Length (cm.)			4.37 ± .23			
Fish Weight (gm.)			.8 ± .10			
Number Fish/Dilution	5	5	5	5	5	5
Number Dilutions/Conc.	2	2	2	2	2	2
Volume of Dilutions (1.)	20	20	20	20	20	20
LT_{50} (hrs.)			4.78	2.86 (2.25-3.63)	3.25 (2.62-4.03)	1.03 (0.89-1.19)
LC_{50} (Conc. by Vol.)	35.0%					

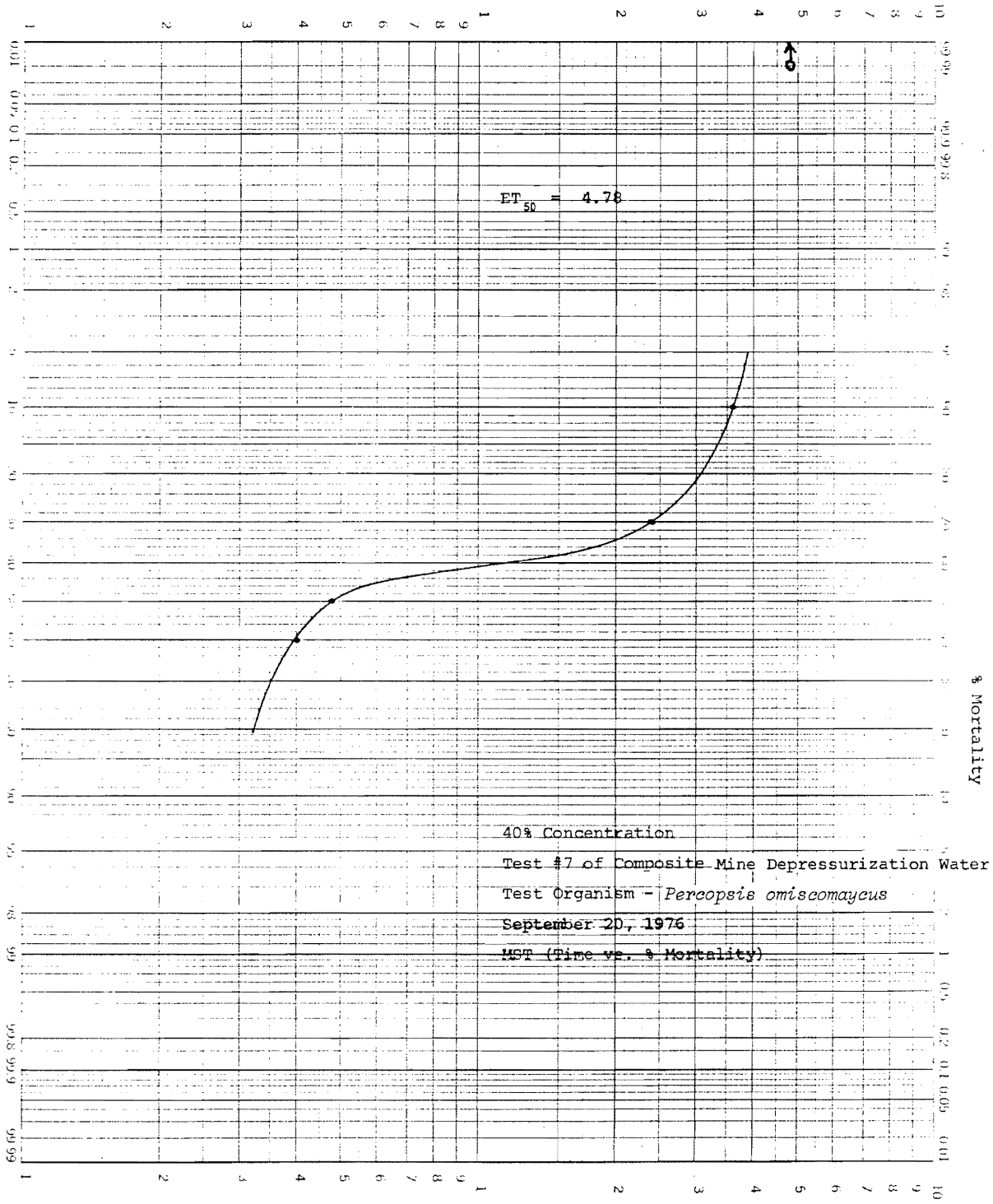



% Mortality
99.99 99.9 99.8 99 98 95 90 80 70 60 50 40 30 20 10 5 2 1 0.5 0.2 0.1 0.05 0.01
10 9 8 7 6 5 4 3 2 1
0.01 0.05 0.1 0.2 0.5 1 2 5 10 20 30 40 50 60 70 80 90 95 98 99 99.8 99.9 99.99
268
Time (Hours)
ET84 = 1.4
ET50 = 1.03 (0.89 - 1.19)
ET16 = 0.77
S = 1.345
PET50 = 1.16
100% Concentration
Test #7 of Composite Mine Depressurization Water
Test Organism - (Pteronarcys Pteronarcys)
September 20, 1976
MST (Time vs. % Mortality)


Time (Hours)
ET_{84} = 4.99
ET_{50} = 3.25 (2.62 - 4.03)
ET_{16} = 2.11
S = 1.538
FET_{50} = 1.24
80% Concentration
Test #7 of Composite Mine Depressurization Water
Test Organism - *Percopsis omiscomaycus*
September 20, 1976
MST (Time vs. % Mortality)

270

Time (Hours)


Time (Hours)
% Mortality
ET_{50} = 4.78
40% Concentration
Test #7 of Composite Mine Depressurization Water
Test Organism - *Percopsis omiscomaycus*
September 20, 1976
MOT (Time vs. % Mortality)

LETHAL CONCENTRATION DETERMINATION

COMPOSITE

2 Hrs.

Concentration	N	No. Dead	No. Alive	Accumulated Dead	Accumulated Alive	Total	Cumulative Mortality %
Control	10	0	10	0	89	89	0
15	10	0	10	0	79	79	0
20	10	0	10	0	69	69	0
25	10	0	10	0	59	59	0
30	10	0	10	0	49	49	0
35	10	0	10	0	39	39	0
40	10	0	10	0	29	29	0
60	10	0	10	0	19	19	0
80	10	1	9	1	9	10	10
100	10	10	0	11	0	11	100

$LC_{50} = 88.9 \pm 7.5$

LETHAL CONCENTRATION DETERMINATION

COMPOSITE

12 Hrs.

Concentration	N	No. Dead	No. Alive	Accumulated Dead	Accumulated Alive	Total	Cumulative Mortality %
Control	10	0	10	0	60	60	0
15	10	0	10	0	50	50	0
20	10	0	10	0	40	40	0
25	10	1	9	1	30	31	3.2
30	10	0	10	1	21	22	4.5
35	10	4	6	5	11	16	31.2
40	10	5	5	10	5	15	66.7
60	10	10	0	20	0	20	100
80	10	10	0	30	0	30	100
100	10	10	0	40	0	40	100

$LC_{50} = 37.7 \pm 6.1$

LETHAL CONCENTRATION DETERMINATION

COMPOSITE

24 Hrs.

Concentration	N	No. Dead	No. Alive	Accumulated Dead	Accumulated Alive	Total	Cumulative Mortality %
Control	10	0	10	0	54	54	0
15	10	0	10	0	44	44	0
20	10	1	9	1	34	35	2.9
25	10	1	9	2	25	27	7.4
30	10	0	10	2	16	18	11.1
35	10	7	3	9	6	15	60
40	10	7	3	16	3	19	84.2
60	10	10	0	26	0	26	100
80	10	10	0	36	0	36	100
100	10	10	0	46	0	46	100

$LC_{50} = 34.0 \pm 5.8$

LETHAL CONCENTRATION DETERMINATION

COMPOSITE

48 Hrs.

Concentration	N	No. Dead	No. Alive	Accumulated Dead	Accumulated Alive	Total	Cumulative Mortality %
Control	10	0	10	0	52	52	0
15	10	0	10	0	42	42	0
20	10	1	9	1	32	32	3.1
25	10	1	9	2	20	22	9.1
30	10	0	10	2	13	15	13.3
35	10	7	3	9	3	12	75
40	10	10	0	19	0	19	100
60	10	10	0	29	0	29	100
80	10	10	0	39	0	39	100
100	10	10	0	49	0	49	100

$LC_{50} = 33.0 \pm 4.5$

LETHAL CONCENTRATION DETERMINATION

COMPOSITE

72 Hrs.

Concentration	N	No. Dead	No. Alive	Accumulated Dead	Accumulated Alive	Total	Cumulative Mortality %
Control	10	0	10	0	49	49	0
15	10	0	10	0	39	39	0
20	10	1	9	1	29	30	3.3
25	10	1	9	2	20	22	9.1
30	10	0	10	2	11	13	15.4
35	10	9	1	11	1	12	91.6
40	10	10	0	21	0	21	100
60	10	10	0	31	0	31	100
80	10	10	0	41	0	41	100
100	10	10	0	51	0	51	100

$LC_{50} = 32.3 \pm 4.1$

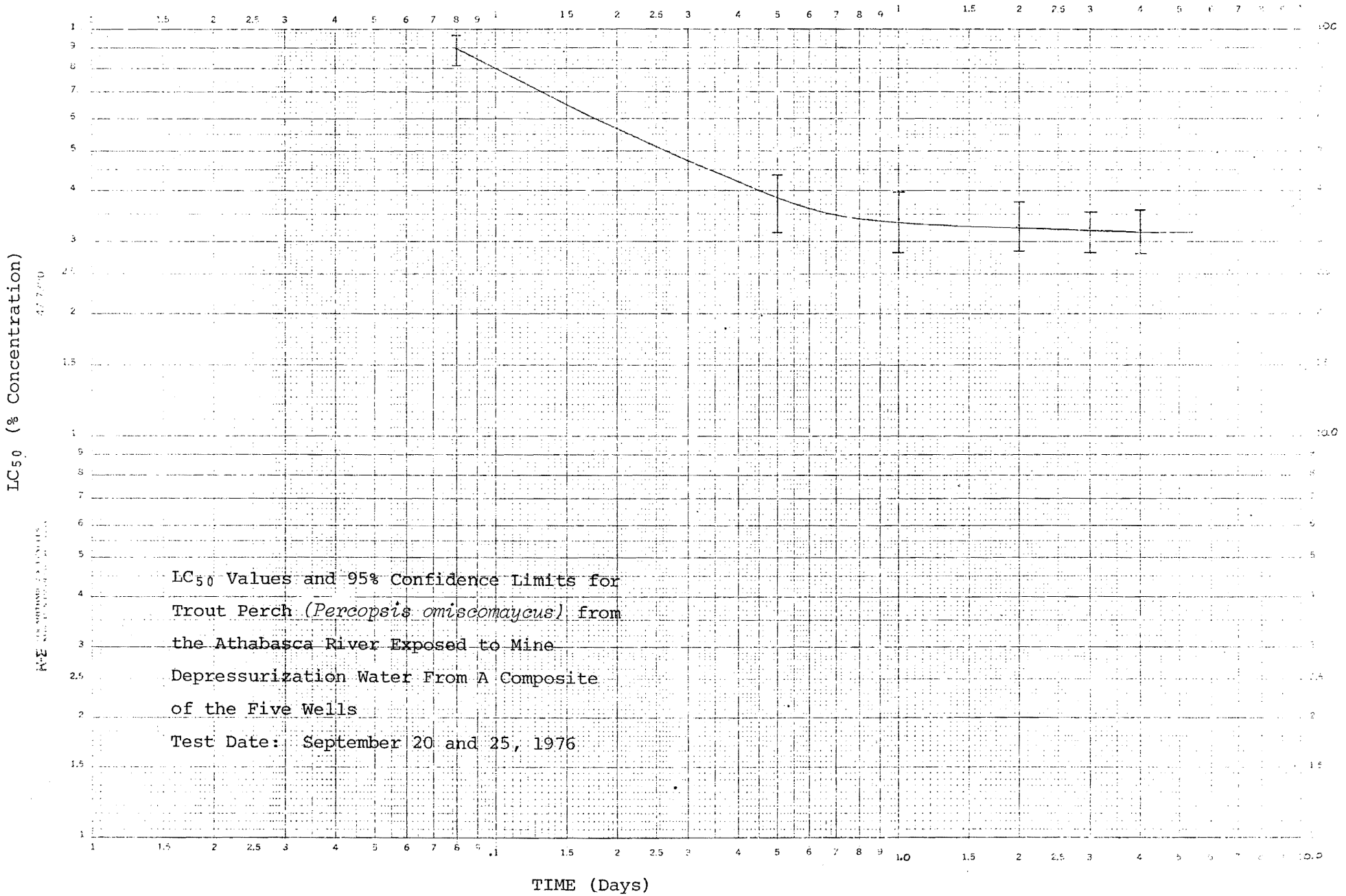
LETHAL CONCENTRATION DETERMINATION

COMPOSITE

96 Hrs.

Concentration	N	No. Dead	No. Alive	Accumulated Dead	Accumulated Alive	Total	Cumulative Mortality %
Control	10	0	10	0	48	48	0
15	10	0	10	0	38	38	0
20	10	1	9	1	28	29	3.4
25	10	1	9	2	19	31	6.5
30	10	0	10	2	10	12	16.7
35	10	10	0	12	0	12	100
40	10	10	0	22	0	22	100
60	10	10	0	32	0	32	100
80	10	10	0	42	0	42	100
100	10	10	0	52	0	52	100

$LC_{50} = 32.0 \pm 3.9$



LC_{50} Values and 95% Confidence Limits for Trout Perch *(Percopsis omiscomaycus)* from the Athabasca River Exposed to Mine Depressurization Water From A Composite of the Five Wells

Test Date: September 20 and 25, 1976

6.4 TEST NO. 8 BIOASSAY DATA, 30 September 1976

Data presented here include:

1. cumulative mortality of Trout-perch (*Percopsis omiscomaycus*); and
2. graphical determination of LC_{50} and MST's (Litchfield 1949).

TEST # 8 COMPOSITE MINE DEPRESSURIZATION WATER SEMI STATIC REPLACEMENT TEST DATE SEPTEMBER 30/76

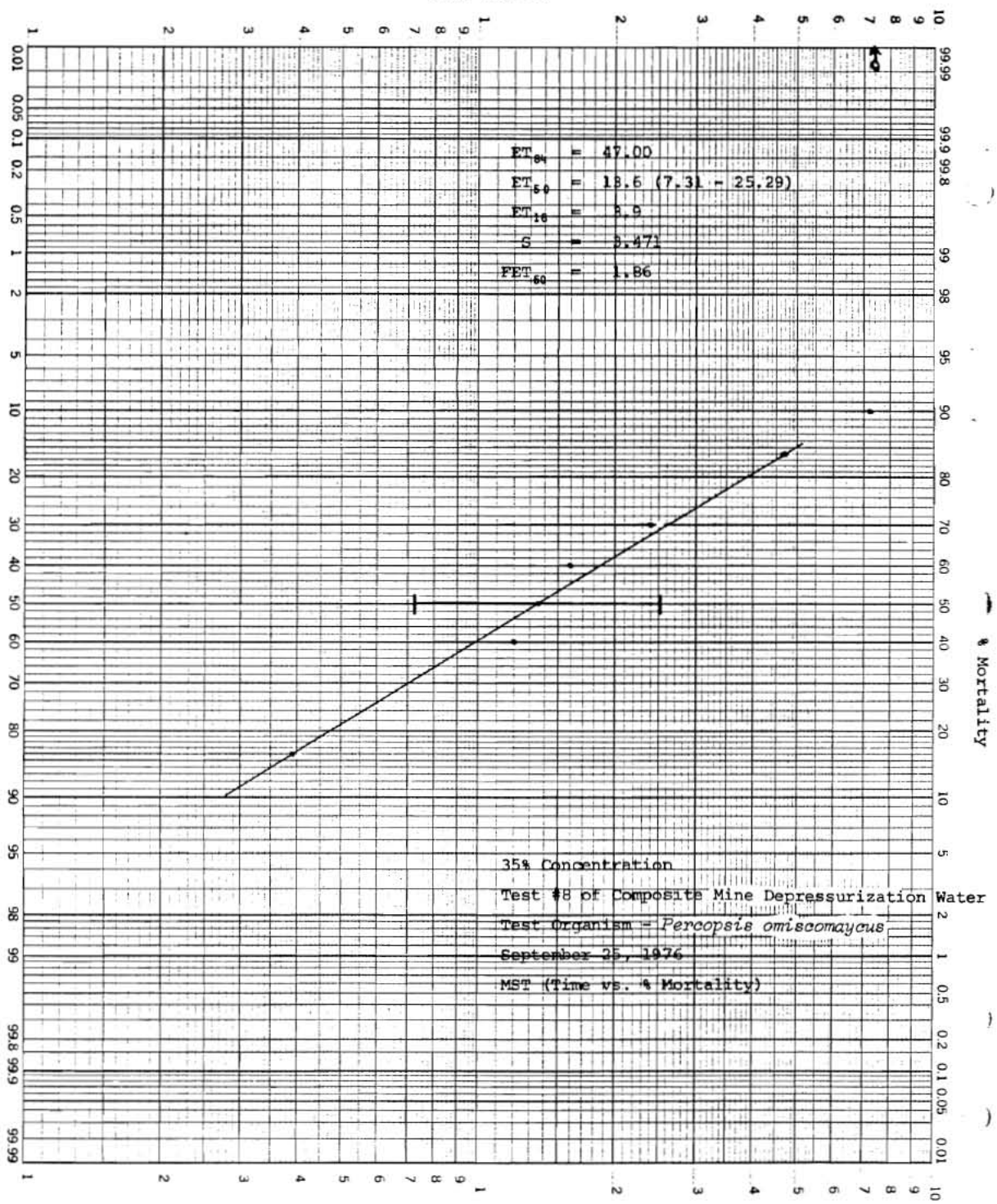
CONCENTRATIONS (MEAN & RANGE)

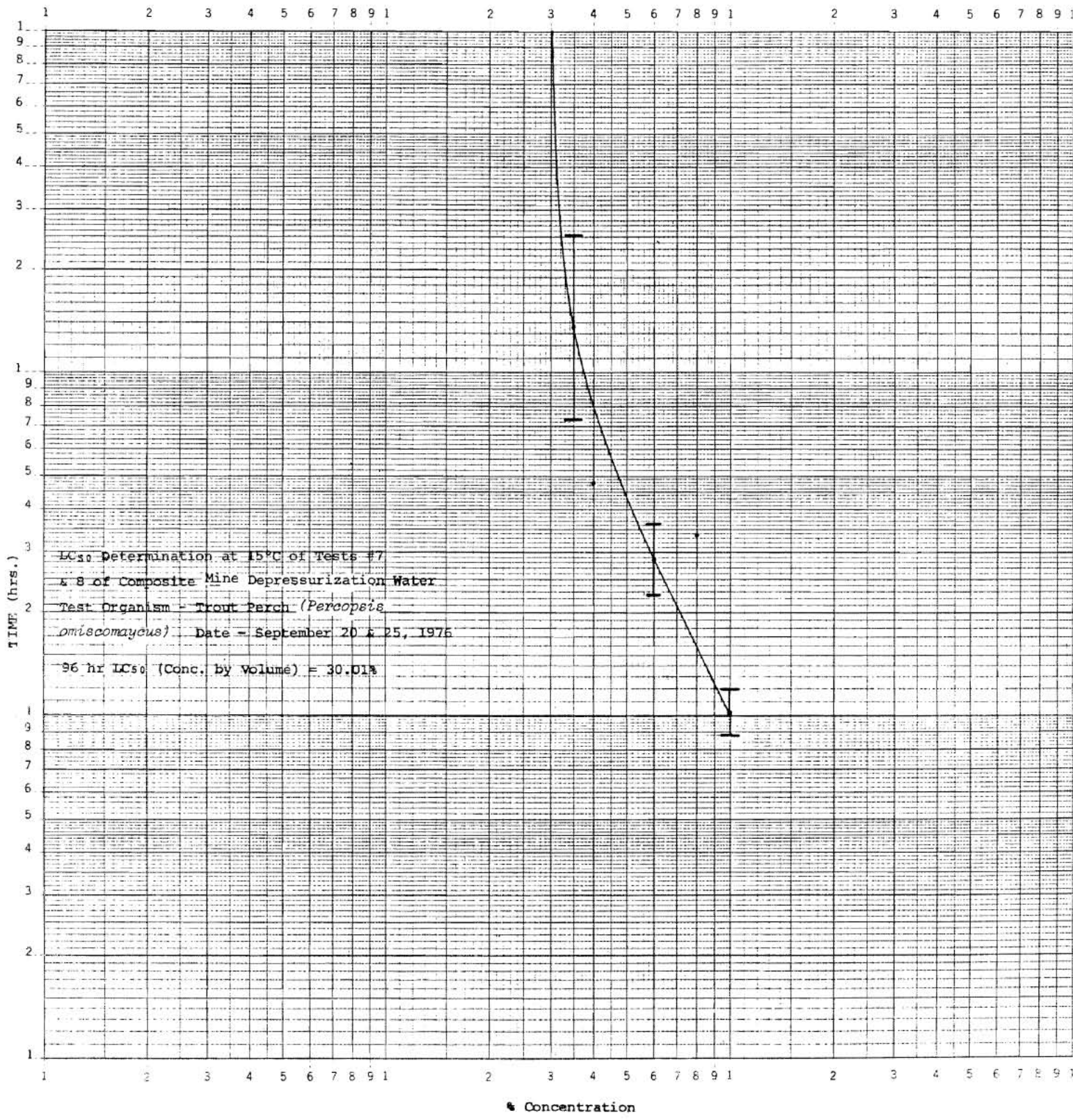
PARAMETERS	CONTROL	15%	20%	25%	30%	35%
Temperature (°C)	14.8 ± .98	14.9 ± .55	14.9 ± .55	14.9 ± .55	14.9 ± .55	14.7 ± .57
Dissolved Oxygen (mg/l)	9.4 ± .22	9.5 ± .17	9.4 ± .14	9.2 ± .28	8.8 ± .35	9.3 ± .16
pH	8.26 ± .01	8.56 ± .12	8.20 ± .11	8.34 ± .10	8.02 ± .03	8.62 ± .19
Conductivity (µs/cm)	227	4117	5371	6446	7562	8495
Fish Length (cm.)			4.3 ± .13			
Fish Weight (gm)			.68 ± .07			
Number Fish/Dilution	5	5	5	5 & 4	5	5
Number Dilutions/Conc.	2	2	2	2	2	2
Volume of Dilutions (l)	20	20	20	20	20	20
LT_{50} (Hrs.)						13.6 (7.31-25.29)
LC_{50} (Conc. by Vol.)	$30 < LC_{50} < 35$					

CUMULATIVE MORTALITY OF TROUT PERCH (*Percopsis omsicomaycus*)

TEST #8 - COMPOSITE

Concentration Mine Depressurization Water (% by volume)	TIME (Hrs.) 0.0	0.25	0.50	1.00	2.00	4.00	8.00	12.00	16.00	24.00	36.00	48.00	60.00	72.00	73.83	84.00	96.00	Total % Mortality (96 hrs.)
Control																		
N = 10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
% mortality	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15																		
N = 10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
% mortality	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20																		
N = 10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
% mortality	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25																		
N = 10	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	
% mortality	0	0	0	0	0	0	10	10	10	10	10	10	10	10	10	10	10	10
30																		
N = 10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
% mortality	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
35																		
N = 10	0	0	0	0	0	0	0	4	6	7	7	7	7	9	10			
% mortality	0	0	0	0	0	0	0	40	60	70	70	70	70	90	100			100


Time (Hours)
% Mortality
ET_{84} = 47.00
ET_{50} = 18.6 (7.31 - 25.29)
ET_{16} = 3.9
S = 0.471
FET_{60} = 1.86
35% Concentration
Test #8 of Composite Mine Depressurization Water
Test Organism = *Percopsis omiscomaycus*
September 25, 1976
MST (Time vs. % Mortality)



6.5 CHEMISTRY DATA (JULY TO NOVEMBER 1976)

Data presented here include summary of chemistry analysis of mine depressurization water collected from Syncrude's Lease 17 and compared to analysis of Athabasca River water.

