

W. Caldwell. Far Mine Env. W. Qual.

ANVIL MINING CORPORATION LIMITED

523 WEST SIXTH STREET
LOS ANGELES, CALIFORNIA 90014
TELEPHONE 629-5771

January 10, 1968

007541

377-35 *PA*
CABLE ADDRESS
ANVLZINC

Mr. Digby Hunt

Mr. W. E. Armstrong
Resource & Economic Development Group
Department of Indian Affairs and Northern Development
Ottawa 4, Canada

Dear Mr. Armstrong:

I am attaching a series of water analyses that have been made on various water sources in the Anvil area which may be of interest to you.

We have not proceeded further in finalizing our plans for tailings disposal and water development for the Anvil project. However, I am keeping in mind your request to be kept informed on this matter and as soon as more detailed engineering is available I will see that it is transmitted to you.

We have arranged with Hazen Research, Inc. to prepare a sample of tailings slurry and have advised them to ship this to the Department of Fisheries in Vancouver. I assume that this has already been done but would appreciate your advising me if the sample has been received.

If there is anything further we can do at this time along the lines of keeping you informed, please do not hesitate to so advise me.

With best regards.

Very truly yours,

R. E. Thurmond

R. E. Thurmond
General Manager

RET:mjf

CAST ELDRIEDEL

ENGINEERS & CHEMISTS LTD.

125 EAST 4TH AVE., VANCOUVER 10, B.C.

TELEPHONE: 876-4111

CABLE ADDRESS: "FLORICO"
TELEX: 0450353

REPORT OF: General Analysis

FILE NO. C.2-P.2-67-0478

AT: Vancouver Laboratory

DATE: June 14, 1967

PROJECT: Water Sample

REPORT NO.

REPORTED TO: B. H. Parsons Company of Canada,
Edmonton, Alberta, Saskatchewan.

ORDER NO.

R 1403-3-1

We have analyzed the water sample submitted to us on June 6, 1967
and report as follows:

ANALYSIS INFORMATION

Paco Creek Water

TEST RESULTS

pH	7.60
Colour (Pt-Co Scale)	56.0 ppm
Colour with Chemical	Trace
Turbidity (SiG, Scale)	7.0 ppm
Suspended Matter	265.0 ppm
Alkalinity: Carbonate	Not Detected
Bicarbonate	37.5 ppm
Total Hardness (Soap Method)	25.4 ppm
Calcium	5.0 ppm
Sulphate	Not Detected
Total Dissolved Solids	62.7 ppm
Fixed Solids	20.5 ppm
Free Solids	42.2 ppm
Calcium	5.6 ppm
Magnesium	3.7 ppm
Sodium	3.5 ppm
Potassium	Trace
Iron	Trace
Total Iron	0.00 ppm
Dissolved Iron	0.02 ppm
Total Aluminum	0.02 ppm
Dissolved Aluminum	0.03 ppm
Dissolved Silica	2.4 ppm

REMARKS

The water as represented by the submitted sample does not meet:

...../2

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A.H. Parsons Company of Canada

- 2 -

June 14, 1957

REMARKS (Continued)

the American Public Health Drinking Water requirements for colour (maximum level 20 ppm). However, filtration of this water will lower the colour to an acceptable level.

COAST ELDREDGE

Wm. Wong
W. Wong
Senior Chemist

13



COAST ELDRIDGE

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CABLE ADDRESS: "ELD
TELEX: 04.

125 EAST 4TH AVE., VANCOUVER 10, B.C.

TELEPHONE: 876-4111

REPORT OF: Chemical Analysis
AT: Vancouver Laboratory
PROJECT: Water Samples
REPORTED TO: The Ralph M. Parsons Construction Co. Ltd.
Whitehorse, Yukon Territories

FILE NO. C.3-P.1-67-3479

DATE June 29, 1967

REPORT NO.

ORDER NO.

R 1402-12-1

We have analyzed the water samples submitted to us on June 20, 1967, and report as hereunder:

SAMPLE IDENTIFICATION

"Job No. 3746-6, Anvil Mining Corp. Ltd.,
Water Sample from Rose Creek"

TEST RESULTS

pH	7.50
Colour (Pt-Co Scale)	11.5 ppm
Colour with Charcoal	Trace
Turbidity (SiO ₂ Scale)	Trace
Suspended Matter	13.0 ppm
Alkalinity: Carbonate	Not Detected
Bicarbonate	168.5 ppm
Total Hardness (Soap Method)	151.4 ppm
Chlorides	5.5 ppm
Sulphates	45.7 ppm
Total Dissolved Solids	239.5 ppm
Volatile Solids	86.4 ppm
Fixed Solids	153.1 ppm
Calcium	48.8 ppm
Magnesium	15.0 ppm
Sodium	4.0 ppm
Potassium	Trace
Manganese	Trace
Total Iron	0.04 ppm
Dissolved Iron	0.02 ppm
Total Aluminum	0.34 ppm
Dissolved Aluminum	0.28 ppm
Dissolved Silicon	4.1 ppm

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W. Wong
W. Wong
SENIOR CHEMIST

/cb

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TELEPHONE: 876-4111

CABLE ADDRESS: "ELDRIDGE"
TELEX: 04-5032

REPORT OF: Chemical Analysis
AT: Vancouver Laboratory
PROJECT: Water Samples
REPORTED TO: R. H. Parsons Construction Co. of Canada Ltd.,
P.O. Box 2960
Whitchurch, Y.T.

FILE NO. C.3-P.1-67-3490A

DATE July 7, 1967

REPORT NO.

ORDER NO. *Seabrook*

We have analyzed the water sample submitted to us and report as
hereunder:

SAMPLE IDENTIFICATION

Water sample from Rose Creek.

RESULTS

pH	7.00
Colour (Pt-Co Scale)	10.5 ppm
Colour with Charcoal	Trace
Turbidity (810 ₂ Scale)	Trace
Suspended Matter	11.0 ppm
Alkalinity: Carbonate	Not detected
Bicarbonate	51.2 ppm
Total Hardness (Soap Method)	30.4 ppm
Chlorides	1.5 ppm
Sulphates	Trace
Total Dissolved Solids	74.2 ppm
Volatile Solids	26.8 ppm
Fixed Solids	47.4 ppm
Calcium	12.5 ppm
Magnesium	3.0 ppm
Sodium	1.0 ppm
Potassium	Trace
Manganese	Trace
Total Iron	0.54 ppm
Dissolved Iron	0.05 ppm
Total Aluminum	0.20 ppm
Dissolved Aluminum	0.32 ppm
Dissolved Silicon	2.4 ppm

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W. Wong
W. Wong,
SENIOR CHEMIST



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TELEPHONE: 876-4111

CABLE ADDRESS: "ELDRIDGE"
TELEX: 04-50353

Hy

REPORT OF: Chemical Analysis
AT: Vancouver Laboratory
PROJECT: Water Samples
REPORTED TO: Ralph M. Parsons Co.
P.O. Box 2960
Whitehorse, Y.T.

FILE NO. C.3-P.1-67-36851

DATE October 12, 1967

REPORT NO.

ORDER NO.

R1403-3-1

ATTENTION: Mr. A.R. Wilton

We have analyzed the water sample submitted to us on October 6, 1967 and report as hereunder:

SAMPLE IDENTIFICATION

Anvil Mining Corporation Ltd. - Water Sample from Test Well No. 3/67.

TEST RESULTS

pH	-	7.20
Colour (Pt-Co Scale)	-	0.5 ppm
Colour with Charcoal	-	Trace
Turbidity (SiO ₂ Scale)	-	0.4 ppm
Suspended Matter	-	8.0 ppm
Alkalinity: Carbonate	-	Not detected
Bicarbonate	-	204.6 ppm
Total Hardness (Soap Method)	-	176.8 ppm
Chlorides	-	3.5 ppm
Sulphates	-	27.0 ppm
Total Dissolved Solids	-	302.4 ppm
Volatile Solids	-	103.0 ppm
Fixed Solids	-	199.4 ppm
Calcium	-	45.5 ppm
Magnesium	-	18.0 ppm
Sodium	-	2.5 ppm
Potassium	-	Trace
Manganese	-	Trace
Total Iron	-	Trace
Dissolved Iron	-	Trace
Total Aluminum	-	0.20 ppm
Dissolved Aluminum	-	0.18 ppm
Dissolved Silicon	-	1.4 ppm

REMARKS

The water as represented by the submitted sample was found to meet the chemical requirements of the American Public Health Association for Drinking Water.

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COAST ELDRIDGE

W. Wong
W. Wong,
SENIOR CHEMIST

/jp



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TELEPHONE: 876-4111

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TELEX: 04-50353

REPORT OF: Chemical Analysis
AT: Vancouver Laboratory
PROJECT: Water Samples
REPORTED TO: Ralph M. Parsons Construction Co. of Canada Ltd.,
P.O. Box 2960
Whitehorse, Y.T.

FILE No. C.3-P.2-67-37818

DATE November 28, 1967

REPORT No.

ORDER No.

R1403-311

ATTENTION: Mr. A. Wilton

We have analyzed two water samples submitted to us and report as hereunder:

SAMPLE IDENTIFICATION

Sample No. 1 - Anvil Mine 8/67 October 24 - 11:00 hours LWS Ltd. Res.
Sample No. 2 - Water from Mine Adit - November 2, 1967

TEST RESULTS

	<u>Sample No. 1</u>	<u>Sample No. 2</u>
pH	7.70	7.60
Colour (Pt-Co Scale)	22.0 ppm	0.5 ppm
Colour with Charcoal	5.5 ppm	Trace
Turbidity (SiO ₂ Scale)	0.3 ppm	Trace
Suspended Matter	5.0 ppm	6.0 ppm
Alkalinity: Carbonate	Not detected	Not detected
Bicarbonate	117.2 ppm	196.2 ppm
Total Hardness (Soap Method)	81.2 ppm	131.4 ppm
Chlorides	3.0 ppm	Trace
Sulphates	2.0 ppm	Trace
Total Dissolved Solids	164.8 ppm	258.6 ppm
Volatile Solids	59.4 ppm	99.4 ppm
Fixed Solids	105.4 ppm	159.2 ppm
Calcium	27.0 ppm	41.5 ppm
Magnesium	6.6 ppm	12.9 ppm
Sodium	2.0 ppm	1.5 ppm
Potassium	Trace	Trace
Manganese	0.04 ppm	0.02 ppm
Total Iron	0.37 ppm	0.66 ppm
Dissolved Iron	0.04 ppm	Trace
Total Aluminum	0.28 ppm	0.24 ppm
Dissolved Aluminum	0.26 ppm	0.20 ppm
Dissolved Silicon	2.4 ppm	3.2 ppm
Chemical Oxygen Demand	24.6 ppm	25.7 ppm

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W. Wong
W. Wong,
SENIOR CHEMIST

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125 EAST 4TH AVE., VANCOUVER 10, B.C.

TELEPHONE: 876-4111

CABLE ADDRESS: "ELDRICO"
TELEX: 0450353

REPORT OF: Chemical Analysis

AT: Vancouver Laboratory

PROJECT: Water Samples

REPORTED TO: R.M. Parsons Construction Co. of Canada Ltd.,
P.O. Box 2960
Whitehorse, Y.T.

FILE NO. C.3-P.5-67-37552

DATE: November 7, 1967

REPORT NO.

ORDER NO.

ATTENTION: Mr. Wilton

We have tested eleven samples of Water submitted by you on October 23, 1967 and report as hereunder:

SAMPLE IDENTIFICATION

- Sample No. 1 - Water sample from test well # 1/67 dated Sept. 13/67 after pumping 400 USGM for 8 hours.
- Sample No. 2 - Water sample from test well #1/67 dated Sept. 14/67 after pumping 400 USGM for 21 hours.
- Sample No. 3 - Water sample from test well #1/67 dated September 14/67 after pumping 400 USGM for 32 1/2 hours.
- Sample No. 4 - Water sample from test well # 2/67 dated Sept. 21/67 after pumping 6 IGPM for 2 hours.
- Sample No. 5 - Water sample from test well # 2/67 dated Sept. 22/67 after pumping 120 IGPM for 4 hours.
- Sample No. 6 - Water sample from test well # 2/67 dated Sept. 27/67 after pumping 120 USGM for 6 hours.
- Sample No. 7 - Water sample from test well # 6/67 dated Oct. 8/67 after pumping rate of 360 IGPM.
- Sample No. 8 - Water sample from test well # 6/67 dated Oct. 9/67 after 0800 hrs.
- Sample No. 9 - Water sample taken from Faro Creek dated Oct. 8/67.
- Sample No. 10 - Water sample taken from Rosa Creek near test well # 1/67 dated Sept. 17/67.
- Sample No. 11 - Water sample taken from the Anvil Corp. Adit Drain dated Sept. 17/67.

RESULTS

As per attached.

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W. Wong
W. Wong,
SENIOR CHEMIST

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/jp

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R1403-3-1

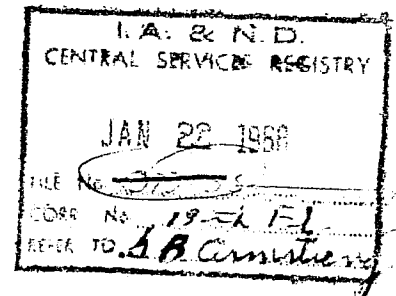
RESULTS

<u>Sample No.</u>	<u>Arsenic</u>	<u>Lead</u>	<u>Zinc</u>	<u>Silver</u>
1	Not detected	0.012 ppm	Not detected	Trace
2	Trace	0.010 ppm	Not detected	Trace
3	Trace	0.010 ppm	Not detected	Trace
4	Not detected	0.012 ppm	Not detected	Trace
5	Not detected	0.008 ppm	Not detected	Trace
6	Not detected	0.008 ppm	Not detected	Trace
7	Not detected	0.010 ppm	Not detected	Trace
8	Not detected	0.010 ppm	Not detected	Trace
9	Not detected	0.010 ppm	Not detected	Trace
10	Not detected	0.010 ppm	Not detected	Trace
11	Not detected	0.010 ppm	Not detected	Trace

ANVIL MINING CORPORATION LIMITED
523 WEST SIXTH STREET
LOS ANGELES, CALIFORNIA 90014
TELEPHONE 629-5771

January 18, 1968

CABLE ADDRESS
ANVLZINC



Mr. G. B. Armstrong
Resource and Economic Development Group
Department of Indian Affairs & Northern Development
Ottawa 4, Ontario, Canada

Dear Bill:

R 1403-3-1

I have received the teletyped revised language for Clause 4B of the Surface Lease.

By chance, while in Vancouver early this week, I ran into Harry Coldwell and we spent some time discussing various aspects of this subject. Harry left it with me that all of you would be willing to consider revised wording of the Clause that we might propose.

I am attaching a copy of the letter to Harry on this subject with the proposed revised wording and hope to receive a reaction shortly.

We would much appreciate your serious consideration of this revision.

Very truly yours,

R. E. Thurmond
General Manager

RET:mjf
Attachment

ANVIL MINING CORPORATION LIMITED

523 WEST SIXTH STREET
LOS ANGELES, CALIFORNIA 90014
TELEPHONE 629-5771

January 18, 1968

CABLE ADDRESS
ANVLZINC

Mr. G. H. Coldwell, Chief
Resources Management Division
Department of Indian Affairs & Northern Development
Ottawa 4, Ontario, Canada

R 1443-7-1

Dear Harry:

It was a pleasure to run into you in Vancouver on Tuesday evening and I enjoyed our brief chat. As a result of our conversation, during which you indicated that consideration would be given to a proposed change in wording of Clause 4B of the Surface Lease, I am submitting to you the following revision:

"4B. Lessee will control the quality of effluent or overflow discharged from the leased premises into any streams, rivers or other bodies of water as directed by the Minister so as to maintain such water quality standards as may be prescribed by law."

We feel that this revised wording accomplishes the control that you desire. Additionally, it accomplishes the public relations aspect in regard to control of pollution and at the same time leaves Anvil in a position whereby they are not subject to arbitrary or discriminatory powers of any individual.

We sincerely request that you give serious consideration to our proposal and hope to hear from you in this regard as soon as possible.

With best personal regards.

Very truly yours,

R. E. Thurmond
General Manager

RET:mjf

CC: Mr. D. Hunt
Mr. G. Armstrong

*Mr. Armstrong
- to discuss pls. - at your 2.0 by
conference*

ANVIL MINING CORPORATION LIMITED
523 WEST SIXTH STREET
LOS ANGELES, CALIFORNIA 90014
TELEPHONE 629-5771

January 18, 1968

CABLE ADDRESS
ANVLZINC

Mr. G. H. Coldwell, Chief
Resources Management Division
Department of Indian Affairs & Northern Development
Ottawa 4, Ontario, Canada

I. A. & N. D.	
CENTRAL SERVICES REGISTRY	
JAN 22 1968	
FILE NO.	
CORR. No.	
REFER TO	<i>Mr. Coldwell</i>

R 1463-3-1

Dear Harry:

It was a pleasure to run into you in Vancouver on Tuesday evening and I enjoyed our brief chat. As a result of our conversation, during which you indicated that consideration would be given to a proposed change in wording of Clause 4B of the Surface Lease, I am submitting to you the following revision:

"4B. Lessee will control the quality of effluent or overflow discharged from the leased premises into any streams, rivers or other bodies of water as directed by the Minister so as to maintain such water quality standards as may be prescribed by law."

We feel that this revised wording accomplishes the control that you desire. Additionally, it accomplishes the public relations aspect in regard to control of pollution and at the same time leaves Anvil in a position whereby they are not subject to arbitrary or discriminatory powers of any individual.

We sincerely request that you give serious consideration to our proposal and hope to hear from you in this regard as soon as possible.

With best personal regards.

Very truly yours,

R. E. Thurmond
R. E. Thurmond
General Manager

RET:mjf

CC: Mr. D. Hunt
Mr. G. Armstrong

Cyprus Anvil Mining Corporation

Post Office Box 1000
Faro, Yukon Territory
Y0B 1K0
Telephone 403) 994-2600

Telex 036-8-208

February 26, 1979

Mr. W.G. Whitley,
Controller of Water Rights,
200 Range Road,
Whitehorse, Y.T.
Y1A 3V1

Dear Mr. Whitley,

Re: Your letter of January 24, 1979.

Thanks very much for your letter, the report on water quantity data, the summary of water quality data and your proposal for identifying and locating seepage from Cyprus Anvil tailing pond into Rose Creek.

1. I agree with some of your comments on the sand filter treatment pond. The removal of metal ions by sand filtration cannot be a long term solution to the quality of decant sample 9BC S1. There are however several quality parameters of sample 9BC S1 which should receive long term benefits from the sand filtration. These parameters are:
 - (1) More neutral P.H.
 - (2) Degrading of NH_3 by natural oxidation and aging.
 - (3) Degrading of CN^- by natural oxidation and aging.
 - (4) Reduction in suspended solids, turbidity and possibly color by natural sand filtration.
 - (5) Reduction in other organic reagent such as xanthates, flocculants, collectors and frothers.
 - (6) Reduction in toxicity as a result of the above benefits.
2. The source of high copper levels in the decant has been tentatively identified as coming from copper sulphate crystal stored near the concentrate thickeners in the mill. There was approximately 300,000 pounds of CuSO_4 xtals stored in bags and drums in this area. Some of these containers have deteriorated and some of the crystal has been dissolved. This crystal is being relocated and used up to eliminate this potential contamination. Moving this crystal is believed the cause of the copper in S1 during January. The tailing discharge is being sampled as 9BC S11 on a weekly basis.
3. The zinc content of sample 9BC S1 is now reduced to well below acceptable limits. Now that we are aware of this potential problem we will control the water level in the pond in such a manner that this problem should not reoccur.

CYPRUS ANVIL

We will conduct a detailed stream quality survey as outlined in attached report as soon as conditions permit, probably during the month of April. Glaciation in the diversion ditch will make sampling and stream flow measurements impracticable until late summer from stations R2 to about R12.

We very much appreciate your offer to carry out stream measurements at locations shown on your attached map. We will try to carry out our quality survey at the same time that the stream flow measurements are made. The proposal calls for some detailed measurements during the second and third phase of the program.

Would you please assist us in the selection and procurement of meters to carry out the insitu measurement survey. Since we will not have a regular use for these precision meters we would prefer to borrow or rent them.

Thanks again for your assistance.

Yours truly,
CYPRUS ANVIL MINING CORPORATION



A. vonKursell
VICE PRESIDENT OF YUKON OPERATION

for

N.G. Cornish
SUPERINTENDENT OF ENVIRONMENTAL CONTROL

NGC/df

cc: N. Cornish (2)

To W. W. Muir
Date January 13, 1980
From S. Chmelyk
CC R.C.S., B.C., R.J.V., N.G.C.
Subject Flotation Performance using Mine Water
(Faro Creek) to Supplement Reservoir Water

INTRODUCTION

It was proposed that mine water be used as a substitution for part of our regular supply of water from the reservoir in order to reduce the inflow to the tailing pond.

A testing program was initiated to determine any adverse effects on flotation with the use of mine water because of contaminants such as anti-freeze or diesel fuel. A series of twenty rougher flotation tests were conducted on rod mill feed, ten standards and ten standards using 10% mine water. Four sets of standard rougher tests were also done using 100% mine water.

DATA

Attached.

CONCLUSIONS AND OBSERVATIONS

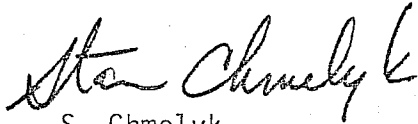
Rougher tests using 10% mine water and 90% reservoir water displayed much the same metallurgy as standard rougher tests using reservoir water. Referring to graphs 1. and 2. the grade/recovery curves for both sets of tests are very similar. Lead metallurgy actually displayed slight improvement using 10% mine water.

Referring to graphs 3. and 4. again there is little change in zinc or lead metallurgy when 10% mine water is used. Zinc grade suffered a 4 to 5% drop when 100% mine water was used. The zinc flotation displayed extensive pyrite activation when 100% mine water was used. Lead metallurgy surprisingly showed a slight improvement again with the use of mine water.

Soda ash consumption between the 10% mine water tests and standards was comparable. Soda ash consumption went up 0.5 kg/t when 100% mine water was used. This is likely due to the slightly lower pH of the mine water, pH 7.5 versus pH 8.0 in reservoir water.

CYPRUS ANVIL MINING

Mine water (Faro Creek) contains a water supply of about 500 to 800 gal/min. This would represent about 10% of the water the mill normally uses. At this concentration its use should present no problem to flotation.

A handwritten signature in cursive script, appearing to read "S. Chmelyk".

S. Chmelyk
Senior Metallurgical
Technician

/klc

Att.