CHEMICAL DATA COMPOSITE

PARAMETERS	POLLUTION CONTROL LAB NAQUADAT CODE	DETECTION LIMIT	SAMPLE DATES 1976 JULY 08	15	CHEMEX LABS (ALTA) LTD. NAQUADAT CODE	DETECTION LIMIT	JULY 27	SEPTEMBER 15	28**	OCTOBER 19	NOVEMBER 01(a)	01(b)	19(a)	19(b)	MEAN	RANGE Low - High
Conductivity	02041L	0.2	26000	24500	02041L	1.0	32000	29500	24500	26000	27000	27000	24000	24000	26450	24000 - 32000
Odor	02001L	0.0		10.0	02001L	1.0	16	8	4	16	8	8	4	16	10	4 - 16
Color	02011L	1.0	97	98	02011L	1.0	5*	5*	5*	5*	5*	5*	5*	5*	23.5	5* - 98
Color T_2	02011L	1.0	98	99											98.5	98 - 99
Color T_3	02011L	1.0	96	97											96.5	96 - 97
Tanin & Lignin	06551L	0.1	0.3	0.1*	06551L	0.1	0.06	0.35	0.4	0.5	0.1*	0.1*	0.1*	0.1*	0.21	0.1* - 0.35
T.R.	10471L	10.0	16142	15796											15969	15796 - 16142
T.F.R.	10571L	10.0	15680		10451L	1.0	16060	15000	14600	14700	14535	14670	14320	14500	14896.1	14320 - 16060
T.F.R.F.					10551L	1.0	15480	14180	14130	14235	13995	14050	14140	14240	14306.25	13995 - 15480
T.N.F.R.					10401L	1.0	10.8	125.6	8.4	20.4	14.8	0.4*	0.4*	1.2	22.75	0.4* - 125.6
T.N.F.R.F.					10510L	1.0	7.6	113.6	5.2	11.6	11	0.4*	0.4*	0.4*	18.78	0.4* - 113.6
Turbidity	02073L	0.0		6.0	02073L	0.0	8.2						0.1*	1.2	3.88	0.1* - 8.2
Surfactants	10701L	0.05	1.58	1.71	10701L	0.02	0.02	0.14	0.02*	0.02*	0.02*	0.02*	0.02*	0.02*	0.36	0.02* - 1.71
Humic Acids					00000L	2.0	2.0*	1.0*	1.0*	1.0*	1.0*	1.0*	1.0*	1.0*	1.125*	
T.O.C.	06001L	2.0	301	21.0	06001L	1.0	30	40	10	50	50	50	20	5	57.69	5 - 301
T.I.O.C.	06051L	2.0	546	303	06501L	0.5	680	540	520	250	425	425	470	530	468.9	250 - 680
Nitrite	07205L	0.1	0.1*											0.1*	0.1*	

CHEMICAL DATA COMPOSITE

PARAMETERS	POLLUTION CONTROL LAB NAQUADAT CODE	DETECTION LIMIT	SAMPLE DATES 1976 JULY 08	15	CHEMEX LABS (ALTA) LTD. NAQUADAT CODE	DETECTION LIMIT	JULY 27	SEPTEMBER 15	28**	OCTOBER 19	NOVEMBER 01(a)	01(b)	19(a)	19(b)	MEAN	RANGE Low - High
NO_2 & NO_3	07105L	0.1	0.1*	0.033	07110L	0.01	0.04	0.04	0.02	0.01	0.01	0.01	0.01	0.01	0.03	0.01 - 0.04
NH_3	07555L	0.05	10.55	10.47	07506L	0.005	7.3	5.4	9.2	7.8	8	8.1	9.2	9.3	8.53	5.5 - 10.55
Nitrogen Tk	07003L	0.05	10.30	10.81	07013L	0.3	11.7	14	10.9	10.5	9.05	8.95	9.8	9.85	10.59	8.95 - 11.7
Phosplate T	15407L		0.21	0.2											0.07	0.005* - 0.18
Phosphorus T	15001L	0.05			15406L	0.003	0.005*	0.07	0.18	0.15	0.03	0.04	0.04	0.05	0.205	0.2 - 0.21
Phosphorus O	15256L			0.069	15256L	0.003	0.005*	0.01	0.03	0.04	0.03	0.04	0.04	0.05	0.035	0.005* - 0.069
Phenol	06532L	0.001		0.002	06532L	0.002	0.001*	0.001*	0.001*	0.004	0.019	0.005	0.001*	0.001*	0.004	0.001* - 0.019
Oil & Grease	06521L	1.0		4.6	06521L	0.1	2.3	0.3	0.1*	0.3	0.1*	0.1*	0.8	0.7	1.03	0.1* - 4.6
Sulphide	06101L	0.02		0.02*	16101L	0.05	0.07	0.05*	0.05*	0.05*	0.05*	0.05*	0.05*	0.05*	0.05	0.02* - 0.07
Cyanide	06601L	0.002	0.01*	0.26	00000L	0.1	0.01*	0.01*	0.01*	0.01*	0.01*	0.01*	0.01*	0.01*	0.035	0.01* - 0.35
Hydrocarbon	06500L	0.001	0.18	0.001*	00000L	10.	192		0.01*		0.01*	0.01*	0.01*	0.01*	24.09	0.001* -192
B.O.D.	08201L	0.01		2.0											2.0	
C.O.D.	08301L	5.0	81.9	105.6	08301L	5.0	47.9	366	470	84	98	86	190	194	174.34	47.9 -470
Cadmium	48302L	0.001		0.002	48302L	0.001	0.019	0.001*	0.001*	0.001*	0.001*	0.001*	0.001*	0.001*	0.003	0.001* - 0.019
Chromium+6	24101L	0.002	0.002*	0.002*	24101L	0.003	0.011	0.003*	0.003*	0.003*	0.003*	0.003*	0.003*	0.003*	0.004	0.002* - 0.011
Copper	29305L	0.001		0.006	29306L	0.01	0.019	0.001	0.03	0.003	0.058	0.012	0.006	0.004	0.015	0.001 - 0.58
Iron	26302L	0.05	0.7	0.6	26304L	0.05	0.35	2.15	6.63	2.75	0.7	0.3	0.14	0.14	1.61	0.14 - 6.63
Lead	82302L	0.003		0.003*	82302L	0.002	0.042	0.015	0.003	0.002*	0.002*	0.002*	0.002*	0.002*	0.009	0.002* - 0.042

CHEMICAL DATA COMPOSITE

PARAMETERS	POLLUTION CONTROL LAB NAQUADAT CODE	DETECTION LIMIT	SAMPLE DATES 1976 JULY 08	15	CHEMEX LABS (ALTA) LTD. NAQUADAT CODE	DETECTION LIMIT	JULY 27	SEPTEMBER 15	28**	OCTOBER 19	NOVEMBER 01(a)	01(b)	19(a)	19(b)	MEAN	RANGE Low - High
Manganese	25004L	0.008		0.14	25004L	0.01	0.19	0.181	0.291	0.24	0.21	0.18	0.18	0.18	0.181	0.018 - 0.291
Silver	47303L	0.001			47301L	0.01	0.02	0.005*	0.01	0.005*			0.005*	0.005*	0.009	0.005*- 0.02
Zinc	30305L	0.001		0.001*	30304L	0.01	0.021	0.007	0.058	0.028	0.048	0.019	0.001	0.002	0.02	0.001*- 0.058
Selenium	34102L	0.0002				0.0025	0.0005*	0.0005*	0.0005*	0.0005*	0.0005*	0.0005*	0.0005*	0.0005*	0.0008	0.0005*- 0.0025
Mercury	80003L	0.0001	0.0001*	0.0001*			0.0004	0.0063	0.0002*	0.0024	0.072	0.0001*	0.07	0.0043	0.016	0.0001*- 0.07
Arsenic	33104L	0.0002	0.0002*				0.005*	0.009	0.009	0.001*	01001*	0.001*	0.0015	0.0015	0.003	0.0002*- 0.009
Nickel	28302L	0.001		0.001*			0.15	0.002*	0.006	0.004	0.002*	0.002*	0.002*	0.002*	0.019	0.001* - 0.15
Aluminum	13005L	0.02					0.05*	0.82	0.82	0.23	0.11	0.09	0.08	0.08	0.29	0.05* - 0.82
Cobalt	27302L	0.001		0.002			0.123	0.002*	0.002*	0.002*	0.002*	0.002*	0.002*	0.002*	0.016	0.002*- 0.123
Boron	05102L	0.1					2.21	2.23	2156	2.93	2.82	2.08	1.93	2.32	2.39	1.93 - 2.93
Pesticides	00000L															
T.D.S.	00205L	0.0	16326	15297											15811.5	15297 -16326
P.C.B.'s	00000L	0.0001	0.0001*	0.0001*							0.0006*		0.0006*	0.0006*	0.0004*	
Carbon T	06006L	2.0	847	21.0											434	21.0 - 847
Chromium				1111.0											1111.0	
Vanadium	23301L	0.05					0.02	0.008	0.006	0.001*	0.001*	0.001*	0.001*	0.001*	0.005	0.001*- 0.02

CHEMICAL DATA COMPOSITE

(1) Winnipeg Composite (2) Out Test (3) Our Test - Kananaskis Sample

July 08 Collection date of Winnipeg sample

July 15 Analysis of Winnipeg sample after transport to Winnipeg

July 27 Analysis of our composite collected July 08

September 15 Colection date of composite for Kananaksis sample

September 28 Bioassay sample

October 19 Collection date of Winnipeg sample

November 01(a) Analysis of unfiltered sample after transport to Winnipeg

November 01(b) Analysis of filtered sample

November 19(a) Analysis of unfiltered sample after bioassay

November 19(b) Analysis of filtered sample

Conductivity in microsiemens/cm

Turbidity in J.T.U.

Metals as Totals mg/l

Alkalinity and Hardness expressed as Calcium Carbonate

Nitrite, NO_2 + NO_3, NH_3 expressed as N

Phosphorus T expresses as PO_4

Phosphorus O expressed as P

pH in pH units

* less than

SUMMARY OF CHEMISTRY ANALYSIS OF

MINE DEPRESSURIZATION WATER COLLECTED FROM

SYNCRUDE'S LEASE 17 AND COMPARED TO ANALYSIS

OF ATHABASCA RIVER WATER

COMPOSITE #1

PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	DATE OF BIOASSAY SAMPLE JULY 15/76	WELL PROFILE MEANS AND RANGES L - H	ATHABASCA RIVER JULY 15/76	RIVER PROFILE MEANS AND RANGES L - H
Calcium	20103L	0.002	14.0	48.44 3.4 - 136.0	21.5	31.35 17.5 - 40.0
Magnesium	12102L	0.001	218.0	141.7 108.0 - 233.0	6.3	6.57 4.5 - 10.0
Sodium	11102L	0.5	5600.0	5668.2 5250.0 - 6250.0	6.0	9.29 5.9 - 36.0
Potassium	19102L	0.5	57.5	45.0 36.5 - 57.5	0.7	0.91 0.4 - 1.5
Chloride	17203L	0.5	7821.0	7598.79 7175.0 - 8272.0	4.5	6.11 1.0 - 51.0
Sulphate	16306L	1.0	10.0*	11.49 0.5 - 29.0	2.6	13.8 0.5 - 41.0
Alkalinity T	10101L	1.0	2644.0	2655.0 2160.0 - 4104.0	90.1	86.69 66.8 - 129.0
pH	10301L	0	7.9	8.08 7.5 - 9.1	7.6	7.5 6.8 - 8.3
Carbonate	06301L	1.0		99.0 0.0 - 396.0	0.0	0.0
Bicarbonate	06201L	1.0	3223.0	3075.5 1828.5 - 5002.8	109.8	105.76 81.4 - 158.0
Hardness T	10603L	0.1	934.0	707.3 469.8 - 1300.0	79.6	89.1 63.5 - 138.0
Conductivity	20401L	1.0	24500.0	26450.0 24000.0 - 32000.0	156.0	185.7 132.0 - 270.0
Surfactants	10701L	0.02	1.71	0.36 0.02* - 1.71	0.02	0.03 0.02* - 0.09
T.O.C.	06001L	1.0	21.0	57.69 5.0 - 301.0	16.5	25.82 10.5 - 70.0
T.I.O.C.	06051L	1.0	303.0	468.9 250.0 - 680.0	21.5	19.44 11.0 - 40.0
Phenol	06532L	0.002	0.002	0.004 0.001* - 0.019	0.001*	0.005 0.001* - 0.022

COMPOSITE #1 (Continued)

PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	DATE OF BIOASSAY SAMPLE JULY 15/76	WELL PROFILE MEANS AND RANGES L - H	ATHABASCA RIVER JULY 15/76	RIVER PROFILE MEANS AND RANGES L - H
Oil & Grease	06521L	0.1	4.6	1.03 0.1* - 4.6	0.1*	0.56 0.1* - 5.0
Sulphide	16101L	0.05	0.02*	0.05 0.02* - 0.07	0.05*	0.05*
Cyanide	00000L	0.1	0.26	0.035 0.01* - 0.26	0.01*	0.01*
Hydrocarbon T	00000L	1.0	0.001*	24.09 0.001* - 192.0	1.0*	0.9 0.001* - 2.0
C.O.D.	08301L	5.0	105.6	172.34 47.9 - 470.0	45.8	86.83 37.0 - 267.0
Cadmium	48302L	0.001	0.002	0.003 0.001* - 0.019	0.001*	0.002 0.001* - 0.019
Chromium $^{+6}$	24101L	0.003	0.002*	0.004 0.002* - 0.011	0.003*	0.004 0.002* - 0.018
Copper	29306L	0.01	0.006	0.015 0.001 - 0.58	0.014	0.019 0.002 - 0.059
Iron	26304L	0.05	0.6	1.61 0.14 - 6.63	2.30	7.26 0.9 - 63.0
Lead	82302L	0.002	0.003*	0.009 0.002* - 0.042	0.002	0.0056 0.002* - 0.026
Manganese	25304L	0.01	0.14	0.181 0.018 - 0.291	0.11	0.24 0.056 - 1.7
Silver	47301L	0.01		0.009 0.005* - 0.02	0.005*	0.005*
Zinc	30304L	0.01	0.001*	0.02 0.001* - 0.058	0.02	0.053 0.014 - 0.069
Vanadium	23301L	0.02		0.005 0.001* - 0.02	0.01*	0.004 0.001* - 0.014
Selenium	34302L	0.00015		0.0008 0.0005* - 0.0025	0.002*	0.0012 0.0005* - 0.0018
Mercury	80011L	0.0002	0.0001*	0.016 0.0001* - 0.07	0.0002*	0.0067 0.0001* - 0.0044
Arsenic	33004L	0.001		0.003 0.0002* - 0.009	0.02	0.0065 0.0025* - 0.02
Nickel	28302L	0.002	0.001*	0.019 0.001* - 0.15	0.01	0.014 0.002* - 0.08
Aluminum	13302L	0.5		0.29 0.5* - 0.82	1.21	2.1 0.43 - 10.6

COMPOSITE #1 (Continued)

PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	DATE OF BIOASSAY SAMPLE JULY 15/76	WELL PROFILE MEANS AND RANGES L - H	ATHABASCA RIVER JULY 15/76	RIVER PROFILE MEANS AND RANGES L - H
Cobalt	27302L	0.002	0.002	0.016 0.002* - 0.123	0.002*	0.005 0.002* - 0.043
Boron	05105L	0.05		2.39 1.93 - 2.93	0.10	0.2 0.01 - 1.51
Carbon T			21.0	434.0 21.0 - 847.0		44.5 41.0 - 48.0

Conductivity in microsiemens/cm

Turbidity in J.T.U.

Metals as Totals mg/l

Alkalinity and Hardness expressed as Calcium Carbonate

Nitrite, NO_2 + NO_3, NH expressed as N

Phosphorus T expressed as PO_4

Phosphorus O expressed as P

pH in pH units

* less than

Analysis by Chemex Labs (Alberta) Ltd.

SUMMARY OF CHEMISTRY ANALYSIS OF

MINE DEPRESSURIZATION WATER COLLECTED FROM

SYNCRUDE'S LEASE 17 AND COMPARED TO ANALYSIS

OF ATHABASCA RIVER WATER

COMPOSITE #2

PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	DATE OF BIOASSAY SAMPLE JULY 27/76	WELL PROFILE MEANS AND RANGES L - H	ATHABASCA RIVER JULY 27/76	RIVER PROFILE MEANS AND RANGES L - H
Calcium	20103L	0.002	11.0	48.44 3.4 - 136.0	22.0	31.35 17.5 - 40.0
Magnesium	12102L	0.001	160.0	141.7 108.0 - 233.0	6.5	6.57 4.5 - 10.0
Sodium	11102L	0.5	6250.0	5668.2 5250.0 - 6250.0	6.0	9.29 5.9 - 36.0
Potassium	19102L	0.5	40.0	45.0 36.5 - 57.5	1.0	0.91 0.4 - 1.5
Chloride	17203L	0.5	7650.0	7598.79 7175.0 - 8272.0	2.5	6.11 1.0 - 51.0
Sulphate	16306L	1.0	0.5	11.49 0.5 - 29.0	12.2	13.8 0.5 - 41.0
Alkalinity T	10101L	1.0	4104.0	2655.0 2160.0 - 4104.0	87.6	86.69 66.8 - 129.0
pH	10301L	0	7.6	8.08 7.5 - 9.1	7.3	7.5 6.8 - 8.3
Carbonate	06301L	1.0	0.0	99.0 0.0 - 396.0	0.0	0.0
Bicarbonate	06201L	1.0	5002.8	3075.5 1828.5 - 5002.8	106.8	105.76 81.4 - 158.0
Hardness T	10603L	0.1	686.2	707.3 469.8 - 1300.0	81.7	89.1 63.5 - 138.0
Conductivity	20401L	1.0	32000.0	26450.0 24000.0 - 32000.0	175.0	185.7 132.0 - 270.0
Surfactants	10701L	0.02	0.02	0.36 0.02* - 1.71	0.02*	0.03 0.02* - 0.09
T.O.C.	06001L	1.0	30.0	57.69 5.0 - 301.0	13.5	25.82 10.5 - 70.0
T.I.O.C.	06051L	1.0	680.0	468.9 250.0 - 680.0	18.5	19.44 11.0 - 40.0
Phenol	06532L	0.002	0.001*	0.004 0.001* - 0.019	0.001*	0.005 0.001* - 0.022

COMPOSITE #2 (Continued)

PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	DATE OF BIOASSAY SAMPLE JULY 27/76	WELL PROFILE MEANS AND RANGES L - H	ATHABASCA RIVER JULY 27/76	RIVER PROFILE MEANS AND RANGES L - H
Oil & Grease	06521L	0.1	2.3	1.03 0.1* - 4.6	0.1*	0.56 0.1* - 5.0
Sulphide	16101L	0.05	0.07	0.05 0.02* - 0.07	0.05*	0.05*
Cyanide	00000L	0.1	0.01*	0.035 0.01* - 0.26	0.01*	0.01*
Hydrocarbon T	00000L	1.0	192.0	24.09 0.001* - 192.0	5.0*	0.9 0.001* - 2.0
C.O.D.	08301L	5.0	47.9	172.34 47.9 - 470.0	47.3	86.83 37.0 - 267.0
Cadmium	48302L	0.001	0.019	0.003 0.001* - 0.019	0.001*	0.002 0.001* - 0.019
Chromium $^{+6}$	24101L	0.003	0.011	0.004 0.002* - 0.011	0.003*	0.004 0.002* - 0.018
Copper	29306L	0.01	0.019	0.015 0.001 - 0.58	0.053	0.019 0.002* - 0.059
Iron	26304L	0.05	0.35	1.61 0.41 - 6.63	2.70	7.26 0.9 - 63.0
Lead	82302L	0.002	0.042	0.009 0.002* - 0.042	0.003	0.0056 0.002* - 0.026
Manganese	25304L	0.01	0.19	0.181 0.018 - 0.291	0.09	0.24 0.056 - 1.7
Silver	47301L	0.01	0.02	0.009 0.005* - 0.02	0.005*	0.005*
Zinc	30304L	0.01	0.021	0.02 0.001* - 0.058	0.039	0.053 0.014 - 0.069
Vanadium	23301L	0.02	0.02	0.005 0.001* - 0.002	0.01*	0.004 0.001* - 0.014
Selenium	34302L	0.00015	0.0025	0.0008 0.0005* - 0.0025	0.002*	0.0012 0.0005* - 0.0018
Mercury	80011L	0.0002	0.0004	0.016 0.0001* - 0.07	0.0002*	0.0067 0.0001* - 0.0044
Arsenic	33004L	0.001	0.005*	0.003 0.0002* - 0.009	0.005*	0.0065 0.0025* - 0.02
Nickel	28302L	0.002	0.15	0.019 0.001* - 0.15	0.002*	0.014 0.002* - 0.08
Aluminum	13302L	0.5	0.05*	0.29 0.05* - 0.82	1.22	2.1 0.43 - 10.6

COMPOSITE #2 (Continued)

PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	DATE OF BIOASSAY SAMPLE JULY 27/76	WELL PROFILE MEANS AND RANGES L - H	ATHABASCA RIVER JULY 27/76	RIVER PROFILE MEANS AND RANGES L - H
Cobalt	27302L	0.002	0.123	0.016 0.002* - 0.123	0.002	0.005 0.002* - 0.043
Boron	05105L	0.05	2.21	2.39 1.93 - 2.93	0.04	0.2 0.01 - 1.5.
Carbon T				343.0 21.0 - 847.0		44.5 41.0 - 48.0

Conductivity in microsiemens/cm

Turbidity in J.T.U.

Metals as Totals mg/l

Alkalinity and Hardness expressed as Calcium Carbonate

Nitrite, NO_2 + NO_3, NH expressed as N

Phosphorus T expressed as PO_4

Phosphorus O expressed as P

pH in pH units

* less than

Analysis by Chemex Labs (Alberta) Ltd.

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SYNCRUDE'S LEASE 17 AND COMPARED TO ANALYSIS

OF ATHABASCA RIVER WATER

COMPOSITE #3

PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	DATE OF BIOASSAY SAMPLE SEPT.15/76	WELL PROFILE MEANS AND RANGES L - H	ATHABASCA RIVER SEPT.15/76	RIVER PROFILE MEANS AND RANGES L - H
Calcium	20103L	0.002	24.5	48.44 3.4 - 136.0	18.5	31.35 17.5 - 40.0
Magnesium	12102L	0.001	108.0	141.7 108.0 - 233.0	4.5	6.57 4.5 - 10.0
Sodium	11102L	0.5	5600.0	5668.2 5250.0 - 6250.0	6.5	9.29 5.9 - 36.0
Potassium	19102L	0.5	38.0	45.0 36.5 - 57.5	0.8	0.91 0.4 - 1.5
Chloride	17203L	0.5	7500.0	7598.79 7175.0 - 8272.0	1.0	6.11 1.0 - 51.0
Sulphate	16306L	1.0	0.6	11.49 0.5 - 29.0	4.8	13.8 0.5 - 41.0
Alkalinity T	10101L	1.0	2564.0	2655.0 2160.0 - 4104.0	66.8	86.69 66.8 - 219.0
pH	10301L	0	7.6	8.08 7.5 - 9.1	7.6	7.5 6.8 - 8.3
Carbonate	06301L	1.0	0.0	99.0 0.0 - 396.0	0.0	0.0
Bicarbonate	06201L	1.0	3125.5	3075.5 1828.5 - 5002.8	814.	105.76 81.4 - 158.0
Hardness T	10603L	0.1	505.8	707.3 469.8 - 1300.0	64.7	89.1 63.5 - 138.0
Conductivity	20401L	1.0	29500.0	26450.0 24000.0 - 32000.0	143.0	185.7 132.0 - 270.0
Surfactants	10701L	0.02	0.14	0.36 0.02* - 1.71	0.02*	0.03 0.02* - 0.09
T.O.C.	06001L	1.0	40.0	57.69 5.0 - 301.0	31.0	25.82 10.5 - 70.0
T.I.O.C.	06051L	1.0	540.0	468.9 250.0 - 680.0	11.0	19.44 11.0 - 40.0
Phenol	06532L	0.002	0.0001*	0.004 0.001* - 0.019	0.001*	0.005 0.001* - 0.02

COMPOSITE #3 (Continued)

PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	DATE OF BIOASSAY SAMPLE SEPT.15/76	WELL PROFILE MEANS AND RANGES L - H	ATHABASCA RIVER SEPT.15/76	RIVER PROFILE MEANS AND RANGES L - H
Oil & Grease	06521L	0.1	0.3	1.03 0.1* - 4.6	0.7	0.56 0.1* - 5.0
Sulphide	16101L	0.05	0.05*	0.05 0.02* - 0.07	0.05	0.05*
Cyanide	00000L	0.1	0.01*	0.035 0.01* - 0.26	0.01*	0.01*
Hydrocarbon T	00000L	1.0		24.09 0.001* - 192.0		0.9 0.001* - 2.0
C.O.D.	08301L	5.0	366.0	172.34 47.9 - 470.0	124.6	86.83 37.0 - 267.0
Cadmium	48302L	0.001	0.001*	0.003 0.001* - 0.019	0.001*	0.002 0.001* - 0.019
Chromium $^{+6}$	24101L	0.003	0.003*	0.004 0.002* - 0.011	0.003*	0.004 0.002* - 0.018
Copper	29306L	0.01	0.001	0.015 0.001 - 0.58	0.004	0.019 0.002 - 0.059
Iron	26304L	0.05	2.15	1.61 0.14 - 6.63	5.25	7.26 0.9 - 63.0
Lead	82302L	0.002	0.015	0.009 0.002* - 0.042	0.002*	0.0056 0.002* - 0.026
Manganese	25304L	0.01	0.181	0.181 0.018 - 0.291	0.13	0.24 0.056 - 1.7
Silver	47301L	0.01	0.005*	0.009 0.005* - 0.02	0.005*	0.005*
Zinc	30304L	0.01	0.007	0.02 0.001* - 0.058	0.015	0.053 0.014 - 0.069
Vanadium	23301L	0.02	0.008	0.005 0.001* - 0.02	0.001*	0.004 0.001* - 0.014
Selenium	34302L	0.00015	0.0005*	0.0008 0.0005* - 0.0025	0.0005*	0.0012 0.0005* - 0.0018
Mercury	80011L	0.0002	0.0063	0.016 0.0001* - 0.07	0.0002*	0.0067 0.0001* - 0.0044
Arsenic	33004L	0.001	0.009	0.003 0.0002 - 0.009	0.006	0.0065 0.0025* - 0.02
Nickel	28302L	0.002	0.002*	0.019 0.001* - 0.15	0.002*	0.014 0.002* - 0.08
Aluminum	13302L	0.5	0.82	0.29 0.05* - 0.82	1.25	2.1 0.43 - 10.6

COMPOSITE #3 (Continued)

PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	DATE OF BIOASSAY SAMPLE SEPT.15/76	WELL PROFILE MEANS AND RANGES L - H	ATHABASCA RIVER SEPT.15/76	RIVER PROFILE MEANS AND RANGES L - H
Cobalt	27302L	0.002	0.002*	0.016 0.002* - 0.123	0.002*	0.005 0.002* - 0.043
Boron	05105L	0.05	2.23	2.39 1.93 - 2.93	0.02	0.2 0.01 - 1.51
Carbon T				4.34 21.0 - 847.0		44.5 41.0 - 48.0

Conductivity in microsiemens/cm

Turbidity in J.T.U.

Metals as Totals mg/l

Alkalinity and Hardness expressed as Calcium Carbonate

Nitrite, NO_2 + NO_3, NH expressed as N

Phosphorus T expressed as PO_4

Phosphorus O expressed as P

pH in pH units

* less than

Analysis by Chemex Labs (Alberta) Ltd.