DATA

Mine Water Assay Average:

Pb	Zn	Fe	Cu	Mn	NH ₃	pH
0.07 ppm	3.21 ppm	0.18 ppm	0.06 ppm	1.38 ppm	1.95 ppm	7.5

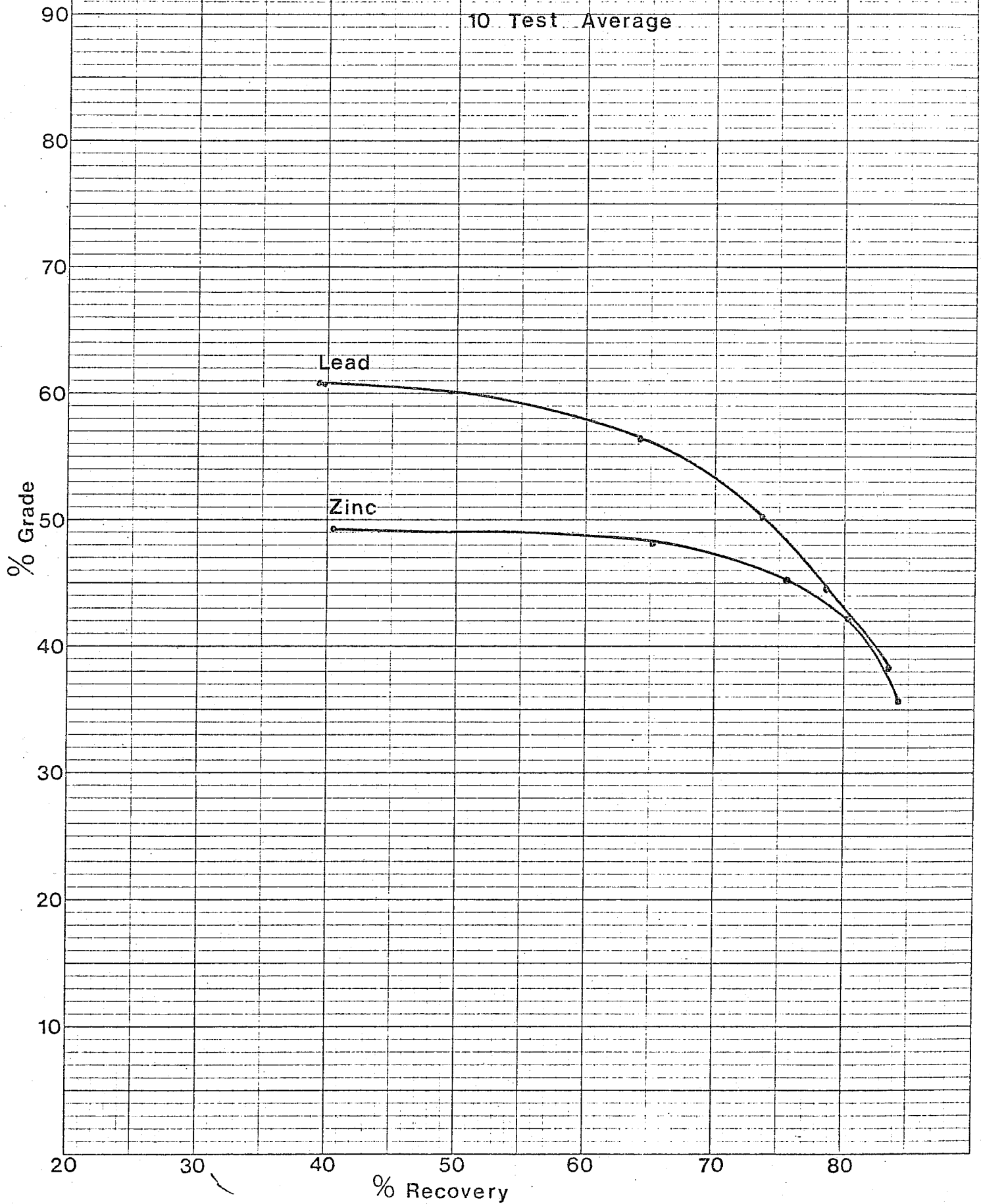
10 Test Average: See Graphs 1. and 2.:

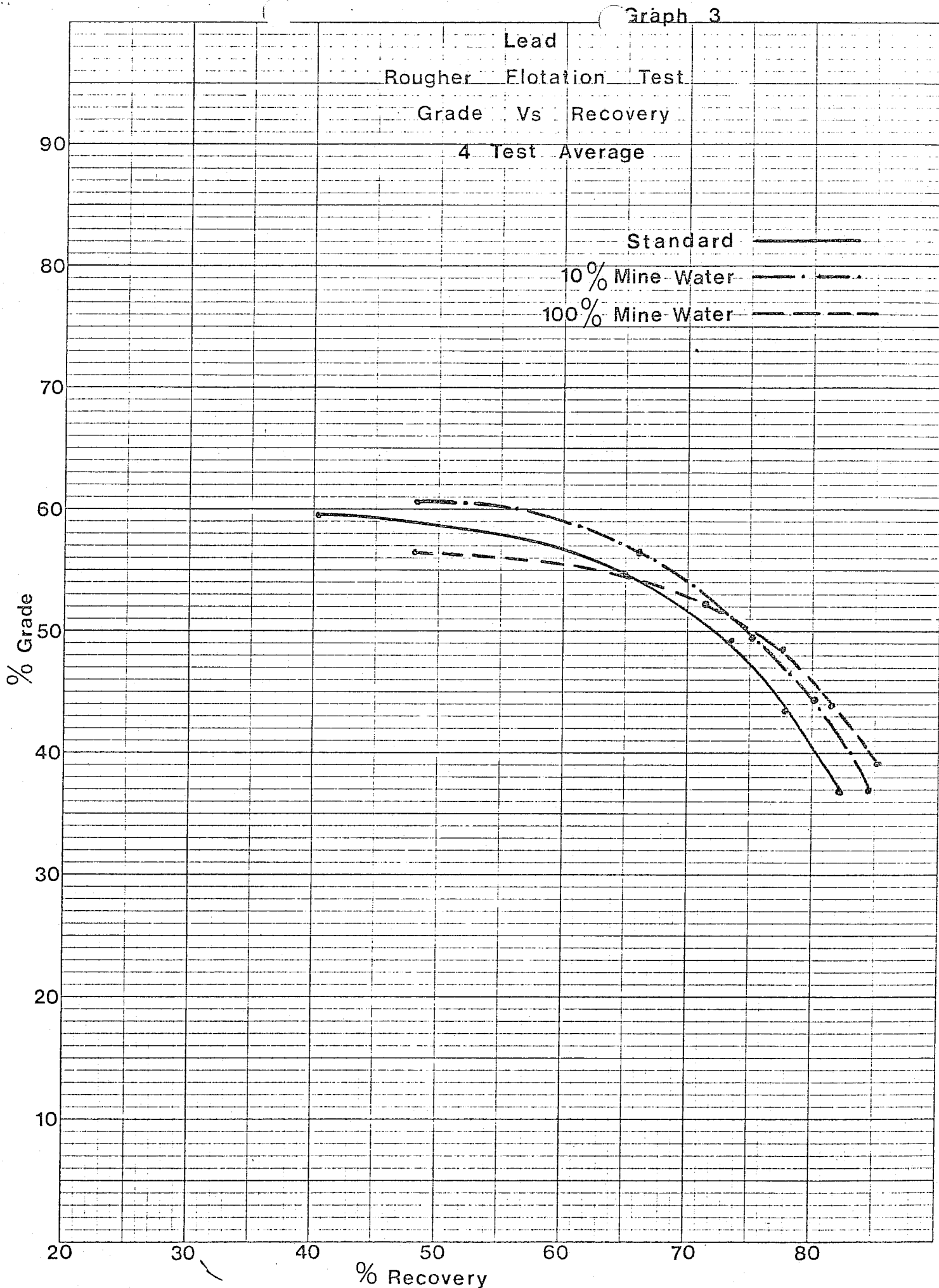
	Lead Cumulative Grades		Lead Cumulative Recoveries	
	Standard	10% Mine Water	Standard	10% Mine Water
Lead Rougher Concentrate:	61.14	60.91	39.75	39.34
	66.31	56.56	64.65	64.06
	49.26	50.26	73.41	73.47
	43.18	44.78	78.43	78.65
	36.84	38.24	82.96	83.42
	Zinc Cumulative Grades		Zinc Cumulative Recoveries	
	Standard	10% Mine Water	Standard	10% Mine Water
Zinc Rougher Concentrate:	48.96	49.19	40.49	40.41
	47.80	48.05	65.60	65.03
	45.15	45.13	75.43	75.52
	42.47	42.13	79.99	80.27
	36.17	35.50	84.01	84.26

4 Test Average: See Graphs 3. and 4.:

	Lead Cumulative Grades			Lead Cumulative Recoveries		
	Standard	10% Mine Water	100% Mine Water	Standard	10% Mine Water	100% Mine Water
Pb Ro. Conc:	59.33	60.65	56.40	40.40	48.59	48.06
	54.78	56.49	52.04	64.87	66.02	71.50
	49.12	49.61	48.42	73.48	75.08	77.72
	43.54	44.28	43.93	77.83	80.02	81.59
	36.93	36.99	39.16	82.00	84.45	85.14
	Zinc Cumulative Grades			Zinc Cumulative Recoveries		
	Standard	10% Mine Water	100% Mine Water	Standard	10% Mine Water	100% Mine Water
Zn Ro. Conc:	48.33	48.58	46.70	40.08	38.82	48.69
	47.21	47.43	44.99	65.33	63.33	71.22
	44.57	44.80	41.31	75.42	73.77	78.52
	42.06	41.83	37.74	79.94	78.62	82.11
	35.63	34.06	29.99	83.88	82.71	84.92

Graph 2
10% Mine Water
Rougher Flotation Test
Grade Vs Recovery
10 Test Average





Graph 4

Zinc
Rougher Flotation Test
Grade Vs Recovery
4 Test Average

Standard
10% Mine Water
100% Mine Water

% Grade

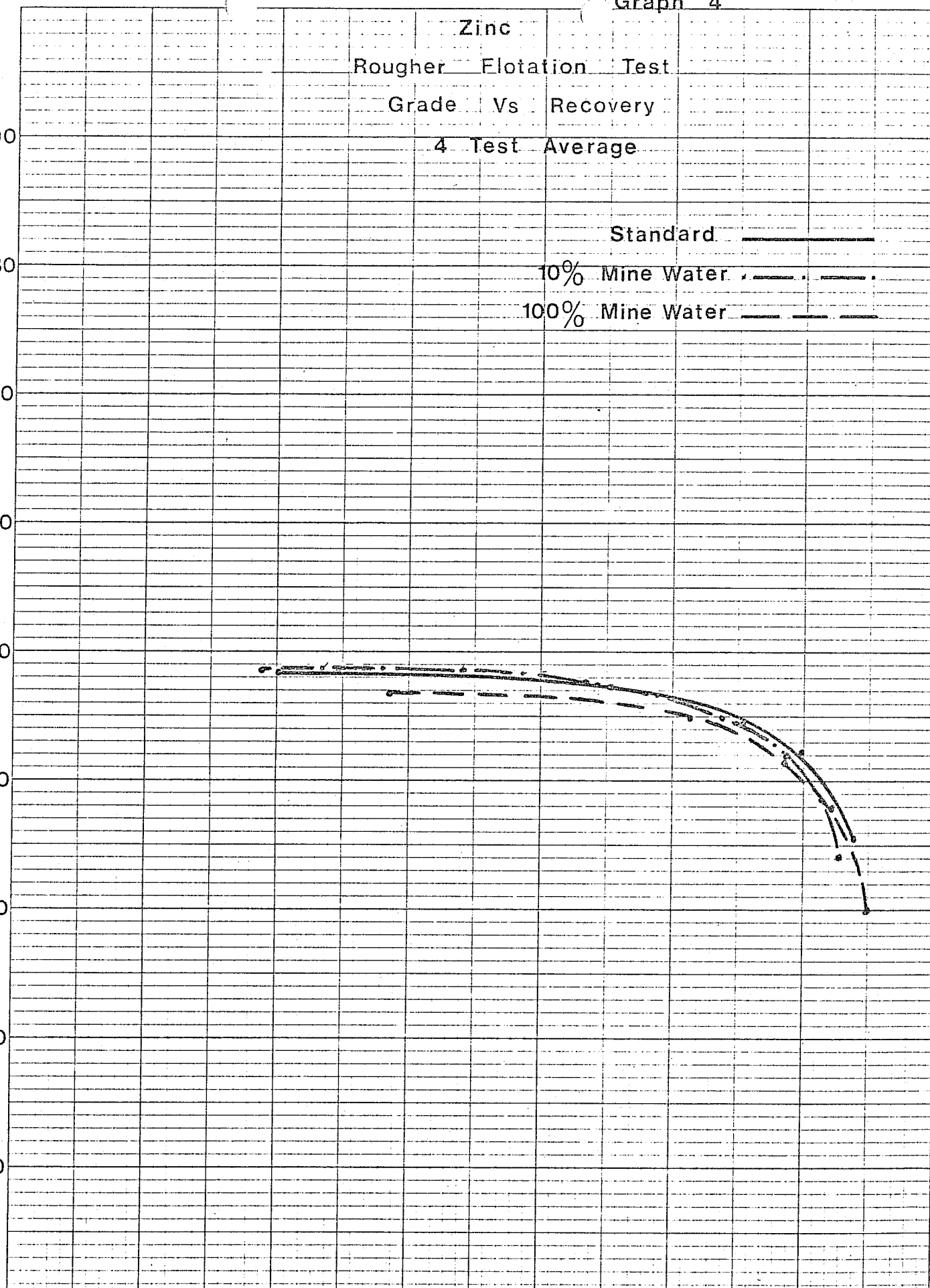
% Recovery

46 0780

10 X 10 TO THE INCH • 7 X 10 INCHES
KEUFFEL & ESSER CO. MADE IN U.S.A.

90
80
70
60
50
40
30
20
10

20 30 40 50 60 70 80





Cyprus Anvil Corporation Ltd.
P.O. Box 1000
Faro, Y.T.
Y0B 1K0

Northern Affairs Program
200 Range Road,
Whitehorse, Y.T. Y1A 3V1
11 June 1980

Your file Votre référence

Our file Notre référence

Attention: Mr. J. K. Carrington
Manager of Operations

Dear Sirs:

Re: Tailings Containment Construction
1980 Embankment Dam Raising

Please consider this letter as your authority to proceed with the construction of the enlarged or raised tailings dam as described per the report "Cyprus Anvil Mining Corporation - Summarizing Geotechnical Considerations Tailings Containment Construction - 1980 Embankment Dam Raising" and associated and supporting plans, subject to the following concerns and conditions:

(The report and plans have been reviewed by this office and it appears previous conditions or guidelines for construction have been taken into account.)

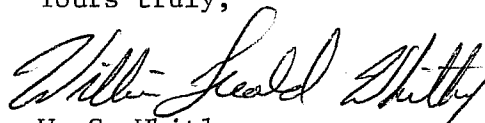
1. There is some concern over the possibility of having to add further lifts to this dam in the event that additional disposal capacity is required (because the new containment site may not be ready for use or operation) prior to alternate tailings disposal facilities. It is presumed that this possibility is addressed or considered in the presently proposed design.
2. It is suggested that a sufficient number of the piezometers be installed during construction and be maintained in place for monitoring after construction for continued performance records.
3. That the Company maintain on site an engineer from Golder & Associates to monitor and direct the construction of the tailings dam construction in accordance with the plans and design reports submitted to this office.
4. That the Company provide "as-constructed plans" of the works within 60 days of the completion of this construction phase.

RECEIVED

JUN 16 1980

FARO

Yours truly,


W. G. Whitley
Contrôleur de Water Rights

YUKON TERRITORY WATER BOARD

200 RANGE ROAD
WHITEHORSE, YUKON
Y1A 3V1

8th July, 1980.

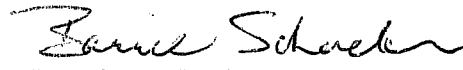
Mr. J. K. Carrington,
Manager of Operations,
Cyprus Anvil Mining Corporation,
Post Office Box 1000,
FARO, Yukon.
YOB 1K0.

Dear Mr. Carrington:

Enclosed for your company's review and consideration are two copies of a report that the Board had commissioned when the initial proposal for the down valley tailings system was presented some months ago. The Board was reluctant to release the report prior to an application for a specific site because of the concern it had for the lack of detail contained in the review of site alternatives and the rationales for site acceptance or rejection. The Board did not want to appear to be giving credence to any one site.

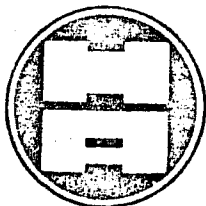
In response to your application, the Board has decided to schedule a public hearing for September 16, 1980, at 1:00 p.m., in the Faro Legion Hall. The Board also is planning a visit to Faro on July 28, 1980 to inspect the proposed site. It would be appreciated if you could make someone available to assist the Board in this regard.

Yours truly,


Barrie Schacker,
Secretary.

Encl.

RECEIVED
JUL 10 1980
FARO



HARDY ASSOCIATES (1978) LTD.

CONSULTING ENGINEERING & PROFESSIONAL SERVICES

File No. K4946

June 23, 1981

Indian & Northern Affairs
200 Range Road
Whitehorse, Yukon
Y1A 3B1

Attention: Mr. H.F. McAlpine, P.Eng.

Dear Sir:

RE: Cyprus Anvil;
Down Valley Tailings
Containment Project

This letter summarizes observations and comments arising from my June 4, 1981 visit to the above site. The main objective of the site visit was to review seepages occurring in the south Rose Creek valley wall, in an area adjacent to the diversion canal.

Seepage zones identified in the field, together with estimated volumes, are listed below:

Location	Estimated Volume
Through diversion dams and its abutments	120 Igpm
At Canal Station 1+290	10 Igpm
Intermediate dam abutment	390 Igpm
Cross Valley Dam	< 5 Igpm

Estimated total: 525 Igpm



All identified seepages occur in areas where the natural slope cover has been excavated or where the canal dyke is not covered with additional fill (waste) material. It should be appreciated that seepages from the canal possibly occur also at other locations. These seepages are likely discharged into granular deposits along the old Rose Creek channel in the valley bottom. According to Cyprus Anvil estimates, the total flow through the old creek channel, by source, is as follows:

- tailings decant - $10 \text{ m}^3/\text{sec}$
- north valley streams - $3 \text{ m}^3/\text{sec}$
- seepages from tailings and diversion dams - $3 \text{ m}^3/\text{sec}$

While the identified seepages do not impose an immediate hazard to existing or planned structures, some mitigative measures are required to ensure the long term integrity of the project. Continuous monitoring of identified seepage zones would facilitate the design of necessary mitigative measures.

A brief description of individual seepage zones and my comments regarding their significance is presented in the following paragraphs.



1.1 Seepage Through Diversion Dam

Most of the seepage (estimated at 75% of the total) is discharging from the toe of the dyke directly into the old diversion canal (Photo 1). Additional seepage occurs from both sides of the old canal and from the bottom of the canal for a distance of some 20 m downstream from the dyke toe. Despite a relatively low flow and low hydrostatic head between water levels upstream and downstream of the dyke, there are numerous boils associated with piping of fines in the canal bottom (Photo 2). It appears (based on information obtained from Cyprus Anvil and Golder Associates personnel) that the seepage has increased in volume since mid-May when the diversion became operational.

Since the diversion dam is not designed for this amount of seepage, and because of piping, modification of the downstream segment of the dyke is required.

1.2 Seepage at Canal Station 1+290

A scattered seepage zone occurs for a relatively short distance along the toe of the canal dyke in the vicinity of Station 1+290. The seepage is partly covered by



a randomly placed gravel toe berm. Seepage water is ponded in an abandoned borrow pit further downslope (Photo 4). It appears that the amount of seepage is decreasing. Thus, on May 23, 1981, a total of 13 Igpm was measured, while on June 4, 1981 the total volume was approximately 10 Igpm.

It may be prudent to install a collector drain along the dyke to ensure that a build-up of pore pressures is prevented during the winter season.

Ponding of water in the abandoned borrow pit should be prevented, in order to control saturation of the downslope segment of the hillside.

1.3 South Abutment of Intermediate Dam

A number of scattered seepage zones and two major springs exist in the south abutment of the intermediate dam. The entire area is wet and a granular drainage blanket has been placed across the abutment. Recently, seepage flows have been collected by means of two drainage ditches, as shown on Photo 5.



While some proportion of the seepage may represent natural discharge from the adjacent hillside and from the floodplain into this area, there is evidence that leakage from the diversion canal contributes to existing flows. There are five areas above the drainage blanket which have experienced concentrated seepage and washouts (Photo 7). These areas are located some 40 feet horizontally from the toe of the canal dyke. It appears that the seepage from the canal was originally discharged higher up on the slope and that the flow has since changed its pattern. Recently, the discharges have occurred primarily along the toe of the slope.

Again, in my view, these seepages should not be detrimental to the integrity of the canal as long as free discharge of seepage flows is ensured. On the other hand, the amount of seepage (estimated at 390 Igpm) is a concern since it complicates the intermediate dam foundation and construction procedures.

It is my opinion that the intermediate dam design should incorporate an adequate drainage system. The drainage system should be designed for greater capacity than that currently measured.



1.4 Cross Valley Dam

Only a couple of minor seepage zones have been identified in the cut for the access road to the south abutment of the Cross Valley Dam. It appears that the amount of seepage is decreasing in this area. The origin of these seepages could be either natural seepage from the hillside, leakage from the canal, or a combination of both.

2.0 OTHER OBSERVATIONS

2.1 Diversion Canal

The performance of the canal at the present flow and its general appearance, including the quality of materials used, appears to be good. Indeed, the quality of the construction works exceeds what I have seen in the past on similar mine-related projects. However, there are several minor problem areas which can be mitigated, in conjunction with anticipated canal maintenance:

- low quality of rip-rap material placed near the canal inlet,



- localized erosion of south canal slope due to tributary streams (Photos 8 and 9) and deposition of eroded material into the canal bottom.

The remedial work may be delayed until a longer performance record is obtained.

2.2 Cross Valley Dam

The excavation for the key trench was in progress. According to Golder Associates personnel, a relatively clean gravel was encountered locally, and heavy seepage into the excavation has occurred. Reportedly, the trench has been deepened to penetrate through such areas.

2.3 Project and Construction Documentation

Construction drawings are not being updated and construction drawings for the diversion dyke were not available during my site visit.

Similarly, the previously-requested monitoring plans for the diversion cannal and cross-valley dam were not available at the site.



Most of the foregoing was discussed during the site visit with Mr. N.G. Cornish and Golder Associates site personnel.

Should you have any questions regarding this matter, please contact the writer at your convenience.

Yours truly,

HARDY ASSOCIATES (1978) LTD.