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SYNCRUDE'S LEASE 17 AND COMPARED TO ANALYSIS

OF ATHABASCA RIVER WATER

COMPOSITE #4

PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	DATE OF BIOASSAY SAMPLE SEPT.28/76	WELL PROFILE MEANS AND RANGES L - H	ATHABASCA RIVER SEPT.28/76	RIVER PROFILE MEANS AND RANGES L - H
Calcium	20103L	0.002	56.0	48.44 3.4 - 136.0	26.0	31.35 17.5 - 40.0
Magnesium	12102L	0.001	114.0	141.7 108.0 - 233.0	6.8	6.57 4.5 - 10.0
Sodium	11102L	0.5	5250.0	5668.2 5250.0 - 6250.0	8.0	9.29 5.9 - 36.0
Potassium	19102L	0.5	55.0	45.0 36.5 - 57.5	0.4	0.91 0.4 - 1.5
Chloride	17203L	0.5	7345.0	7598.79 7175.0 8272.0	1.4	6.11 1.0 - 51.0
Sulphate	16306L	1.0	1.0	11.49 0.5 - 29.0	14.6	13.8 0.5 - 41.0
Alkalinity T	10101L	1.0	2450.0	2655.0 2160.0 - 4104.0	84.0	86.69 66.8 - 129.0
pH	10301L	0	7.6	8.08 7.5 - 9.1	7.6	7.5 6.8 - 8.3
Carbonate	06301L	1.0	0.0	99.0 0.0 - 396.0	0.0	0.0
Bicarbonate	06201L	1.0	3125.5	3075.5 1828.5 - 5002.8	102.4	105.76 81.4 - 158.0
Hardness T	10603L	0.1	505.8	707.3 469.8 - 1300.0	92.9	89.1 63.5 - 138.0
Conductivity	20401L	1.0	24500.0	26450.0 24000.0 - 32000.0	193.0	185.7 132.0 - 270.0
Surfactants	10701L	0.02	0.02*	0.36 0.02* - 171	0.002*	0.03 0.02* - 0.09
T.O.C.	06001L	1.0	10.0	57.69 5.0 - 301.0	19.0	25.82 10.5 - 70.0
T.I.O.C.	06051L	1.0	520.0	468.9 250.0 - 680.0	19.0	19.44 11.0 - 40.0
Phenol	06532L	0.002	0.001*	0.004 0.001* - 0.019	0.009	0.005 0.001* - 0.022

COMPOSITE #4 (Continued)

PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	DATE OF BIOASSAY SAMPLE SEPT.28/76	WELL PROFILE MEANS AND RANGES L - H	ATHABASCA RIVER SEPT.28/76	RIVER PROFILE MEANS AND RANGES L - H
Oil & Grease	06521L	0.1	0.1*	1.03 0.1* - 4.6	0.4	0.56 0.1* - 5.0
Sulphide	16101L	0.05	0.05*	0.05 0.02* - 0.07	0.05*	0.05*
Cyanide	00000L	0.1	0.01*	0.035 0.01* - 0.26	0.01*	0.01*
Hydrocarbon T	00000L	1.0	0.1*	24.09 0.001* - 192.0	0.1*	0.9 0.001* - 2.0
C.O.D.	08301L	5.0	366.0	172.34 47.9 - 470.0	64.0	86.63 37.0 - 267.0
Cadmium	48302L	0.001	0.001*	0.003 0.001* - 0.019	0.001*	0.002 0.001* - 0.019
Chromium $^{+6}$	24101L	0.003	0.003*	0.004 0.002* - 0.011	0.003*	0.004 0.002* - 0.018
Copper	29306L	0.01	0.03	0.015 0.001 - 0.58	0.009	0.019 0.002 - 0.059
Iron	26304L	0.05	6.63	1.61 0.14 - 6.63	2.1	7.26 0.9 - 63.0
Lead	82302L	0.002	0.003	0.009 0.002* - 0.042	0.012	0.0056 0.002* - 0.026
Manganese	25304L	0.01	0.291	0.181 0.018 - 0.291	0.063	0.24 0.056 - 1.7
Silver	47301L	0.01	0.01	0.009 0.005* - 0.02	0.005*	0.005*
Zinc	30304L	0.01	0.058	0.02 0.001* - 0.058	0.015	0.053 0.014 - 0.069
Vanadium	23301L	0.02	0.006	0.005 0.001* - 0.02	0.003	0.004 0.001* - 0.014
Selenium	34302L	0.00015	0.0005*	0.0008 0.0005* - 0.0025	0.005*	0.0012 0.0005* - 0.0018
Mercury	80011L	0.0002	0.0002*	0.016 0.0001* - 0.07	0.0002*	0.0067 0.0001* - 0.0044
Arsenic	33004L	0.001	0.009	0.003 0.0002* - 0.09	0.009	0.0065 0.0025* - 0.02
Nickel	28302L	0.002	0.006	0.019 0.001* - 0.15	0.002	0.014 0.002* - 0.02
Aluminum	13302L	0.5	0.82	0.29 0.05* - 0.82	0.62	2.1 0.43 - 10.6

COMPOSITE #4 (Continued)

PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	DATE OF BIOASSAY SAMPLE SEPT.28/76	WELL PROFILE MEANS AND RANGES L - H	ATHABASCA RIVER SEPT.28/76	RIVER PROFILE MEANS AND RANGES L - H
Cobalt	27302L	0.002	0.002*	0.016 0.002* - 0.123	0.002*	0.005 0.002* - 0.043
Boron	05105L	0.05	2.56	2.39 1.93 - 2193	0.16	0.2 0.01 - 1.51
Carbon T				434.0 21.0 - 847.0		44.5 41.0 - 48.0

Conductivity in microsiemens/cm

Turbidity in J.T.U.

Metals as Totals mg/l

Alkalinity and Hardness expressed as Calcium Carbonate

Nitrite, NO_2 + NO_3, NH expressed as N

Phosphorus T expressed as PO_4

Phosphorus O expressed as P

pH in pH units

* less than

Analysis by Chemex Labs (Alberta) Ltd.

6.6 TEST NO. 15 BIOASSAY DATA, 12 FEBRUARY 1977

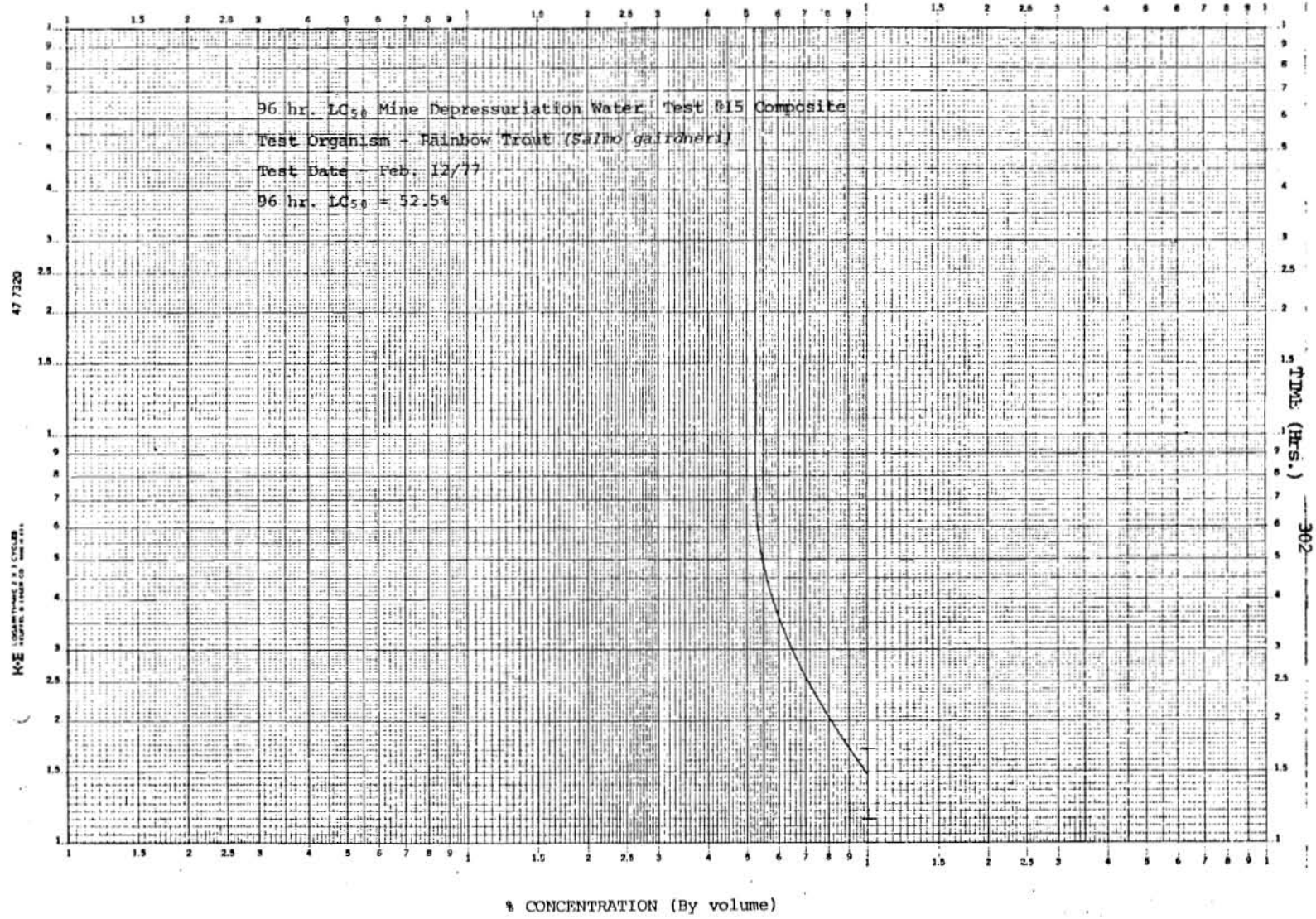
Data presented here include:

1. cumulative mortality of Rainbow trout (*Salmo gardneri*); and
2. graphical determination of LC_{50} and MST's (Litchfield 1949).

TEST #15 MINE DEPRESSURIZATION WATER COMPOSITE CONTINUOUS FLOW TEST DATE FEBRUARY 12, 1977

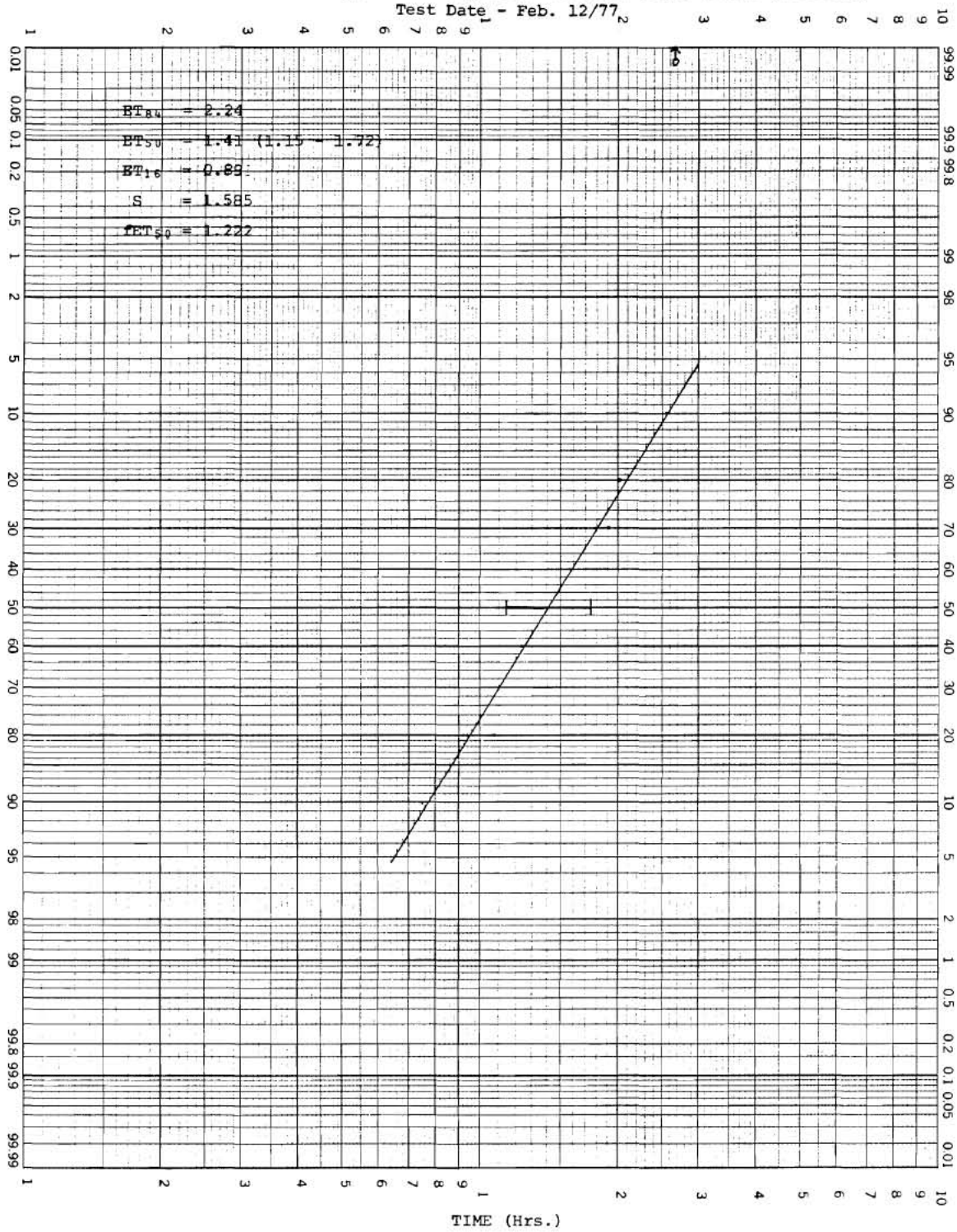
CONCENTRATION (MEAN & RANGE)

PARAMETERS	CONTROL 5 Readings	20% 5 Readings	40% 5 Readings	60% 5 Readings	80% 2 Readings	100% 2 Readings
Temperature °C	15.52 15.0 - 16.5	15.5 15.0 - 16.0	15.28 15.0 - 16.0	15.0 14.5 - 16.0	15	15
Dissolved Oxygen (mg/ℓ)	8.9 8.2 - 9.8	9.1 8.2 - 9.8	9.3 8.8 - 9.9	9.4 9.0 - 10.0	9.2 8.9 - 9.5	9.3 8.7 - 9.9
pH	7.68 7.64 - 7.74	8.13 7.61 - 8.34	8.16 7.57 - 8.36	8.13 7.56 - 8.32	7.54 7.50 - 7.58	7.475 7.47 - 7.48
Conductivity (µs/cm)	173.89 165 - 185	3250 900 - 3950	7388.89 6500 - 8500	10633.33 10000 - 11500	14800	17000
Salinity (ppt Cl)	0	3.0	6.0	8.8	11.5	13.5
Fish Length (cm)		TOTAL 5.39 ± .47				
Fish Weight (gm)		TOTAL 1.57 ± .34				
Loading Density (gm/ℓ)		TOTAL 0.079				
Number Fish/Dilution	10	10	10	10	10	10
Number Dilutions/Conc	1	1	1	1	1	1
Volume of Dilutions (ℓ)	20	20	20	20	20	20
LT_{50} (Hr.)				3.30	2.35	1.41 (1.15 - 1.72
LC_{50} (Conc by Vol)	52.5%					


96 hr. LC_{50} Mine Depressuriation Water Test 815 Composite
Test Organism - Rainbow Trout (*Salmo gairdneri*)
Test Date - Feb. 12/77
96 hr. LC_{50} = 52.5%
TIME (Hrs.)
% CONCENTRATION (By volume)

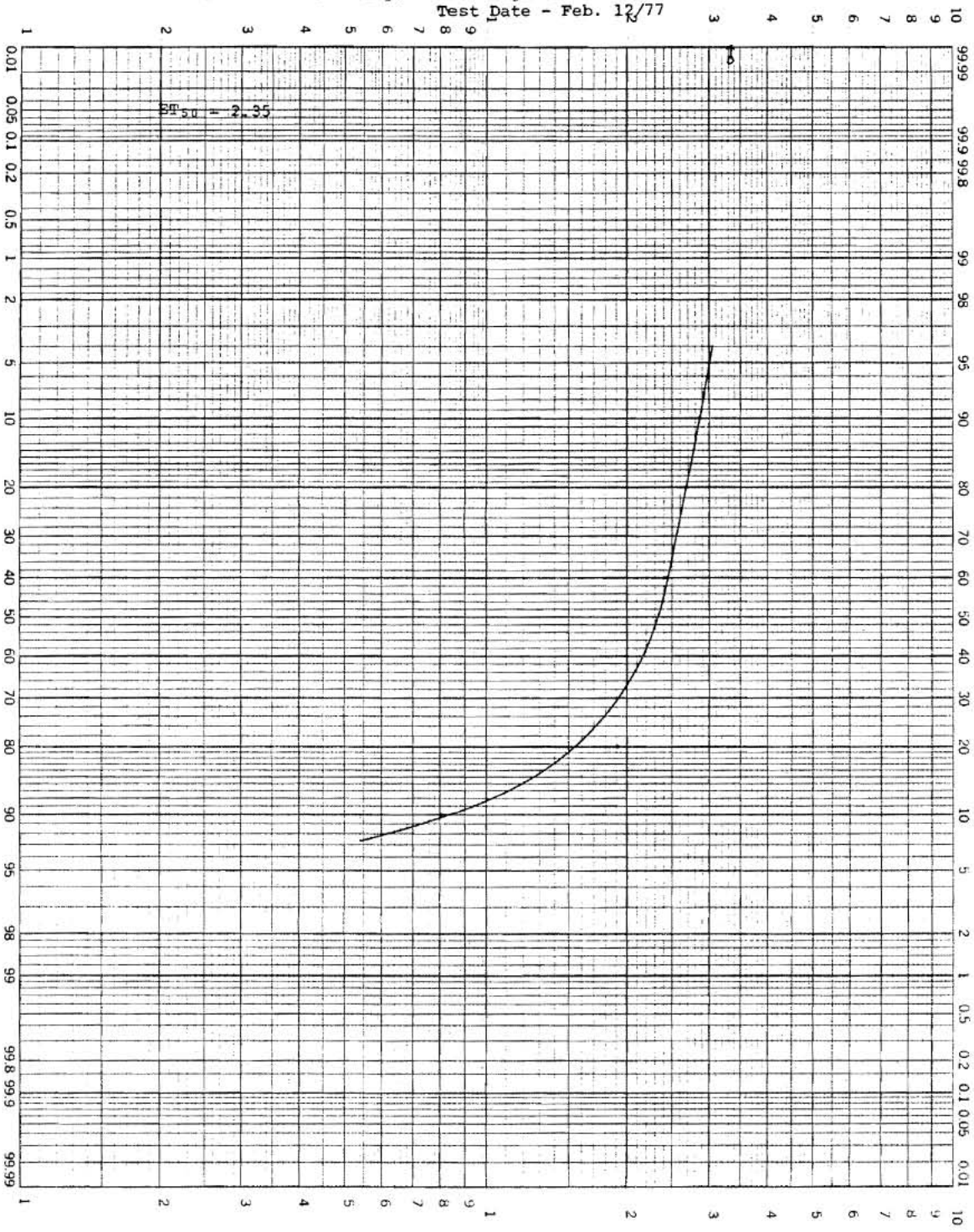
303

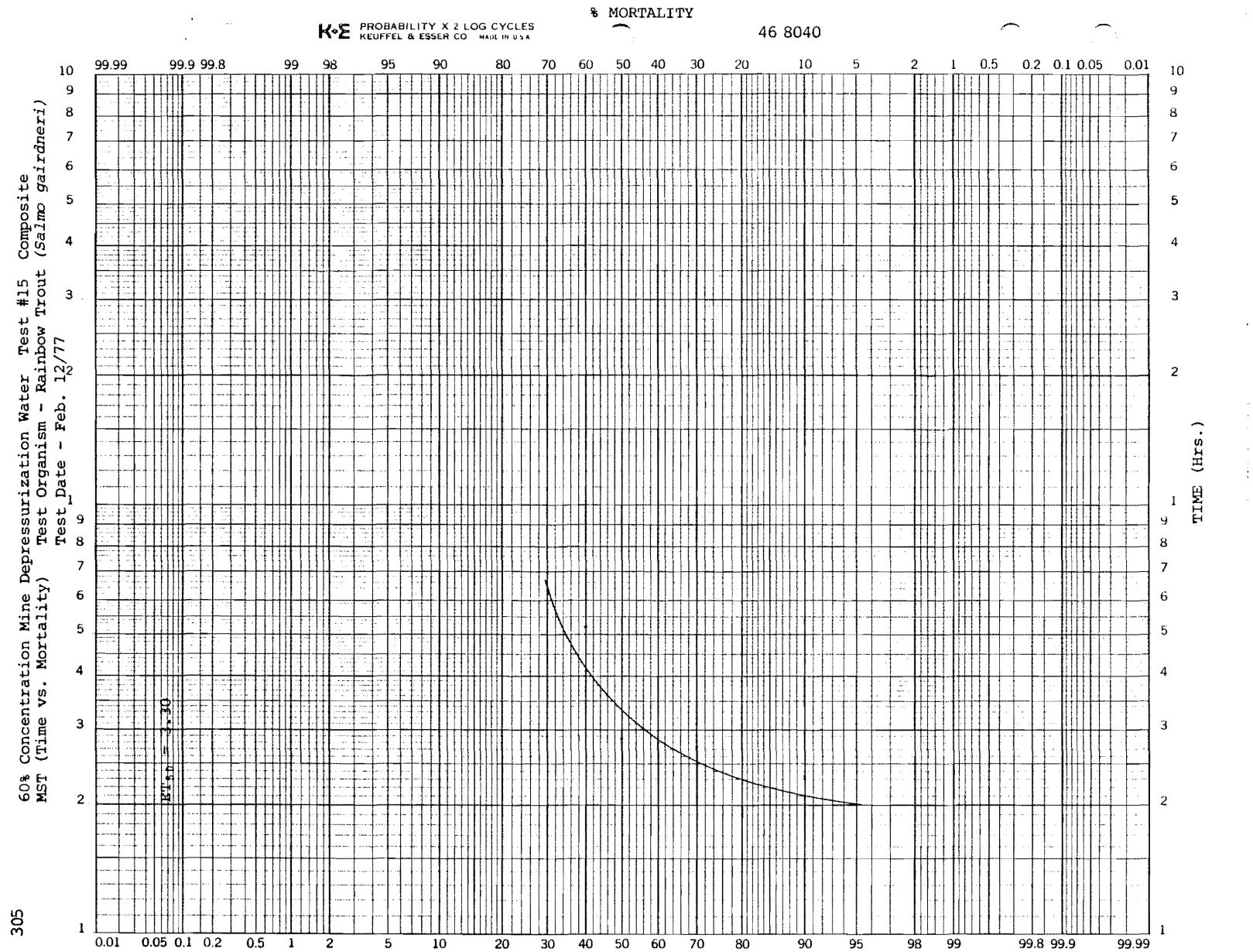
100% Concentration Mine Depressurization Water Test #15 Composite
MST (Time vs. Mortality) Test Organism - Rainbow Trout *(Salmo gairdneri)*
Test Date - Feb. 12/77



304

80% Concentration Mine Depressurization Water Test #15 Composite
MST (Time vs. Mortality) Test Organism - Rainbow Trout *(Salmo gairdneri)*
Test Date - Feb. 12/77




% MORTALITY
K+E PROBABILITY X 2 LOG CYCLES
KEUFFEL & ESSER CO MADE IN U.S.A.
46 8040
99.99 99.9 99.8 99 98 95 90 80 70 60 50 40 30 20 10 5 2 1 0.5 0.2 0.1 0.05 0.01
0.01 0.05 0.1 0.2 0.5 1 2 5 10 20 30 40 50 60 70 80 90 95 98 99 99.8 99.9 99.99
10 9 8 7 6 5 4 3 2 1
TIME (Hrs.)
60% Concentration Mine Depressurization Water Test #15 Composite
MST (Time vs. Mortality) Test Organism - Rainbow Trout (Salmo gairdneri)
Test Date - Feb. 12/77
ETsb = 3.30

6.7 TEST NO. 16 BIOASSAY DATA, 12 February 1977

Data presented here include:

1. cumulative mortality of Rainbow trout (*Salmo gardneri*); and
2. graphical determination of LC_{50} and MST's (Litchfield 1949).

TEST #16 MINE DEPRESSURIZATION WATER SEMI-STATIC REPLACEMENT COMPOSITE TEST DATE FEBRUARY 12, 1977

CONCENTRATIONS (MEAN & RANGE)

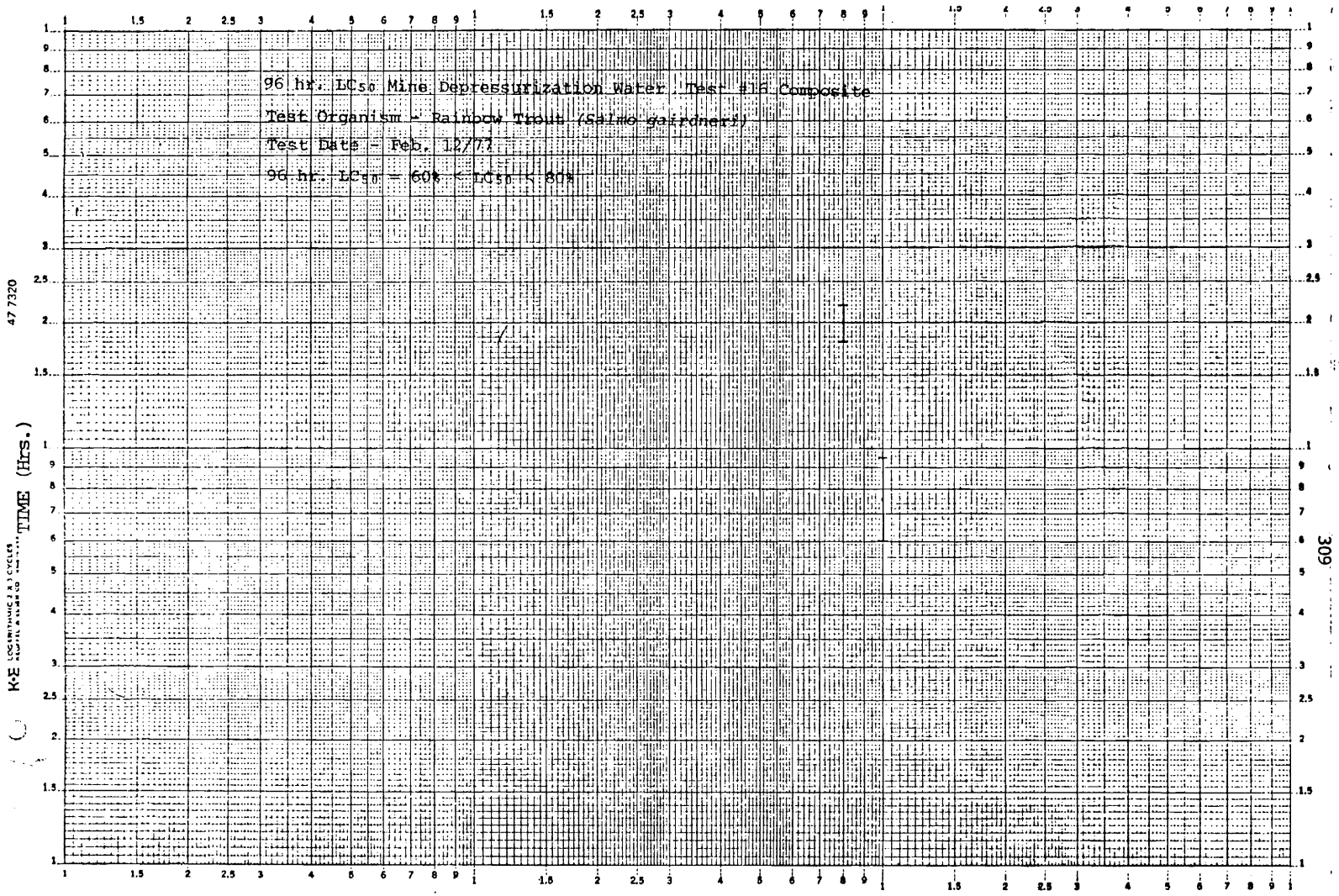
PARAMETERS	CONTROL 5 Readings	20% 5 Readings	40% 5 Readings	60% 5 Readings	80% 2 Readings	100% 2 Readings
Temperature (°C)	14.92 14.5 - 15.0	14.92 14.5 - 15.0	14.92 14.5 - 15.0	14.92 14.5 - 15.0	15.0	15.0
Dissolved Oxygen (mg/ℓ)	8.95 7.0 - 11.0	9.43 8.0 - 10.8	9.02 6.9 - 10.8	8.74 6.0 - 10.6	8.7 8.4 - 9.0	8.2 8.0 - 8.4
pH	7.57 7.28 - 7.87	8.32 7.79 - 8.63	8.29 7.71 - 8.65	8.29 7.65 - 8.87	7.42 7.40 - 7.44	7.43
Conductivity (μs/cm)	189.17 160 - 240	3837.5 3500 - 3950	7541.67 7000 - 8000	10891.67 10200 - 11000	14500	16500
Salinity (ppt Cl)	0	3.0	6.0	8.8	11.5	13.5
Fish Length (cm)		TOTAL 5.49 $\pm$ .41				
Fish Weight (gm)		TOTAL 1.68 $\pm$ .37				
Loading Density (gm/ℓ)		TOTAL 0.084				
Number Fish/Dilution	8	8	8	8	8	8
Number Dilutions/Conc	1	1	1	1	1	1
Volume of Dilutions (ℓ)	20	20	20	20	20	20
LT_{50} (Hr.)					2.0 (1.8 - 2.2)	0.759 (0.6 - 0.95)
LC_{50} (Conc by Vol.)	60% < LC_{50} < 80%					

CUMULATIVE MORTALITY OF RAINBOW TROUT *(Salmo gairdneri)*

Test #16 Composite Semi-Static Replacement

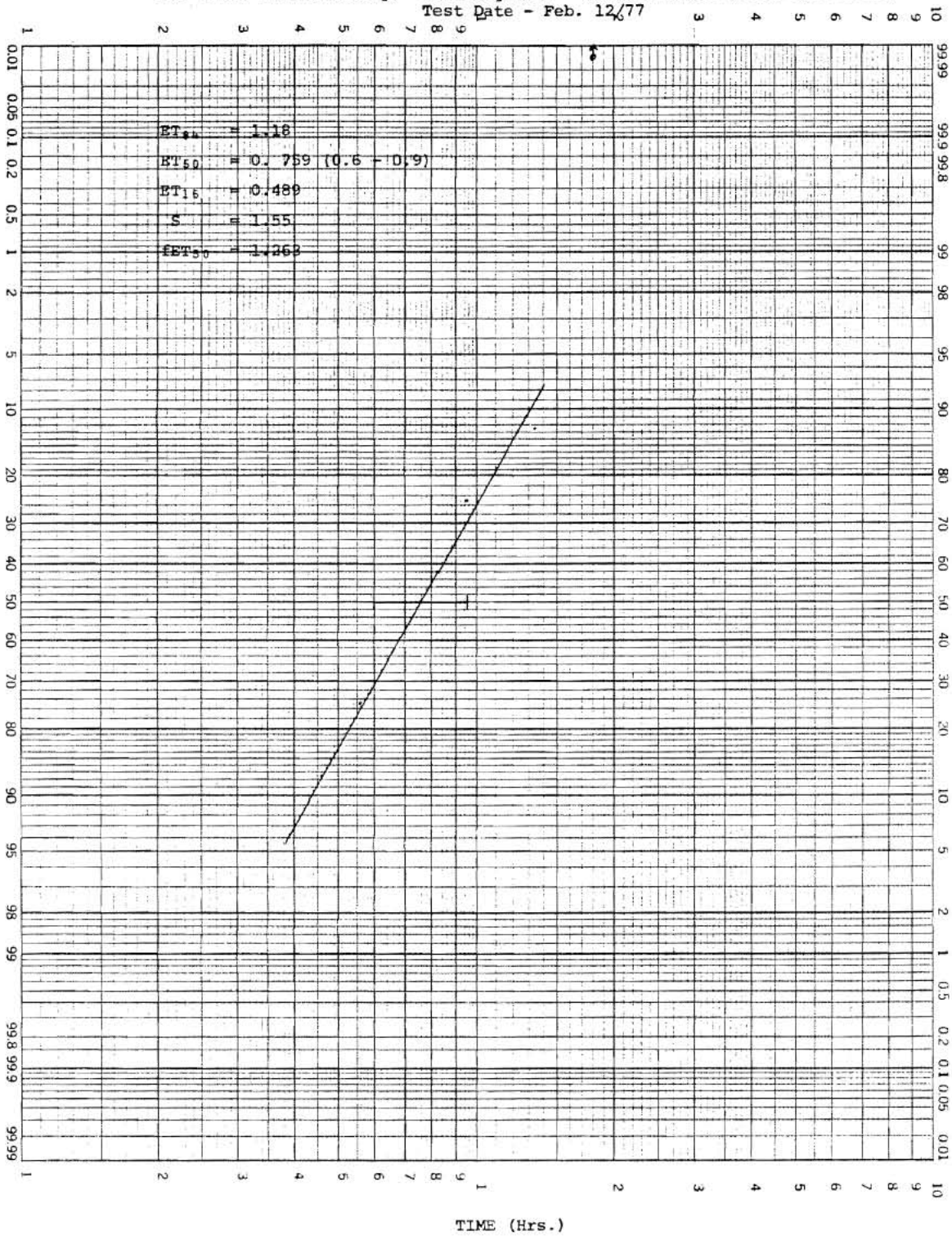
Time (Hrs.)

Concentration Mine Depressurization Water (% by Volume)	0.0	.25	.46	.50	.56	.95	1.00	1.35	1.80	1.81	2.0	2.08	2.16	2.41	4.0	8.0	12.0	18.0	24.0	24.66	36.0	48.0	60.0	72.0	84.0	96.0	Total % Mortality 96 hours
Control																											
N = 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
% Mortality	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20%																											
N = 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
% Mortality	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40%																											
N = 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
% Mortality	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
60%																											
N = 8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	
% Mortality	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5
80%																											
N = 8	0	0	0	0	0	0	0	0	2	3	3	4	5	8													
% Mortality	0	0	0	0	0	0	0	0	25.0	37.5	37.5	50.0	62.5	100.0													100.0
100%																											
N = 8	0	0	1	1	2	6	6	7	8																		
% Mortality	0	0	12.5	12.5	25.0	75.0	75.0	87.5	100.0																		100.0


96 hr. LC_{50} Mine Depressurization Water Test #16 Composite
Test Organism - Rainbow Trout (Salmo gairdneri)
Test Date - Feb. 12/77
96 hr. LC_{50} = 60% < LC_{50} < 80%
TIME (Hrs.)
% CONCENTRATION (By Volume)
47 7320
K·E
309

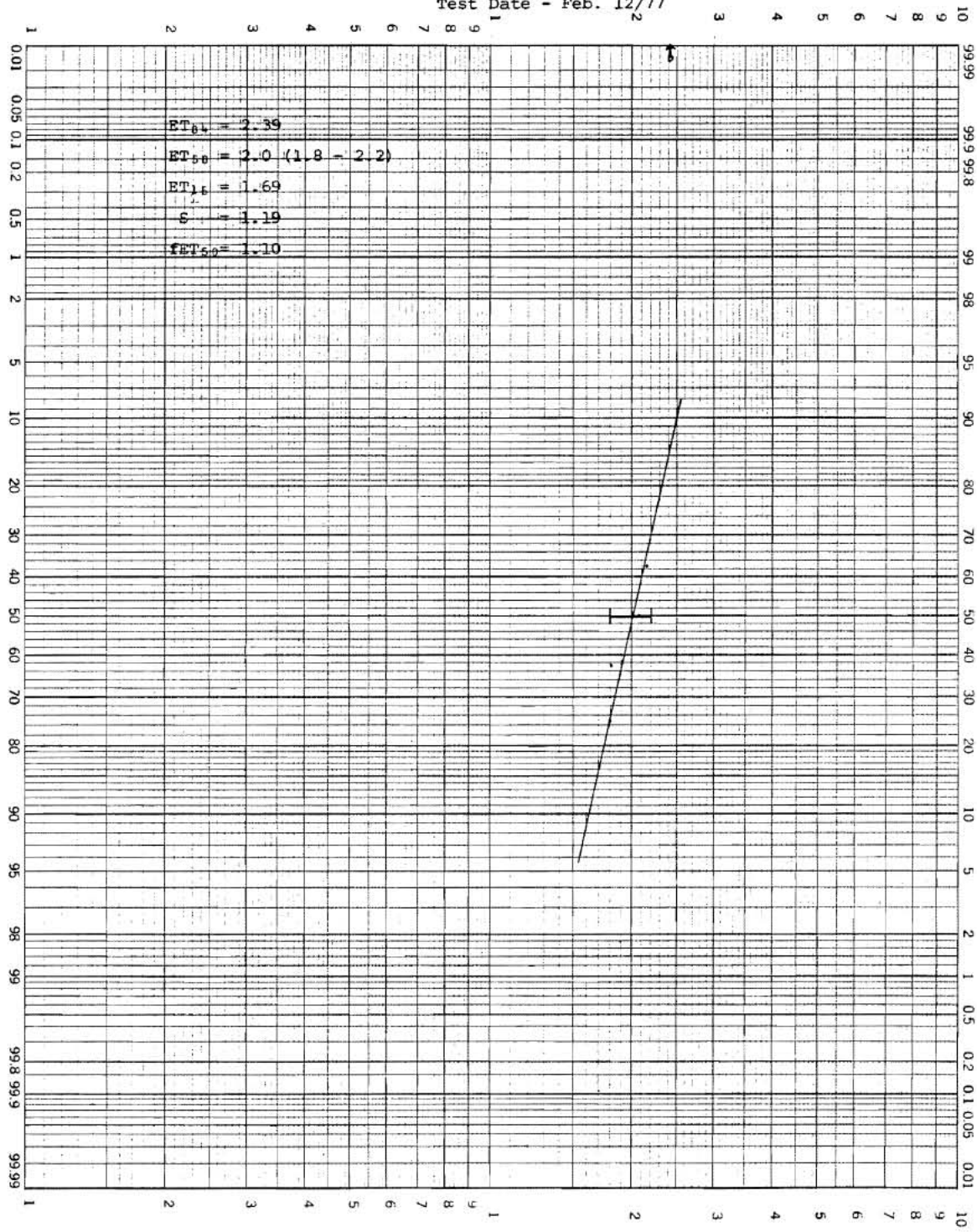
310

100% Concentration Mine Depressurization Water Test #16 Composite
MST (Time vs. Mortality) Test Organism - Rainbow Trout *(Salmo gairdneri)*
Test Date - Feb. 12, 77



311

80% Concentration Mine Depressurization Water Test #16 Composite
MST (Time vs. Mortality) Test Organism - Rainbow Trout *(Salmo gairdneri)*
Test Date - Feb. 12/77



6.8 TEST NO. 17 BIOASSAY DATA, 22 FEBRUARY 1977

Data presented here include:

1. cumulative mortality of Rainbow trout (*Salmo gardneri*); and
2. graphical determination of LC_{50} and MST's (Litchfield 1949).

TEST # 17 MINE DEPRESSURIZATION WATER COMPOSITE CONTINUOUS FLOW TEST DATE FEBRUARY 22, 1977

CONCENTRATIONS (MEAN & RANGE)

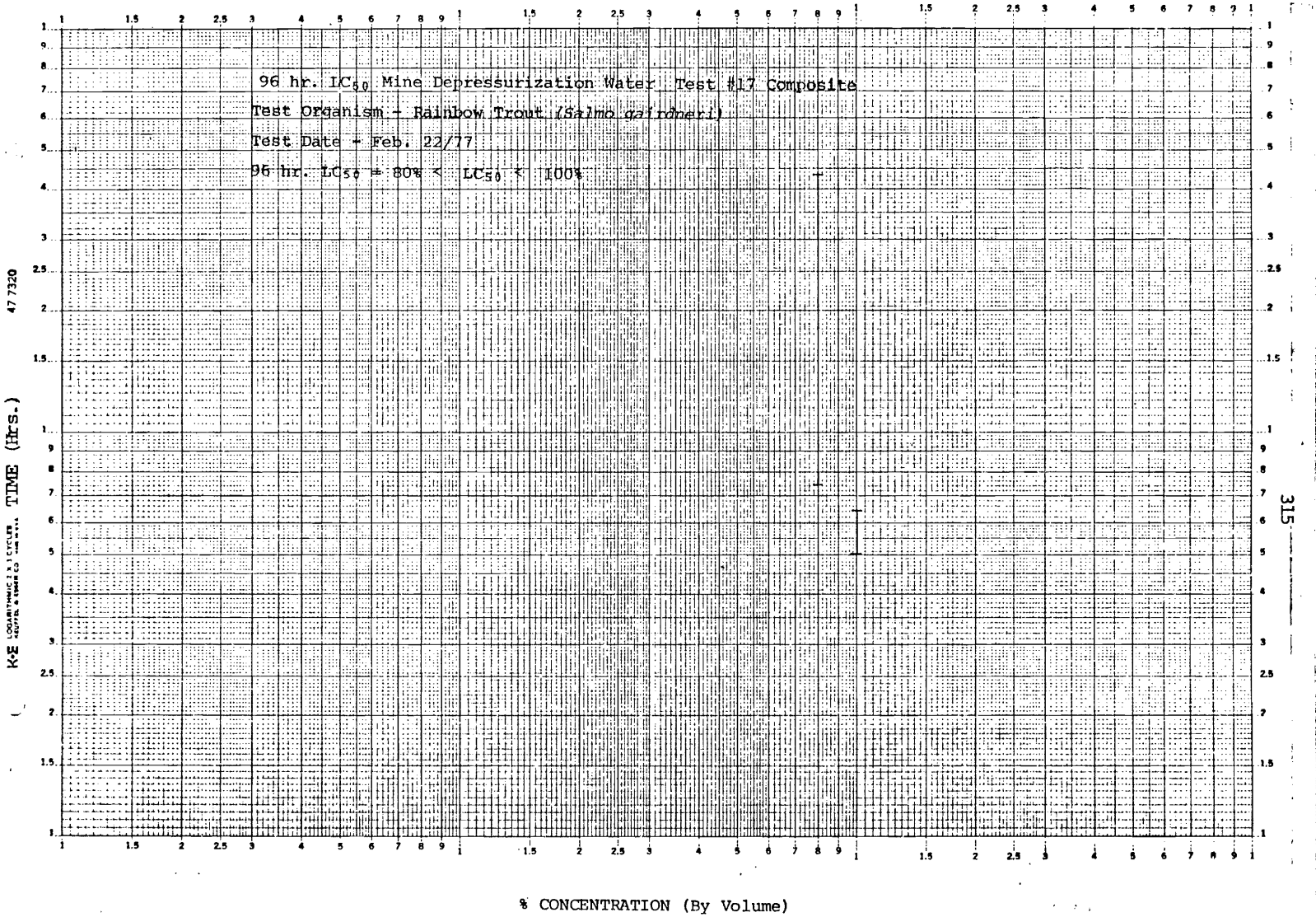
PARAMETERS	CONTROL 5 Readings	20% 5 Readings	40% 5 Readings	60% 5 Readings	80% 5 Readings	100% 2 Readings
Temperature °C	15.06 14 - 15.5	15.06 14.0 - 15.5	15.06 14.0 - 15.5	15.06 14.0 - 16.0	15.0 14.0 - 15.5	14.5 14.0 - 15.0
Dissolved Oxygen (mg/ℓ)	8.62 8.2 - 10.4	8.64 8.0 - 9.8	8.36 7.7 - 9.0	8.78 7.7 - 11.2	9.31 8.4 - 11.4	10.6 9.6 - 11.6
pH	7.59 7.48 - 7.69	8.58 8.34 - 8.74	8.42 7.68 - 8.92	8.65 8.33 - 8.90	8.59 8.28 - 8.83	8.29 8.21 - 8.37
Conductivity (µs/cm)	158.89 145 - 200	2500 850 - 3800	3973.89 175 - 7000	9312.5 7500 - 10500	13875 13000 - 15000	15500 15000 - 16000
Salinity (ppt Cl)	0	2.5	4.5	7.0	9.0	11.0
Fish Length (cm)		TOTAL	6.11 ± .49			
Fish Weight (gm)		TOTAL	2.27 ± .77			
Loading Density (gm/ℓ)		TOTAL	0.114			
Number Fish/Dilution	11	10	10	10	10	10
Number Dilutions/Conc	1	1	1	1	1	1
Volume of Dilutions (ℓ)	20	20	20	20	20	20
LT_{50} (Hr.)					18.0 (7.44 - 43.56)	5.69 (5.03 - 6.44)
LC_{50} (Conc by Vol.)	80% < LC_{50} < 100%					

CUMULATIVE MORTALITY OF RAINBOW TROUT *(Salmo gairdneri)*

Test #17 Composite Continuous Flow

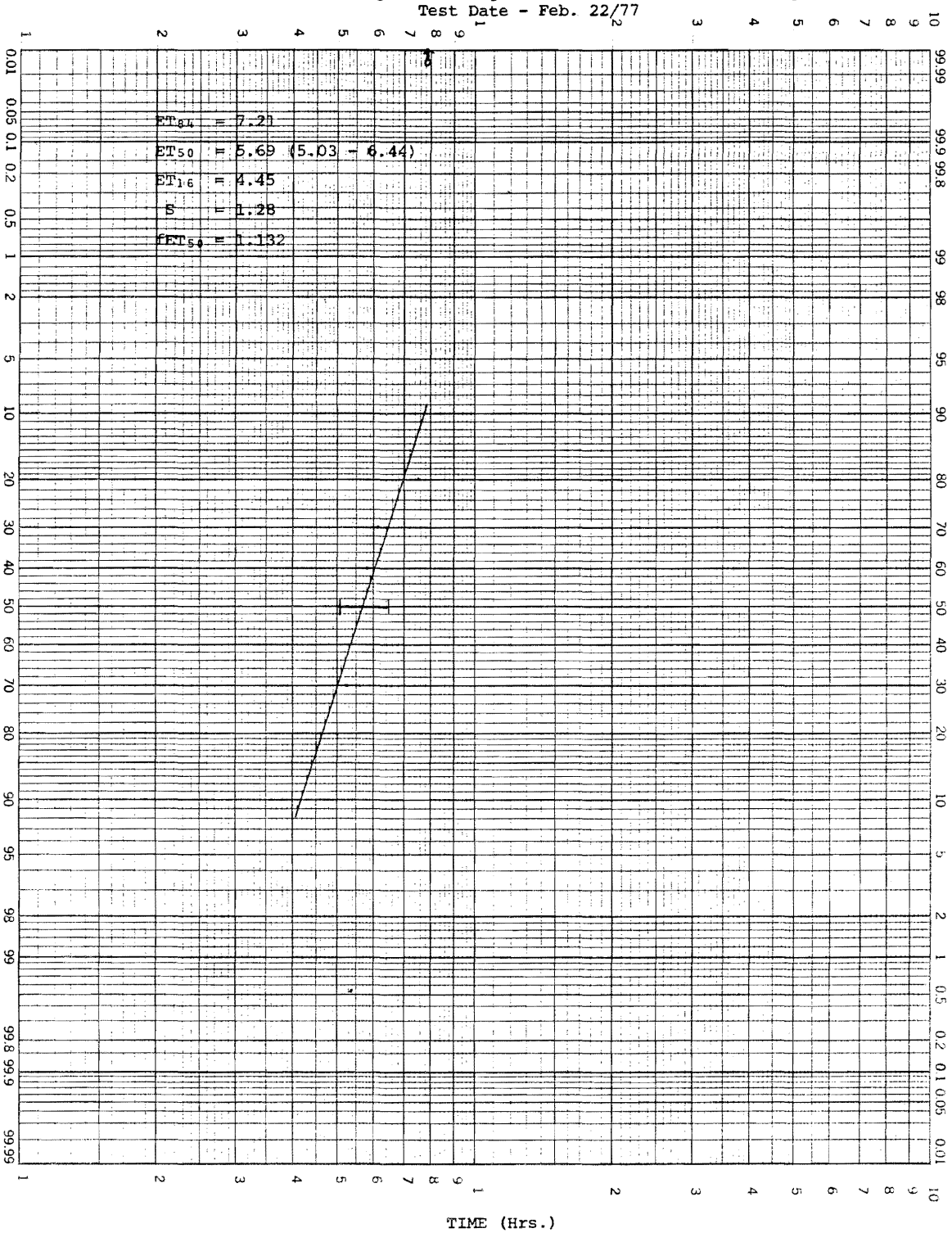
Time (Hrs.)

Concentration Mine Depressurization Water (% by Volume)	0.0	.25	.50	1.0	2.0	4.0	5.0	5.25	5.28	5.83	6.12	7.51	7.91	8.0	12.0	18.0	24.0	36.0	48.0	60.0	72.0	84.0	96.0	Total % Mortality 96 hours
Control																								
N = 11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
% Mortality	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20%																								
N = 10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
% Mortality	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40%																								
N = 10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
% Mortality	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
60%																								
N = 10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
% Mortality	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
80%																								
N = 10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	5	5	5	5	5	5		
% Mortality	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	50	50	50	50	50	50		50
100%																								
N = 10	0	0	0	0	0	0	2	3	5	6	7	8	10											
% Mortality	0	0	0	0	0	0	20	30	50	60	70	80	100											100


96 hr. LC_{50} Mine Depressurization Water Test #17 Composite
Test Organism - Rainbow Trout (*Salmo gairdneri*)
Test Date - Feb. 22/77
96 hr. LC_{50} = 80% < LC_{50} < 100%
TIME (Hrs.)
% CONCENTRATION (By Volume)
K+E 47 7320

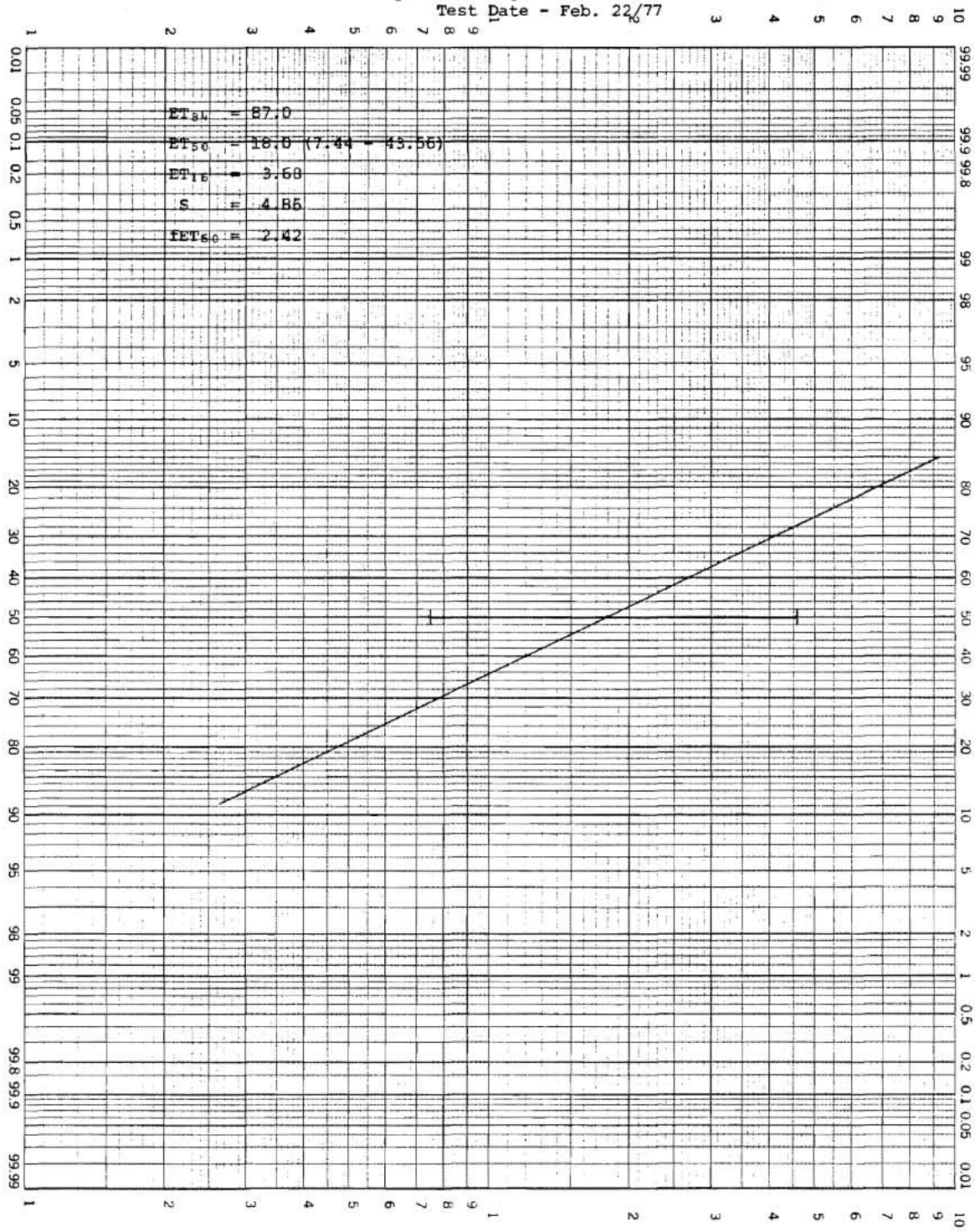
316

100% Concentration Mine Depressurization Water Test #17 Composite
MST (Time vs. Mortality) Test Organism - Rainbow Trout *(Salmo gairdneri)*
Test Date - Feb. 22/77