M. Stepanek
M. Stepanek, M.Sc., P.Eng.

MS:pm

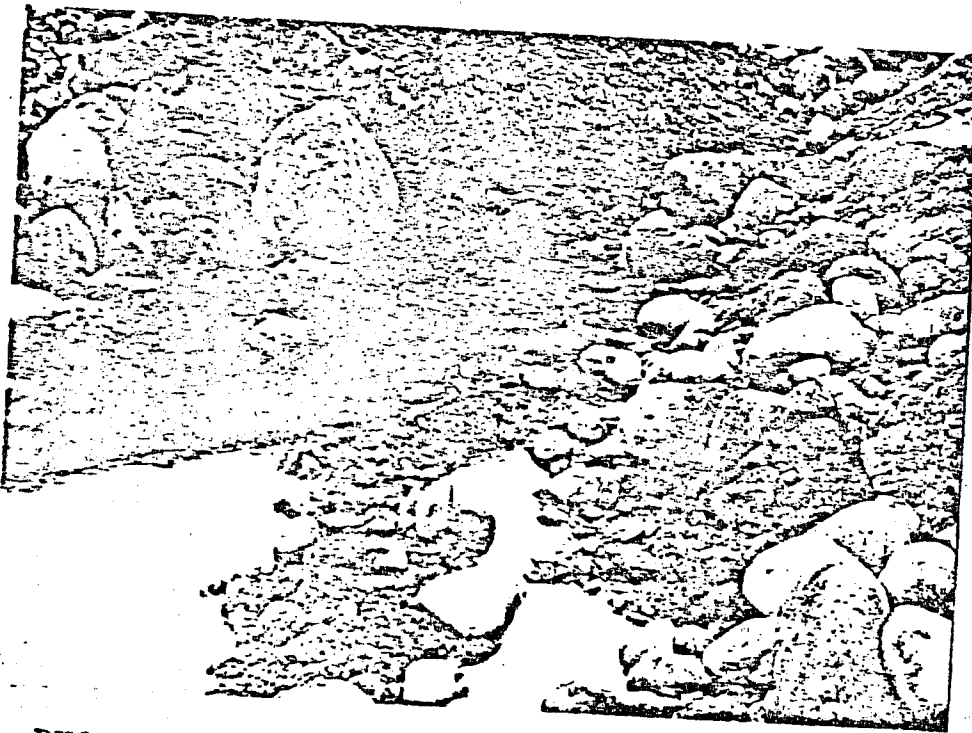


PHOTO 1 - Seepage through the diversion dam

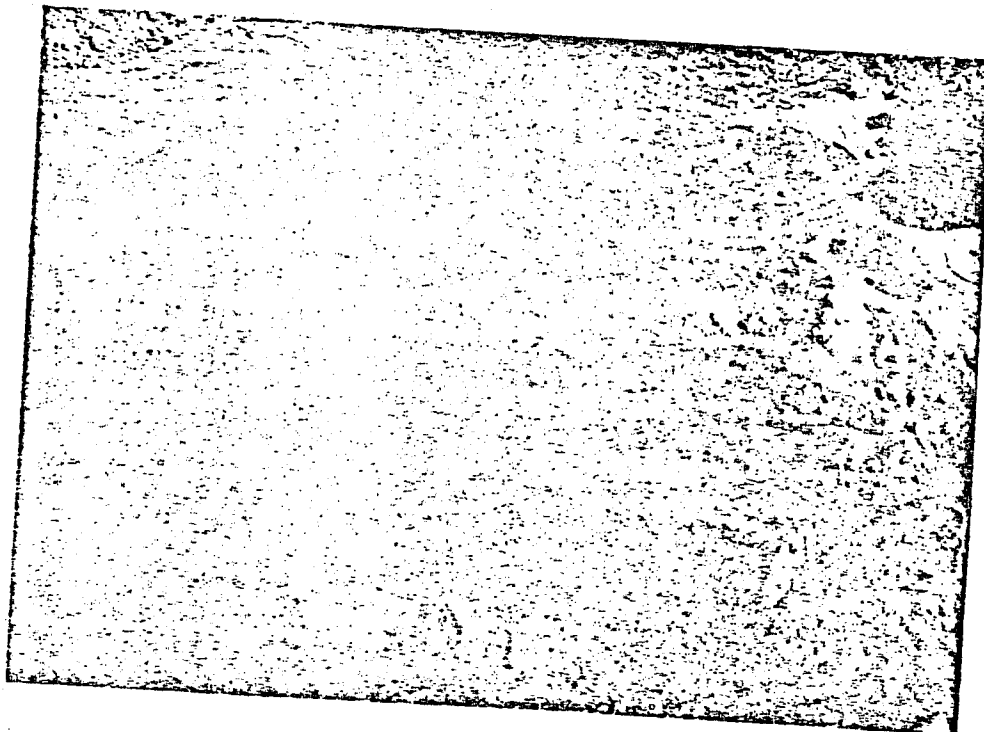


PHOTO 2 - Piping of fines occurs in the bottom of temporary diversion canal downstream of the dam

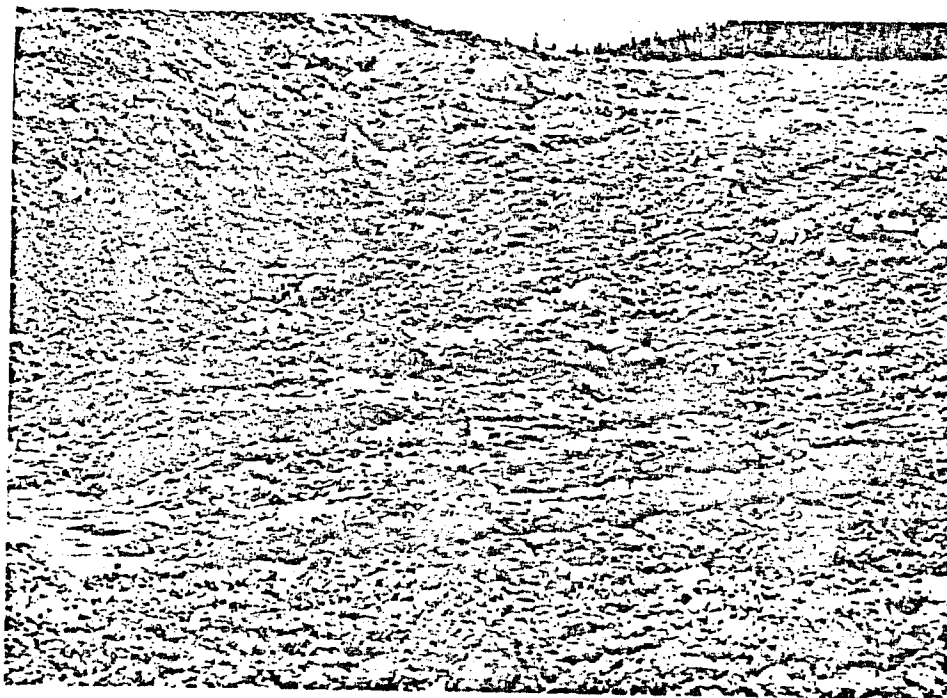


PHOTO 3 - Seepage zones from the canal, Station 1+290
(approximate)

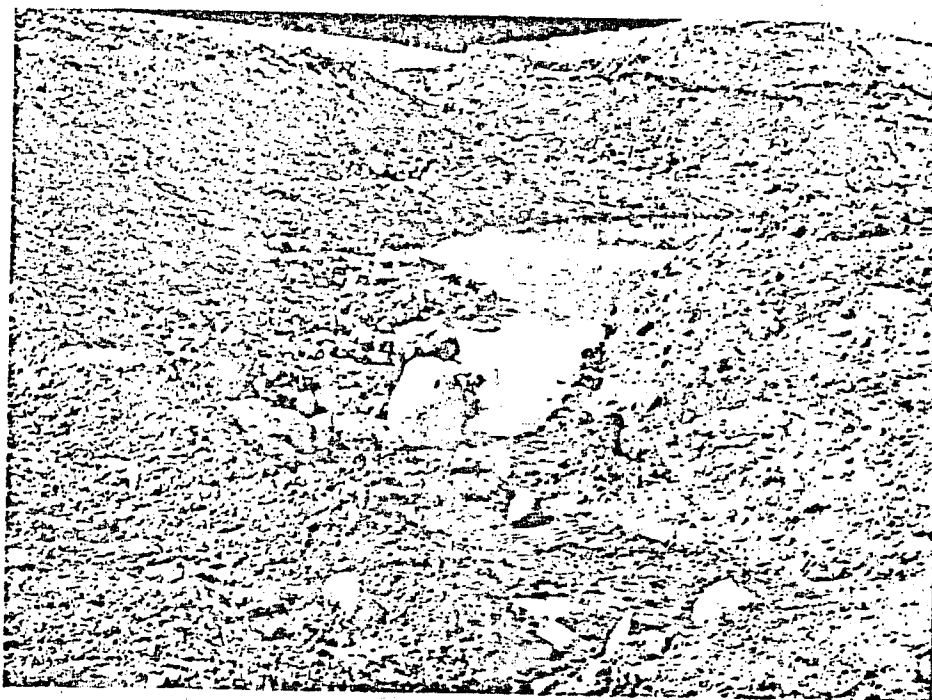


PHOTO 4 - Seepage from the above location collects in
former borrow pit

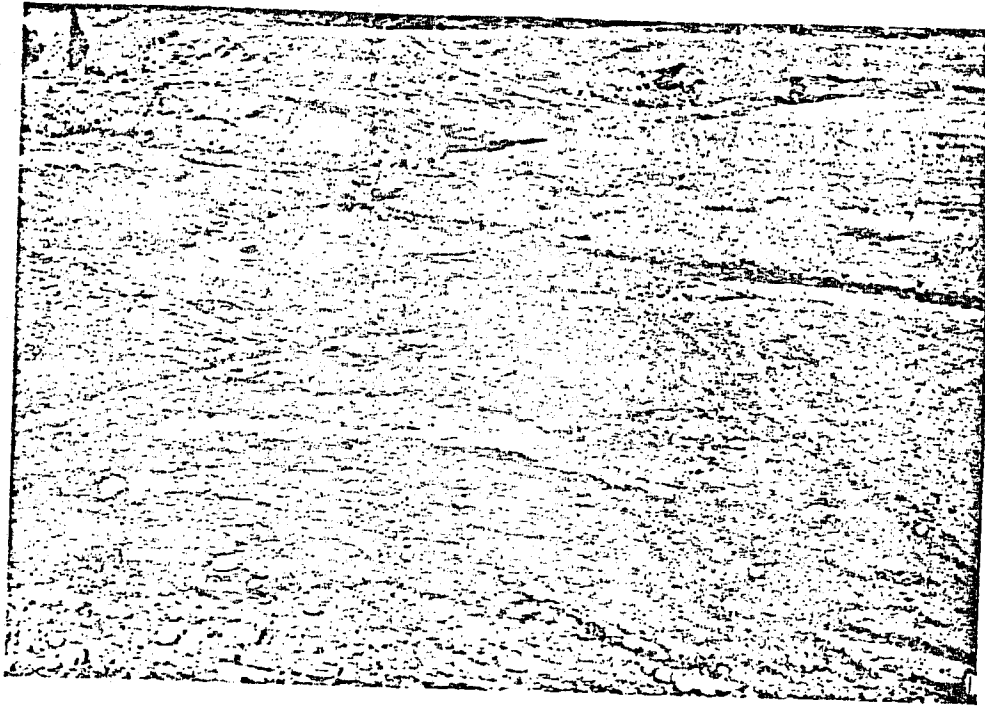


PHOTO 5 - Seepages from the south abutment of intermediate dam

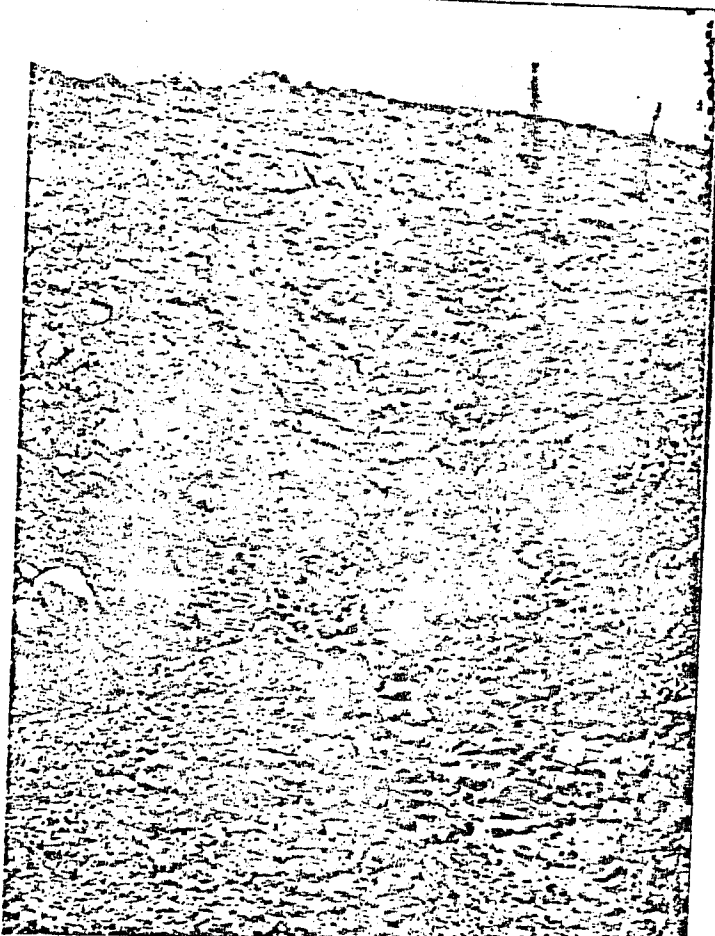


PHOTO 6 - Concentrated seepage
(est. volume 300 Igpm)
at southwest segment of
above abutment

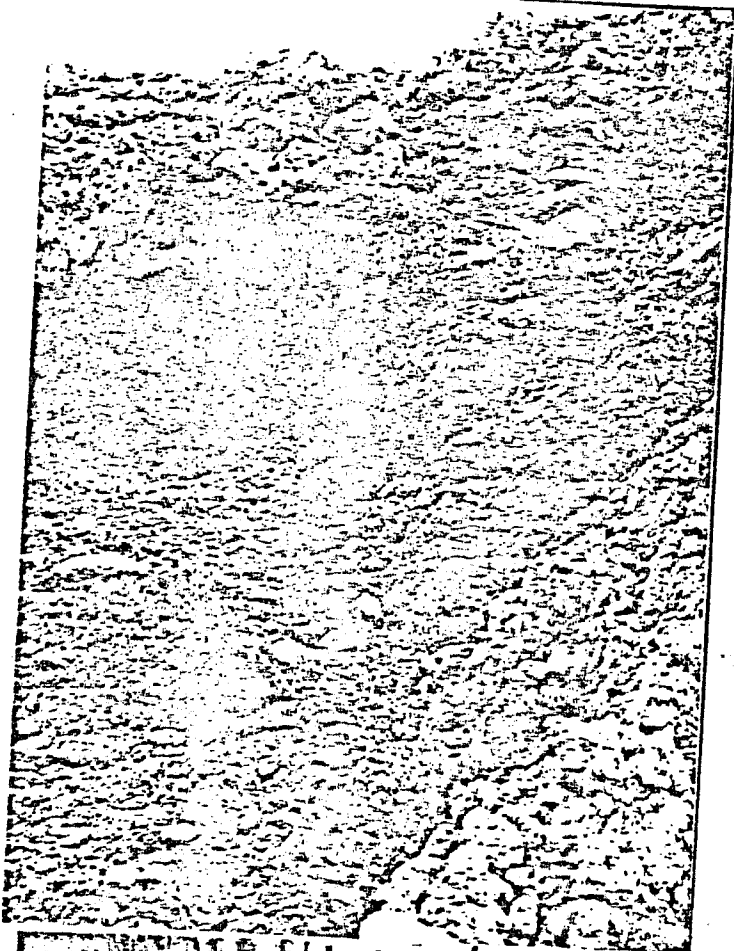


PHOTO 7 - Seepage zone (above granular blanket) in the south abutment



PHOTO 8 - Tributary stream eroding canal slope outside of rockfill conduit

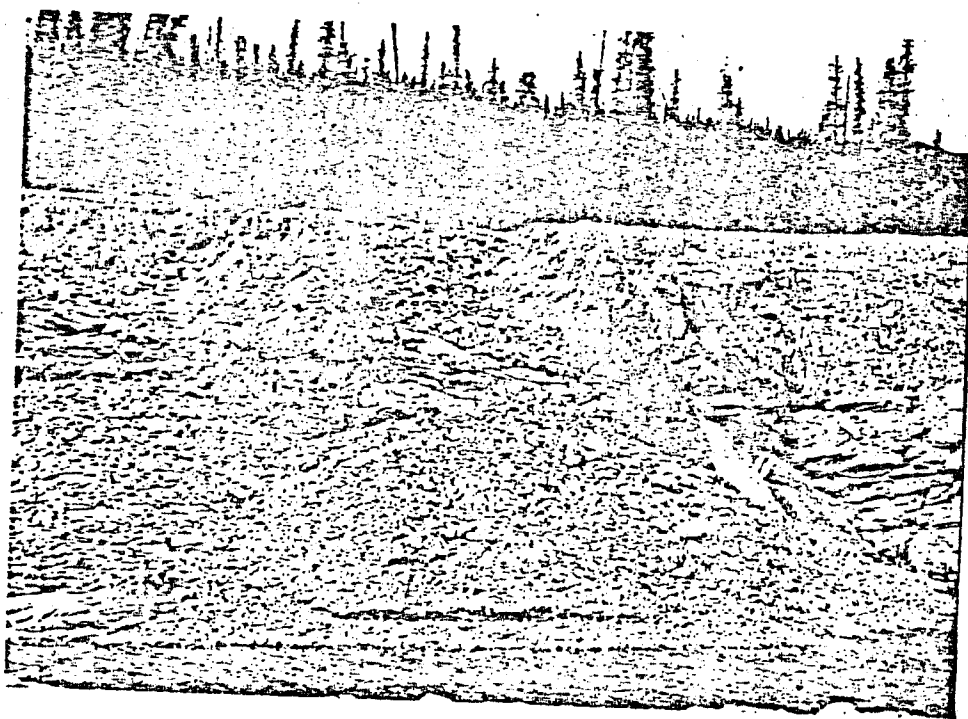


PHOTO 9 - Formation of debris cones due to uncontrolled surface runoff

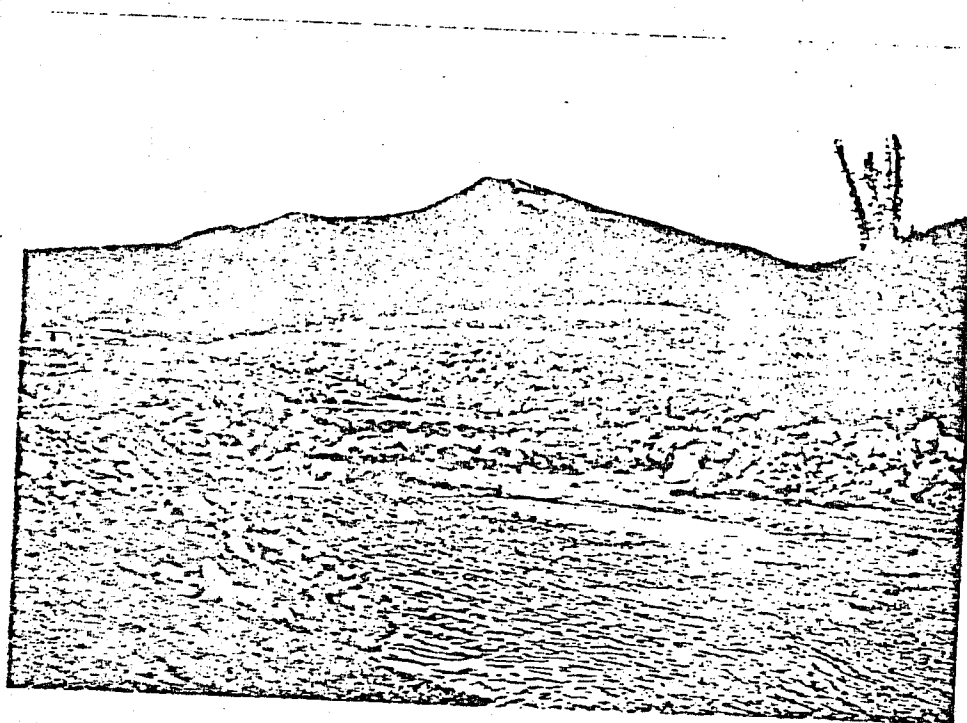


PHOTO 10 - Weir spillway and outfall



Indian and Northern
Affairs Canada

Affaires indiennes
et du Nord Canada

cc NC

Northern Affairs Program
200 Range Road,
Whitehorse, Y.T. Y1A 3V1
2 July 1981

Cyprus Anvil Mining Corp.
Box 1000
Faro, Y.T.

Your file Votre référence

Our file Notre référence

Attention: Mr. John Carrington

Dear Sirs:

Enclosed are the reports of CAMC design review committee members to Mr. H. F. McAlpine (Chairman) subsequent to CAMC construction site reviews of April 28 and June 4, 1980.

These reports raise some concerns about various aspects of the tailing containment project and, as such, I would request your attention to them.

Please direct your reply to Mr. McAlpine of this office.

Yours truly,

W. G. Whitley
Controller of Water Rights

cc: N. G. Cornish, CAMC(2)
Milos Stepanek - Hardy Assoc.

encls.

RECEIVED
JUL 3 - 1981

FARO

4823-99 st., edmonton, alberta T6E 4Y1
tel.(403) 436-5868

4823 - 99 st., edmonton, alberta T6E 4Y1
tel. (403) 436-5868

Our File Number DIA-REV

May 14, 1981

Mr. Bud McAlpine
Indian and Northern Affairs
200 Range Road
Whitehorse, Yukon
Y1A 3V1

Dear Mr. McAlpine:

RE: Cypress-Anvil; Down Valley Tailings
Containment Project

This letter contains a summary of observations and comments arising from my recent site-inspection of the Cypress-Anvil, Down Valley Tailings Containment Project. The site visit was made on April 28, 1981 with you and Mr. M. Stepanek of Hardy Associates Ltd. During the visit we met with Mr. N.G. Cornish (Cypress Anvil) and Mr. Dave Goodall (Golder Associates) and discussed various items related to the current construction and implementation of the project, and to areas of concern raised in our past reports.

At the time of our visit, construction of the canal was approaching a state of completion where water could be diverted into the canal to avoid passing high snowmelt runoff through the temporary drainage ditch.

The drop segments of the canal were essentially complete so placement of the Class V rock weirs could be examined. Generally the sizing and placement of riprap in these segments appeared satisfactory. I expect that numerous individual rocks will experience displacement if subjected to extreme discharges, but that the overall drop structure will be stable.

.....2

[illegible]

In my previous report, a concern was expressed that the highly permeable rock weirs would convey all or most of the lower discharges in the canal by percolation below the weir surface and thereby prevent fish passage. The solution that was implemented involved placement of a blanket of Class IV quarry waste material on the upstream face of each rock weir to force the flow to surface. A fine sand gravel cap was to be placed on top of the blanket on the belief that this material would be transported hydraulically and fill the voids in the downstream rock weir.

Based on my site examination, I believe that the Class IV blankets should be effective in forcing the flow to surface upstream of each weir. I was led to understand, however, that these blankets were not carried through the canal side slope riprap. If this is the case and if canal flows are low enough to allow all or most of the flow to percolate through the side-slope-riprap, then surface flows over the weir may be negligible.

There is some doubt in my mind about whether the fine gravel placed on top of the aprons will effectively seal the weirs and force low canal flows over the weir crests. This is, however, a minor concern if the Class IV aprons are effective, as the flow will now be at the surface, and it should be possible to modify the low flow hydraulic performance of individual weirs to facilitate fish passage as a post-construction maintenance activity.

In-place Class IV riprap was examined along several segments of the main canal that were complete or near complete. The quality of placement of this material appeared quite satisfactory.

In our meeting with Newt Cornish and Dave Goodall the following topics relevant to the hydraulic performance of the project were discussed:

- (i) Conceptual design of the canal diversion dam.
- (ii) Solutions to concerns expressed in my previous report regarding the capability of the canal-dam-spillway complex to convey the 'contingency' design flood event.

During the meeting we were shown conceptual drawings of the canal diversion dam. From the viewpoint of hydraulic performance, I have no problem with the concepts that were put forth. I note that the proposed dam will result in a sizable zone upstream of the canal offtake where water will be ponded, and sediment transported by the North Fork can be expected to deposit. This will prevent deposition of canal sediment in the upstream end of the canal which could have resulted in reduction of canal capacity. Deposition of fine sediment on the bed upstream of the dam can be expected to progressively reduce seepage beneath the dam.

In my earlier report (February, 1981) I expressed a concern that the canal dyke might be overtopped should a flood of the magnitude of the contingency design event be experienced. My reasons for this concern were first, the hydraulic roughness of the riprapped canal might prove to be greater than assumed in design, and second, there was no freeboard being allowed on the canal dyke for the 'contingency' flood event. Because the canal dyke could breach quite rapidly if overtopped, I expressed a concern that all or most of the contingency event could be diverted through the valley tailings ponds particularly if overtopping occurred at a location where little if any of the canal flow is conveyed in cut.

In a response to this concern, W.M. Veldman of Hydrocon Engineering (Continental) Ltd., in a report prepared for Golder Associates dated April 24, 1981, made the following comments and recommendations:

- (i) A post-construction monitoring and 'design check' program of the hydraulic performance of the canal was recommended. This program would establish an actual stage-discharge relationship and thereby determine if and where there is a need to increase canal dyke freeboard.

*Flows during
1981. too low
to make this stage
discharge relationship*

- (ii) Construction of a "designed lower section in the downhill dyke" was suggested as a means of controlling canal overflow in the original Hydrocon design report, but was not implemented in the actual canal design. This measure was again recommended by Veldman in his response. Presumably the overflow section would be constructed following completion of the canal if the 'design check' program indicates that the canal could not safely convey the contingency flood.
- (iii) Because in the current design, the dam crest was established at a level 0.8 metres above the 50-year flood level on the spillway, Veldman points out that the spillway actually has capacity to convey the contingency event with a freeboard of 0.2 metres.