317

80% Concentration Mine Depressurization Water Test #17 Composite
MST (Time vs. Mortality) Test Organism - Rainbow Trout *(Salmo gairdneri)*
Test Date - Feb. 22/77



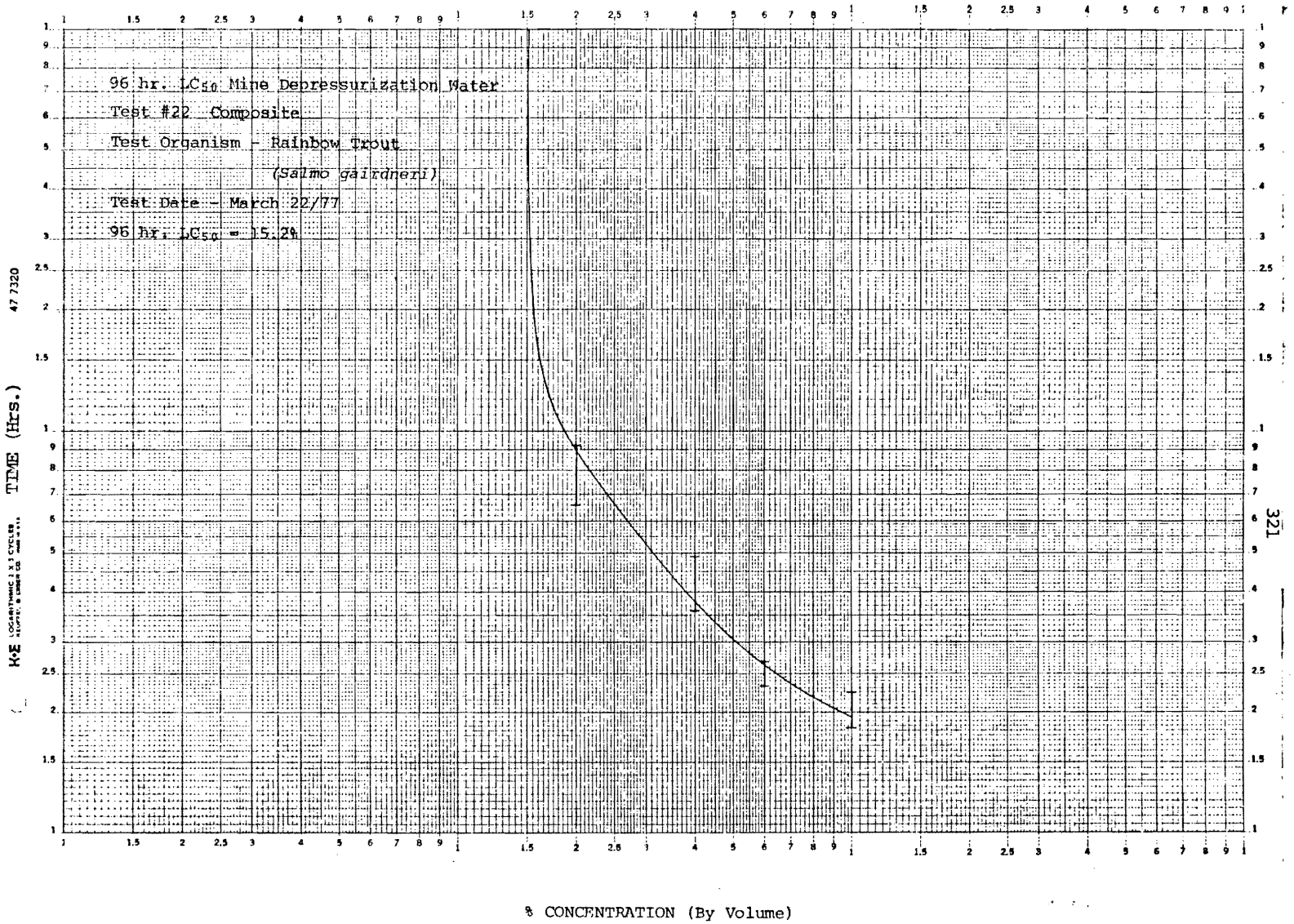
6.9 TEST NO. 22 BIOASSAY Data, 22 MARCH 1977

Data presented here include:

1. cumulative mortality of Rainbow trout (*Salmo gairdneri*); and
2. graphical determination of LC_{50} and MST's (Litchfield 1949).

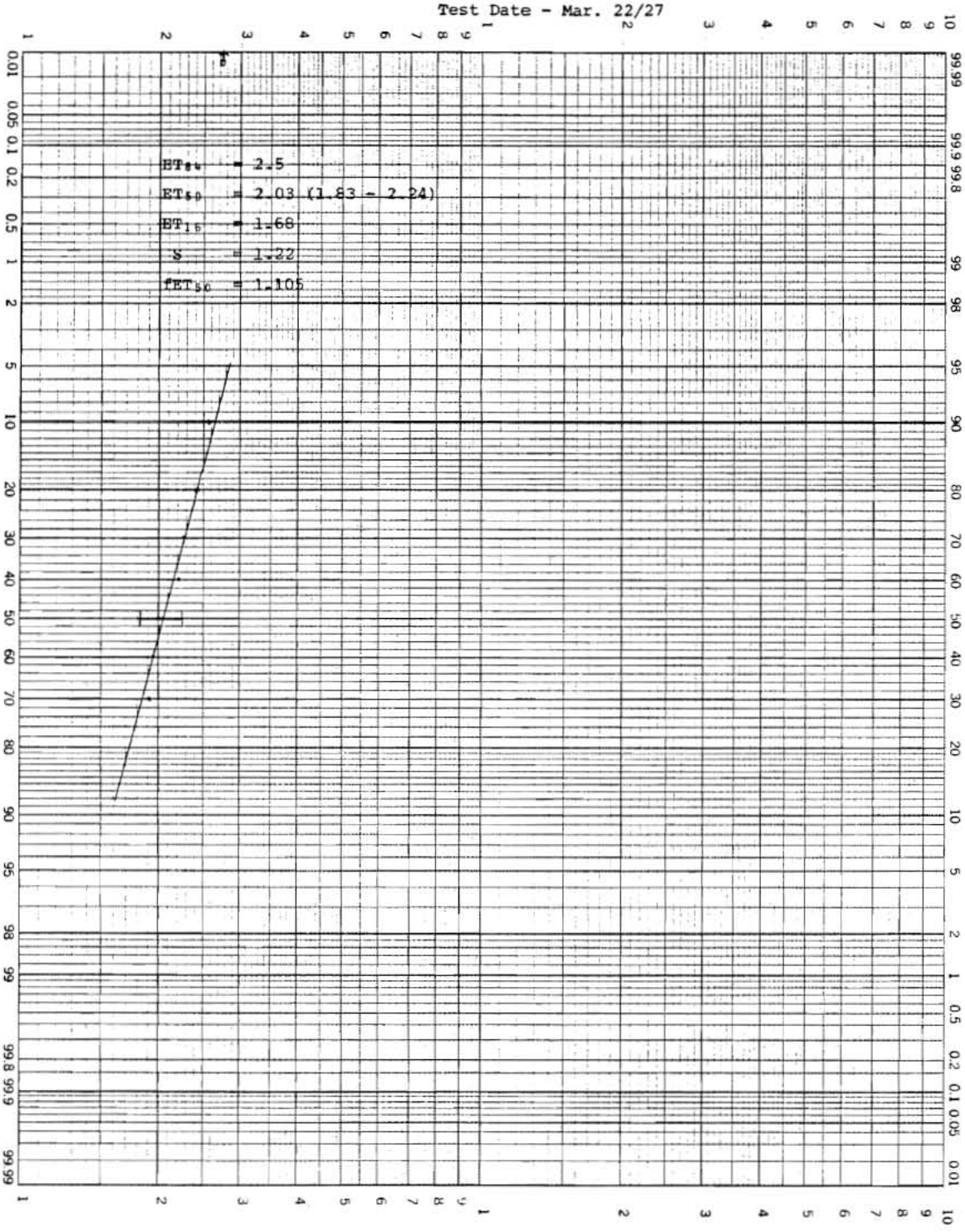
TEST #22 MINE DEPRESSURIZATION WATER COMPOSITE CONTINUOUS FLOW TEST DATE MARCH 22, 1977

PARAMETERS	CONTROL 5 Readings	20% 5 Readings	40% 2 Readings	60% 2 Readings	80% 2 Readings	100% 2 Readings
Temperature (°C)	16.1 15.0 - 17.0	16.3 15.5 - 17.0	16.25 15.5 - 17.0	14.5 14.0 - 15.0	14.5 14.0 - 15.0	11.8 11.0 - 12.5
Dissolved Oxygen (mg/ℓ)	9.6 9.3 - 10.6	9.9 9.5 - 10.7	10.1 9.5 - 10.7	10.9 10.8 - 11.0	10.9 10.8 - 11.0	11.0
pH	7.62 7.50 - 7.77	9.12 9.08 - 9.15	9.15	9.11 9.10 - 9.12	9.075 9.07 - 9.08	9.04
Conductivity (µs/cm)	151.88 150 - 160	5700 4400 - 7000	5700 4000 - 7400	10250 10000 - 10500	13500 13000 - 14000	14500 13000 - 16000
Salinity (ppt Cl)	0.0	2.5	5.0	7.0	9.25 9.0 - 9.50	10.0 9.0 - 11.0
Fish Length (cm)		TOTAL 4.48 ± .25				
Fish Weight (gm)		TOTAL 0.82 ± .12				
Loading Density (gm/ℓ)		TOTAL 0.041				
Number Fish/Dilution	10	10	10	10	10	10
Number Dilutions/Conc	1	1	1	1	1	1
Volume of Dilutions (ℓ)	20	20	20	20	20	20
LT_{50} (Hr.)		7.81 (6.59 - 9.25)	4.20 (3.59 - 4.91)	2.50 (2.33 - 2.69)	2.20	2.03 (1.83 - 2.24)
LC_{50} (Conc by Vol)	15.2%					


96 hr. LC_{50} Mine Depressurization Water
Test #22 Composite
Test Organism - Rainbow Trout
(*Salmo gairdneri*)
Test Date - March 22/77
96 hr. LC_{50} = 15.2%
TIME (Hrs.)
% CONCENTRATION (By Volume)
47 7320
321

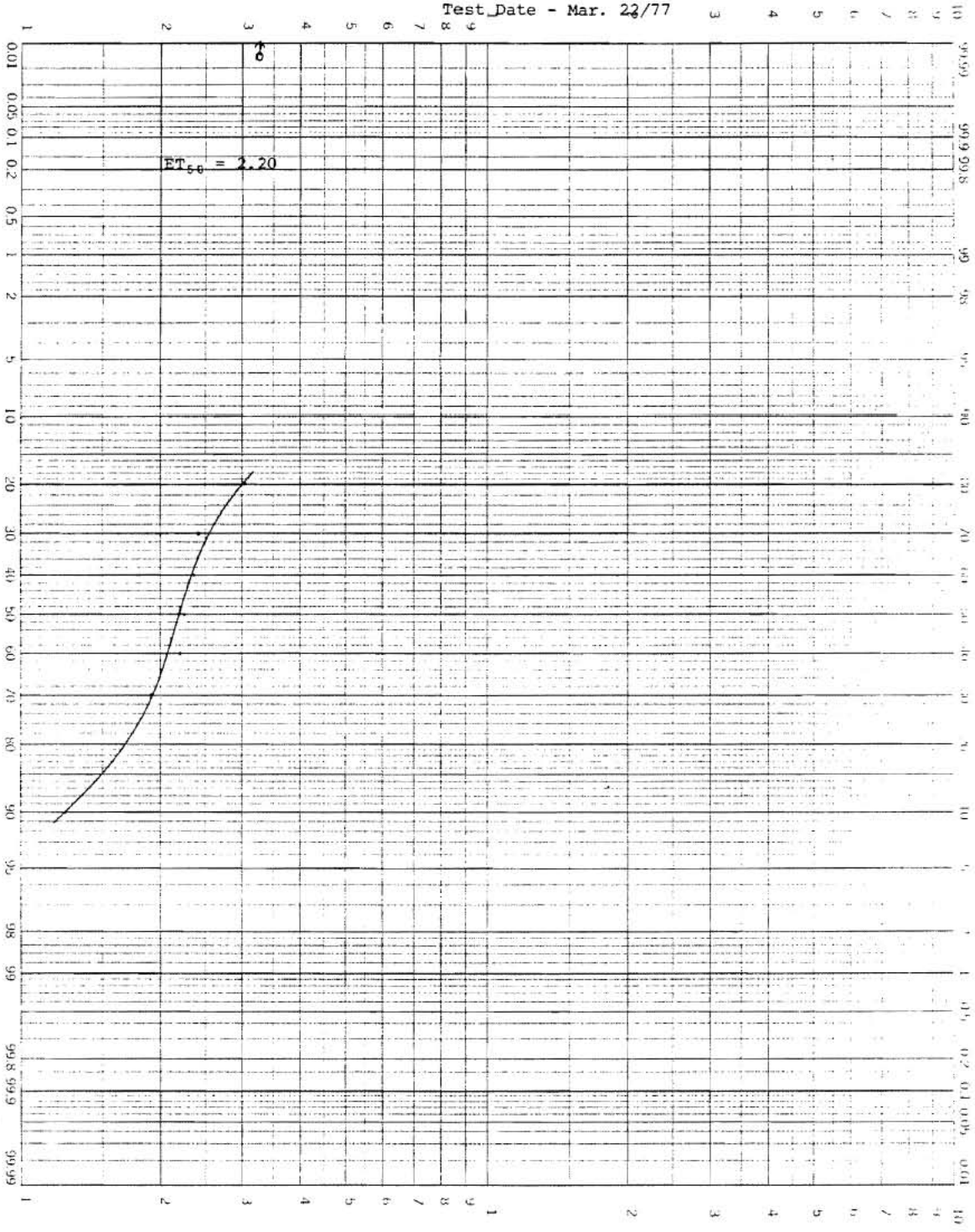
322

100% Concentration Mine Depressurization Water Test #22 Composite
MST (Time vs. Mortality) Test Organism - Rainbow Trout *(Salmo gairdneri)*
Test Date - Mar. 22/27

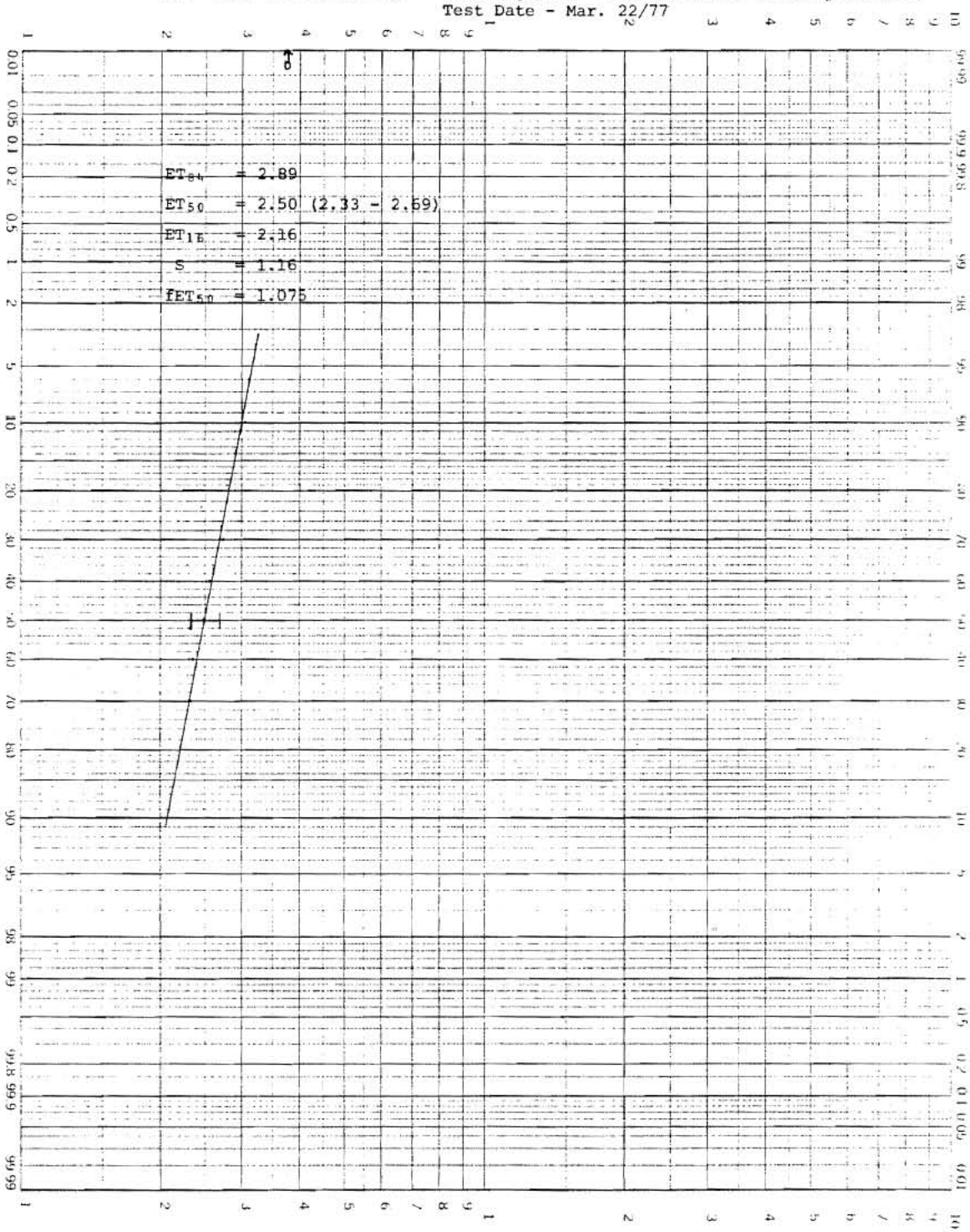


323

80% concentration Mine Depressurization Water Test #22 Composite
MST (Time vs. Mortality) Test Organism - Rainbow Trout *(Salmo gairdneri)*
Test Date - Mar. 22/77



60% Concentration Mine Depressurization Water Test #22 Composite
MST (Time vs. Mortality) Test Organism - Rainbow Trout *(Salmo gairdneri)*
Test Date - Mar. 22/77

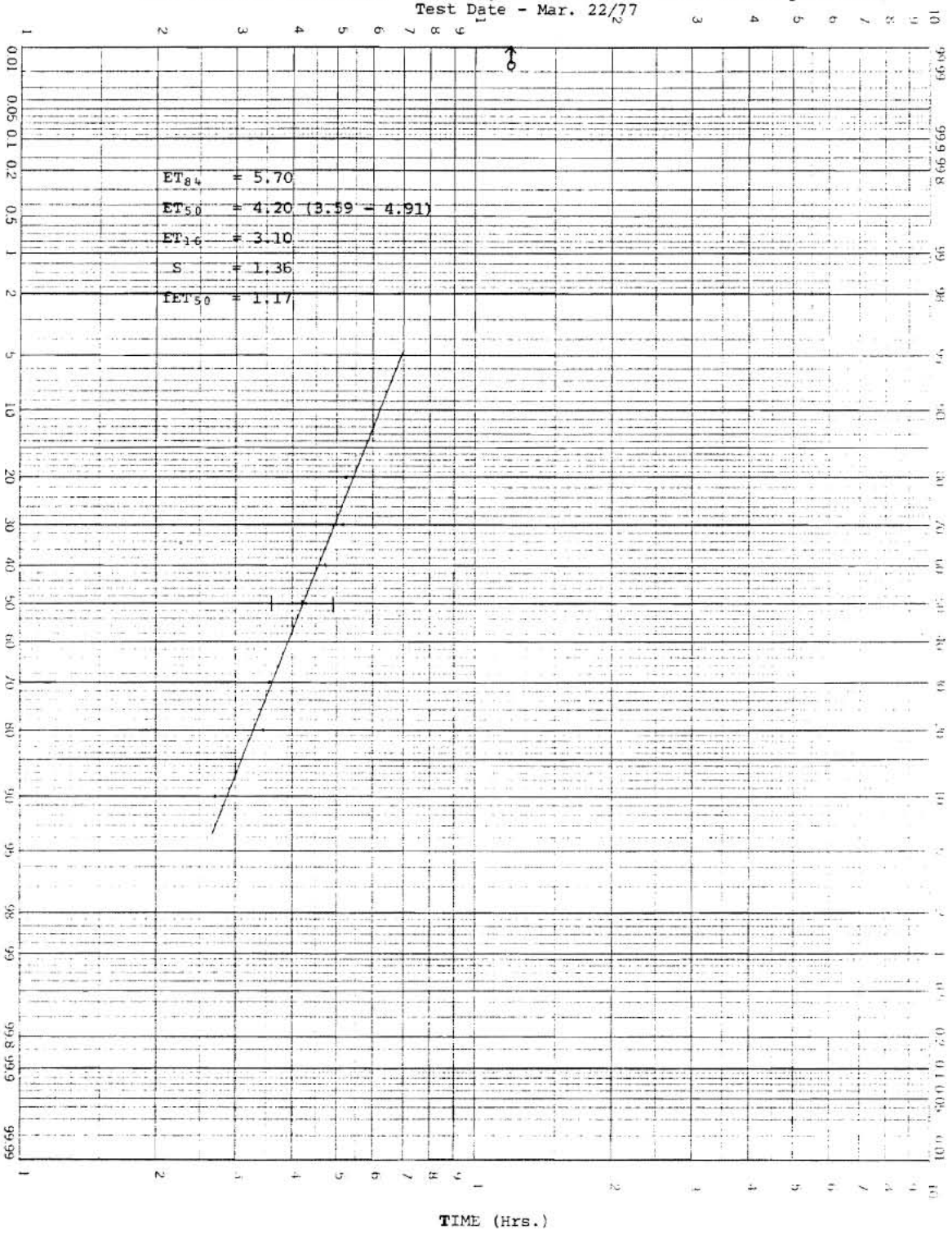


325

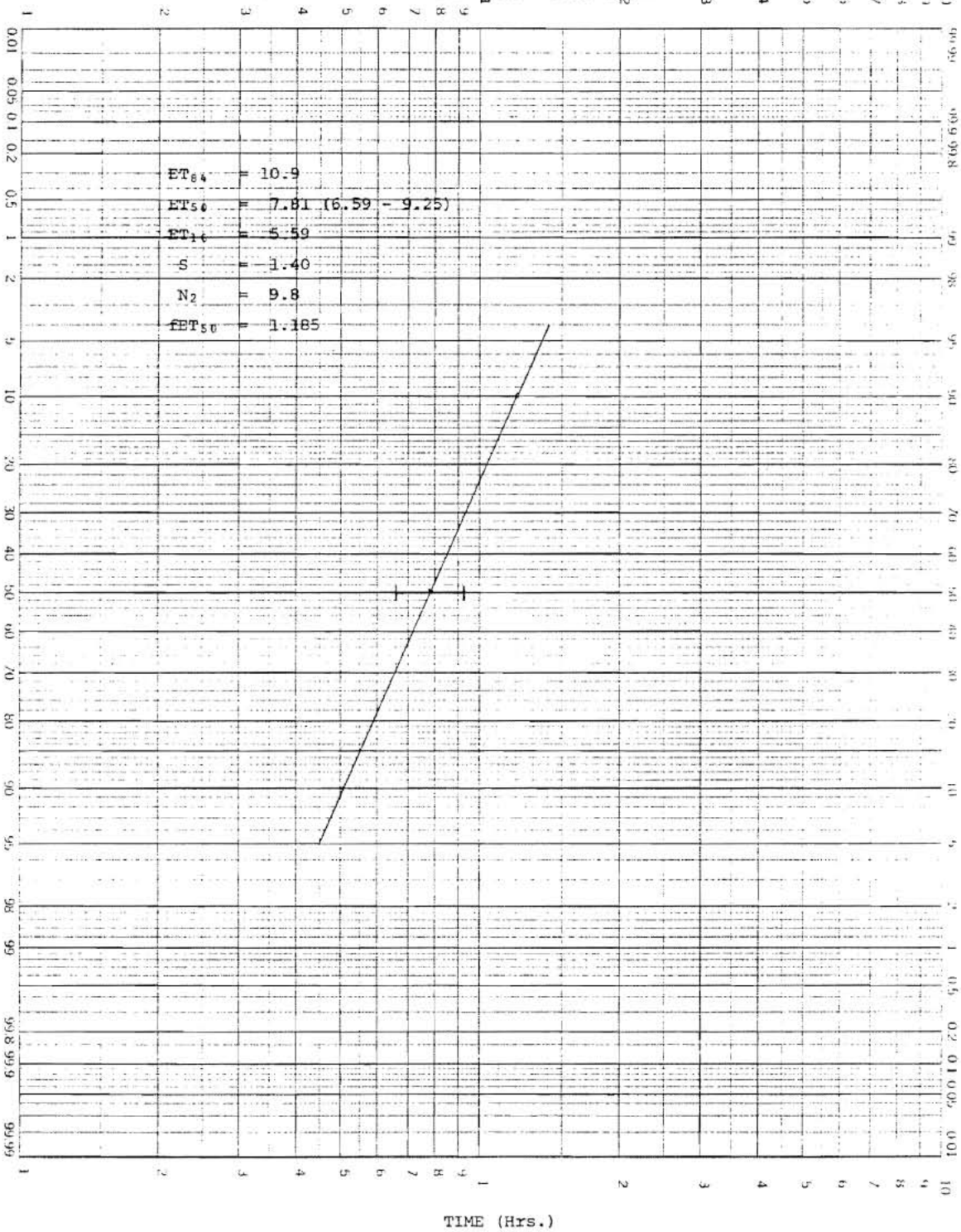
40% Concentration Mine Depressurization Water Test #22 Composite

MST (Time vs. Mortality) Test Organism - Rainbow Trout *(Salmo gairdneri)*

Test Date - Mar. 22/77



20% Concentration Mine Depressurization Water Test #22 Composite
MST (Time vs. Mortality) Test Organism - Rainbow Trout *(Salmo gairdneri)*
Test Date - Mar. 22/77



6.10 CHEMISTRY DATA (FEBRUARY TO MARCH 1977)

Data presented here include summary of chemistry analysis of mine depressurization water collected from Syncrude's Lease 17 and compared to analysis of City of Edmonton treated water.

96 hr. LC_{50} = (1) 52.5 (Sprague)

(2) 60% $<LC_{50}<$ 80% (Sprague)

(3) 60% $<LC_{50}<$ 80% (Sprague)

(4) 15.2% (Sprague)

MINE DEPRESSURIZATION WATER

SYNCRUDE LEASE 17

CHEMISTRY DATA COMPOSITE

M.S.T. = Conc. = (1) 100% = 1.41 (1.15 - 1.72)

M.S.T. (hrs.) 80% = 2.35

60% = 3.30

(2) 100% = 0.759 (0.6 - 0.9)

80% = 2.0 (1.8 - 2.2)

(3) 100% = 5.69 (5.03 - 6.44)

80% = 18.0 (7.44 - 43.56

(4) 100% = 2.03 (1.83 - 2.24)

80% = 2.20

60% = 2.50 (2.33 - 2.69)

40% = 4.20 (3.59 - 4.91)

20% = 7.81 (6.59 - 9.25)

POLLUTION CONTROL LAB

PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	SAMPLE DATES 1977 Feb. 12***	Feb. 12	Feb. 22	Mar. 22	MEAN	RANGES Low - High
Calcium	20105L	2.0	67.0	20.0	81.0	33.0	50.25	20.0 - 81.0
Magnesium	12102L	1.0	100.0	84.0	106.0	129.0	104.75	84.0 - 129.0
Codium	11102L	0.1	5000.0	5000.0	5000.0	5400.0	5100.0	5000.0 - 5400.0
Potassium	19102L	0.1	36.4	35.2	36.8	40.8	37.3	35.2 - 40.8
Chloride	17203L	1.0	6964.0	6943.0	6750.0	6615.0	6818.0	6615.0 - 6964.0
Sulphate	16306L	10.0	23.0	19.0	36.0	32.0	27.5	19.0 - 36.0
Alkalinity	10101L	5.0	2547.0	2694.0	2561.0	2696.0	2624.5	2547.0 - 2696.0
pH	10301L	0.0	9.1	8.3	8.4	8.9	8.43	8.1 - 8.9
Carbonate	06301L	5.0			67.0	267.0	167.0	67.0 - 267.0
Bicarbonate	06201L	5.0	3105.0	3283.0	2986.0	2745.0	3029.75	2745.0 - 3283.0
Hardness T	10604L	5.0	580.0	394.0	639.0	613.0	556.5	394.0 - 639.0
Fluoride	09107L	0.05	0.72	0.70	0.16	0.68	0.57	0.16 - 0.72

POLLUTION CONTROL LAB

PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	SAMPLE DATES 1977 Feb. 12***	Feb. 12	Feb. 22	Mar. 22	MEAN	RANGES Low - High
Silica	14102L	0.5	5.5	5.3	20.7	5.4	9.23	5.3 - 20.7
Conductivity	02041L	0.2	23500.	22750.	22000.	24500.	23187.5	22000. - 24500.
Odor	02001L	0.0			1.0	1.0	1.0	
Color	02011L	1.0	100	100	100	99	99.75	99 - 100
Color T	02011L	1.0	99	99	100	98	99.0	99 - 100
Color T	02011L	1.0	98	98	100	96	98.0	96 - 100
Tanin & Lignin	06551L	0.1	0.5	0.6	0.4	0.5	0.5	0.4 - 0.6
T.R.	10471L	10.0	14098	14176	13928	14018	14055	13928 - 14176
T.F.R.	10571L	10.0	13760	13866	13630	13672	13732	13630 - 13866
T.F.R.F.								
T.N.F.R.								
T.N.F.R.F.								
Turbidity	02073L	0.0	5.0	5.0	4.0	4.0	4.5	4.0 - 5.0
Surfactants	10701L	0.05	1.42	1.39	1.80	1.30	1.48	1.30 - 1.80
Humic Acids								
T.O.C.	06001L	2.0	140.0	64.0		16.0	73.33	16.0 - 140.0
T.I.O.C.	06051L	2.0	594.0	357.0		338.0	429.67	338.0 - 594.0
Nitrite	07205L	0.1	0.1*	0.1*	0.1*	0.1*	0.1*	
NO_2 & NO_3	07105L	0.1	0.1*	0.1*	0.1*	0.2	0.13	0.1* - 0.2
NH_3	07555L	0.05	8.68	9.70	8.32	8.25	8.74	8.25 - 9.70
Nitrogen Tk	07003L	0.05	18.25	18.13	9.53	9.80	13.93	9.53 - 18.25
Phosphorus T	15001L	0.05	0.09	0.11	0.20	0.85	0.31	0.09 - 0.85

POLLUTION CONTROL LAB

PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	SAMPLE DATES 1977 Feb. 12***	Feb. 12	Feb. 22	Mar. 22	MEAN	RANGES Low - High
Phosphate T.	15407L							
Phosphorus O.	15256L							
Phenol	06532L	0.001			0.107	0.033	0.07	0.033 - 0.107
Oil & Grease	06521L	1.0			6.5	13.6	10.05	6.5 - 13.6
Sulphide	06101L	0.02			0.02*	0.02*	0.02*	
Cyanide	06601L	0.002	0.03	0.03		0.004	0.02	0.004 - 0.03
Hydrocarbon T	06500L	0.001						
B.O.D.	08201L	0.01				9.3	9.3	
C.O.D.	08301L	5.0	132.0	73.9	352.6	127.7	171.55	73.9 - 352.6
Cadmium	48302L	0.001	0.001*	0.001*	0.001*	0.001*	0.001*	
Chromium^{+6}	24101L	0.002	0.002*	0.002*	0.002*	0.002*	0.002*	
Copper	29305L	0.001	0.001*	0.008	0.045	0.084	0.037	0.001* - 0.094
Iron	26302L	0.05	0.45	0.48	0.42	0.17	0.38	0.17 - 0.48
Lead	82302L	0.003	0.003*	0.003*	0.003*	0.003*	0.003*	
Manganese	25004L	0.008	0.215	0.212	0.180	0.120	0.18	0.120 - 0.215
Silver	47303L	0.001	0.001*	0.001*	0.001*	0.008	0.0028	0.001* - 0.008
Zinc	30305L	0.001	0.006	0.027	0.012	0.008	0.012	0.006 - 0.027
Vanadium	23301L	0.05	0.01*	0.01*		0.01*	0.01*	
Selenium	34102L	0.0002			0.0002*	0.0002*	0.0002*	
Mercury	80003L	0.0001		0.0006	0.0005	0.0001*	0.0004	0.0001*- 0.0006
Arsenic	33104L	0.0002	0.0002*	0.0002*	0.0002*	0.0005	0.00028	0.0002*- 0.0005

PARAMETERS	POLLUTION CONTROL LAB NAQUADAT CODE	DETECTION LIMIT	SAMPLE DATES 1977 Feb. 12***	Feb. 12	Feb. 22	Mar. 22	MEAN	RANGES Low - High
Nickel	28302L	0.001	0.001*	0.001*	0.001*	0.001*	0.001*	
Aluminum	13005L	0.02						
Cobalt	27302L	0.001	0.001*	0.001*	0.001*	0.001*	0.001*	
Boron	05102L	0.1						
Pesticides	00000L							
T.D.S.	00205L	0.0	13720	13726	13547	13868	13715.25	13547. - 13868
P.C.B.'s	00000L	0.0001						
Carbon T	06006L	2.0	734.0	421.0		354.0	503.0	354.0 - 734.0

Conductivity in microsiemens/cm

Turbidity in J.T.U.

Metals as Totals mg/ℓ

Alkalinity and Hardness expressed Calcium Carbonate

Nitrite, NO_2 & NO_3, NH_3 expressed as N

Phosphorus T expressed as PO_4

Phosphorus O expressed as P

pH in pH units

* less than

*** semi-static

SUMMARY OF CHEMISTRY ANALYSIS OF

MINE DEPRESSURIZATION WATER COLLECTED FROM

SYNCRUDE'S LEASE 17 AND COMPARED TO ANALYSIS

OF CITY OF EDMONTON TREATED WATER

COMPOSITE (SEMI-STATIC)

PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	DATE OF BIOASSAY FEB.12/77	WELL PROFILE MEANS AND RANGES L - H	TREATED WATER FEB.12/77	TREATED WATER PROFILE MEANS AND RANGES L - H
Calcium	20105L	2.0	67.0	50.25 20.0 - 81.0	22.0	22.5 22.0 - 23.0
Magnesium	12102L	1.0	100.0	104.75 84.0 - 129.0	11.0	10.5 9.0 - 12.0
Sodium	11103L	0.1	5000.0	51000.0 5000.0 - 5400.0	13.0	65.0 4.0 - 237.0
Potassium	19103L	0.1	36.4	37.3 35.2 - 40.8	0.9	1.75 0.8 - 4.5
Chloride	17203L	1.0	6964.0	6818.0 6615.0 - 6964.0	4.0	2.8 0.1* - 7.0
Sulphate	16306L	10.0	23.0	27.5 19.0 - 36.0	49.0	164.25 46.0 - 505.0
Alkalinity T	10101L	5.0	2547.0	2624.5 2547.0 - 2696.0	66.0	56.25 46.0 - 66.0
pH	10301L	0	8.1	8.43 8.1 - 8.9	8.2	8.18 8.1 - 8.3
Carbonate	06301L	5.0		167.0 67.0 - 267.0		
Bicarbonate	06201L	5.0	3105.0	3029.75 2745.0 3283.0	80.0	68.25 56.0 - 80.0
Hardness	10604L	5.0	580.0	556.5 3940.0 - 639.0	102.0	100.5 96.0 - 108.0
Conductivity	02041L	0	23500.0	23187.5 22000.0 - 24500.0	220.0	217.0 188.0 - 260.0
Surfactants	10701L	0.05	1.42	1.48 1.30 - 1.80	0.13	0.07 0.05* - 0.13
T.O.C.	06001L	2.0	140.0	73.33 16.0 - 140.0		
T.I.O.C.	06051L	2.0	594.0	429.67 338.0 - 594.0		
Phenol	06532L	0.001		0.07 0.033 - 0.107		0.001*

COMPOSITE (SEMI-STATIC) (Continued)

PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	DATE OF BIOASSAY FEB.12/77	WELL PROFILE MEANS AND RANGES L - H	TREATED WATER FEB.12/77	TREATED WATER PROFILE MEANS AND RANGES L - H
Oil & Grease	06521L	0.02		10.05 6.5 - 13.6		2.1
Sulphide	16101L	0.02		0.02*		
Cyanide	06601L	0.002	0.03	0.02 0.004 - 0.03		
Hydrocarbon T	06500L	0.001				
C.O.D.	08301L	5.0	132.0	171.55 73.9 - 352.6		5.47 5.0* - 6.4
Cadmium	48302L	0.001	0.001*	0.001*		0.001*
Chromium^{+6}	24101L	0.002	0.002*	0.002*		0.002*
Copper	29305L	0.001	0.001*	0.037 0.001* - 0.094		0.001*
Iron	26302L	0.05	0.45	0.38 0.17 - 0.48		0.27 0.06 - 0.80
Lead	82302L	0.003	0.003*	0.003*		0.003*
Manganese	25304L	0.008	0.215	0.18 0.12 - 0.215		0.008*
Silver	47303L	0.001	0.001*	0.0028 0.001* - 0.008		
Zinc	30305L	0.001	0.006	0.012 0.006 - 0.027	0.007	0.005 0.002 - 0.007
Vanadium	04303L	0.01	0.01*	0.01*		
Selenium	34102L	0.0002		0.0002*		
Mercury	80011L	0.0001		0.004 0.0001* - 0.0006		0.001*
Arsenic	33104L	0.0002	0.0002*	0.0028 0.0002* - 0.0005		
Nickel	28302L	0.001	0.001*	0.001*		0.001*
Aluminum						
Cobalt	27302L	0.001	0.001*	0.001*		0.001*
Boron						
Carbon T	06006L	2.0	734.0	503.0 354.0 - 734.0		

COMPOSITE (SEMI-STATIC) (Continued)

Conductivity in microsiemens/cm
Turbidity in J.T.U.
Metals as Totals mg/l
Alkalinity and Hardness expressed as Calcium Carbonate
Nitrite, No_2 + NO_3, NH_3 expressed as N
Phosphorus T expressed as PO_4
Phosphorus O expressed as P
pH in pH units
* less than

Analysis by Department of Environment, Pollution Control Division Laboratory.

SUMMARY OF CHEMISTRY ANALYSIS OF

MINE DEPRESSURIZATION WATER COLLECTED FROM

SYNCRUDE'S LEASE 17 AND COMPARED TO ANALYSIS

OF CITY OF EDMONTON TREATED WATER

COMPOSITE (CONTINUOUS FLOW)

PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	DATE OF BIOASSAY FEB.12/77	WELL PROFILE MEANS AND RANGES L - H	TREATED WATER FEB.12/77	TREATED WATER PROFILE MEANS AND RANGES L - H
Calcium	20105L	2.0	20.0	50.25 20.0 - 81.0	22.0	22.5 22.0 - 23.0
Magnesium	12102L	1.0	84.0	104.75 84.0 - 129.0	11.0	10.5 9.0 - 12.0
Sodium	11103L	0.1	5000.00	5100.0 5000.0 - 5400.0	13.0	65.0 4.0 - 237.0
Potassium	19103L	0.1	35.2	37.3 35.2 - 40.8	0.9	1.75 0.8 - 4.5
Chloride	17203L	1.0	6943.0	6818.0 6615.0 - 6964.0	4.0	2.8 0.1* - 7.0
Sulphate	16306L	10.0	19.0	27.5 19.0 - 36.0	49.0	164.25 46.0 - 505.0
Alkalinity T	10101L	5.0	2694.0	2624.5 2547.0 - 2696.0	66.0	56.25 46.0 - 66.0
pH	10301L	0	8.3	8.43 8.1 - 8.9	8.2	8.18 8.1 - 8.3
Carbonate	06301L	5.0		167.0 67.0 - 267.0		
Bicarbonate	06201L	5.0	3283.0	3029.75 2745.0 - 3283.0	80.0	68.25 56.0 - 80.0
Hardness T	10604L	5.0	394.0	556.5 394.0 - 639.0	102.0	100.5 96.0 - 108.0
Conductivity	02041L	0	22750.0	23187.5 22000.0 - 24500.0	220.0	217.0 188.0 - 260.0
Surfactants	10701L	0.05	1.39	1.48 1.30 - 1.80	0.13	0.07 0.05* - 0.13
T.O.C.	06001L	2.0	64.0	73.33 16.0 - 140.0		
T.I.O.C.	06051L	2.0	357.0	429.67 338.0 - 594.0		
Phenol	06532L	0.001		0.07 0.033 - 0.107		0.001*

COMPOSITE (CONTINUOUS FLOW) (Continued)

PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	DATE OF BIOASSAY FEB.12/77	WELL PROFILE MEANS AND RANGES L - H	TREATED WATER FEB.12/77	TREATED WATER PROFILE MEANS AND RANGES L - H
Oil & Grease	06521L	0.02		10.05 6.5 - 13.6		2.1
Sulphide	16101L	0.02		0.02*		
Cyanide	06601L	0.002	0.03	0.02 0.004 - 0.03		
Hydrocarbon T	06500L	0.001				
C.O.D.	08301L	5.0	73.9	171.55 73.9 - 352.6		5.47 5.0* - 6.4
Cadmium	48302L	0.001	0.001*	0.001*		0.001*
Chromium^{+6}	24101L	0.002	0.002*	0.002*		0.002*
Copper	29305L	0.001	0.008	0.037 0.001* - 0.094		0.001*
Iron	26302L	0.05	0.48	0.38 0.17 - 0.48		0.27 0.06 - 0.80
Lead	82302L	0.003	0.003*	0.003*		0.003*
Manganese	25304L	0.008	0.212	0.18 0.12 - 0.215		0.008*
Silver	47303L	0.001	0.001*	0.0028 0.001* - 0.008		
Zinc	30305L	0.001	0.027	0.012 0.006 - 0.027	0.007	0.005 0.002 - 0.007
Vanadium	04303L	0.01	0.01*	0.01*		
Selenium	34102L	0.0002		0.002*		
Mercury	80011L	0.0001	0.0006	0.0004 0.0001* - 0.0006		0.0001*
Arsenic	33104L	0.0002	0.0002*	0.00028 0.0002* - 0.0005		
Nickel	28302L	0.001	0.001*	0.001*		0.001*
Aluminum						
Cobalt	27302L	0.001	0.001*	0.001*		0.001*
Boron						
Carbon T.	06006L	2.0	421.0	503.0 354.0 - 734.0		

COMPOSITE (CONTINUOUS FLOW) (Continued)

Conductivity in microsiemens/cm
Turbidity in J.T.U.
Metals as Totals mg/l
Alkalinity and Hardness expressed as Calcium Carbonate
Nitrite, NO_2 + NO_3, NH_3 expressed as N
Phosphorus T expressed as PO_4
Phosphorus O expressed as P
pH in pH units
* less than

Analysis by Department of Environment, Pollution Control Division Laboratory.

COMPOSITE (CONTINUOUS FLOW) (Continued)

PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	DATE OF BIOASSAY FEB.22/77	WELL PROFILE MEANS AND RANGES L - H	TREATED WATER FEB.22/77	TREATED WATER PROFILE MEANS AND RANGES L - H
Oil & Grease	06521L	0.02	6.5	10.05 6.5 - 13.6		2.1
Sulphide	16101L	0.02	0.02*	0.02*		
Cyanide	06601L	0.002		0.02 0.004 - 0.03		
Hydrocarbon T	06500L	0.001				
C.O.D.	08301L	5.0	352.6	171.55 73.9 - 352.6	6.4	5.47 5.0* - 6.4
Cadmium	48302L	0.001	0.001*	0.001*	0.001*	0.001*
Chromium^{+6}	24101L	0.002	0.002*	0.002*	0.002*	0.002*
Copper	29305L	0.001	0.045	0.037 0.001* - 0.094	0.001*	0.001*
Iron	26302L	0.05	0.042	0.38 0.17 - 0.48	0.80	0.27 0.06 - 0.80
Lead	82302L	0.003	0.003*	0.003*	0.003*	0.003*
Manganese	25304L	0.008	0.18	0.18 0.120 - 0.215	0.008*	0.008*
Silver	47303L	0.001	0.001*	0.0028 0.001* - 0.008		
Zinc	30305L	0.001	0.012	0.012 0.006 - 0.027	0.002	0.005 0.002 - 0.007
Vanadium	04303L	0.01		0.01*		
Selenium	34102L	0.0002	0.0002*	0.0002*		
Mercury	80011L	0.0001	0.0005	0.0004 0.0001* - 0.0006		0.0001*
Arsenic	33104L	0.0002	0.0002*	0.00028 0.0002* - 0.0005		
Nickel	28302L	0.001	0.001*	0.001*	0.001*	0.001*
Aluminum						
Cobalt	27302L	0.001	0.001*	0.001*	0.001*	0.001*
Boron						
Carbon T	06006L	2.0		503.0 354.0 - 734.0		

SUMMARY OF CHEMISTRY ANALYSIS OF

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OF CITY OF EDMONTON TREATED WATER

COMPOSITE (CONTINUOUS FLOW)

PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	DATE OF BIOASSAY FEB.22/77	WELL PROFILE MEANS AND RANGES L - H	TREATED WATER FEB.22/77	TREATED WATER PROFILE MEANS AND RANGES L - H
Calcium	20105L	2.0	81.0	50.25 20.0 - 81.0	23.0	22.5 22.0 - 23.0
Magnesium	12102L	1.0	106.0	104.75 84.0 - 129.0	9.0	10.5 9.0 - 12.0
Sodium	11103L	0.1	5000.0	5100.0 5000.0 - 5400.0	237.0	65.0 4.0 - 237.0
Potassium	19103L	0.1	36.8	37.3 35.2 - 40.8	4.5	1.75 0.8 - 4.5
Chloride	17203L	1.0	6750.0	6818.0 6615.0 - 6964.0	7.0	2.8 0.1* - 7.0
Sulphate	16306L	10.0	36.0	27.5 19.0 - 36.0	505.0	164.25 46.0 - 505.0
Alkalinity T	10101L	5.0	2561.0	2624.5 2547.0 - 2696.0	60.0	56.25 46.0 - 66.0
pH	10301L	0	8.4	8.43 8.1 - 8.9	8.3	8.18 8.1 - 8.3
Carbonate	06301L	5.0	67.0	167.0 67.0 - 267.0		
Bicarbonate	06201L	5.0	2986.0	3029.75 2745.0 - 3283.0	73.0	68.25 56.0 - 80.0
Hardness T	10604L	5.0	639.0	556.5 394.0 - 639.0	96.0	100.5 96.0 - 108.0
Conductivity	02041L	0	22000.0	23187.5 22000.0 - 24500.0	260.0	217.0 188.0 - 260.0
Surfactants	10701L	0.05	1.80	1.48 1.30 - 1.80	0.05*	0.07 0.05* - 0.13
T.O.C.	06001L	2.0		73.33 16.0 - 140.0		
T.I.O.C.	06051L	2.0		429.67 338.0 - 594.0		
Phenol	06532L	0.001	0.107	0.07 0.033 - 0.107	0.001*	0.001*

COMPOSITE (CONTINUOUS FLOW) (Continued)

Conductivity in microsiemens/cm
Turbidity in J.T.U.
Metals as Totals mg/l
Alkalinity and Hardness expressed as Calcium Carbonate
Nitrite, NO_2 + NO_3, NH_3 expressed as N
Phosphorus T expressed as PO_4
Phosphorus O expressed as P
pH in pH units
* less than

Analysis by Department of Environment, Pollution Control Division Laboratory.

SUMMARY OF CHEMISTRY ANALYSIS OF

MINE DEPRESSURIZATION WATER COLLECTED FROM

SYNCRUDE'S LEASE 17 AND COMPARED TO ANALYSIS

OF CITY OF EDMONTON TREATED WATER

COMPOSITE (CONTINUOUS FLOW)

PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	DATE OF BIOASSAY MAR.22/77	WELL PROFILE MEANS AND RANGES L - H	TREATED WATER MAR.22/77	TREATED WATER PROFILE MEANS AND RANGES L - H
Calcium	20105L	2.0	33.0	50.25 20.0 - 81.0	23.0	22.5 22.0 - 23.0
Magnesium	12102L	1.0	129.0	104.75 84.0 - 129.0	12.0	10.5 9.0 - 12.0
Sodium	11103	0.1	5400.0	5100.0 5000.0 - 5400.0	4.0	65.0 4.0 - 237.0
Potassium	19103L	0.1	40.8	37.3 35.2 - 40.8	0.8	1.75 0.8 - 4.5
Chloride	17203L	1.0	6615.0	6818.0 6615.0 - 6964.0	0.1*	2.8 0.1* - 7.0
Sulphate	16306L	10.0	32.0	27.5 19.0 - 36.0	57.0	164.25 46.0 - 505.0
Alkalinity T	10101L	5.0	2696.0	2624.5 2547.0 2696.0	53.0	56.25 46.0 - 66.0
pH	10301L	0	8.9	8.43 8.1 - 8.9	8.1	8.18 8.1 - 8.3
Carbonate	0630L	5.0	267.0	167.0 67.0 - 267.0		
Bicarbonate	06201L	5.0	2745.0	3029.75 2745.0 - 3283.0	64.0	68.25 56.0 - 80.0
Hardness T	10604L	5.0	613.0	556.5 394.0 - 639.0	108.0	100.5 96.0 - 108.0
Conductivity	02041L	0	24500.0	23187.5 22000.0 - 24500.0	200.0	217.0 188.0 - 260.0
Surfactants	10701L	0.05	1.30	1.48 1.30 - 1.80	0.05*	0.07 0.05* - 0.13
T.O.C.	06001L	2.0	16.0	73.33 16.0 - 140.0		
T.I.O.C.	06051L	2.0	338.0	429.67 338.0 - 594.0		
Phenol	06532L	0.001	0.033	0.07 0.033 - 0.107	0.001*	0.001*

COMPOSITE (CONTINUOUS FLOW) (Continued)

PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	DATE OF BIOASSAY MAR.22/77	WELL PROFILE MEANS AND RANGES L - H	TREATED WATER MAR.22/77	TREATED WATER PROFILE MEANS AND RANGES L - H
Oil & Grease	06521L	0.02	13.6	10.05 6.5 - 13.6	2.1	2.1
Sulphide	16101L	0.02	0.02*	0.02*		
Cyanide	06601L	0.002	0.004	0.02 0.004 - 0.03		
Hydrocarbon T	06500L	0.001				
C.O.D.	08301L	5.0	127.7	171.55 73.9 - 352.6	5.0*	5.47 5.0* - 6.4
Cadmium	48302L	0.001	0.001*	0.001*		0.001*
Chromium^{+6}	24101L	0.002	0.002*	0.002*	0.002*	0.002*
Copper	29305L	0.001	0.094	0.037 0.001* - 0.094		0.001*
Iron	26302L	0.05	0.17	0.38 0.17 - 0.48	0.06	0.27 0.06 - 0.80
Lead	82302L	0.003	0.003*	0.003*		0.003*
Manganese	25304L	0.008	0.12	0.18		0.008
Silver	47303L	0.001	0.008	0.0028 0.001* - 0.008		
Zinc	30305L	0.001	0.008	0.012 0.006 - 0.027		0.005 0.002 - 0.007
Vanadium	04303L	0.01	0.01*	0.01*		
Selenium	34102L	0.0002	0.0002*	0.0002*		
Mercury	80011L	0.0001	0.0001*	0.0004 0.0001* - 0.0006	0.0001*	0.0001*
Arsenic	33104L	0.0002	0.0005	0.0028 0.0002* - 0.0005		
Nickel	28302L	0.001	0.001*	0.001*		0.001*
Aluminum						
Cobalt	27302L	0.001	0.001*	0.001*	*	0.001*
Boron						
Carbon T	06006L	2.0	354.0	503.0 354.0 - 734.0		

COMPOSITE (CONTINUOUS FLOW) (Continued)

Conductivity in microsiemens/cm
Turbidity in J.T.U.
Metals as Totals mg/l
Alkalinity and Hardness expressed as Calcium Carbonate
Natrite, NO_2 + NO_3, NH_3 expressed as N
Phosphorus T expressed as PO_4
Phosphorus O expressed as P
pH in pH units
* less than

Analysis by Department of Environment, Pollution Control Division Laboratory.