In our meeting the reasons for my concerns were discussed as were the comments and recommendations contained in the response by Veldman. In this discussion I indicated that my concerns would be eliminated by the measures proposed by Veldman providing these measures are implemented so that the canal could safely convey the contingency design flood. I also indicated that an acceptable alternative solution would be to raise the crest of the cross valley dam so as to provide adequate freeboard should it be necessary to convey the contingency flood through the emergency spillway.

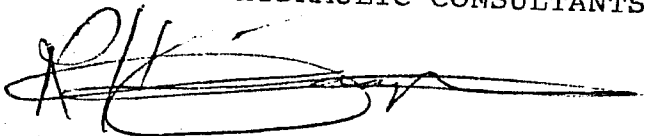
Mr. Cornish indicated following this discussion that Cypress Anvil would be prepared to provide additional freeboard on the dam crest.

It is my view that either of the alternatives (ie. increased freeboard on the dam crest or the measures recommended by Veldman) will be adequate to insure that the project will safely withstand a 500-year contingency flood event, which, I understand was a fundamental design objective for the project.

Lastly, I would like to stress the need for project documentation specifying design changes and as-built conditions. This documentation will be required to assess whether the as-built structures will perform in accordance with the design objectives, and will be valuable as baseline information for post-construction monitoring.

Yours truly,

NORTHWEST HYDRAULIC CONSULTANTS LTD.

A handwritten signature in dark ink, appearing to be 'R.H. Cooper', written over a horizontal line.

R.H. Cooper, P. Eng.

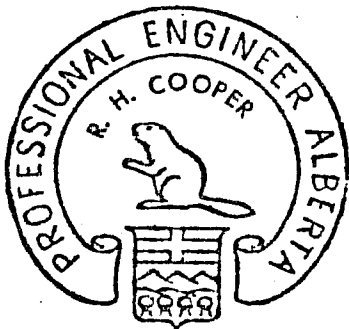
RHC:sv

cc: Mr. M. Stepanek, P. Eng.
Hardy Associates - Calgary

northwest hydraulic consultants ltd.

Respectfully submitted,

NORTHWEST HYDRAULIC CONSULTANTS LTD.



R.H. Cooper, P.Eng.

THE ASSOCIATION OF
PROFESSIONAL ENGINEERS
OF ALBERTA
PERMIT NUMBER
P.654
NORTHWEST HYDRAULIC
CONSULTANTS LTD.

YUKON TERRITORY WATER BOARD

200 RANGE ROAD
WHITEHORSE, YUKON
Y1A 3V1

①

21 September, 1981.

RECEIVED
SEP 25 1981

FARO

Mr. R. A. McCallum, P. Eng.,
Vice-President and General Manager,
Operations,
Cyprus Anvil Mining Corporation,
Box 1,000,
FARO, Yukon.

Dear Sir:

Re: Down Valley Tailings Project

At its meeting 14 September, 1981, the Water Board considered the re-convening of the Public Hearing of Cyprus Anvil's application for an amendment to its water licence which would allow for the operation of the Down Valley Tailings Disposal facility.

As you know the Board decided at its meeting the 7th July, 1981, that the hearing should be re-convened. At that time it was deemed necessary to open only the question of the abandonment plan to public scrutiny, since other aspects of the projects had been dealt with at the hearing of September 3, 1980. However the Board's counsel advises that giving due consideration to all factors involved, it is better the hearing have as its subject matter the project in its entirety, including those matters already discussed, the abandonment plan and any other matters that intervenors may wish to address. The Board has accepted this advice. When the full range of information requested has been assembled the Board will arrange for the complete hearing to take place. It is suggested that the company make any necessary preparations to address the subject in its entirety at the hearing.

The Board's decision in this matter has been communicated to Mr. Andrew J. Roman, Counsel for the Yukon Conservation Society, and a copy of that letter is enclosed for your information. Prior to the date of the hearing a meeting will be held between the representatives of the Board, the Company and the intervenors, to discuss questions of procedure for the meeting. The Board secretariate will be in contact with Cyprus Anvil to arrange a convenient time and place for such a meeting.

The Board has also arranged to make public announcement of its decision.

In the matter of the abandonment plan, the Board is in receipt of twelve copies of the final report from the consultants to Cyprus Anvil and of a letter from you dated September 9, 1981 in which you endorse

②

Mr. R. A. McCallum, P. Eng.,
Vice-President and General Manager.

21 September, 1981.

Page 2 -

the main conclusions reached by Klohn Leonoff and set forth a schedule of ongoing studies related to the project. I have also just received a letter from Mr. Davis dated 15 September, 1981 assuring the Board of the Company's commitment to an acceptable abandonment strategy. This information will be distributed to all Board members and to the Board's technical advisors and a decision as to its adequacy for presentation to a public hearing will be communicated to you in due course.

Please do not hesitate to contact me or the Board Secretary, Mr. Lendrum, should you have any questions about the process which the Board envisages.

Yours truly,

A handwritten signature in dark ink, appearing to read "P. H. Beaubier". The signature is fluid and cursive, with a long horizontal stroke at the end.

P. H. Beaubier,
Acting Chairman,
Yukon Territory Water Board.

Encl.



Environment
Canada

Environnement
Canada

Conservation and
Protection

Conservation et
Protection

RECEIVED MAY 13 1987

Environmental Protection
Room 225 Federal Building
308 Main Street
Whitehorse, Yukon
Y1A 2B5

Your file Votre référence

Our file Notre référence

4780-37/A293

1986 05 11

Mr. Larry Carlyle
Technical Advisor
Yukon Territory Water Board
Suite 302
4114 - 4th Avenue
Whitehorse, Yukon
Y1A 4N7

Dear Larry:

Re: Curragh Resources Monitoring Requirements

Further to your request on April 30, 1987 regarding Curragh Resources' request to modify the monitoring requirements in their licence, we have reviewed Curragh's 1986 Annual Report, SRK Report 60601 and the water licence.

The modifications to the water quality monitoring station network recommended in the SRK Report 60601 are very extensive. The recommendations include the deletion of at least eight (8) surface water monitoring stations and major adjustments to the network of ground water monitoring wells.

Based upon a preliminary review of the monitoring requirements and the water quality data generated over recent years, I agree that there is a need for a comprehensive assessment of the location of the monitoring stations and the water quality parameters specified in the licence. However, in my opinion, the company has not completed a thorough analysis of all of the information and they certainly have not presented adequate rationale for all of their recommendations.

Accordingly, I recommend that Curragh Resources and their consultants be required to prepare a detailed report which clearly states all of the proposed modifications and provides full documentation supporting their request.

.../2

Canada

Mr. Larry Carlyle
Page 2

The detailed submissions from the company should then be forwarded to the regulatory agencies and other concerned organizations for their review. Subsequently, the Water Board should convene a Technical Advisory Committee meeting with representatives of the company, concerned agencies and public organizations for a detailed discussion of the proposals.

I would be pleased to discuss my recommendations with you and others when I return to Whitehorse on May 19. If you wish to discuss this matter earlier than May 19, please contact George Mackenzie-Grieve or Bob Allan at 667-3400.

Yours sincerely,



for K. Wile
Manager, Industrial Programs
EP - Yukon Branch

KW/lm

c.c. G. Whitley, DIAND
A. von Finster, DFO
R. Grant, Curragh Resources
P. Mehling, EP - Vancouver
L. Mychasiw, Renewable Resources, YTG



INTERNAL CORRESPONDENCE

JUN 1 1986
YIFA/AB/CORR
56
85-02

To H.M. Visagie, K. Forgaard, M. Pelly

Date 86-05-28
YEAR MONTH DAY

From Gary Webster

Environmental Services
DEPARTMENT AND LOCATION

File 8.12.0

PROGRESS BY STEFFEN, ROBERTSON
& KIRSTEN ON ABANDONMENT STUDIES

I spoke with Andy Robertson on May 23, he advised while the work has been progressing slower than expected because of the amount of data that had to be reviewed they are still making good progress. Mr. Hakle was on-site Faro during the week of the 23rd to collect additional samples of tailings to determine rate of oxidation. The data is being reviewed. The evidence is that the total mass of water that moves downward through the tailings is very low. As such oxygen availability to the tailings is not considered to be very high, thus, the potential for oxidation appears to be small. During the time that the tailings are in a frozen state or simply wet, there is little opportunity for oxygen movement. There appears to be only a short period of the year where oxygen can move in the tailings and therefore any oxidation will be very short-term and terminate when conditions change. The tailings samples will be tested to confirm oxidation penetration rates.

At present the consultants are reviewing what options there will be to reduce penetration of water by either capping, vegetating or other methods. I advised them that the capping was probably more practical than trying to maintain a vegetation cover on the tailings and that in the report the capping should be stressed over the vegetation. They have reviewed the information on the basal groundwater movement under the tailings and the chemical quality of the basal chemistry, and feel they are reasonably complete. They feel that they will complete the work on time and that their progress is satisfactory.

Newt Cornish telephoned on May 26 to advise all the samples from his spring testing program had been collected and presently are with Bondar Clegg for analysis. The samples should be complete with analyses received in about two weeks time. These data will be given to SRK for inclusion in their assessment. This should give a further six months groundwater chemistry that will help to confirm the slow rate of oxidation of the tailings.

GAW/lr

BC RESEARCH

June 9th, 1986
Our File: 5-41-581

3650 Wesbrook Mall,
Vancouver, B.C.,
Canada V6S 2L2
Phone (604) 224-4331
Cable RESEARCHBC
Telex 04-507748

A. Bruynesteyn and Associates
2175 Greylinn Crescent
North Vancouver, B.C.
V7J 2X6

Dear Mr. Bruynesteyn,

Attached are the results of the test work performed on four Curragh tailing samples and five water samples received May 27th, 1986.

Objectives of the testwork were:

1. To determine the degree of sulphide oxidation of tailing samples.
2. To determine water-soluble zinc and iron contents of tailing samples.
3. To determine pH, presence of bacteria, sulphate, and trace metal contents of tailing water samples.

Four wet tailing samples, listed in Table 1, were oven dried at 70°C. A 100 gram representative portion of each sample was agitated with 500 ml of distilled water in a 1 litre Erlenmeyer flask on a gyratory shaker for 20 minutes. The slurries were filtered and the filtrates analyzed for pH, zinc, total iron and sulphate.

Zinc and total iron were determined spectrophotometrically with a model 306 Perkin Elmer spectrophotometer. Sulphate in solutions was measured gravimetrically by precipitation with barium sulphate. Sulphide sulphur contents of dried solids were also determined for tailings samples by the barium sulphate gravimetric method after preleaching with dilute HCl to remove sulphate, aqua regia digestion and filtration.

Results of tests performed on the tailing solids samples are presented in Table 1.

Results of analyses on water samples are presented in Table 2. Trace metal analysis are being performed by Chemex; results will be forwarded when available.

Testing for the presence of bacteria was performed by microscopic examination and by 5 ml addition of each sample to sterile 9 K medium, followed by incubation for ten days.

*Technical Operation of the
BRITISH COLUMBIA
RESEARCH COUNCIL,
a Non-profit Industrial
Research Society*

I hope you find these results satisfactory. Please call if you have any queries.

Yours very truly,

B.C. RESEARCH

A handwritten signature in dark ink, appearing to read 'R.O. McElroy', written in a cursive style.

R.O. McElroy

Head

Division of Extractive Metallurgy

ROM/dlt

TABLE 1

Results of Tests on Curragh Resources
Tailing Samples

Sample Identification	Sulphide Sulphur Sulphide (% of dry solids)	pH	Filtrate*		SO ₄ mg/Kg	Byerson conc in wash water
			Zn mg/Kg	Fe mg/Kg		
Old Tailing, top 1"	29.11	2.41	49 10	845	4250	8850 mg/L
Old Tailing, 10" down	33.90	2.44	875 175	2450	9700	1940 mg/L
New Tailing, top 1"	32.84	2.43	11.5 3	1100	9700	1940 mg/L
New Tailing, 18" deep	35.13	2.53	2450 500	4645	21550	4230 mg/L

* Filtrate (dissolved) materials as mg/Kg of dry solids

Get samples from 24" - 60" - 120" & 180"

100 g in 500 ml.
200 g in 1000 ml.

21,550 mg/kg

21,550 mg/100g = 4,230 mg/L

4.6
1.8
2

TABLE 2

Results of Analysis on Curragh Resources
Water Samples

Sample Identification	pH	SO ₄ g/l	Presence of Bacteria Microscopic Inspection	Bacteria Sterile 9K Medium <i>in Duplicate</i>
"Finger" Effluent Discharge, May 23, 1986	7.10	0.23	negative	negative
Acid Water going to Collection Pond May 23, 1986	7.32	0.59	negative	negative
Seepage into Effluent Discharge, May 23, 1986	6.87	0.38	negative	negative
Treated Effluent Decant Discharge, May 23, 1986	7.32	0.10	negative	negative
Typical Stagnant Pond on Tailings, May 23, 1986	4.26	0.76	negative	~~negative~~ POSITIVE <i>BOTH DUPLICATES!</i>



INTERNAL CORRESPONDENCE

To K. Forgaard (Faro), Roy Burke (Faro), Date 86-06-16
YEAR MONTH DAY
M. Pelley (Whitehorse), H.M. Visagie (Toronto) From Gary Webster
A. Robertson (SRK Vancouver) Environmental Services
DEPARTMENT AND LOCATION
File 8.12.0

PROGRESS REPORT ON SRK ACID GENERATION STUDIES

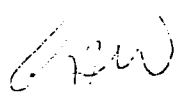
Andy Robertson of SRK called on June 12, 1986 and reported the following:

1. Microbiological analyses of tailings samples collected showed no bacterial activity. As a result, this portion of the study will now focus on samples of tailings collected last October by Golder Associates and stored frozen. These samples will allow much deeper (i.e., older) tailings to also be tested. These investigations will be done within budget projections.
2. The water collected from the tailings near the surface has been found to contain very high levels of sulphate. This is a good sign from two points of view:
 - . These sulphate levels essentially preclude bacterial survival so bacterial leaching should not occur.
 - . Creating an impoundment over the tailings would force sulphate levels into the groundwater and Rose Creek possibly causing water quality problems in downstream Rose Creek. Nonflooded tailings would likely result in slower release rates of sulphate. Some investigation into milling or liming of mine wastes will be done to confirm what sulphate levels occur in the various water sources. The mechanism that causes these elevated levels of sulphate is not yet understood. Robertson will try to obtain information on sulphate levels from milling in the past. Review of data at X7 and X23 would not lead him to believe the mine water has these levels of sulphate. I suggested that the pumping from Zone 1 might be checked after neutralization for sulphate levels.
3. Groundwater work has focussed more on the probable movement of groundwater in the tailings and estimating impact of various infiltration rates of precipitation to help estimate what type of cover might be best in the dry Faro climate.

Regional groundwater data is not available for Rose Creek east of the water storage reservoir, nor for Anvil Creek above Zone 1. This will not hinder the conclusion that the groundwater discharges to gravels

in the bottom of Rose Creek Valley. This should go a long way to meeting the groundwater report clause of the Water Licence.

4. Robertson advises that they are back on schedule and a little under budget.


GAW/lr

BC RESEARCH

3650 Wesbrook Mall,
Vancouver, B.C.,
Canada V6S 2L2
Phone (604) 224-4331
Cable RESEARCHBC
Telex 04-507748

August 14, 1986
File No: 5-41-581

A. Bruynesteyn and Associates
2175 Greylynn Crescent
North Vancouver, B.C.
V7J 2X6

Dear Mr. Bruynesteyn,

Attached are the results of the test work performed on 15 curragh tailing samples received June 16, 1986.

Objectives of the test work were:

1. To determine water soluble zinc, iron, calcium and magnesium contents of tailing samples.
2. To determine the pH and presence of bacteria of tailing samples.
3. To determine the sulfide content of tailing samples.

15 wet tailing samples, listed in Table 1, were oven dried. A 100 gram representative portion of each sample was agitated with 500 mL of distilled water in a 1 litre Erlenmeyer flask on a gyratory shaker for 20 minutes. The slurries were filtered and filtrates analyzed for pH, zinc, total iron, sulfate, calcium and magnesium.

Zinc, total iron, calcium and magnesium were determined spectrophotometrically. Sulphate on solution was measured gravimetrically by precipitation with barium sulphate. Sulfide sulfur contents of dried solids were also determined for tailing samples by barium sulphate gravimetric method.

Results of tests performed on the tailing sample filtrates are presented in Table 1 and Table 2 shows the sulphide results for dried tailing samples.

Testing for the presence of bacteria was performed in duplicate. The test was carried out by adding 5 g of wet tailing sample to sterile 9 k medium and incubated at 35°C on a gyratory shaker. The leach test

- 2 -

was carried out for a period of thirty days and monitored for Fe^{+2} oxidation by allowing the solids to settle. Table 3 summarized the results.

We hope you find these results satisfactory. We apologize for the delay and thank you for using B.C. Research.

Yours truly,

B.C. RESEARCH



for
R.O. McElroy, Program Leader
Extractive Metallurgy Group
Industrial Chemistry Division

ROM/lgg
Encl.

TABLE 1
TAILING FILTRATES

TEST #	PIT #	SAMPLE #	pH	Zn (mg/L)	Zn (mg/kg)	Fe (mg/L)	Fe (mg/kg)	SO ₄ (mg/L)	SO ₄ (g/kg)	Ca (mg/L)	Ca (mg/kg)	Mg (mg/L)	Mg (mg/kg)
1		2	3.02	195	975	41	205	950	4.75	221	1105	8.5	42.5
1		4	3.82	190	950	16	80	976	4.85	191	955	52.6	263
1		6	5.84	1300	6500	<2	<10	4850	24.25	530	2650	336	1680
2		1	3.13	47	235	37	185	700	3.50	233	1165	5.5	27.5
2		6	4.66	2305	11525	19	95	1110	5.55	163	815	65.7	328.5
3		1	2.85	35	175	32	160	700	3.50	272	1360	2.4	12
3		5	5.80	455	2275	<2	<10	1110	5.55	15.3	76.5	61	305
3		6	4.81	51	255	<2	<10	776	3.88	192	960	46.1	232.5
4		1	2.34	64	320	515	2575	2020	10.10	251	1255	3.8	19
4		4	5.86	51	255	<2	<10	460	2.30	132	660	23.8	119
5		1	2.58	94	470	122	610	810	4.05	83	415	3.6	18
5		3	4.39	240	1200	12	60	1510	7.55	264	1320	74.5	372.5
6		1	2.96	59	295	22	110	160	0.80	2.4	12	0.66	3.3
6		3	4.04	100	500	20	100	870	4.35	166	830	49.4	247.5
6		6	5.76	415	2075	<2	<10	2180	10.90	109	545	231	1155

TABLE 2
TAILING SAMPLES FOR $S^=$

TEST PIT	SAMPLE	S_{SO_4}	S_T	$S^=$
#	#	(%)	(%)	(%)
1	2	0.69	35.30	34.61
1	4	0.42	19.70	19.28
1	6	1.01	16.89	15.88
2	1	0.54	32.45	31.91
2	6	0.35	35.73	35.38
3	1	0.65	30.57	29.92
3	5	0.35	41.87	41.52
3	6	0.27	33.23	32.96
4	1	1.17	29.47	28.30
4	4	0.19	31.57	31.38
5	1	0.79	35.72	34.93
5	3	0.49	25.22	24.73
6	1	0.33	33.62	33.29
6	3	0.33	23.02	22.69
6	6	0.45	22.59	22.14

TABLE 3
PRESENCE OF BACTERIA

TEST PIT #	SAMPLE #	JUNE 18 T = 0	JUNE 26 T = 18	JULY 3 T = 15	JULY 7 T = 19	JULY 14 T = 26	JULY 18 T = 30
1	2a	-	-	-	-	-	-
1	2b	-	-	-	-	-	-
1	4a	-	-	-	-	-	-
1	4b	-	-	-	-	-	-
1	6a	-	-	-	-	-	-
1	6b	-	-	-	-	-	-
2	1a	-	-	-	-	-	-
2	1b	-	-	-	-	-	-
2	6a	-	-	-	-	-	-
2	6b	-	-	-	-	-	-
3	1a	-	-	-	-	-	-
3	1b	-	-	-	-	-	-
3	5a	-	-	-	-	-	-
3	5b	-	-	-	-	-	-
3	6a	-	-	-	-	-	-
3	6b	-	-	-	-	-	-
4	1a	-	-	-	-	-	-
4	1b	-	-	-	-	-	-
4	4a	-	-	-	-	-	-
4	4b	-	-	-	-	-	-
5	1a	-	-	-	-	-	-
5	1b	-	-	-	-	-	-
5	3a	-	-	-	-	-	-
5	3b	-	-	-	-	-	-
6	1a	-	-	-	-	-	-
6	1b	-	-	-	-	-	-
6	3a	-	-	-	-	-	-
6	3b	-	-	-	-	-	-
6	6a	-	-	-	-	-	-
6	6b	-	-	-	-	-	-
Controls	a	-	-	-	-	-	-
	b	-	-	-	-	-	-

T = # of Days
 (-) = Bacteria absent
 (+) = Bacteria present



Curragh
Resources

117 Industrial Road
Whitehorse, Yukon
Y1A 2T8
Tel: (403) 668-3578

August 15, 1986

Diane Granger
Chairman
Yukon Territory Water Board
200 4114 Fourth Avenue
Whitehorse, Yukon
Y1A 4N7

Dear Madam Chairman,

I wish to thank you and the other members of the Board for the expediant manner in which you dealt with our recent application to amend our water use licence. The authorization for the increased water use is an important element in the re-establishing the Faro mine as a viable operation.

My recent letter to you (dated July 1, 1986,) indicated that Curragh was investigating the feasibility of installing groundwater wells to supplement the existing water supply. We have now completed our investigation and results indicate that the use of ground water is feasible. For your information please find the design and construction plans and specifications of the system (attached).

We propose to complete the installation of the wells by approximately October 15, 1986 to allow their operation prior to the anticipated low surface water flows of November. This ground water supply is essential to help meet our requirements of 6550 1GPM during the low flow period of November-April.

Installation and operation of the wells will not require any additional amendmets to our Water Use Licence.

- 2 -

We have taken the liberty to discuss the groundwater wells and other issues with the Board's staff and other government agencies. We are prepared to provide any additional information to the Board or any other interested party.

Yours sincerely,

CURRAGH RESOURCES

Marvin Pelley
Vice President
Transportation and Engineering

Attachment

cc: J. Nichol
200 Range Road
Whitehorse

Curragh Resources
Proposal for
Construction and Operation of
Ground Water Wells

August 15, 1986

Summary

Curragh Resources proposes the development of three groundwater wells PW-1, PW-2 and PW-3 in the area between the tailings pond and the pumphouse reservoir (see the attached Map #1 for the specific locations of these three wells) to augment the existing water supply from the water reservoir to the concentrator. The wells will be 24" X 16" double cased, gravel-wall wells of projected depths of 40', 75' and 60' respectively (see Drawing 586-773, attached). Each well will be equipped with a 40 H.P. submersible pump rated at 1200 USGPM. Water will be pumped through 8" diameter steel pipe to the existing pump-house reservoir and from there via the existing pumping system to the concentrator.

Background

International Water Supply Co. (IWS) completed for Cyprus Anvil Mining Corporation (CAMC) ground water potential studies during the late 1960's. Curragh Resources commissioned IWS during the spring of 1986 to review these studies, and conduct further field tests to more accurately determine the feasibility to provide water from ground sources. During the summer of 1986 Midnight Sun Drilling under the supervision of International Water Supply Co. (I.W.S.) completed an extensive exploration and testing program to investigate the water supply potential of the region. Two aquifers were identified in the Rose Creek Valley between the existing water reservoir and the tailing pond. Test results indicate that the lower aquifer had an extremely slow recharge rate and I.W.S. concluded that this aquifer was not capable of being developed as a groundwater supply. However, the upper or "Economic Aquifer" had reasonable recharge capability and can be developed as a groundwater supply. Ground water wells in this "Economic Aquifer" could have a potential of producing an average of 2000-3000 IGPM during the summer period and, although not certain, should be capable of providing 1000-1550 IGPM during the critical November to April (low flow) period.

Impact on Rose Creek

Since none of these three wells will be placed in the stream beds, their installation and operation will have minimal impact on Rose Creek. The wells (when operating during the winter period) are expected to intercept and draw approximately 160-400 IGPM of the surface water upstream of the tailings pond flowing from the North Fork and the Rose Creek.

Ground Water Quality

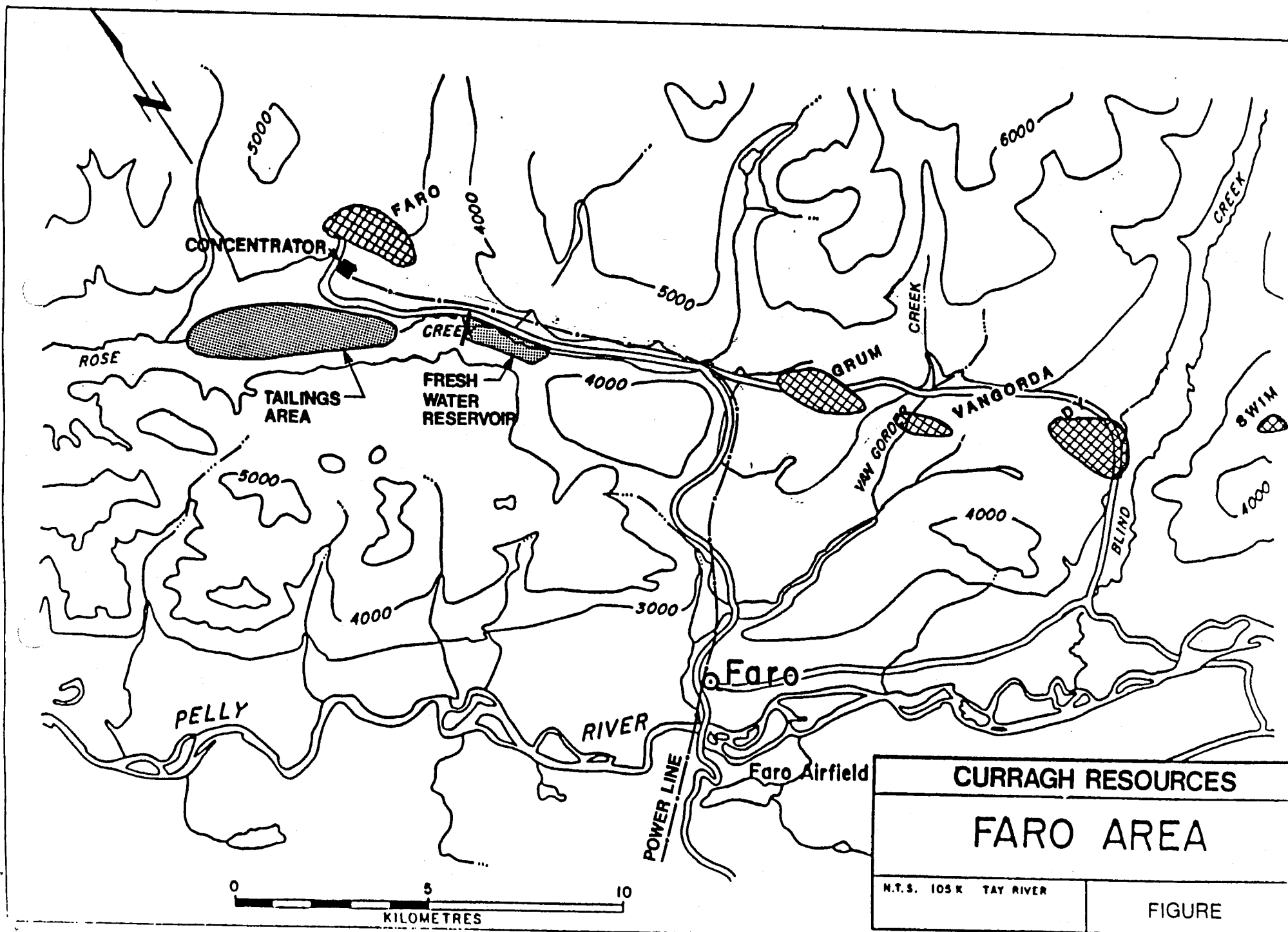
The ground water quality in this area is acceptable to Curragh and meet Water Licence requirements. Table II lists the analytical results from fourteen water samples taken from test holes in the "Economic Aquifer".

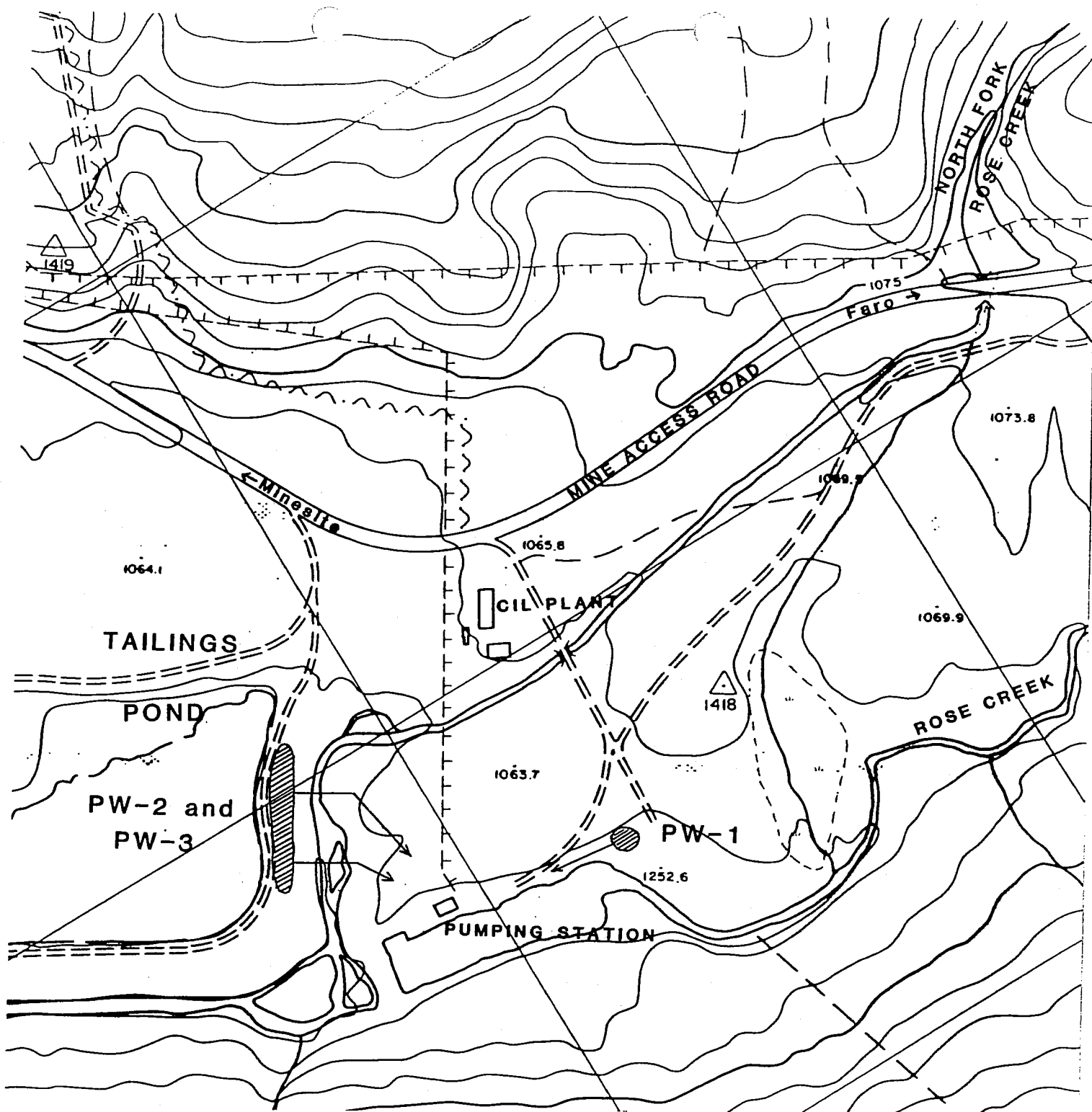
TABLE II

Sample #	ppb Cu	ppb Pb	ppb Zn	ppb Fe	ppb Mn	ppm Na	ppm SO ₄
1	L2	L5	8	84	3	32.0	16
2	2	9	23	115	10	3.0	19
3	3	6	70	260	13	2.7	21
4	4	16	23	294	9	2.5	7
5	2	8	28	112	5	2.8	19
6	2	L5	21	52	2	2.8	14
7	3	L5	26	40	2	2.7	19
8	2	L5	17	40	2	2.7	17
9	2	L5	38	40	2	2.7	16
10	2	L5	6	340	590	2.3	14
11	2	L5	5	168	345	2.5	22
12	2	L5	5	425	360	2.0	6
13	L2	6	18	30	2	2.0	17
14	L2	7	15	22	L2	2.0	14

Construction Schedule

August	18-23	Installation of PW-1
August	25-30	Testing of PW-1
September	2-6	Installation of PW-2
September	8-13	Testing of PW-2
September	15-20	Installation of PW-3
September	22-27	Testing of PW-3
September	29-October 10	Commissioning of System
October	13	Groundwater Well System Ready for Operation





LEGEND



PROPOSED WELL SITE

CURRAGH RESOURCES FARO YUKON

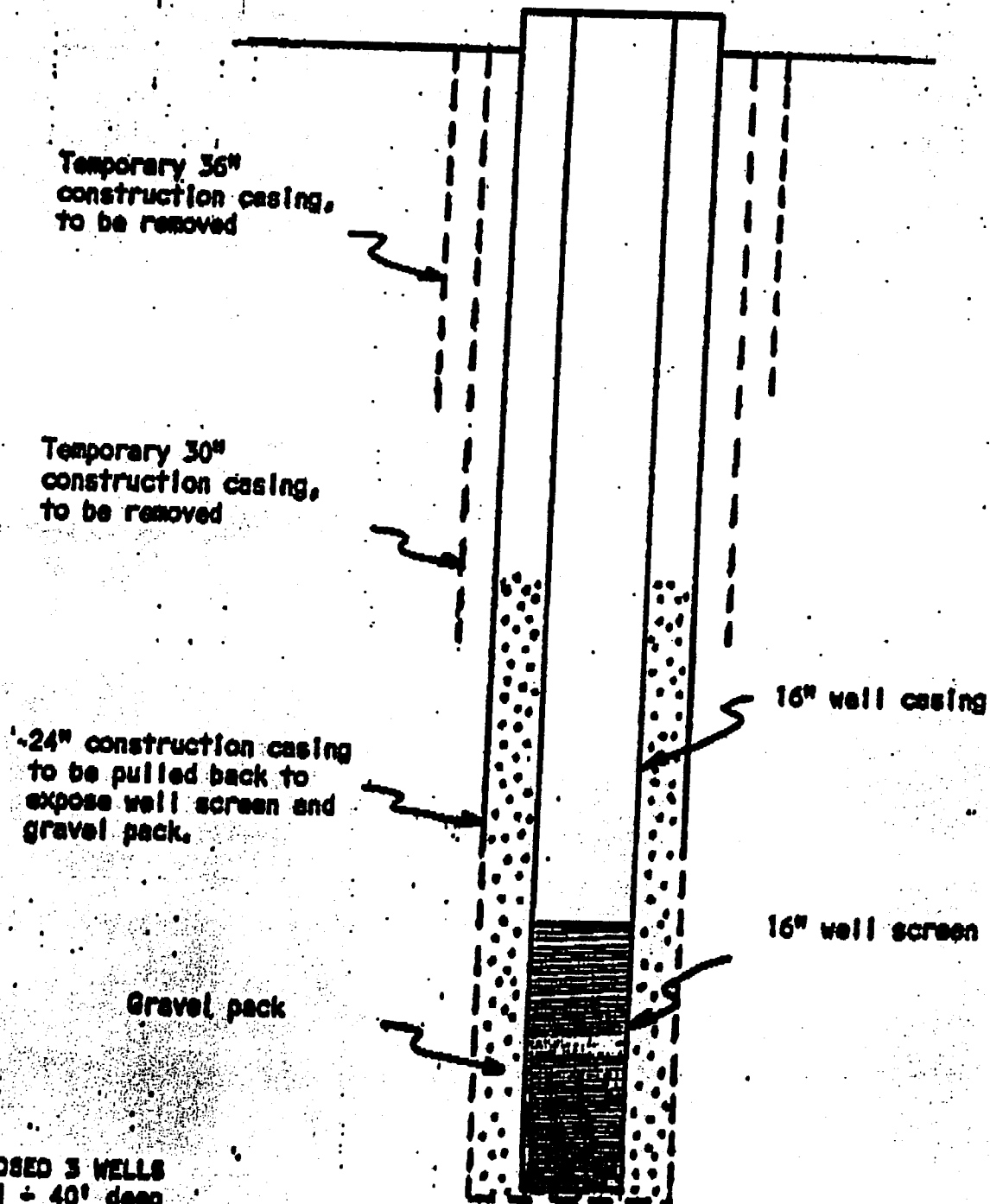
PROPOSED WATER WELL SITES

A.M. TOTH, P. ENG.
INTERNATIONAL WATER SUPPLY, LTD.

JULY 1986 scale 1:5000

MAP 1

CURRAGH RESOURCES
FARO YUKON
SCHEMATIC DIAGRAM FOR
PROPOSED WELLS
JULY 10/86



NOTE:

PROPOSED 3 WELLS
PW #1 - 40' deep
PW #2 - 75' deep
PW #3 - 60-70' deep

DRAWING 586-773
A.M.TOTH, P. ENG.
IWS LTD.



GEO TECHNICAL DESIGN & CONSULTING SERVICES

PRELIMINARY

November 28, 1986

Northern Affairs Program
Water Resources Division
200 Range Road
Whitehorse, Yukon
Y1A 3V1

Attention: Mr. H.F. McAlpine, P. Eng.

Dear Sir:

RE: Curragh Resources Proposed Rock
Drain and Waste Dump Across
North Fork of Rose Creek, Faro

Further to your request of November 19, 1986, we have undertaken a review of Golder Associates Report No. 2 (dated September, 1986) prepared for Curragh Resources and dealing with various aspects of the above-proposed rock drain. The results of our review as well as our recommendations are summarized in the following paragraphs.

1.0 PROPOSED ROCK-FILL CAUSEWAY

Curragh Resources considers development of an approximately 70 m high rockfill causeway across the North Fork of Rose Creek to provide road access to the future Vangorda Pit. The end-dumping method is proposed for the development of the rockfill; consequently the fill slopes will be inclined at the angle of repose for the waste rock (approximately 37°). At this inclination, the Factor of Safety against sliding (for a "dry" slope) is unity. A berm (fillet) sloping 3:1 (H:V) is designed at the outfall of the rock drain to increase the stability of the downstream toe of the fill.

The rockfill causeway will interrupt the natural creek flow. A rock drain consisting of coarse fragments of waste rock is proposed to convey the flow of the North Fork of Rose Creek from the upstream to the downstream limits of the rockfill. The design width of the drain is 70 m and approximately 1.5 million tons of durable calciumsilicate rock will be required to form the rock drain.

During floods, flow in the creek will back-up and a temporary pond will develop above the inlet end of the rock drain. However, the storage volume on the upstream side of the causeway fill is sufficiently large to store the 100-year discharge event with the water surface still remaining some 30 m below the causeway crest level.

Glaciation, i.e. the formation of ice within the rock drain during the winter months, could occur and could result in at least temporary reduction in the through-flow capacity of the drain. An emergency overflow spillway, located within the crest of the fill, is conceptually considered for the abandonment of the structure.

2.0 PRECEDENTS OF WASTE DUMPS IN STREAM VALLEYS

The designer claims that valley fills with rock drains are currently employed in the East Kootenay region of British Columbia and references a waste dump causeway across Swift Creek as an example of successful construction and operation. These references should be correlated relative to the actual stage of construction and flows, as summarized in Table 1.

The only currently operating "rock drained dumps" are, to our knowledge, located at the Smoky River Mine (Dump M2 placed over an intermittent creek) and the Fording Coal Mine. It is of interest to note that the 200-year peak discharge of the North Fork of Rose Creek is approximately 10 times greater than the same type of event predicted for Swift Creek.

TABLE 1
Proposed and Existing Mine Waste Dumps in Stream Valleys

MINE OWNER	NAME OF DUMP	PROPOSED CAPACITY (10^6m^3)	PREDICTED 200-YEAR MEAN DAILY FLOOD (m^3/s)	METHOD OF FLOW CONVEYANCE	CONSTRUCTION STATUS
Byron Creek Collieries	East dump	320	8.8	Manufactured under- drain and containment berm in downstream toe	To start in 1987
Crows Nest Resources	West Line Creek	480	7.0	Select rockfill in downstream lower portion; contingency containment berm and rock apron	Started in 1981; main fill across valley slated for 1988
Westar Mining	Cataract Creek	57	3.0	No special measures	Started in 1985
Westar Mining	Porter Creek	21	3.8	No special measures	To start in 1986
Gregg River Resources Ltd.	D2 dump (Camp Creek)	60	1.2	2 m thick drainage layer of select rock	Started in 1983; continuing
Fording Coal	Swift Creek		5.8	Manufactured under- drain for overflow	Completed in 1981

It is also of interest to note that according to the U.S. Bureau of Mines (Claridge et. al., 1986) and the U.S. Office of Surface Mining (personal communication with Mr. L.W. Hamm, Denver, Colorado), the common practice with waste dumps in the United States is to place waste dumps outside of valleys with perennial flows or to direct surface flow around the perimeter of the dump in diversion channels. There are several experiments underway, using culverts and drains, mostly involving minor streams and designed as temporary measures. Some of the dumps are supposed to be relocated prior to the discontinuation of the mining.

There is not, to our knowledge, a precedent case involving a through flowing waste dump constructed and operated in the Yukon or Northwest Territories. However, we are aware of a number of rock waste dumps which became unstable due to seepage conditions, weak foundations or a combination of both.

3.0 CONCERNS

When evaluating the proposed waste dump causeway with rock drain, the following aspects were considered:

3.1 WASTE ROCK PROPERTIES

While it is very likely that the calcium-silicate rock, proposed for the drain, is durable and in sufficient quantities available at the time of the construction, there are two concerns:

- the relative susceptibility of this rock to mechanical degradation was not tested;
- sources of suitable material were not identified relative to the mining schedule.

Residual explosive compounds, which may influence the water quality, have not been identified or evaluated.

It is our understanding that other overburden waste at the site is predominantly of the schistose-type which deteriorates with time and will be incorporated outside of the proposed rock drain in the causeway. The concern related to this material is regarding possible future lower strength, i.e. a lower angle of repose than at the time of the fill placement. This could cause surface sliding, eventually blocking the drain.

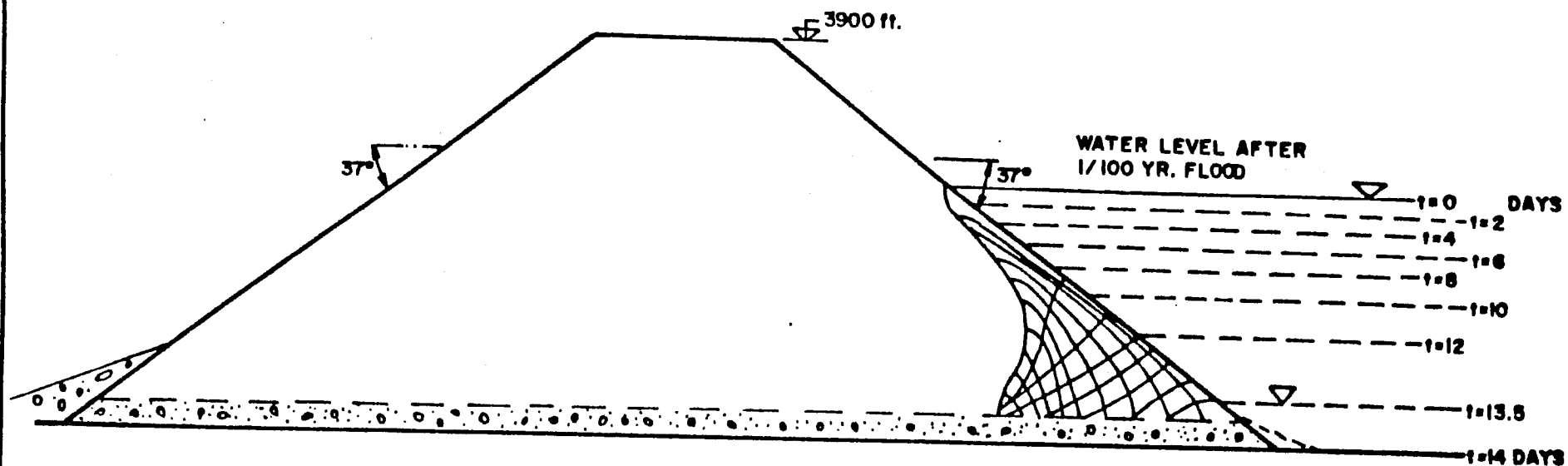
3.2 FLOW CAPACITY OF DRAIN AND HYDROLOGICAL ANALYSES

The designer compiled the flood frequency curve, discharge curve for the drain and storage volume upstream of the dump for various floods. The range of average discharge capacity of the drain (assuming 250 m² as an effective cross-section area) is considered to be realistic to slightly conservative. However, the levels of saturation of the dump upstream face during various flood events were not evaluated. As shown on Figure 1, a significant saturation of the flooded fill face may occur and, following the termination of the flood, a rapid drawdown condition will develop.

The upstream face would, under rapid drawdown conditions, have a Factor of Safety considerably less than unity. The surface layer of the dump will very likely fail, possibly blocking the drain. Because of the loss of toe support, the upper slope segment will collapse as well. This process could repeat itself following every major flood.

3.3 FOUNDATION CONDITIONS

The report does not consider geology of the North Fork valley and does not address stability of the dump foundation.



NOTE: t = time elapsed since culmination of flood

CLIENT
NORTHERN
AFFAIRS PROGRAM


geo-engineering

CURRAGH RESOURCES CORPORATION
NORTH FORK ROSE CREEK CAUSEWAY

DRAWDOWN CONDITIONS
AFTER 1 IN 100 YEAR FLOOD

Based on our knowledge of this area, it is expected that abutments of the valley are in glacial till and colluvium overlying bedrock. The valley is likely infilled with a complex assemblage of glacial and fluvial deposits.

Permafrost occurs on many sections of the north and east facing slopes and within adjacent sectors of the valley bottom. Several slopes affected by solifluction and soil creep (caused by freeze-thaw of the active layer) were identified in this general area.

The proposed fill may modify the thickness of the active layer and cause significant changes to the permafrost table. Whether the permafrost table locally advances and elsewhere in the vicinity of the dump recedes, depends on the actual energy balance.