7. ATHABASCA RIVER CHEMISTRY ANALYSIS (JUNE TO OCTOBER 1976)

CHEMISTRY DATA SITE #6

ATHABASCA RIVER

	POLLUTION CONTROL LAB		SAMPLE DATES 1976		CHEMEX LABS (ALTA) LTD.									
PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	JUNE 14	JULY 08	NAQUADAT CODE	DETECTION LIMIT	JULY 22	27**	28	AUGUST 04	09**	18	24**	30**
Calcium	20105L	2.0	39	40	20103L	0.002	21.5	22	22	23	25	25	340	21
Magnesium	12102L	1.0	10	8	12102L	0.001	6.3	6.5	6.5	6.2	7.2	7.5	7.4	5.7
Sodium	11102L	0.1	36	15	11102L	0.5	6.0	6.0	6.0	5.9	5.9	8.2	6.2	7.4
Potassium	19102L	0.1	1.5	1.1	19102L	0.5	0.7	1.0	1.0	0.7	1.0	1.0	1.1	1.5
Chloride	17203L	1.0	51	13	17203L	0.5	4.5	2.5	2.5	3.0	5.1	6.0	1.6	1.4
Sulphate	16306L	10.0	41	20	16306L	1.0	2.6	12.2	12.2	0.5	27.0	19.6	15.2	11.0
Alkalinity T	10101L	5.0	129	106	10101L	1.0	90.1	87.6	87.6	98.2	80.0	82.0	104.0	86.6
pH	10301L	0.0	8.3	7.9	10301L	0.0	7.6	7.3	7.3	7.3	8.1	7.6	7.8	7.6
Carbonate	06301L	5.0			06301L	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bicarbonate	06201L	5.0	158	130	06201L	1.0	109.8	106.8	106.8	119.7	97.5	100.0	126.8	105.6
Hardness T	10604L	5.0	132	132	10603L	1.0	97.6	81.7	81.7	83.0	92.1	93.3	115.4	75.9
Fluoride	09107L	0.05	0.17	0.16	09105L	0.1	0.10	0.10	0.10	0.08	0.10	0.09	0.08	0.09
Silica	14102L	0.5			14101L	0.02	5.7	4.9	4.9	4.7	4.8	5.4	6.3	6.2
Conductivity	02041L	0.2	270	205	02041L	1.0	156	175	175	196	220	193	200	200

CHEMISTRY DATA SITE 6 ATHABASCA RIVER

PARAMETERS	September 02	September 08	September 15	September 24**	September 28	September 30**	October 06**	MEAN	RANGE Low - High
Calcium	17.5	18	18.5	23	26	25	22.5	31.35	17.5 - 40
Magnesium	5.0	4.5	4.5	6.4	6.8	7	6.2	6.57	4.5 - 10
Sodium	7.1	8.5	6.5	7.5	8	8.1	9.6	9.29	5.9 - 36
Potassium	1.4	1	0.8	0.4	0.4	0.4	0.5	0.91	0.4 - 1.5
Chloride	1.4	3.8	1	1.1	1.4	2	2.6	6.11	1.0 - 51
Sulphate	6.6	4.2	4.8	14.1	14.6	15	14.1	13.8	0.5 - 41
Alkalinity	68.1	66.8	66.8	75	84	86	76	86.69	66.8 - 129
pH	6.8	7.1	7.6	7.5	7.6	7.4	7.2	7.5	6.8 - 8.3
Carbonate	0.0	0	0	0	0	0	0	0	
Bicarbonate	83.0	81.4	81.4	91.4	102.4	104.8	92.6	105.76	81.4 - 158
Hardness T	64.3	63.5	64.7	83.8	92.9	91.2	81.7	89.1	63.5 - 138
Fluoride	0.09	0.09	0.1	0.09	0.1	0.06	0.07	0.09	0.06 - 0.17
Silica	6.9	5.9	5.7	6.1	5.9	5.8	5.9	5.67	4.7 - 6.9
Conductivity	132	140	143	178	193	199	182	185.7	132 - 270

CHEMISTRY DATA SITE #6 ATHABASCA RIVER

	POLLUTION CONTROL LAB		SAMPLE DATES 1976		CHEMEX LABS (ALTA) LTD.									
PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	JUNE 14	JULY 08	NAQUADAT CODE	DETECTION LIMIT	JULY 22	27**	28	AUGUST 04	09**	18	24**	30**
Odor	02001L	0.0	1		02001L	1.0	4	2	2	2	2	4	32	4
Color	02011L	1.0	98	92	02011L	1.0	50	50	50	50	35	25	60	120
Color T_2	02011L	1.0	99	94										
Color T_3	02011L	1.0	97	79										
Tanin & Lignin	06551L	0.1	0.5	1.2	06551L	0.1	1.10	1.10	1.10	1.3	0.90	1.00	1.00	2.60
T.R.	10471L	10.0	372	636										
T.F.R.	10571L	10.0		486	10451L	1.0	128	120	120	101	131	122	131	110
T.F.R.F.					10551L	1.0	114	114	114	52	84	108	84	64.0
T.N.F.R.					10401L	1.0	148.8	62.8	62.8	15.2	94.0	87	389	2602
T.N.F.R.F.					10510L	1.0	128	52.4	52.4	10.0	8312	83	362	2456
Turbidity	02073L	0.0	15		02073L	0.0	73	48.0	48.0	33.0	62.4	84.5	230	675
Surfactants	10701L	0.05	0.09	0.06	10701L	0.02	0.02	0.02*	0.02*	0.02*	0.02*	0.02*	0.02*	0.02*
Humic Acids					00000L	2.0	11.0	14.0	14.0	8.0	5.5	2.0	7.5	11.5
T.O.C.	06001L	2.0	23	34	06001L	1.0	16.5	13.5	13.5	12	12	10.5	19.5	57.0
T.I.O.C.	06051L	2.0	18	14	06501L	0.5	21.5	19.5	18.5	40	23	25	24.5	23.0
Nitrite	07205L	0.1	0.1*	0.1*										
NO_2 & NO_3	07105L	0.1	0.1*	0.1*	07110L	0.01	0.01	0.01*	0.01*	0.01*	0.01*	0.02	0.01*	0.01*

CHEMISTRY DATA SITE 6 ATHABASCA RIVER

PARAMETERS	September 02	September 08	September 15	September 24**	September 28	September 30**	October 06**	MEAN	RANGE Low	-	High
Odor	2	4	2	4	2	2	2	4.44	1	-	32
Color	140	200	160	85	100	70	110	87.94	25	-	200
Color T								96.5	94	-	99
Color T_3								88	79	-	97
Tanin & Lignin	3.10	2.9	2.3	2	2.2	2.25	2.15	1.69	0.5	-	3.1
TR								504	372	-	636
TFR	85.2	84	84	114	114	114	107	134.45	85.2	-	486
TFRF	78.4	76	80	110	97	95	85	90.36	52	-	114
TNFR	386	271.6	165.6	4.4	50.8	130	49.6	301.31	4.4	-	2602
TNFRF	344	245.6	152.8	1.6	43.6	114	41.6	278.01	1.6	-	2456
Turbidity	345							471.39	15	-	675
Surfactants	0.02*	0.02*	0.02*	0.02*	0.02*	0.02*	0.02*	0.03	0.02*	-	0.09
Humic Acids	12.5	14.5	14	5.5	6.5	6	7	9.3	2	-	14.5
TOC	70.0	38	31	24	19	22.5	23	25.82	10.5	-	70
TIOC	14.5	13	11	16.5	19	13.5	17	19.44	11	-	40
Nitrite								0.1*			
NO_2 & NO_3	0.01*	0.04	0.03	0.01*	0.01*	0.01*	0.01	0.024	0.01*	-	0.04

CHEMISTRY DATA SITE #6 ATHABASCA RIVER

	POLLUTION CONTROL LAB		SAMPLE DATES 1976		CHEMEX LABS (ALTA) LTD.									
PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	JUNE 14	JULY 08	NAQUADAT CODE	DETECTION LIMIT	JULY 22	27**	28	AUGUST 04	09**	18	24**	30**
NH_3	07555L	0.05		0.20*	07506L	0.005	0.24	0.10	0.10	0.02	0.02	0.03	0.03	0.04
Nitrogen Tk	07003L	0.05	0.49	0.98	070131L	0.3	1.85	1.15	1.15	0.7	1.50	0.92	2.40	3.20
Phosplate T	15407L		0.31	1.27			0.10	0.112						
Phosphorus T	15001L	0.05			15406L	0.003	0.10	0.112	0.112	0.13	0.15	0.62	0.38	1.85
Phosphorus O	15256L				15256L	0.003	0.009	0.010	0.010	0.01	0.02	0.01	0.01	0.03
Phenol	06532L	0.001			06532L	0.002	0.0001*	0.0001*	0.001*	0.00	0.001*	0.008	0.022	0.001*
Oil & Grease	06521L	1.0			06521L	0.1	0.1*	0.1*	0.1*	0.1*	0.1*	0.1*	5.0*	0.1*
Sulphide	06101L	0.02			16101L	0.05	0.05*	0.05*	0.05*	0.05*	0.05*	0.05*	0.05*	0.05*
Cyanide	06601L	0.002	0.01*	0.01*	00000L	0.1	0.01*	0.01*	0.01*	0.01*	0.01*	0.01*	0.01*	0.01*
Hydrocarbon T	06500L	0.001	0.001*	0.51	00000L	10.	1.0*	5.0*	5.0*	0.1*	0.1*	0.1*	2.0	0.1*
B.O.D.	08201L	0.01												
C.O.D.	08301L	5.0	205.4	57.4	08301L	5.0	45.8	47.3	47.3	34.2	64.0	85.0	43.0	267.0
Cadmium	48302L	0.001	0.019		48302L	0.001	0.001*	0.001*	0.001*	0.001*	0.001*	0.001*	0.001*	0.001*
Chromium^{+6}	24101L	0.002	0.002*	0.002*	24101L	0.003	0.003*	0.003*	0.003*	0.003*	0.005	0.003*	0.008	0.018
Copper	29305L	0.001			29306L	0.01	0.014	0.053	0.053	0.002	0.006	0.004	0.011	0.059
Iron	26302L	0.05	1.3	0.9	26304L	0.05	2.30	2.70	2.70	1.60	2.90	2.55	9.80	63.0
Lead	82302L	0.003			82302L	0.002	0.002	0.003	0.003	0.002*	0.002*	0.004	0.002	0.019
Manganese	25004L	0.008			25004L	0.01	0.11	0.09	0.09	0.06	0.11	0.09	0.32	1.70

CHEMISTRY DATA SITE 6 ATHABASCA RIVER

PARAMETERS	September 02	September 08	September 15	September 24**	September 28	September 30**	October 06**	MEAN	RANGE Low - High
NH_3	0.03*	0.07	0.02	0.08	0.1	0.13	0.12	0.08	0.02 - 0.24
Nitrogen Tk	2.0	2	0.73	0.37	0.4	0.88	0.89	1.27	0.37 - 3.2
Phosphorus T	0.55	0.36	0.12	0.2	0.1	0.2	0.14	0.34	0.1 - 1.85
Phosphate T									0.31 - 1.27
Phosphorus O	0.02	0.02	0.01	0.01	0.01	0.01*	0.02	0.014	0.01* - 0.03
Phenol	0.001*	0.001*	0.001*	0.008	0.009	0.009	0.006	0.005	0.001* - 0.022
Oil & Grease	0.1*	0.1*	0.7	0.4	0.4	0.4	0.7	0.56	0.1* - 5
Sulphide	0.05*	0.05*	0.05	0.05*	0.05*	0.05*	0.05*	0.05*	
Cyanide	0.01*	0.01*	0.01*	0.01*	0.01*	0.01*	0.01*	0.01*	
Hydrocarbon T	0.1*	0.1*		0.1*	0.1*	0.1*	0.1*	0.9	0.001* - 2
BOD									
COD	100.0	135.8	124.6	48.3	64	70	37	86.83	37 - 267
Cadmium	0.001*	0.001*	0.001*	0.001*	0.001*	0.001*	0.001*	0.002	0.001* - 0.019
Chromium $^{+6}$	0.003	0.005	0.003*	0.003*	0.003*	0.003*	0.003*	0.004	0.002* - 0.018
Copper	0.012	0.034	0.004	0.005	0.009	0.009	0.008	0.019	0.002 - 0.059
Iron	10.2	8.45	5.25	2.45	2.1	2.95	2.15	7.26	0.9 - 63
Lead	0.002*	0.026	0.002*	0.002*	0.012	0.002*	0.004	0.0056	0.002* - 0.026
Manganese	0.315	0.194	0.13	0.066	0.063	0.152	0.056	0.24	0.056 - 1.7

CHEMISTRY DATA SITE #6 ATHABASCA RIVER

	POLLUTION CONTROL LAB SAMPLE DATES 1976				CHEMEX LABS (ALTA) LTD.									
PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	JUNE 14	JULY 08	NAQUADAT CODE	DETECTION LIMIT	JULY 22	27**	28	AUGUST 04	09**	18	24**	30**
Silver	47303L	0.001			47301L	0.01	0.005*	0.005*	0.005*	0.005*	0.005*	0.005*	0.005*	0.005*
Zinc	30305L	0.001			30304L	0.01	0.020	0.039	0.039	0.036	0.03	0.069	0.036	0.331
Vanadium	23301L	0.05			23301L	0.05	0.01*	0.01*	0.01*	0.001*	0.001*	0.002	0.003	0.001*
Selenium	34102L	0.0002					0.002*	0.002*	0.002*	0.002*	0.002*	0.002*	0.0005*	0.0005*
Mercury	80003L	0.0001	0.0001*	0.0001*			0.0002*	0.0002*	0.0002*	0.0002*	0.0002*	0.0002*	0.0002*	0.0002*
Arsenic	33104L	0.0002		0.0025*			0.02	0.005	0.005*	0.005*	0.005*	0.005*	0.005*	0.015
Nickel	28302L	0.001	0.006				0.01	0.002*	0.002*	0.004	0.08	0.004	0.022	0.071
Aluminum	13005L	0.02					1.21	1.22	1.22	0.43	1.50	0.91	2.95	10.60
Cobalt	27302L	0.001					0.002*	0.002*	0.002*	0.002*	0.002*	0.002*	0.006	0.043
Boron	05102L	0.1					0.10	0.04	0.04	0.03	0.05	0.29	0.02	1.51
Pesticides	00000L													
T.D.S.	00205L	0.0	256	162										
P.C.B.'s	00000L	0.0001		0.0001*										
Carbon T	06006L	2.0	41	48										

Conductivity in microsiemens/cm

Turbidity in J.T.U.

Metals as Totals mg/l

Alkalinity and Hardness expressed Calcium Carbonate

Nitrite, NO_2 + NO_3, NH_3 expressed as N

Phosphorus T expressed as PO_4

Phosphorus O expressed as P

pH in pH units

* less than

CHEMISTRY DATA SITE 6 ATHABASCA RIVER

PARAMETERS	September 02	September 08	September 15	September 24**	September 28	September 30**	October 06**	MEAN	RANGE Low - High
Silver	0.005*	0.005*	0.005*	0.005*	0.005*	0.005*		0.005*	
Zinc	0.058	0.064	0.015	0.014	0.015	0.014	0.016	0.053	0.014 - 0.069
Vanadium	0.014	0.001*	0.001*	0.001*	0.003	0.001*	0.001*	0.004	0.001* - 0.014
Selenium	0.0005*	0.0005*	0.0005*	0.0005*	0.0005*	0.0018	0.0013	0.0012	0.0005*- 0.0018
Mercury	0.0002*	0.0044	0.0002*	0.0002*	0.0002*		0.0002*	0.0067	0.0001*- 0.0044
Arsenic	0.005*	0.005*	0.006	0.009	0.009	0.001*	0.004	0.0065	0.0025*- 0.02
Nickel	0.009	0.008	0.002*	0.002*	0.002	0.002	0.002*	0.014	0.002* - 0.08
Aluminum	4.50	2.95	1.25	0.7	0.62	0.82	0.58	2.1	0.43 - 10.6
Cobalt	0.006	0.002*	0.002*	0.002*	0.002*	0.002*	0.002*	0.005	0.002* - 0.043
Boron	0.03	0.01	0.02	0.12	0.16	0.1	0.45	0.2	0.01 - 1.51
Pesticides									
TDS								209	162 - 256
PCB's								0.0001*	
Carbon T								44.5	41 - 48

8. CITY OF EDMONTON TREATED WATER CHEMISTRY ANALYSIS (FEBRUARY TO MARCH 1977)

MINE DEPRESSURIZATION WATER

SYNCRUDE LEASE 17

CHEMISTRY DATA CITY OF EDMONTON TREATED WATER

PARAMETERS	POLLUTION CONTROL LAB NAQUADAT CODE	DETECTION LIMIT	SAMPLE DATES 1977 Feb. 12	Feb. 22	Mar. 1	Mar. 22	MEAN	RANGES Low - High
Calcium	20105L	2.0	22.0	23.0	22.0	23.0	22.5	22.0 - 23.0
Magnesium	12102L	1.0	11.0	9.0	10.0	12.0	10.5	9.0 - 12.0
Sodium	11102L	0.1	13.0	237.0	6.0	4.0	65.0	4.0 - 237.0
Potassium	19102L	0.1	0.9	4.5	0.8	0.8	1.75	0.8 - 4.5
Chloride	17203L	1.0	4.0	7.0	0.1*	0.1*	2.8	0.1* - 7.0
Sulphate	16306L	10.0	49.0	505.0	46.0	57.0	164.25	46.0 - 505.0
Alkalinity	10101L	5.0	66.0	60.0	46.0	53.0	56.25	46.0 - 66.0
pH	10301L	0.0	8.2	8.3	8.1	8.1	8.18	8.1 - 8.3
Carbonate	06301L	5.0						
Bicarbonate	06201L	5.0	80.0	73.0	56.0	64.0	68.25	56.0 - 80.0
Hardness T	10604L	5.0	102.0	96.0	96.0	108.0	100.5	96.0 - 108.0
Fluoride	09107L	0.05	0.75	0.18	0.37	0.67	0.49	0.18 - 0.75
Silica	14102L	0.5	4.2	18.3	3.2	3.9	7.4	3.2 - 18.3
Conductivity	02041L	0.2	220.0	260.0	188.0	200.0	217.0	188.0 - 260.0
Odor	02001L	0.0		1.0	1.0	1.0	1.0	
Color	02011L	1.0		100	100	100	100	
Color T_2	02011L	1.0		100	100	100	100	
Color T_3	02011L	1.0		100	99	99	99.33	99 - 100

POLLUTION CONTROL LAB

PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	SAMPLE DATES 1977 Feb. 12	Feb. 22	Mar. 1	Mar. 22	MEAN	RANGES Low - High
Tanin & Lignin	06551L	0.1		0.1*	0.1*	0.1*	0.1*	
T.R.	10471L	10.0		212.0		184.0	198.0	184.0 - 212.0
T.F.R.	10571L	10.0		168.0		148.0	158.0	148.0 - 168.0
T.F.R.F.								
T.N.F.R.								
T.N.F.R.F.								
Turbidity	02073L	0.0		1.0	1.0	4.0	2.0	1.0 - 4.0
Surfactants	10701L	0.05	0.13	0.05*	0.05*	0.05*	0.05*	0.05* - 0.13
Humic Acids								
T.O.C.	06001L	2.0						
T.I.O.C.	06051L	2.0						
Nitrite	07205L	0.1	0.1*	0.1*	0.1*	0.1*	0.1*	
NO_2 & NO_3	07105L	0.1	0.1*	0.1*	0.1*	0.1*	0.1*	
NH_3	07555L	0.05	0.53	0.36	0.56	0.75	0.55	0.36 - 0.75
Nitrogen Tk	07003L	0.05	0.63	0.41	0.61	0.82	0.62	0.41 - 0.82
Phosphorus T	15001L	0.05	0.05*	0.05*	0.05*	0.06	0.053	0.05* - 0.06
Phosphate T	15407L							
Phosphorus O	15256L							
Phenol	06532L	0.001		0.001*	0.001*	0.001*	0.001*	
Oil & Grease	06521L	1.0						
Sulphide	06101L	0.02						

POLLUTION CONTROL LAB

PARAMETERS	NAQUADAT CODE	DETECTION LIMIT	SAMPLE DATES 1977 Feb. 12	Feb. 22	Mar. 1	Mar. 22	MEAN	RANGES Low - High
Cyanide	06601L	0.002						
Hydrocarbon T	06500L	0.001						
B.O.D.	08201L	0.01				1.0*	1.0*	
C.O.D.	08301L	5.0		6.4	5.0*	5.0*	5.47	5.0* - 6.4
Cadmium	48302L	0.001		0.001*			0.001*	
Chromium^{+6}	24101L	0.002		0.002*	0.002*	0.002*	0.002*	
Copper	29305L	0.001	0.001*	0.001*			0.001*	
Iron	26302L	0.05	0.16	0.80	0.07	0.06	0.27	0.06 - 0.80
Lead	82302L	0.003	0.003*	0.003*			0.003*	
Manganese	25004L	0.008	0.008*	0.008*			0.008*	
Silver	47303L	0.001						
Zinc	30305L	0.001	0.007	0.002			0.005	0.002 - 0.007
Vanadium	23301L	0.05						
Selenium	34102L	0.0002						
Mercury	80003L	0.0001				0.0001*	0.0001*	
Arsenic	33104L	0.0002						
Nickel	28302L	0.001	0.001*	0.001*			0.001*	
Aluminum	13005L	0.02						
Cobalt	27302L	0.001		0.001*			0.001*	
Boron	05102L	0.1						

PARAMETERS	POLLUTION CONTROL LAB NAQUADAT CODE	DETECTION LIMIT	SAMPLE DATES 1977 Feb. 12	Feb. 22	Mar. 1	Mar. 22	MEAN	RANGES Low - High
Pesticides	00000L							
T.D.S.	00205L	0.0	140.0	823.0	127.0	134.0	306.0	127.0 - 823.0
P.C.B.'s	00000L	0.0001						
Carbon T	06006L	2.0						

Conductivity in microsiemens/cm

Turbidity in J.T.U.

Metals as Totals mg/ℓ

Alkalinity and Hardness expressed as Calcium Carbonate

Nitrite, NO_2 & NO_3, NH_3 expressed as N

Phosphorus T expressed as PO_4

Phosphorus O expressed as P

pH in pH units

* less than

9. A COMPARISON OF THE ACUTE TOXICITY RESULTS FROM AQUATIC ENVIRONMENTS LTD. AND AOSERP AF 1.1.2 STUDY OF MINE DEPRESSURIZATION WATER TO TROUT PERCH (*PERCOPSIS OMISCOMAYCUS*)

Data presented here include:

1. a comparison of median lethal concentrations at a specific time for trout perch (*Percopsis omiscomaycus*) between Aquatic Environments Ltd. study and AF 1.1.2 study at 15°C;
2. cumulative mortality of trout-perch (*Percopsis omiscomaycus*), Aquatic Environments Ltd. test conducted at 5°C;
3. cumulative mortality of trout-perch (*Percopsis omiscomaycus*), Aquatic Environments Ltd. test conducted at 15°C;
4. graphical determination of LC_{50} (Litchfield 1949); and
5. comparison of chemistry data (means and ranges) from wells on Syncrude's Lease 17 and the Athabasca River taken by AOSERP AF 1.5.1 and Aquatic Environments Ltd.

A COMPARISON OF MEDIAN LETHAL CONCENTRATIONS AT A SPECIFIC TIME FOR TROUT-PERCH (*Percopsis omiscomaycus*) BETWEEN AQUATIC ENVIRONMENTS LIMITED STUDY AND AF 1.1.2 STUDY AT 15°C

WELL SITE	TIME/LC_{50} WITH 95% CONFIDENCE INTERVALS								
	2.5 Hrs.	12 Hrs.	24 Hrs.	48 Hrs.	72 Hrs.	96 Hrs.	120 Hrs.	144 Hrs.	168 Hrs.
A.E.L. 2600S-4800E		86.6 (65.1-115.2)	82.5 (59.4-114.7)	64.2 (38.6-108)	42.5 (20.9-86.7)	34.7 13.7-87.9)	33.1 (9.7-113.3)	24.3 (9.3-62.5)	14.9 (5.4-41.2)
AF 1.1.2									
1. 2900E-1000S	95.2	70.0 (62.9-77.1)	68.9 (62.1-75.7)	54.3 (45.3-63.3)	50.1 (42.2-58.0)	50.1 (42.2-58.0)			
2. 5300E-1400S	92.5	34.7 (29.1-40.3)	31.6 (26.6-36.6)	29.2 (24.3-34.1)	29.2 (24.3-34.1)	28.3 (24.1-32.5)			
3. 4800E-14,600S	83.8	48.9 (40.8-57.0)	48.9 (40.8-57.0)	44.3 (34.2-54.4)	41.7 (31.3-52.1)	31.3 (23.0-39.6)			
4. 4900E-15,700S	82.5 (70.5-94.5)	63.3 (51.3-75.3)	46.4 (35.6-57.6)	45.0 (34.1-55.9)	37.4 (24.5-50.3)	37.4 (24.5-50.3)			
5. 5300E-14,600S	90.1	70.0 (65.9-74.1)	37.8 (24.1-51.5)	33.5 (29.3-37.7)	31.2 (23.8-38.7)	24.4 (16.8-32.0)			
Composite		70.0 (59.9-80.1)	56.7 (42.7-70.7)	48.0 (37.0-59.0)	45.0 (30.8-59.2)	45.0 (30.8-59.2)	30.0 17.7-42.3)	23.3 (9.4-37.2)	
Composite	88.9 (81.4-96.4)	37.7 (31.6-43.8)	34.0 (28.2-39.8)	33.0 (28.5-37.5)	32.3 (28.2-36.4)	32.0 (28.1-35.9)			

CUMULATIVE MORTALITY OF TROUT PERCH *(Percopsis omiscomaycus)*

Aquatic Environments Ltd. (A.E.L.)[1]

Test Conducted at 5° C

Concentration Mine Depressurization Water (% by Volume)	TIME (hrs.) 12	24	48	72	96	120	144	168	Total % Mortality
Control									
N = 6	0	0	0	0	0	0	0	0	
% mortality	0	0	0	0	0	0	0	0	
0.12									
N = 6	0	0	0	0	1	1	1	2	
% Mortality	0	0	0	0	16.66	16.66	16.66	33.33	33.33
1.25									
N = 6	0	0	0	0	0	0	0	0	
% mortality	0	0	0	0	0	0	0	0	0
5.0									
N = 6	0	0	0	0	0	0	0	0	
% Mortality	0	0	0	0	0	0	0	0	0
12.6									
N = 6	0	0	0	0	0	0	0	0	
% Mortality	0	0	0	0	0	0	0	0	0
31.6									
N = 6	0	0	0	1	4	5	5	5	
% mortality	0	0	0	16.66	66.66	83.33	83.33	83.33	83.33
50.1									
N = 6	0	2	6						
% Mortality	0	33.3	100						100
79.4									
N = 6	2	6							
% Mortality		100							100
100.0									
N = 6	3	6							
% Mortality	50	100							100

[1] B. McMahon, P. McCart, A. Peltzner, G. Walder; 1976;

Toxicity of Saline Groundwater from Syncrude's Lease 17 to Fish and Benthic Macroinvertebrates; Table 22;
Aquatic Environments Ltd.

CUMULATIVE MORTALITY OF TROUT PERCH *(Percopsis omiscomaycus)*

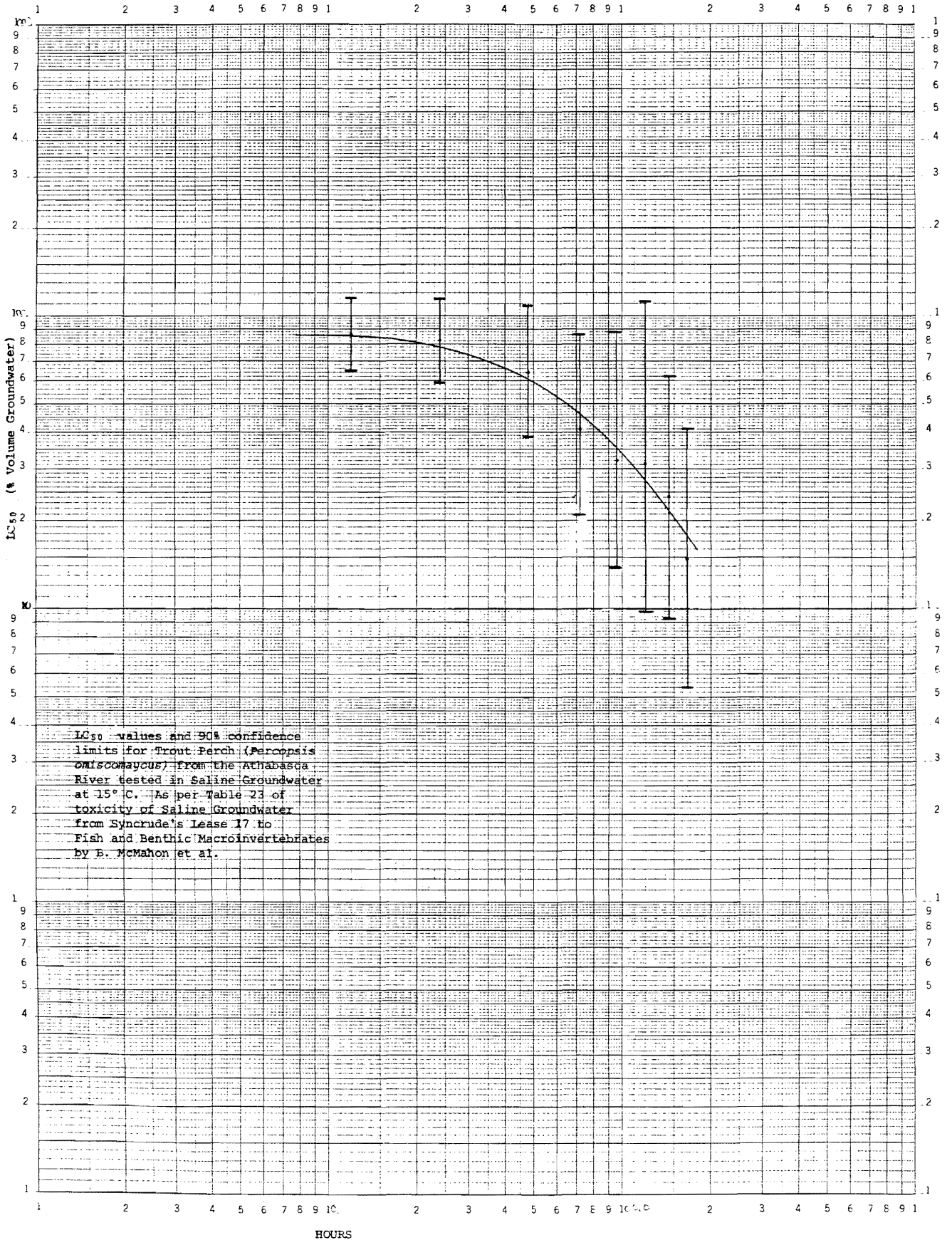
Aquatic Environments Ltd. (A.E.L.)[1]

Test Conducted at 15° C

Concentration Mine Depressurization Water (% by Volume)	TIME (hrs.) 12	24	48	72	96	120	144	168	Total % Mortality
Control									
N = 6	0	0	0	0	0	0	0	0	
% mortality	0	0	0	0	0	0	0	0	0
0.12									
N = 6	0	0	0	1	1	1	1	1	
% mortality	0	0	0	16.66	16.66	16.66	16.66	16.66	16.66
1.25									
N = 5	0	0	1	1	1	1	1	1	
% mortality	0	0	20	20	20	20	20	20	20
5.0									
N = 5	0	0	0	0	0	0	0	0	
% mortality	0	0	0	0	0	0	0	0	0
12.6									
N = 5	0	0	0	1	2	2	2	2	
% mortality	0	0	0	20	40	40	40	40	40
31.6									
N = 5	0	0	0	0	0	0	1	2	
% mortality	0	0	0	0	0	0	20	40	40
50.1									
N = 5	0	0	1	2	4	5			
% mortality	0	0	20	40	80	100			100
79.4									
N = 5	1	2	3	5					
% mortality	20	40	60	100					100
100.0									
N = 5	5								
% mortality	100								100

[1] B. McMahon, P. McCart, A. Peltzner, G. Walder; 1976;

Toxicity of Saline Groundwater from Syncrude's Lease 17 to Fish and Benthic Macroinvertebrates; Table 23;
Aquatic Environments Ltd.



LC_{50} values and 90% confidence limits for Trout Perch (*Percopsis omiscomaycus*) from the Athabasca River tested in Saline Groundwater at 15° C. As per Table 23 of toxicity of Saline Groundwater from Syncrude's Lease 17 to Fish and Benthic Macroinvertebrates by B. McMahon et al.

10. ACUTE LETHALITY BIOASSAYS CONDUCTED BY THE ENVIRONMENTAL PROTECTION SERVICES BIOASSAY LAB., EDMONTON

Data presented here include:

1. acute lethality bioassay using rainbow trout conducted on mine depressurization water;
2. acute lethality bioassays using rainbow trout conducted on two liquid effluents associated with the Great Canadian Oil Sands operation; and
3. chemistry analysis: GCOS.

10.1 ACUTE LETHALITY BIOASSAY USING RAINBOW TROUT CONDUCTED ON MINE DEPRESSURIZATION WATER

ENVIRONMENTAL PROTECTION SERVICE
NORTHWEST REGION BIOASSAY LABORATORY
EDMONTON, ALBERTA.

BIOASSAY DATA SHEET I.

COMPANY Syncrude	TYPE OF TEST 96 hour Static	TEST NUMBER 0-11-001
SOURCE Well Water	MATERIAL TESTED Composite Sample of 5 Water Wells	DATE SAMPLED 15/9/76 (1300-1600)
PLANT TREATMENT --	AMOUNT OF EFFLUENT RECEIVED 50 Gallons	DATE RECEIVED 20/9/76
STATUS OF PLANT Operational	DILUTIONS (%) 100,80,60,40,20,control	DATE TEST TIME 21/9/76 0900
SAMPLED BY AOSERP	TEST ORGANISM LOCATION *Salmo gairdneri* NF-876 'A'	SEND RESULTS TO: G. Webster

ORIGINAL FIELD ANALYSIS		ORIGINAL LAB ANALYSIS (100%)		TEST RACK
Temp (^{o}C)	--	Temp (^{o}C)	16.0	
D.O. (mg/l)	--	D.O. (mg/l)	6.0	2 - 2
pH	--	pH	7.39	OBSERVER
Cond (umhos)	--	Cond (umhos)	18500	M. Lamont
NH_3 (mg/l)		~~Nitrate (mg/l)~~ Salinity (o/oo)	14.5	

REMARKS:-

BIOASSAY DATA SHEET II

Test Number: 0-11-001 Test Date: 21/9/76

PARAMETERS	CONCENTRATIONS (MEAN & STANDARD DEVIATION)						
	CONTROL	20	40	60	80	100	
TEMPERATURE (°C)	14.4 ± 0.4	14.3 ± 0.4	14.3 ± 0.4	14.2 ± 0.3	14.2 ± 0.3	14.3 ± 0.4	
DISSOLVED OXYGEN (mg/l)	9.9 ± 0.5	9.0 ± 0.9	8.3 ± 1.3	9.5 ± 0.9	9.4 ± 1.1	8.1 ± 1.3	
pH	7.57 ± 0.16	8.29 ± 0.35	8.25 ± 0.47	8.55 ± 0.58	8.41 ± 0.51	7.98 ± 0.59	
CONDUCTIVITY (umhos)	138 ± 4	4170 ± 91	7600 ± 224	11300 ± 274	14,700 ± 274	17,500 ± 0	
AMMONIA (mg/l)							TOTAL
FISH LENGTH (cm)	6.8 ± 0.4	6.6 ± 0.4	7.0 ± 0.5	6.8 ± 0.6	6.1 ± 0.4	6.7 ± 0.6	6.7
FISH WEIGHT (gm)	3.2 ± 0.6	2.8 ± 0.5	3.4 ± 0.9	3.9 ± 1.0	2.8 ± 0.5	3.2 ± 0.9	3.2
LOADING DENSITY (l/gm)	1.25	1.43	1.18	1.03	1.43	1.25	1.2
NUMBER FISH/DILUTION	10	10	10	10	10	10	
NUMBER DILUTIONS/CONC	1	1	1	1	1	1	
VOLUME OF DILUTIONS (l)	40	40	40	40	40	40	
LT_{50} (Hr)				63.000 (44.567 - 89.05)	35.000 (6.288 - 174.816)	13.200 (11.098 - 15.700)	
LC_{50} (Conc by Vol)	By Calculator - 96 hr LC50 = 54.56 By graph - 96 hr LC50 = 53			40 % < LC50 < 60 %			

REMARKS:

Test Number: 0-11-001

BIOASSAY DATA SHEET III

EFFLUENT CONCENTRATION	REPLICATE HOURS	NUMBER OF MORTALITIES	% DEATH
100 %	8.00	1	10
	12.00	3	40
	24.00	6	100
80 %	0.25	1	10
	1.00	1	20
	24.00	3	50
	72.00	1	60
	84.00	1	70
	96.00	1	80
60 %	24.00	1	10
	36.00	1	20
	44.00	2	40
	72.00	2	60
	84.00	2	80
	96.00	2	100
40 %	96.00	0	0
20 %	48.00	1	10
	96.00	0	10
Control	24.00	1	10
	96.00	0	10

10.2 ACUTE LETHALITY BIOASSAYS USING RAINBOW TROUT ON TWO LIQUID EFFLUENTS ASSOCIATED WITH THE GREAT CANADIAN OIL SANDS OPERATION

ENVIRONMENTAL PROTECTION SERVICE
NORTHWEST REGION BIOASSAY LABORATORY
EDMONTON, ALBERTA.

BIOASSAY DATA SHEET I.

COMPANY Great Canadian Oil Sands	TYPE OF TEST 96 hour Static	TEST NUMBER 0-11-002
SOURCE Tailings Pond Effluent (?)	MATERIAL TESTED Final Process Effluent	DATE SAMPLED 14/9/76 (1200-1220)
PLANT TREATMENT Tailings Pond	AMOUNT OF EFFLUENT RECEIVED 25 Gallons	DATE RECEIVED 20/9/76
STATUS OF PLANT Operational	DILUTIONS (%) 100,80,65,35,10,control	DATE TEST TIME 21/9/76 0900
SAMPLED BY AOSERP	TEST ORGANISM LOCATION *Salmo gairdneri* NF-876 'B'	SEND RESULTS TO: G. Webster
ORIGINAL FIELD ANALYSIS	ORIGINAL LAB ANALYSIS (100%)	TEST RACK
Temp (^{o}C) --	Temp (^{o}C) 15.5	
D.O. (mg/l) --	D.O. (mg/l) 3.6	2 - 3
pH --	pH 8.07	OBSERVER
Cond (umhos) --	Cond (umhos) 455	M. Lamont
NH_3 (mg/l) --	NH_3 (mg/l) --	Tom Ruberg

REMARKS: -

BIOASSAY DATA SHEET II

Test Number: 0 - 11 - 002 Test Date: 21/9/76

PARAMETERS	CONCENTRATIONS (MEAN & STANDARD DEVIATION)						
	CONTROL	10	35	65	80	100	
TEMPERATURE (°C)	13.9 ± 0.2	14 ± 0.4	14.1 ± 0.4	14.1 ± 0.4	14.2 ± 0.3	14.2 ± 0.3	
DISSOLVED OXYGEN (mg/l)	9.9 ± 0.6	10.0 ± 0.5	9.6 ± 0.9	9.6 ± 0.8	9.6 ± 0.9	9.4 ± 1.1	
pH	7.58 ± 0.14	7.72 ± 0.14	7.72 ± 0.10	7.98 ± 0.08	8.01 ± 0.08	8.02 ± 0.05	
CONDUCTIVITY (umhos)	135 ± 8	174 ± 23	254 ± 26	340 ± 8	383 ± 6	456 ± 19	
AMMONIA (mg/l)							TOTAL
FISH LENGTH (cm)	6.5 ± 0.6	6.6 ± 0.5	7.0 ± 0.5	6.6 ± 0.7	6.8 ± 0.6	6.8 ± 0.6	6.7
FISH WEIGHT (gm)	2.9 ± 0.7	2.9 ± 0.4	3.5 ± 0.7	3.0 ± 1.0	3.3 ± 0.9	3.4 ± 0.9	3
LOADING DENSITY (1/gm)	1.38	1.38	1.14	1.33	1.21	1.18	1.3
NUMBER FISH/DILUTION	10	10	10	10	10	10	
NUMBER DILUTIONS/CONC	1	1	1	1	1	1	
VOLUME OF DILUTIONS (1)	40	40	40	40	40	40	
LT_{50} (Hr)							
LC_{50} (Conc by Vol)	NOT ACUTELY LETHAL						

REMARKS:

Test Number: 0 - 11 - 002

BIOASSAY DATA SHEET III

EFFLUENT CONCENTRATION	REPLICATE HOURS	NUMBER OF MORTALITIES	% DEATH
100%	96.00	0	0
90%	77.00	1	10
	96.00	0	10
65%	96.00	1	10
35%	96.00	0	0
10%	96.00	0	0
Control	34.00	1	10
	36.00	1	20
	96.00	0	20

ENVIRONMENTAL PROTECTION SERVICE
NORTHWEST REGION BIOASSAY LABORATORY
EDMONTON, ALBERTA.

BIOASSAY DATA SHEET I.

COMPANY	TYPE OF TEST	TEST NUMBER
Great Canadian Oil Sands	96 hour Static	0-11-003
SOURCE	MATERIAL TESTED	DATE SAMPLED
Coke Pile Seepage	Coke Storage Effluent	14/9/76
PLANT TREATMENT	AMOUNT OF EFFLUENT RECEIVED	DATE RECEIVED
--	25 Gallons	20/9/76
STATUS OF PLANT	DILUTIONS (%)	DATE TEST TIME
Operational	100,80,65,35,10,control	21/9/76 0900
SAMPLED BY	TEST ORGANISM LOCATION	SEND RESULTS TO:
AOSERP	*Salmo gairdneri* NF-876 'B'	G. Webster

ORIGINAL FIELD ANALYSIS		ORIGINAL LAB ANALYSIS (100%)		TEST RACK
Temp (^{o}C)	--	Temp (^{o}C)	16.0	
D.O. (mg/l)	--	D.O. (mg/l)	6.0	2 - 4
pH	--	pH	2.83	OBSERVER
Cond (umhos)	--	Cond (umhos)	3200	M. Lamont
NH_3 (mg/l)	--	NH_3 (mg/l)	--	

REMARKS:-

BIOASSAY DATA SHEET II

Test Number: 0 [illegible] 11 - 003 Test Date: 21/9/76

PARAMETERS	CONCENTRATIONS (MEAN & STANDARD DEVIATION)						
	CONTROL	10	35	65	80	100	
TEMPERATURE (°C)	13.9 ± 0.2	14.0 ± 0.4	14.0 ± 0	14.0 ± 0	14.0 ± 0	14.0 ± 0	
DISSOLVED OXYGEN (mg/1)	9.7 ± 1.1	10.0 ± 0.6	9.9 ± 0	9.2 ± 0	9.0 ± 0	8.9 ± 0	
pH	7.56 ± 0.07	6.96 ± 0.65	3.41 ± 0	3.11 ± 0	3.02 ± 0	2.92 ± 0	
CONDUCTIVITY (umhos)	137 ± 4	442 ± 6	1300 ± 0	2200 ± 0	2650 ± 0	3200 ± 0	
AMMONIA (mg/1)							TOTAL
FISH LENGTH (cm)	7.0 ± 0.6	6.6 ± 0.6	6.9 ± 0.5	6.8 ± 0.5	7.1 ± 0.5	7.0 ± 0.6	6.3
FISH WEIGHT (gm)	3.7 ± 0.8	3.1 ± 0.8	3.7 ± 0.8	3.7 ± 1.0	3.8 ± 0.8	3.8 ± 1.1	3.0
LOADING DENSITY (1/gm)	1.08	1.29	1.08	1.08	1.05	0.89	1.0
NUMBER FISH/DILUTION	10	10	10	10	10	10	
NUMBER DILUTIONS/CONC	1	1	1	1	1	1	
VOLUME OF DILUTIONS (1)	40	40	40	40	40	34	
LT_{50} (Hr)			2.300 (1.599 - 3.308)	2.300 (1.787 - 2.961)	1.700 (1.382 - 2.091)	1.650 (1.412 - 1.928)	
LC_{50} (Conc by Vol)	By graph 96 hr. LC_{50} = 10.5 By computer 96 hr. LC_{50} = 10.03			10% < LC_{50} < 35%			

REMARKS:

Test Number: 0 - 11 - 003

BIOASSAY DATA SHEET III

EFFLUENT CONCENTRATION	REPLICATE HOURS	NUMBER OF MORTALITIES	% DEATH
100%	0.50	1	10
	1.00	1	20
	1.50	1	30
	2.00	7	100
80%	1.00	1	10
	2.00	6	70
	2.50	2	90
	3.50	1	100
65%	2.00	4	40
	2.50	2	60
	3.00	2	80
	3.50	1	90
	4.00	1	100
35%	1.00	1	10
	2.00	4	50
	2.50	1	60
	4.00	2	80
	6.00	2	100
10%	72.00	1	10
	84.00	1	20
	96.00	0	20
Control	72.00	1	10
	96.00	0	10

10.3 CHEMISTRY ANALYSIS: GCOS

CHEMISTRY ANALYSIS: GCOS; September 14, 1976

Parameter	Sample	
	GCOS Process Effluent	GCOS Coke Storage Pile Seepage
Calcium	39	440
Magnesium	10.8	70
Sodium	67.5	350
Potassium	2.5	7
Chloride	61.5	420
Sulphate	56	1780
Alkalinity T	125	
pH	7.5	2.7
Carbonate	0	
Bicarbonate	152.4	
Hardness T	141.8	1386.9
Fluoride	0.12	0.05
Silica	5.5	30
Conductance	590	4200
Odor	8	8
Color	35	25
Tanin & Lignin	0.8	3.35
TFR	354	3070
TFRF	336	2800
TNFR	20	50
TNFRF	15.6	34.4
Surfactants	0.02*	0.02*
Humic Acids	2	1*

Parameter	Sample	
	GCOS Process Effluent	GCOS Coke Storage Pile Seepage
TOC	18	15.5
TIOC	21	11.5
NO_2 & NO_3	0.01*	0.01*
NH_3	3	0.94
Nitrogen Tk	7	1.09
Phosphorous T	0.43	0.3
Phosphorous O	0.03	0.01
Phenol	0.137	0.001*
Oil & Grease	0.6	0.1*
Sulphide	0.05*	0.05*
Cyanide	0.01*	0.01*
Hydrocarbon T	0.6	0.3
COD	57	136
Cadmium	0.001*	0.001
Chromium $^{+6}$	0.003*	0.015
Copper	0.004	0.009
Iron	0.45	14.7
Lead	0.002*	0.028
Manganese	0.044	1.92
Silver	0.005*	0.005*
Zinc	0.006	0.083
Vanadium	0.064	0.023
Selenium	0.0007	0.0005*
Mercury	0.0014	0.0043

Parameter	Sample	
	GCOS Process Effluent	GCOS Coke Storage Pile Seepage
Arsenic	0.012	0.005*
Nickel	0.011	0.1
Aluminum	0.38	5.7
Cobalt	0.002*	0.024
Boron	0.08	0.17

Conductivity in µs

Metals as Totals mg/l

pH in pH units

* less than

11. AOSERP RESEARCH REPORTS

1.		AOSERP First Annual Report, 1975
2.	AF 4.1.1	Walleye and Goldeye Fisheries Investigations in the Peace-Athabasca Delta--1975
3.	HE 1.1.1	Structure of a Traditional Baseline Data System
4.	VE 2.2	A Preliminary Vegetation Survey of the Alberta Oil Sands Environmental Research Program Study Area
5.	HY 3.1	The Evaluation of Wastewaters from an Oil Sand Extraction Plant
6.		Housing for the North--The Stackwall System
7.	AF 3.1.1	A Synopsis of the Physical and Biological Limnology and Fisheries Programs within the Alberta Oil Sands Area
8.	AF 1.2.1	The Impact of Saline Waters upon Freshwater Biota (A Literature Review and Bibliography)
9.	ME 3.3	Preliminary Investigations into the Magnitude of Fog Occurrence and Associated Problems in the Oil Sands Area
10.	HE 2.1	Development of a Research Design Related to Archaeological Studies in the Athabasca Oil Sands Area
11.	AF 2.2.1	Life Cycles of Some Common Aquatic Insects of the Athabasca River, Alberta
12.	ME 1.7	Very High Resolution Meteorological Satellite Study of Oil Sands Weather: "a Feasibility Study"
13.	ME 2.3.1	Plume Dispersion Measurements from an Oil Sands Extraction Plant, March 1976
15.	ME 3.4	A Climatology of Low Level Air Trajectories in the Alberta Oil Sands Area
16.	ME 1.6	The Feasibility of a Weather Radar near Fort McMurray, Alberta
17.	AF 2.1.1	A Survey of Baseline Levels of Contaminants in Aquatic Biota of the AOSERP Study Area
18.	HY 1.1	Interim Compilation of Stream Gauging Data to December 1976 for the Alberta Oil Sands Environmental Research Program
19.	ME 4.1	Calculations of Annual Averaged Sulphur Dioxide Concentrations at Ground Level in the AOSERP Study Area
20.	HY 3.1.1	Characterization of Organic Constituents in Waters and Wastewaters of the Athabasca Oil Sands Mining Area

21.		AOSERP Second Annual Report, 1976-77
22.		
23.	AF 1.1.2	Acute Lethality of Mine Depressurization Water on Trout Perch and Rainbow Trout
24.	ME 4.2.1	Air System Winter Field Study in the AOSERP Study Area, February 1977.
25.	ME 3.5.1	Review of Pollutant Transformation Processes Relevant to the Alberta Oil Sands Area
26.	AF 4.5.1	Interim Report on an Intensive Study of the Fish Fauna of the Muskeg River Watershed of Northeastern Alberta
27.	ME 1.5.1	Meteorology and Air Quality Winter Field Study in the AOSERP Study Area, March 1976
28.	VE 2.1	Interim Report on a Soils Inventory in the Athabasca Oil Sands Area
29.	ME 2.2	An Inventory System for Atmospheric Emissions in the AOSERP Study Area
30.	ME 2.1	Ambient Air Quality in the AOSERP Study Area, 1977
31.	VE 2.3	Ecological Habitat Mapping of the AOSERP Study Area: Phase I
32.		AOSERP Third Annual Report, 1977-78
33.	TF 1.2	Relationships Between Habitats, Forages, and Carrying Capacity of Moose Range in northern Alberta. Part I: Moose Preferences for Habitat Strata and Forages.
34.	HY 2.4	Heavy Metals in Bottom Sediments of the Mainstem Athabasca River System in the AOSERP Study Area
35.	AF 4.9.1	The Effects of Sedimentation on the Aquatic Biota
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45.	VE 3.3	Interim Report on Physiology and Mechanisms of Air-Borne Pollutant Injury to Vegetation, 1975 to 1978

46.	VE 3.4	Interim Report on Ecological Benchmarking and Biomonitoring for Detection of Air-Borne Pollutant
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51.	HY 1.3	Interim Compilation of 1976 Suspended Sediment Data in the AOSERP Study Area
52.	ME 2.3.2	Plume Dispersion Measurements from an Oil Sands Extraction Plant, June 1977
53.	HY 3.1.2	Baseline States of Organic Constituents in the Athabasca River System Upstream of Fort McMurray
54.	WS 2.3	A Preliminary Study of Chemical and Microbial Characteristics of the Athabasca River in the Athabasca Oil Sands Area of Northeastern Alberta.
55.	HY 2.6	Microbial Populations in the Athabasca River
56.	AF 3.2.1	The Acute Toxicity of Saline Groundwater and of Vanadium to Fish and Aquatic Invertebrates
57.	LS 2.3.1	Ecological Habitat Mapping of the AOSERP Study Area (Supplement): Phase I
58.	AF 2.0.2	Interim Report on Ecological Studies on the Lower Trophic Levels of Muskeg Rivers Within the Alberta Oil Sands Environmental Research Program Study Area
59.	TF 3.1	Self-Aquatic Mammals. Annotated Bibliography
60.	WS 1.1.1	Synthesis of Surface Water Hydrology
61.	AF 4.5.2	An Intensive Study of the Fish Fauna of the Steepbank River Watershed of Northeastern Alberta.
62.	TF 5.1	Amphibians and Reptiles in the AOSERP Study Area
63.		
64.	LS 21.6.1	A Review of the Baseline Data Relevant to the Impacts of Oil Sands Development on Large Mammals in the AOSERP Study Area
65.	LS 21.6.2	A Review of the Baseline Data Relevant to the Impacts of Oil Sands Development on Black Bears in the AOSERP Study Area
66.	AS 4.3.2	An Assessment of the Models LIRAQ and ADPIC for Application to the Athabasca Oil Sands Area

67. WS 1.3.2 Aquatic Biological Investigations of the Muskeg River Watershed

These reports are not available upon request. For further information about availability and location of depositories, please contact:

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