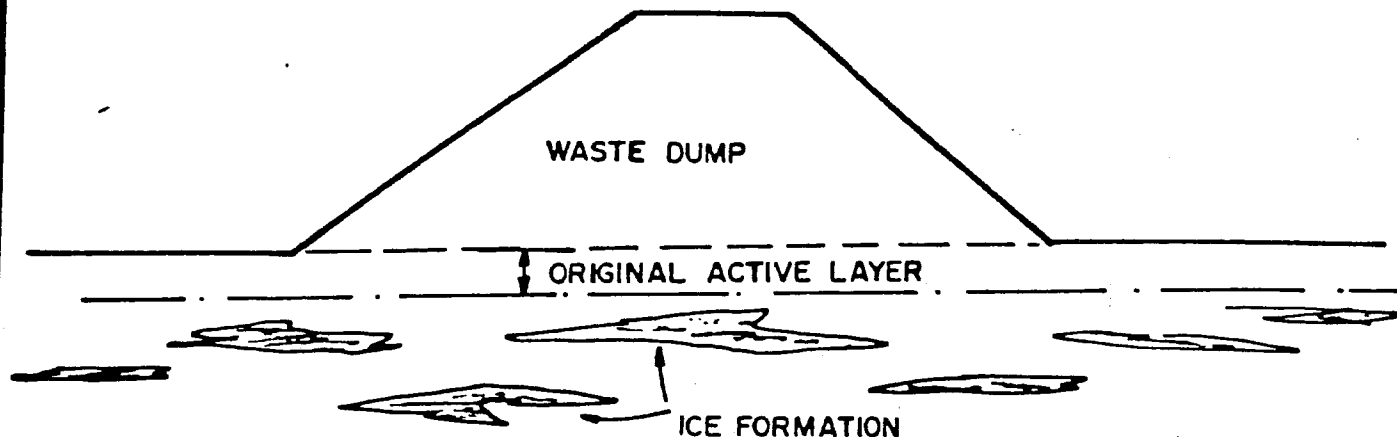
Possible impacts are schematically illustrated on Figure 2. It is our opinion that a thawing subgrade will cause slope failures. In addition, for waste dump segments placed over a hillside with seasonal seepage above the permafrost, the potential for ice glaciating and "anfeis" exists. This could also lead to increased foundation pore pressures and eventual slope failures.

3.4 DESIGN SLOPES OF WASTE EMBANKMENT

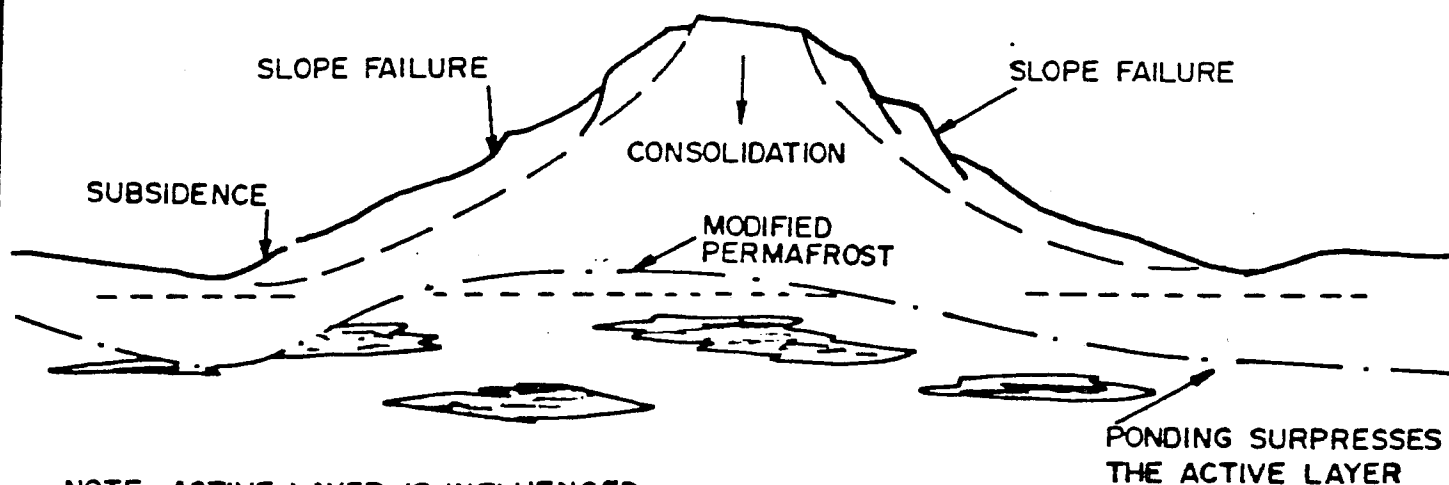
The proposed configuration of the embankment is deficient not only relative to the short-term stability, but also with respect to the long-term performance of the fill.

It would be prudent to organize the dump construction to produce a relatively flat overall angle (such as for example, 20 degrees) and therefore, minimize the risk of a failure. In addition, toe berms and aprons are routinely used to enhance the long-term performance of such drains.

A) ORIGINAL GROUND CONDITIONS



B) POSSIBLE GROUND MODIFICATIONS



NOTE: ACTIVE LAYER IS INFLUENCED BY SEEPAGE AND WASTE DUMP

CLIENT NORTHERN AFFAIRS PROGRAM	CURRAGH RESOURCES CORPORATION NORTH FORK ROSE CREEK CAUSEWAY		
 INSTIT LTD	POSSIBLE GROUND MODIFICATIONS AND CAUSEWAY DEFORMATIONS		
SCALE N.T.S.	PROJECT No A-052-3	FIGURE 2.	

4.0 CLOSURE

The reviewed report on "Proposed Rock Drain Across North Fork of Rose Creek" is, in our opinion, deficient in the following aspects:

- no information is available on the engineering properties of the waste rock and foundation materials,
- no testing of natural soils has been carried out,
- there is no information on the permafrost table and active layer,
- there is no consideration of the possible behavior of the permafrost underneath the proposed causeway,
- there is no analysis of the probable impacts of drawdown conditions on the stability of the embankment upstream face,
- there is no analysis of the possible impacts of thawing subgrade on the embankment stability and integrity of the proposed rock drain, and
- very little attention has been paid to the dump conditions for its abandonment stage.

It is our opinion that the proposed waste embankment and rock drain, at its currently considered configuration and parameters, would deform and eventually fail, causing significant modifications of the creek flow regime.

It is our recommendation that the mining company be requested to revise its position regarding the proposed causeway. This should include ^{review of} other options for the stream conveyance.

Yours truly,

GEO-ENGINEERING (M.S.T.) LTD.



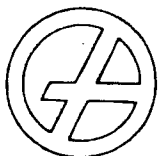
Milos Stepanek, M.Sc., P. Eng.
Principal Consultant

MS/jlw#9

G 052-3

PRELIMINARY

11/15/86
Dec 1/86



Golder Associates

CONSULTING GEOTECHNICAL AND MINING ENGINEERS

E/86/1494

December 31, 1986

Curragh Resources
117 Industrial Road
Whitehorse, Yukon
Y1A 2T8

ATTENTION: Mr. Robert Grant

Re: Proposed Rock Drain
North Fork Rose Creek

Dear Sir:

You have transmitted to us a copy of a letter report prepared by Milos Stepanek, P. Eng. of Geo-Engineering for the Whitehorse office of Water Resources Division, Canada Department of Indian Affairs and Northern Development. Mr. Stepanek's letter, dated December 2, 1986 presents his critique of Golder Associates' Report No. 2 dated September, 1986 to Curragh Resources Corporation re the proposed rock drain at the North Fork of Rose Creek, near Faro, Y.T.

This letter discusses the items raised in Mr. Stepanek's letter. The numbering used in this letter corresponds to the numbering system in Stepanek's letter of December 2.

2.0 Precedents

The number of rock drains currently in use in the East Kootenay region of British Columbia is considerably greater than those listed in Table 1 of Mr. Stepanek's letter. Admittedly, the rate of discharge in the North Fork of Rose Creek at the location where the proposed causeway

will cross the drainage course is larger than the design discharge for existing rock drains. The North Fork rock drain has been sized to accommodate these larger flows.

3.1 Properties of Embankment Materials

Mr. Stapanek states that the susceptibility of the calcium silicate (CaSi) rock to mechanical degradation has not been tested.

As part of their mine planning studies, Cyprus Anvil Mining Corporation conducted uniaxial compression tests on samples of diamond drill core recovered from the calcium silicate zone. The uniaxial strengths from these tests varied between 237 and 280 MPa (34400 to 40600 psi). Considering rock classification on the basis of strength, the results of these uniaxial compression tests as reported by Cyprus Anvil indicate Class A designation, i.e. very high strength.

Golder Associates have also conducted uniaxial compression tests on samples of rock core supplied by Curragh. The results of these tests indicate uniaxial compression strengths in the range of 50 to 115 MPa. This range of strengths is comparable to the strengths reported for the East Kootenay sandstone and siltstone units that have been used in development of existing rock drains at coal mining operations in British Columbia.

The results of the uniaxial compression tests, together with slow rates of production drilling, which are also an indication of the mechanical durability of the CaSi rock, indicate that the CaSi rock fragments that will comprise the North Fork rock drain will have a sufficiently high degree of mechanical durability and that fracturing of these rock fragments under the weight of the rock fill above the drain will not impair its design function.

Mr. Stepanek states that sources of suitable materials for development of the rock drain were not identified. In the course of mine planning studies carried out in 1986, Curragh Resources identified 1.5 million tons of calcium silicate rock that would be available for construction of the rock drain segment of the proposed rockfill causeway that is required as part of the access roadway to the Vangorda property.

Residual explosive compounds within the waste rock were not examined in detail. Water quality analyses at other operating rock drains have shown that the initial discharge through a rock drain may contain nitrates. The concentration of dissolved nitrates reduce quickly, and water quality returns to background levels shortly after the rock drains have been put into operation.

Mr. Stepanak expresses concern that the schistos-type rock that will comprise part of the causeway fill will deteriorate with time and that this fill may assume a slope that is flatter than the angle of repose at the time of placement. There is no indication that any of the existing waste rock dumps on the property, which consist predominantly of the schist waste rock, have experienced flattening of their perimeter slopes. Thus, there is no evidence to support the contention that reduction in the strength of the schistos-type rock overtime will result in sloughing, and blockage of the drain.

3.2 Flow Capacity of Drain and Hydrological Analyses

Mr. Stepanek states the effective cross-sectional area of the rock drain is ~~insufficient~~ insufficient to convey major floods. This is not so. A temporary pool develops at the inlet end of practically every rock drain. This temporary pool increases hydraulic gradient as well as the

area of the wetted cross-section. Both of these factors serve to increase the rate of flow through the drain.

We do not agree with Mr. Stepanek's contention that the factor of safety of the upstream face of the causeway fill comprising the schistos rock above the inlet to the drain will be considerably less than unity as the surface of the temporary pond drops. The concern raised by Mr. Stepanak relates to the potential instability of that segment of the upstream face of the schist rock fill located above the inclined southeastern limit of the zone of CaSi rock, and potential blockage of inlet to the drain. The southeastern limit of the CaSi zone will approximate the surface of a segment of a cone inclined at 37 deg. As a consequence of this shape, there will be only a thin veneer of schist waste rock above the inlet to the drain, and the piezometric levels within this zone during drawdown in the temporary pool will be controlled by the piezometric levels in the drain.

The zone of CaSi rock lying beneath the schistos-type rock fill will serve as an underdrain, which will serve to reduce the piezometric levels within the schistos-type rock fill located above the drain. Figure 1 of the calculation sheets appended to this letter shows a plot of predicted pond surface level versus time in hours. The beginning of the design 1:100 year discharge event is assumed to be at $t=230$ hours.

An indication of the expected rate of drawdown in the temporary pool at any particular time is provided by the slope of the tangent to the curve of pond surface level versus time. At $t=400$ to 450 hours, pond surface following the design 100-year event can be expected to drop at a rate of approximately 2 metres per day. This rate of drop increases progressively, and by $t=540$ hours approximately the expected rate of drop increases to approximately 4 metres per day, corresponding to a pond surface level of approximately 23 metres.

It is reasonable to assume that the void ratio of the schistos-type waste rock is approximately 0.5, and that after drainage by gravity, the degree of saturation of the schist rockfill would remain at approximately 25 percent as a result of capillary-held moisture. Based on these assumptions, gravity drainage from saturated waste rock fill would result in extraction of 0.25 cubic metres of water per cubic metre of waste rock. Stated another way, drainage from the waste rock at a rate of 1 cubic metre per day per square metre of area would result in lowering of the water table within the schist rockfill at a rate of 4 metres per day.

In assessing the drawdown conditions within the schistos-type waste rock located above the zone of CaSi, it was assumed that drainage could take place either toward the upstream face of the causeway fill, or toward the underlying zone of CaSi rock. The average coefficient of permeability of the schistos-type waste rock was assumed to be 10^{-4} metres per second, which we consider to be a reasonable value. Using this assumed value for permeability of the schist waste rock, the excess head corresponding to a flow velocity of 1 metre per day was calculated. This rate of flow results in reduction of the phreatic surface within the schist waste rock at a rate of 4 metres per day. The resulting calculated excess heads in question are shown in the form of contours on Sheet 3 of the calculations appended.

It is reasonable to expect that the piezometric level within the zone of CaSi rock, which will serve as an underdrain for the schist rockfill will remain approximately coincident with the piezometric level within the rock drain. The piezometric levels within the rock drain will at all times remain below pond surface level.

Applying these calculated excess heads to the estimated piezometric levels in the underlying zone of CaSi waste rock indicates that level of

the piezometric surface ~~surface~~ within that segment of the schistos waste rock located above the drain will remain at or below pond surface level as illustrated on the section, sheet 5. Seepage pressures within the schist waste rock above the rock drain will act in a direction into the slope, thereby contributing to stability.

The water held within the schistos-type waste rock as a result of capillary tension will be at sub-atmospheric pressure, and will result in a modest increase in effective stress within the waste rock. That is, the capillary-held water will result in modest apparent cohesion, and as such will contribute to shear strength and serve to improve stability.

Our analyses indicate that the instability of the upstream face of that segment of the schistos-type waste rock located above the sloping south eastern boundary of the CaSi zone will not develop, and that sloughing of the face, and consequent blocking of the entrance to the rock drain as postulated in Geo-Engineering's letter report of December 2 is not a realistic scenario. Some sloughing of the upstream face of the causeway fill at locations remote from the entrance to the rock drain might occur.

As noted, our analyses have been based on an assumed coefficient of permeability of 10^{-4} metres per second for the schistos-type waste rock. While we believe this assumed value to be realistic, Curragh Resources have agreed to proceed with falling head permeability tests within the existing waste rock dump at a location where schist waste rock has been in place for several years in order to check the validity of this assumed value for permeability of the schist waste rock fill.

3.3 Foundation Conditions

At the time of preparation of Golder Associates' Report No. 2 to Curragh Resources, subsurface investigations were not carried out at the location where the proposed rock fill causeway will cross the North Fork Valley. However, in 1980, Golder Associates carried out subsurface investigations for a then-proposed access route between the Vangorda area and the millsite. These investigations included drilling of air-flush rotary test-holes at the left and right slopes of the North Fork Valley, and the excavation of a test pit in the valley bottom. The 1980 test holes and the test pit in the valley bottom were located approximately 400 metres downstream from the proposed causeway crossing.

In order of increasing depth below ground surface, the borehole on the right abutment encountered the following:

<u>Thickness</u> <u>(metres)</u>	<u>Material</u> <u>Description</u>
0.15	Moss
4.72	Sandy silt
2.44	Sand and gravel
0.60	Silty sand till
Below 7.92 m depth	Insitu schist rock

No frozen soil was detected in the borehole on the right abutment, and the hole remained dry.

The borehole on the left abutment encountered the following in descending order:

<u>Thickness</u>	<u>Description</u>
10.50	Sand and gravel
Below 10.50	Insitu schist bedrock

No frozen soil or seepage was detected in this borehole.

The test pit in the valley bottom encountered stratified sand and silt which was interpreted to be Recent alluvial deposits. Isolated segments of frozen soil were exposed to the walls of the test pit. Segregated ice was not present within the in situ soils exposed in the walls of the test pit.

The Curragh Resources mine site is located in a region of discontinuous permafrost. The presence or absence of permafrost in this area is primarily a function of the nature of the surface cover, and the solar radiation received on the ground surface.

At the location where the proposed causeway will cross the North Fork Valley, the topographic slope on the right abutment can be simulated by a plane that strikes approximately 045 degrees and dips at 10 degrees toward the valley. We have calculated the azimuth and altitude of the sun at selected hours of the day during the summer months, and have made a comparison of the solar radiation received by this simulated plane, with the solar radiation received by a level plane. This comparison, which is illustrated in graphical form on sheet 6 accompanying this letter, shows that the solar radiation received per square metre of ground surface on the right abutment is the same as the solar radiation received per square metre on a level surface. These analyses suggest that the likelihood of permafrost beneath the right abutment slope is approximately the same as the likelihood of permafrost within the area of the relatively level topography where existing wasterock dumps have been developed.

There is no indication that degradation of permafrost has ever resulted in instability at the perimeter of the existing wasterock dumps. The analyses of the solar radiation received by the right abutment slope, and the observed performance of the existing waste dumps

indicate that it is unlikely that the presence of permafrost will result in stability problems at the right abutment slope.

Considering the valley bottom, and the 70 metre wide band where the rock drain will be located, this area is flat, and it receives about the same amount of annual solar radiation as did the existing dump area before the mine was developed. This consideration, together with probable energy transfer to the subsoils as a result of down-valley groundwater flow indicates that it is unlikely that the fluvial sediments beneath the foundation area for the proposed rock drain contain segregated ice.

Considering the left abutment slope, the aspect of the topography in this region suggests that permafrost could be present. The presence of permafrost in the absence of segregated ice does not pose a potential stability problem. The presence of segregated ice within the foundation soil beneath the surface of the left abutment slope does not pose a problem unless subsequent melting of such segregated ice were to result in foundation pore water pressures greater than about 55 to 60 percent of the vertical stresses beneath the upstream face of the causeway fill ($r_u = 0.55$ to 0.6). For melting of segregated ice to occur, (assuming that segregated ice is present) there would have to be an increase in the energy transfer to these foundation soils. The causeway fill itself represents an insulating medium on the ground surface, so that energy transferred to the foundation soils would not occur as a result of solar radiation.

Energy transfer to the foundation soils beneath the left abutment slope could occur as a result of ground water flow. The temporary pond on the upstream side of the causeway would persist for such a short period of time that it is unlikely that the energy supplied by ground water flow from the pond would result in any significant change in the

overall thermal regime within the foundation soils beneath the causeway fill on the left-hand side of the drainage coarse.

The foregoing reasoning suggests that potential foundation instability associated with permafrost is unlikely to be a problem. To provide further clarification regarding this matter, Curragh Resources propose to proceed with subsurface investigations within the area of the proposed causeway crossing. If the results of these investigations indicate that the foundation instability attendant with the presence of permafrost might be a potential problem, stabilizing burns could be placed along the toes of the schistos segments of causeway fill.

Mr. Stepaneks statement that toe berms and aprons are routinely used to enhance the long term performance of bottom drains is not correct - at least so far as the inlets to rock drains is concerned.

Yours very truly,

GOLDER ASSOCIATES



D.B. Campbell, P. Eng.

DBC/r1
862-1093

Encl.

cc: With Enclosures to Gordon Grams

RESULTS OF FLOOD ROUTING ANALYSES
FOR 100-YEAR DESIGN DISCHARGE IN NORTH FORK OF ROSE CREEK
SHOWING
PREDICTED POND SURFACE LEVEL ABOVE INLET TO ROCK DRAIN
VS TIME (HOURS)

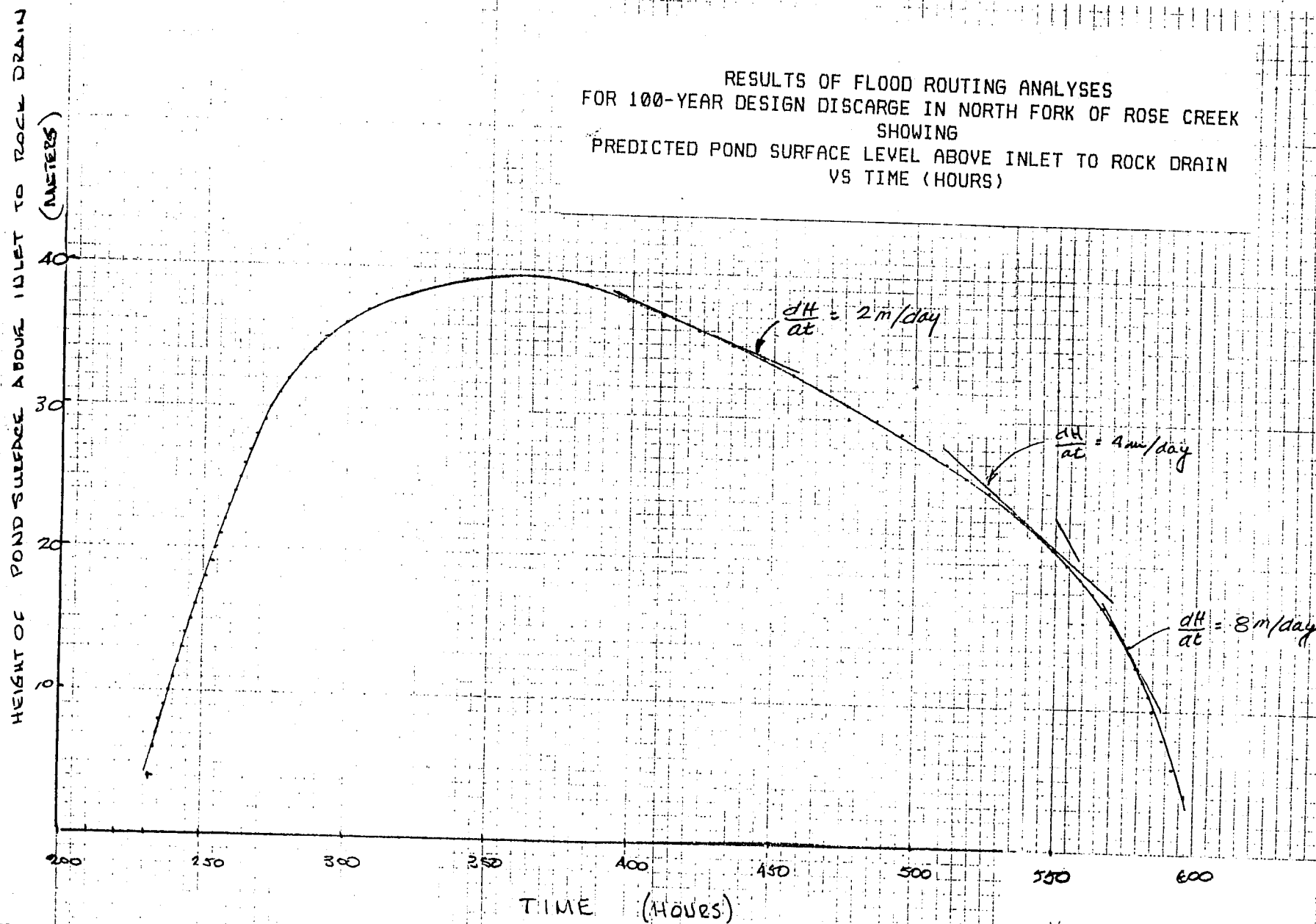


Figure 1

Golder Associates

SUBJECT Quebecan Rock Drain

Job No. 8621 093

Made by Ⓢ

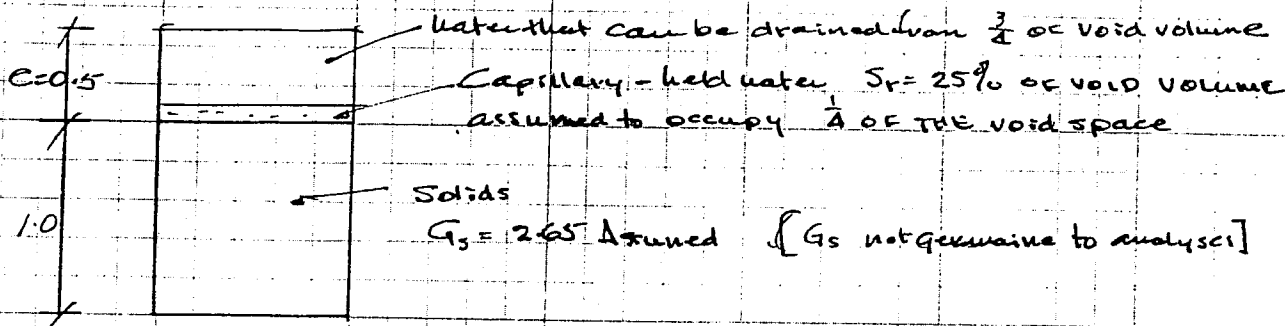
Date 24 Dec 86

Ref.

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Sheet 2 of

Reviewed



$$e = \text{Void ratio} = \frac{\text{Volume voids}}{\text{Volume solids}}$$

Water that can be drained assumed to be $\frac{3}{4}$ of void space

$$\text{Referring to the above} = 0.75 \times 0.5 = 0.375$$

$$\text{Water drained as a fraction of total volume} = \frac{0.375}{1.5} = 0.25$$

$$\text{ie drainage from } 1 \text{ m}^3 \text{ of waste rock} = 0.25 \text{ m}^3$$

$$4 \text{ m}^3 \text{ of saturated waste rock} = 1 \text{ m}^3$$

Drainage from waste rock at a rate of $\frac{1 \text{ m}^3}{\text{day}}$ per m^2 of area
drops the free water surface at a rate of 4 m per day

$$\frac{1 \text{ m}^3}{\text{day}} \text{ per m}^2 = \frac{1 \text{ m}}{\text{day}} = 1.157 \times 10^{-5} \frac{\text{m}}{\text{sec}}$$

What Head ΔH is required to produce a flow rate of $1.157 \times 10^{-5} \frac{\text{m}}{\text{sec}}$
so that water surface in schist drops at 4 m/day?

Assume laminar flow, and validity of Darcy's law for schist waste rock
and $k = 1 \times 10^{-4} \text{ m/sec}$ for schist waste rock.

$$v = ki$$

↑ hydraulic gradient = $\frac{\Delta H}{L}$ ← Driving head
↑ coefficient of permeability ← length of flowpath
↑ flow velocity or permeability

$$v = k \frac{\Delta H}{L}$$

$$\text{or } \frac{v \cdot L}{k} = \Delta H$$

$$\Delta H = \frac{1.157 \times 10^{-5}}{1 \times 10^{-4}} \cdot L$$

Length of flowpath
or $\Delta H = 0.1157 \times L$

Golder Associates

SUBJECT Chubbuck Rock Drain

Job No. 8821.083

Made by CE

Date 24 DEC 86

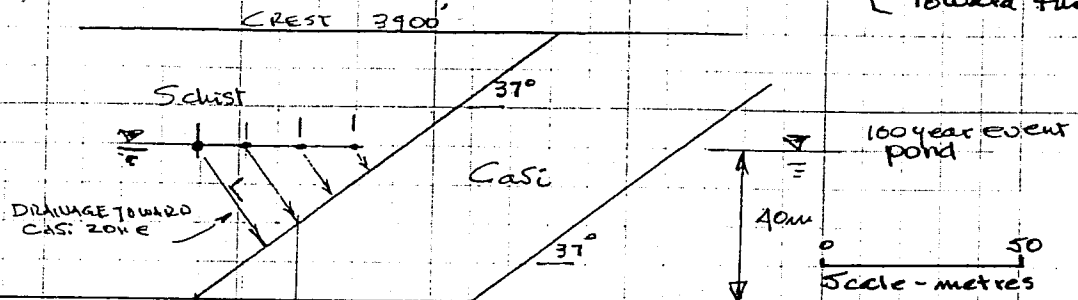
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Checked

Sheet 3 of

Reviewed

Zone of CaSi rock acts as an underdrain
Water in schist waste rock can drain toward [CaSi Zone or ...
Toward the face

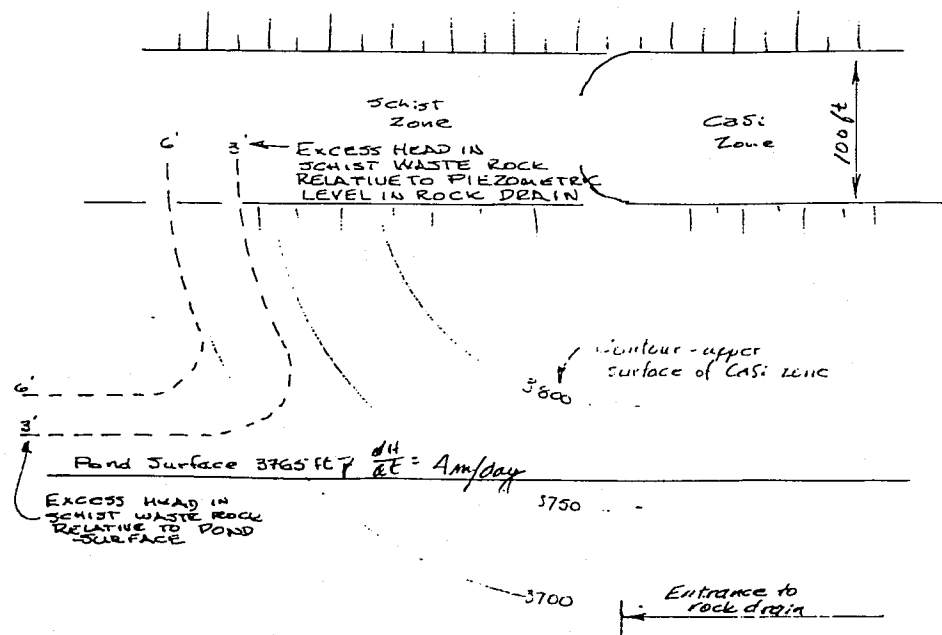


Transverse
Sections

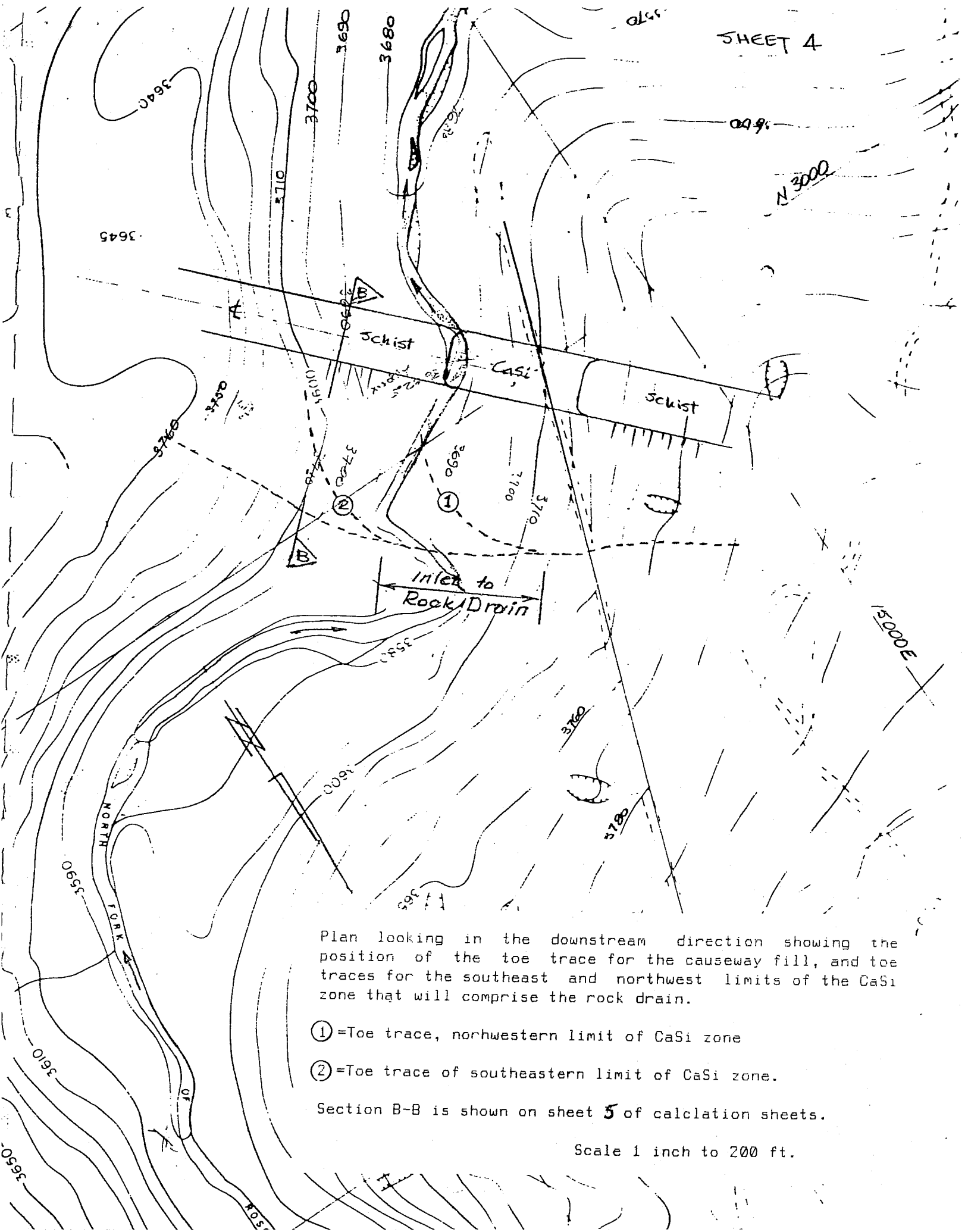
SECTION	HEIGHT OF WATER ABOVE BASE	$L = H \cdot \cos 37^\circ$ metres	ΔH metres
A	40m	31.9	3.7
B	30	23.96	2.77
C	20	15.97	1.85
D	10	7.99	0.92

LONGITUDINAL SECTION and/or
ELEVATION - UPSTREAM
FACE OF CAUSEWAY

ΔH : the excess head which
results in a reduction in
the water table at a rate
of $4m/day$



(ΔH)



Plan looking in the downstream direction showing the position of the toe trace for the causeway fill, and toe traces for the southeast and northwest limits of the CaS1 zone that will comprise the rock drain.

- ① = Toe trace, northwestern limit of CaSi zone
② = Toe trace of southeastern limit of CaSi zone.

Section B-B is shown on sheet 5 of calculation sheets.

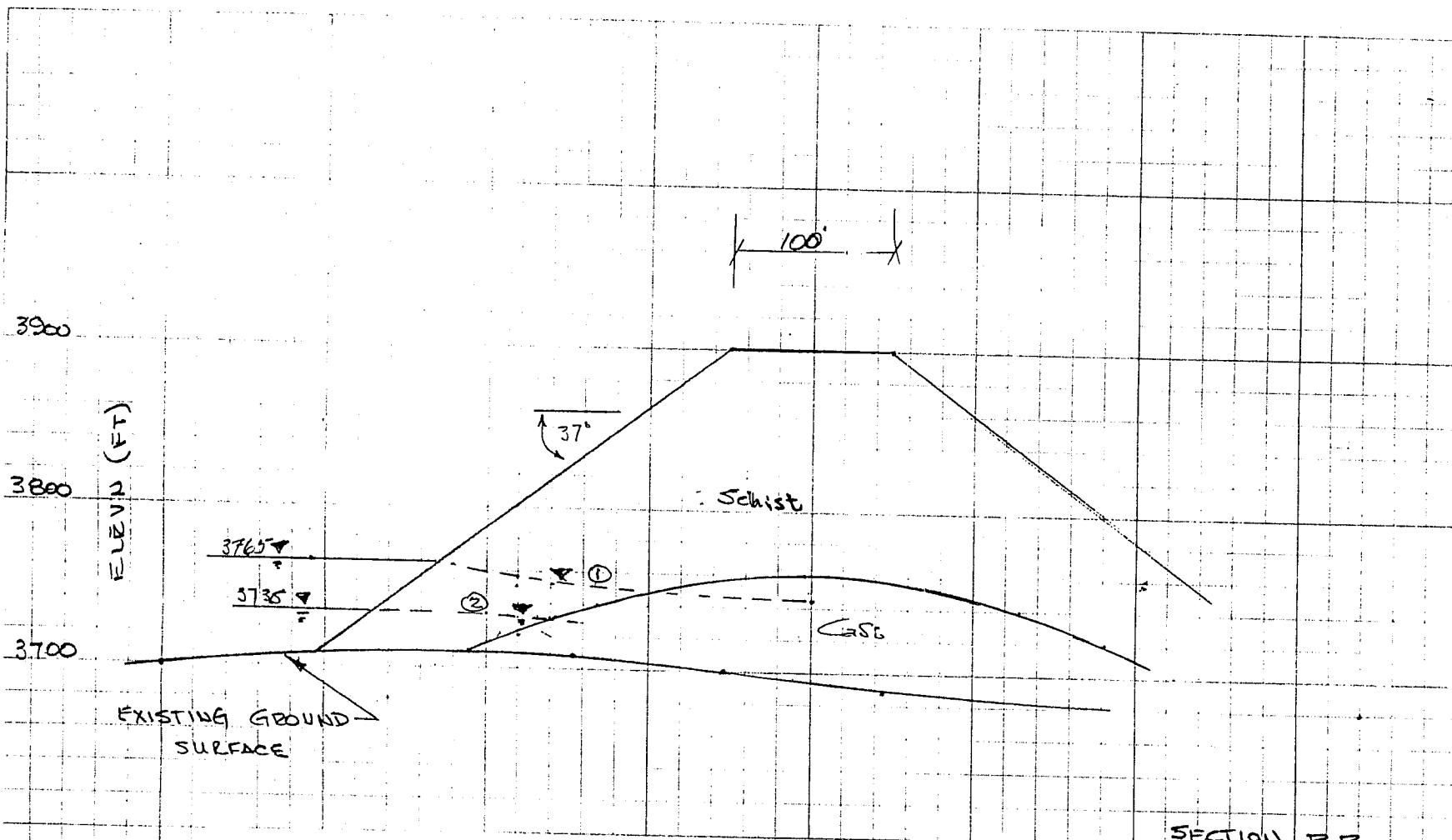
Scale 1 inch to 200 ft.

Golder Associates

SUBJECT: *Chualar - North Fork Rock Drain*
Job No. *8621093*
Ref.

Made by *GP*
Checked
Reviewed

Date *DEC. 28 1986*
Sheet *5* of



SECTION BB
1" = 100'

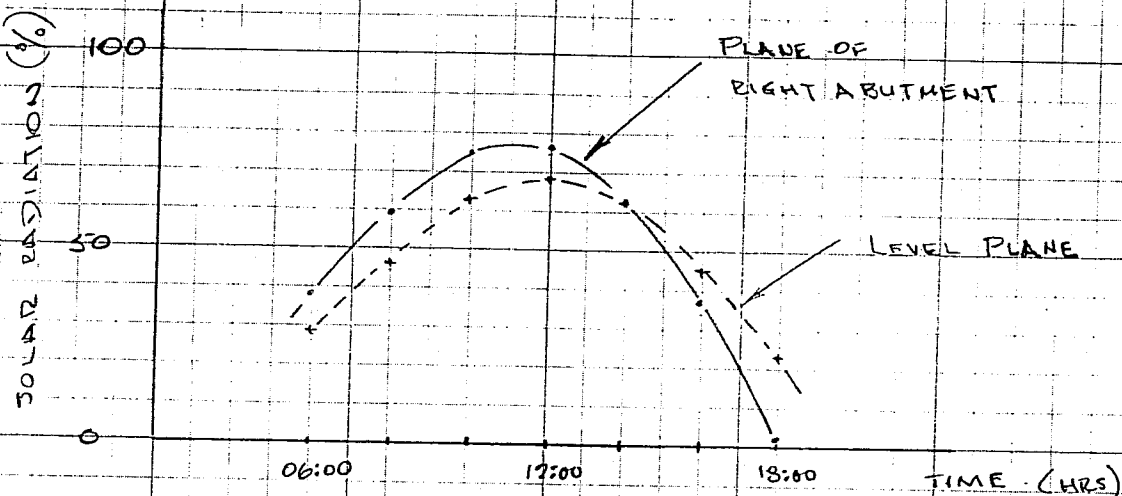
curve 1 is the estimated piezometric profile in the schist rock fill when the pool has dropped to elevation 3765 ft, and the rate of drop is 4 m per day.

Curve 2 is the estimated piezometric profile within the schist rock fill at the time when the pool has dropped to elevation 3736 ft, and the rate of drop is 8 m per day.

Estimated permeability of the schist rock fill is 10^{-4} m/sec.

Golder Associates

SUBJECT <u>CURRAGH - COMPARISON OF SOLAR RADIATION</u>		
Job No.	Made by	Date <u>DEC 86</u>
Ref.	Checked	Sheet <u>6</u> of
	Reviewed	



Comparison of the solar radiation recieved per unit of area of the right abutment slope, with the solar radiation recieved by a level plane.

Assumptions as follows:

Latitude of site = 62.5 deg north
Declination of sun = 15 deg north.

100 per cent on the ordinate scale represents the solar radiation recieved by a plane that is maintained perpendicular to the sun's rays.

MEMORANDUM

NOTE DE SERVICE

TO
AA. von Finster
DFO WhitehorseFROM
DEB.D. Chang
DFO New WestminsterSUBJECT
OBJET

Curragh Resources - Review of Consultants' Proposals for the
Study of the North Fork of Rose Creek

SECURITY - CLASSIFICATION - DE SÉCURITÉ

OUR FILE - N / RÉFÉRENCE

YOUR FILE - V / RÉFÉRENCE

DATE

3 March 1987

Following are some comments regarding the Leverton and Harder proposals submitted to Curragh. I have seen Knapp's comments and I generally agree with them.

I found the Harder proposal to be far superior in its understanding of the goals of the study and in the details of how to carry out the study. In fact, Harder's proposed study may be more detailed than we need. It may be possible to simplify the mark-recapture study and scale analyses and still get the basic data that we need, although sacrificing some detail and accuracy. However, since you know much more about grayling and the study area than I do, you will be in a much better position to determine this than I am.

The Leverton proposal is not detailed enough, neither in its goals or its methods. I'll leave it to you to judge whether or not a fish trap as he suggests would work adequately in this area. It is not clear how many traps he intends to use (probably just one at the mouth of the North Fork) and no alternate methods are indicated in the event that the trap(s) do not function. Regarding the other bio-physical sampling sites, I don't know if the 6 sites Leverton has chosen would be sufficient, since large stretches of the creek would not be sampled (Harder proposes 10 sites upstream of the causeway and 5 sites downstream of the causeway).

I would still like to see an early winter 1987 sampling date, since this would allow comparison with the pre-causeway preliminary sampling by Leverton in November 1986.

It's too bad that Curragh did not indicate in its request for proposals that follow-up studies would be required in order to evaluate the compensation works. It will obviously be necessary to perform such evaluation and there would be economic and logistical advantages to having the firm that recommended the works also be involved in the follow-up (although something could be said for having an independent evaluation by a different consultant).

environmental aspects of the mine operation, including the proposed water licence amendment, the Vangorda deposits, and the abandonment plans. This would probably have been more economic for the company.

B.D. Cy

B.D. Chang

cc. W.D. Knapp



Environment
Canada

Conservation and
Protection

Environnement
Canada

Conservation et
Protection

RECEIVED APR - 8 1987

Environmental Protection
Room 225 Federal Building
308 Main Street
Whitehorse, Yukon
Y1A 2B5

Your file Votre référence

Our file Notre référence

1987 04 06

Mr. M. H. Pelley
Vice-President
Transportation and Engineering,
Curragh Resources
117 Industrial Road
Whitehorse, Yukon
Y1A 2T8

Dear Mr. Pelley:

Further to my telephone discussion with Mr. Grant last week there are a number of items regarding the operation and development of the Curragh Resources Faro Mine that we would like to discuss with you. We propose that a meeting be convened on April 15, 1987 at 10:00 a.m. in the Environmental Protection office at 308 Main Street to discuss the following:

1. Toxicity of tailings pond decant
DIAND advised us that during March decant samples failed a 96 hr. LT50 acute toxicity test.
2. Cyanide Control and Analysis
The analytical data for decant samples collected by DIAND indicates that cyanide may be the principal toxic component contributing to the failed fish toxicity test.
3. Waste Rock Management Plan
A letter dated December 22, 1986 from Curragh Resources to Environmental Protection indicated that a Waste Rock Management Plan would be prepared and submitted to the E.P. Office.

.../2

4. Water Conservation measures and recycle of tailings pond decant water.

A letter dated December 8, 1986 from Curragh Resources to Environmental Protection indicated that tests on the decant water, to determine the potential for recycling, would be done in early 1987.

5. Zinc contaminated seepage in Pit No. 2

The accumulation of zinc contaminated seepage in Pit No. 2 has been an on-going problem since the mine start-up in early 1986. There have been a number of occasions where the contaminated seepage has migrated through the pit wall and into the north fork of Rose Creek.

6. Fisheries Studies on Rose Creek

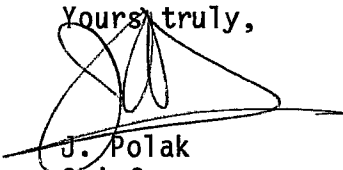
Letters dated November 3, 1986 to D.F.O. indicated that studies on the north fork of Rose Creek would be carried out prior to construction of the Causeway. In addition, the water licence amendment ON 85-05AL requires that Curragh conduct fish studies to assess the impact of eliminating the 1,000 lpm overflow.

7. Metal Mine Liquid Effluent Regulations

The federal MMLER developed under authority of Section 33(2) of the Fisheries Act apply to re-opened mines if the production capacity is increased by 30 per cent over the rated production capacity.

Please call me at 667-3400 to confirm whether the proposed arrangements for the meeting are suitable.

Yours truly,


J. Polak
Chief,
EP - Yukon Branch

8. *Tailing Study
Abandonment Plan*

9. *Compliance monitoring*

10. *General Communications*

Joan

SUBJECT: FARO MINE SITE WATER ANALYSIS LABORATORY

TO: Roy Bourke
FROM: Robert McLenehan
Date: June 26, 1987

Introduction

Under the terms of the existing Water Licence YIN85-07LE, Part C, Curragh Resources is obligated to sample, analyze and report on the water of the Rose Creek Drainage System. This surveillance network program is outlined in Schedule A of the water licence. Currently all water samples are being sent to commercial laboratories for analysis as the existing Faro laboratory facilities are incapable of the accuracy, quality assurance and quality control required for trace element analysis.

The estimated yearly expenditures for the external water analysis of samples from the Rose Creek Surveillance Program is \$62,900. For the first six months of 1987 actual expenditure has been \$33,328. The projection for 1987, therefore, is \$66,656, which agrees well with the estimate. In addition, with plans to begin mining the Vangorda and Grum deposits, a background water surveillance program has been established for the Vangorda Drainage system. This background program is estimated to cost \$8535 per year. Once actual mining of the Vangorda and Grum deposits begins, a more comprehensive surveillance program will most probably be required by the government regulatory agencies. The cost of this expanded Vangorda program will at least be double that of the background program; thus, a yearly expenditure of \$17,070 will be required. Therefore, from 1987 onwards, the minimum yearly cost of water analysis for the Rose Creek and Vangorda drainage systems will be $\$62,900 + \$8535 = \$71,435$ and can be expected to increase to $\$62,900 + \$17,070 = \$79,970$ per year.

In addition to the above Surveillance Network Programs, Curragh Resources is also committed to the Tailings Abandonment Plan Development Program (APDP). This program also has water analysis requirements and costs extending from June, 1987, to December, 1990. An estimate of required water analysis expenditures is difficult in that the type of analysis performed on water samples will be a function of the quantity of water extracted. The water quantity, in turn, is dependent on the sampler type and seasonal weather conditions. The total number of samples is known, however, and by applying a sliding analysis requirement scale to this number a maximum expenditure requirement of \$140,700 over the life of the program is estimated.

The three programs, the Rose Creek Drainage Surveillance Program, the Vangorda Drainage Surveillance program, and the Abandonment Plan Development Program, constitute a considerable commitment of expenditure on the part of Curragh Resources, and it is believed that the above costs can be reduced through the construction and operation of an on-site water quality analysis facility. To demonstrate the feasibility of this proposal, the surveillance and APDP sampling programs will be detailed, and yearly analysis expenditure estimates will be given. The requirements of a water quality analysis laboratory will then be detailed, and construction and operation costs estimated. Yearly expenditure projections to 1996 for both the commercial laboratory analysis and Faro laboratory analysis will then be provided for comparison.

Summary of Current Commitments: Commercial Laboratory Analysis Method

Table 1. summarizes the current and projected sampling requirements of Curragh Resources up to 1996, while Table 2. summarizes the projected expenditures for commercial laboratory sample analysis.

Table 1. Sampling Requirements

Year	* Rose Creek	* Vangorda Crk.	* APDP	* Total	*
1987 @	188	79	241	508	*
1988	591	108	620	1319	*
1989	591	108	511	1210	*
1990	591	108	40	739	*
1991	591	108	0	699	*
1992	591	108	0	699	*
1993	591	108	0	699	*
1994	591	108	0	699	*
1994	591	108	0	699	*
1995	591	108	0	699	*
1996	591	108	0	699	*

@ From June, 1987.

Table 2. Projected Analysis Expenditures

Year	* Rose Creek	* Vangorda Crk.	* APDP	* Total	* Cummul.	*
	* Background	*	*		* Total	*
1987 @	36,075	4,266	23,983	64,324	64,324	*
1988	62,889	8,532	61,752	133,173	197,497	*
1989	62,889	8,532	50,851	122,272	319,769	*
1990	62,889	8,532	4080	75,501	395,270	*
1991	62,889	8,532	0	71,421	466,691	*
1992	62,889	8,532	0	71,421	538,112	*
1993	62,889	8,532	0	71,421	609,533	*
1994	62,889	8,532	0	71,421	680,954	*
1995	62,889	8,532	0	71,421	752,375	*
1996	62,889	8,532	0	71,421	823,796	*

@ From June, 1987

& Analysis Costs for Faro Pit Water Samples not included.

The projected analysis expenditures are based on the number of samples scheduled for 1987 for the Rose Creek Drainage surveillance, the number of samples required yearly for the background surveillance of Vangorda Creek Surveillance, and an estimate of the samples required each year for the APDP. Table 3. lists actual expenditures for analysis costs incurred to date for 1987, while Table 4. lists current analysis costs with respect to specific tests.

Table 3. Actual Laboratory Expenditures for 1987

Month	Period	Laboratory 1. Bondar-Clegg	Laboratory 2. Eco-Tech	Total
Dec.	1	1,136	0	1,136
Jan.	2	2,913	2,144	5,057
Feb.	3	1,319	418	1,737
Mar.	4	4,432	3,122	7,554
Apr.	5	870	714	1,584
May	6	2,578	1,800	4,378
June	7	2,320	-	2,320
July	8	-	-	-
Unpaid Invoices		6,220	3,342	9,562
Total		21,788	11,540	33,328

@ Analysis costs of \$33,328 for first six months.

Projection of \$66,656 for 1987. (\$5,555 per month.)

Table 4. Water Analysis Costs (Breakdown by Test Requested)

Test	Cost	Total
Susp. Solids	8.00	
Ammonia	20.00	
Cu	7.00	
Pb	7.00	
Zn	7.00	
Mn	7.00	
Na	8.00	
Sulphate	15.00	(1) 79.00
Cyanide	30.00	(2) 109.00
Acidity	10.00	
Fe Total	7.00	
Fe Dissolved	7.00	
Alkalinity	10.00	(3) 143.00
Ca	7.00	
Mg	7.00	
Cl	10.00	(4) 167.00
Nitrate	15.00	
Nitrite	15.00	
Ni	7.00	
Hg	10.00	(5) 214.00

(1) Cost of 70% of APDP samples.

(2) Cost of 10% of APDP samples.

(3) Cost of 10% of APDP samples.

(4) Cost of 5% of APDP samples.

(5) Cost of 5% of APDP samples.

(2) Cost of 100% of Rose Crk./
Vangorda samples.

Faro Mine Site Water Analysis Laboratory

For water analysis to be conducted on the mine site a separate laboratory must be established. It is proposed that a water lab be constructed in the office space presently occupied by D. Wright. D. Wright would then share office space with R. McInenehan. The water lab must be constructed such that a clean air environment can be maintained and the necessary accuracy, repeatability, quality control and quality assurance can be achieved. The cost of constructing the water laboratory is estimated in Table 5., and yearly operating costs are given in Table 6.

Table 5. Faro Water Laboratory Construction Cost Estimate.

Item	Cost
1.a. Five 13151 Corner Cupboards.	
b. One 58114 Peninsula Sink Unit.	
c. One 58101 Peninsula Cupboard.	
d. One 60115 Acid Storage Unit.	
e. Five 1.25 in. thick x 30 in. x 30 in. Solid Epoxy Corner Unit Countertops.	
f. Two 1.25 in. thick x 60 in. x 24 in. Solid Epoxy Peninsula End Countertops.	
g. One AFTH-60 Fume Hood c/w Stainless Steel Worktop.	
* F.O.B Edmonton: Lot Budget Price	\$12,950
** Items 1.d and 1.g are for the water lab. The other items replace main lab counters, which then will be used in the water lab.	
2. Fridge	1,000
3. Exhaust Fan	1,300
4. Ducting	400
5. Presurization Hardware	2,500
6. Freight (Estimate only)	3,000
7. Installation (400 man hours @ \$20.00/hr.)	8,000
8. Contingency (15%)	4,500
Total	33,650

Table 6. Annual Operational Expenditures: Faro Water Laboratory

Item	Cost
1. Sample Bottles	7,800
2. Reagents and Glass Ware	10,850
3. Laboratory Technician (1/2 time)	25,000
Total	43,650

Comparisons: Costs/Benifits of Commercial Lab Analysis Use
to Faro Lab Analysis Use.

Yearly projected expenditures for the period starting in June, 1987, and ending in December, 1996, for four different options are given in Table 7.

Option 1: Estimate based on;

- a. The existing Rose Creek Surveillance Program.
- b. The existing Vangorda Creek Background (only) Surveillance Program.
- c. The four year APDP.
- d. 100% Commercial Laboratory Analysis.

Option 2: Estimate based on;

- a. The existing Rose Creek Surveillance Program.
- b. An extended Vangorda Creek Surveillance Program.
- c. The four year APDP.
- d. 100% Commercial Laboratory Analysis.

Option 3: Estimate based on;

- a. Faro Lab Construction Costs.
- b. Faro Lab Operational Costs.
- c. Quality Assurance/Quality Control Costs.
(10% of Total Cost of Option 1.)

Option 4: Estimate based on;

- a. Faro Lab Construction Costs.
- b. Faro Lab Operational Costs.
- c. Quality Assurance/Quality Control Costs.
(20% of Total Cost of Option 2.)

A comparison of the cumulative total projected expenditures is provided in Table 8.. Graph 1. also displays cumulative totals and gives a comparison of the four options. The comparison given in Table 8. indicates the following:

1. During the first year (1987) of operation, the Faro water lab analysis costs are approximately equal to commercial lab costs. The Faro lab base case is \$2,500 cheaper, while the expanded case costs \$3,900 more. This period also bears the full laboratory construction costs.

2. By the end of 1988, the Faro lab analysis is cheaper than the commercial lab analysis by between \$59,000 to \$79,000.

3. By the end of 1991, the Faro lab analysis is cheaper by between \$138,200 to \$215,600.

4. By the end of 1996, the Faro lab analysis is cheaper by between \$197,100 to \$361,400.

The worst case scenerio is shown by comparing the commercial laboratory costs for the Rose Creek/ Vangorda Base Case and the Faro laboratory costs on the Expanded Case. In 1987, the commercial lab is \$3,900 cheaper than the Faro lab. Thereafter, the Faro lab is cheaper. In 1988, 1991 and 1996 the Faro lab analysis costs respectively \$59,000, \$138,000, and \$197,000 less than the commercial lab analysis. Thus, from a strictly financial viewpoint, the construction and operation of a Faro laboratory facility is justified.

Table 7: Comparison of Faro Water Laboratory Costs
to External Laboratory Water Analysis Costs

Item Option	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
1. Rose Crk.	36075	62889	62889	62889	62889	62889	62889	62889	62889	62889
Vangorda Crk.	4266	8532	8532	8532	8532	8532	8532	8532	8532	8532
APDP	23986	61752	50851	4080	0	0	0	0	0	0
Total	64324	133173	122272	75501	71421	71421	71421	71421	71421	71421
Cummulativ.Total	64324	197497	319769	395270	466691	538112	609533	680954	752375	823796
2. Rose Crk.	36075	62889	62889	62889	62889	62889	62889	62889	62889	62889
Vangorda Crk. @	4266	8532	17064	17064	17064	17064	17064	17064	17064	17064
APDP	23983	61752	50851	4080	0	0	0	0	0	0
Total	64324	133173	130804	84033	79953	79953	79953	79953	79953	79953
Cummulativ.Total	64324	197497	328301	412334	492287	572240	652193	732146	812099	892052
3. Lab.Construction	33650	0	0	0	0	0	0	0	0	0
Lab.Operation	21745	43650	43650	43650	43650	43650	43650	43650	43650	43650
QA/QC (1)	6432	13317	12227	7550	7142	7142	7142	7142	7142	7142
Total	61827	56967	55877	51200	50792	50792	50792	50792	50792	50792
Cummulativ.Total	61827	118794	174671	225871	276663	327455	378247	429039	479831	530623
4. Lab.Construction	33650	0	0	0	0	0	0	0	0	0
Lab.Operation	21745	43650	43650	43650	43650	43650	43650	43650	43650	43650
QA/QC (2)	12865	26635	26161	16807	15991	15991	15991	15991	15991	15991
Total	68260	70285	69811	60457	59641	59641	59641	59641	59641	59641
Cummulativ.Total	68260	138545	208356	268813	328454	388095	447736	507377	567018	626659

@ Vangorda Prgm. estimated to double when p.t fully operational.

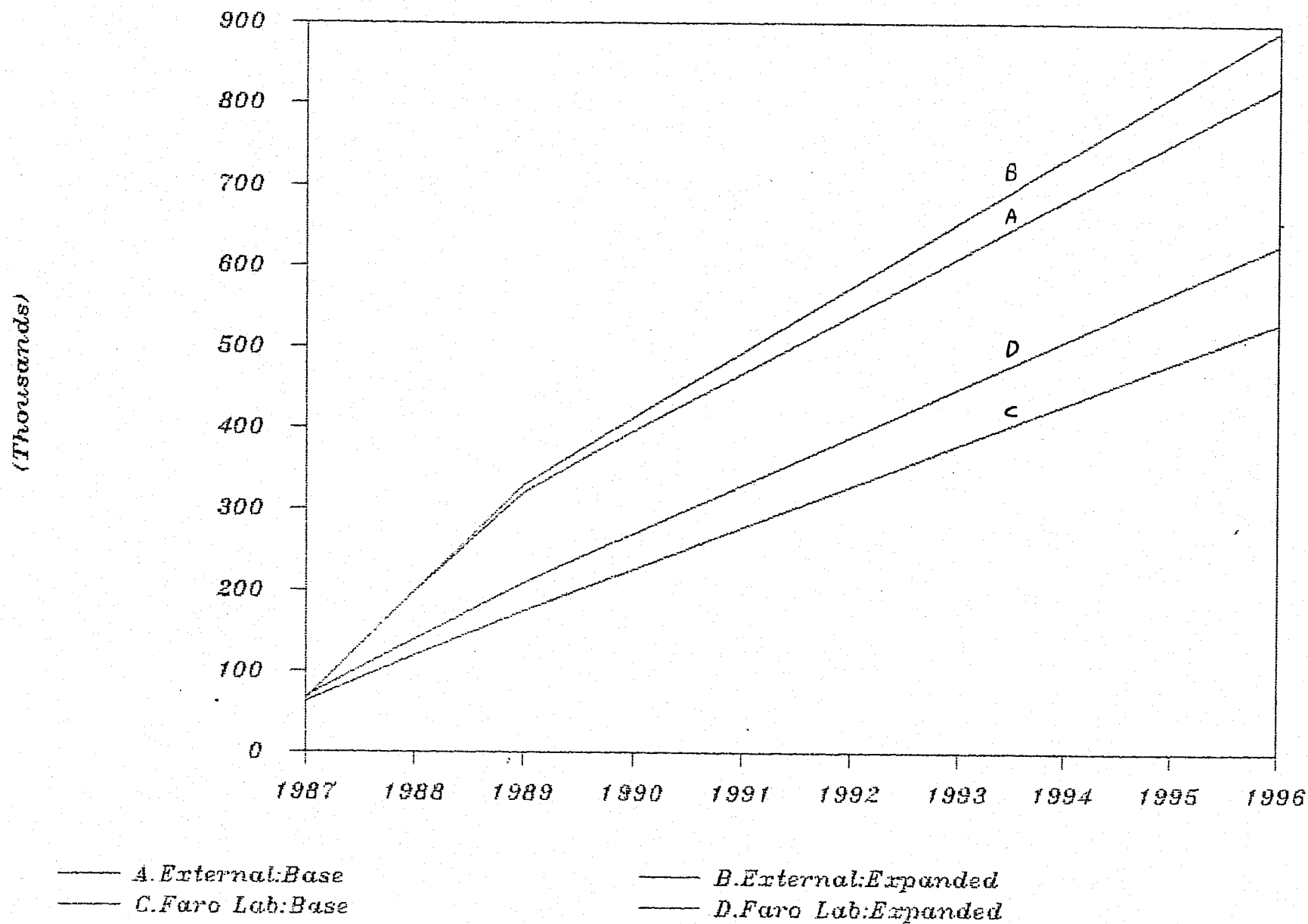
(1) 10% of total present cost in Option 1. Best Case.

(2) 20% of total present cost in Option 2. Worst Case.

Table 8: Cummulative Total Costs - Option Summaries.

Item Option	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
1. Rose Crk./ Vangorda Crk. Base Case	64324	197497	319769	395271	466691	538112	609533	680954	752375	823796
2. Rose Crk./ Vangorda Crk. Expanded Case	64324	197497	328301	412334	492287	572240	652193	732146	812099	892052
3. Faro Water Lab 10% QA/QC on Base Case	61827	118794	174671	225871	276663	327455	378247	429039	479831	530623
4. Faro Water Lab 20% QA/QC on Expanded Case	68260	138545	208356	268813	328454	388095	447736	507377	567018	626659

Graph 1: Comparison of Costs



Besides the costs benefits which are most probable in the short term, and possible in the long term, an on-site laboratory has the advantage of reducing the analysis turn-around time. Hence, if water quality limits are exceeded, reaction time is significantly reduced. Another advantage is that if extra surveillance is deemed necessary, additional expenditures are not required. A supplemental advantage is also realized with the removal of the present water lab counter space from the main assay laboratory. The subsequent re-organization of the main laboratory will increase counter space and provide for a more efficient work environment.

RISKS

The major risk in constructing an on-site water analysis laboratory is not directly financial, but rather, is related to the current Curragh operating water licence. It is stated in the water licence, Part C, sub.2.c, that the Yukon Water Board has final approval of where water quality analysis may be performed. With respect to the Abandonment Plan Development Program, the Environment Protection Service has expressed concern with respect to our plans of conducting on-site analysis. We thus addressed this concern, with the consensus being that;

1. An on-site water analysis laboratory must be separated from the main assay laboratory.
2. The water analysis laboratory must be constructed such that a clean air environment can be maintained. This entails a filtered air intake supply system with the capability of establishing a positive pressure atmosphere.
3. A quality assurance/quality control laboratory must be contracted. B.C. Research was suggested as a candidate. Their function would be to analyze 10% of all of our samples from a duplicate sample set. These samples must be chosen randomly, and if the on-site analysis do not agree, Curragh must then send the entire batch for analysis. In such an event, the Faro laboratory would have to undergo a rigorous self-examination with respect to its internal quality assurance and quality control programs. The worst case expenditure projections included 20% of all samples being processed by the QA/QC external laboratory, and under these conditions the Faro laboratory is still economical. (An external laboratory also serves the purpose of demonstrating that the Faro lab analysis is not biased, and thus maintains the validity of the surveillance data.)
4. With respect to the APDP, the Faro laboratory must demonstrate within the first six months of operation that the required accuracy, repeatability, and desired quality assurance and quality control can be achieved and maintained. Given that the proper laboratory facility is constructed, and detailed analysis procedures are developed and followed, the Faro laboratory should be able to satisfy these requirements.

If the Faro Water Laboratory cannot prove itself with six months, a loss of \$34,000 required for laboratory construction will be incurred. However, most of this amount is recoverable in that the facility can still be used for assay laboratory operations, and the benefit of a re-organized main laboratory will still exist.

Conclusions

In summary, the construction and operation of an on-site water analysis laboratory should result in significant savings to Curragh Resources Inc. A savings of \$138,000 is estimated over a five year period using a worst case scenario. A greater savings could be realized in that inflation has not been considered in the determination of outside laboratory costs.

An internal laboratory also provides the capability to handle unscheduled volume increases in sample analysis requirements with little additional costs.. Additional analysis costs in an internal laboratory increase in proportion to laboratory supplies required. Costs of external laboratory analysis increase directly in proportion to the number of samples and tests per sample required. This additional capacity of an internal lab could be very significant as water analysis requirements are expected to increase as the property increases in the size of workings. This increased analysis has been estimated within this report; however, Yukon Water Board decisions could realistically double or triple this estimate.

The risks of establishing an on-site laboratory have been stated; however, given that a suitable facility is constructed and a proper quality assurance and quality control program is developed, a mine laboratory should be able to prove itself within six months. (Close liaison with the designated QA/QC external laboratory (ie. B.C. Research) will be required initially.) Given the potential benefits of an on-site laboratory, the risks involved in establishing and proving this laboratory are small.

1987 05 05

MEMORANDUM

TO: Kurt Korgaard

RE: April 22 meeting with Environment Canada/
Fisheries and Oceans

As a result of John Polak's letter to Marv Pelley dated April 6, 1987 (attached), I contacted John Polak to suggest that I meet with him to address the issues that I can and make arrangements for other Curragh officials to address any other issues (if necessary), Polak agreed.

Polak and Wile (Environment Canada) and Von Finster (Fisheries) and Grant (Curragh) met at 1:30 p.m. on April 22. The agenda items were the items listed in Polak's letter plus the tailings abandonment study, E.P.S. compliance monitoring and communications between E.P.S. and Curragh.

1. Toxicity of Tailing Effluent
2. Cyanide Control

I indicated that Curragh has been dealing with DIAND on these issues, that Curragh has been keeping DIAND informed and has undertaken mitigative measures acceptable to DIAND.

I suggested that E.P.S. talk with DIAND and if at all possible work through DIAND so that Curragh only has to deal directly with one government agency.

3. Waste Rock Management Plan

This has been promised to E.P.S. for some time. I advised E.P.S. that one exists but just hasn't been put into final form. I indicated that it should be available by May 1. However, to date I haven't received it and advised E.P.S. that it would take a little while longer. We should, if at all possible, submit this to E.P.S. this week.

4. Water Conservation Measures and Recycle of Tailing Water

This matter was discussed when Wile last visited Faro. He was informed that this would be done when the tailings pond reached equilibrium. I repeated this. Wile also requested a water balance for the mill. I provided this on May 4 (see attached letter to Polak).

5. Zone 2 Seepage

I acknowledged that there were some problems last summer which were promptly reported to DIAND. The issue is under control now and mine officials were examining long term solutions to this problem. Present plan is to continue to pump zone 2 to prevent seepage into Rose Creek.

6. Fisheries Studies on Rose Creek

Von Finster confirmed that all was in order on this point and there were no current problems. Further discussions were necessary on the terms of reference for the fisheries impact study from the elimination of 1000 IGPM spill requirement.

7. Metal Mine Liquid Effluent Regulations (M.M.L.E.R.)

I suggested that present production is not a 30% increase in the historical pre 1977 peak production level therefore the above regulations are not applicable. I asked, that, given we have a water licence to follow, what the significance of these regulations is for Curragh. Polak answered that then E.P.S. would have to monitor to see if Curragh was complying. In essence, the water licence would apply but E.P.S. would become more active and "encouraging" compliance with M.M.L.E.R. E.P.S. will be sending a letter on this.

8. Compliance Monitoring

As mentioned above, E.P.S. will be sending us a letter indicating it feels that the M.M.L.E.R. apply to Curragh and that it will be doing its own compliance monitoring.

9. Tailings Abandonment Study

I provided a progress report on this project. I indicated we are proceeding with it and a project manager has been hired. Input from government agencies has been slow in coming.

10. Communications Between Environment Canada and Curragh Resources

I made the following points to assist them in communicating with Curragh Resources.

- day-to-day operational matters with respect to the water licence are dealt with directly by Curragh's on site personnel;
- In any matters that relate to the water licence such as non-compliance problems, the on site personnel communicate directly with DIAND's water resources division.
- Curragh's preference would be for Environment Canada to work with DIAND on water licence compliance issues such as the recent cyanide concerns.

- licence amendments such as abandonment provisions are coordinated by the Whitehorse office;
- Roy Bourke is the contact person in Faro, I am the contact person in Whitehorse. If there is any doubt who to contact within Curragh they can contact me and I will advise them who they should speak to.



Robert A. Grant
Supervisor
Government Relations

c.c.: M.H. Pelley
Roy Bourke

J. Eamer
~~G. Whitley~~

Note to File

4780 - 37/A293

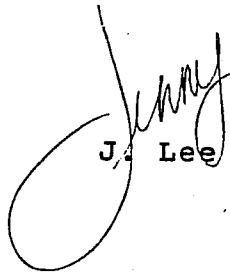
J. Lee

July 28/87

Compliance Audit of Curragh Resources - In Situ Results

A compliance audit of the Curragh Resources operation was conducted by R. Allan and J. Lee at Faro from July 13, 1987 to July 17, 1987. The sampling program was performed according to procedures outlined by the Metal Mining Liquid Effluent Regulations and Guidelines.

Stations were established at X-3(the pumphouse), X-5(tailing pond decant), and X-13(combined seepage from the tailings dam). Grabs and overnight composites were taken at each station and will be analyzed for metals(total and extractable), pH, NFR, FR, T. Hardness, T. Alkalinity, ammonia, sulfate and cyanide. In addition, an LT50 in situ bioassay was performed at each station using chinook salmon fry (Oncorhynchus tshawytscha). Tables detailing the in situ measurements and bioassay results are appended. These tables may be found on the Curragh diskette under "Audit87" and "Bio87". Further information may be found in the CAMC/Curragh fieldbook for July 13/87 to July 17/87.


J. Lee

To: File 4780-37/A293

From: Bob Allan

July 29, 1987

Subject: Lab Bioassay Results, Curragh Resources

I obtained the results of the bioassay from Ron Watts over the telephone. The results are as follows:

Stn S-3 (X-13) Combined seepage flow
100 % survival of test fish
not toxic 96 hr LT50

Stn S-4 This is the total effluent before discharge into Rose Creek. During collection of the 8 hr composite bioassay sample, 2 adult Arctic grayling were observed in this section of the watercourse.

50% of the test fish died after 44 hrs of exposure to 100% effluent sample.

Toxic

These results corroborate with the in situ bioassay test as follows:

Stn S-3 (X-13)

40% of test fish died after 85 hrs. of exposure to 100% effluent. These results maybe upwardly biased due to stress caused by frequent observation. Resident Arctic grayling, adults only, were observed at this station.

Slightly toxic, qualified by the presence of fish and the stress factor.

Stn S-2 (X-5) Surface decant flow

* 100% of fish died in less than 24 hrs on 2 separate in situ bioassays. *

Toxic, absolutely!

Conclusion

The combined seepage from the Cross Valley Dam is non-toxic (Lab) to slightly toxic (in situ). The surface decant flow is toxic (in situ). The decant and seepage effluents combine to form a toxic discharge (lab) which enters Rose Creek.


Bob Allan

Curraoh Resource In Situ Bioassay Results

Station 1(X-3)
Time ON: 1530 14-Jul-87
Time OFF: 0800 17-Jul-87

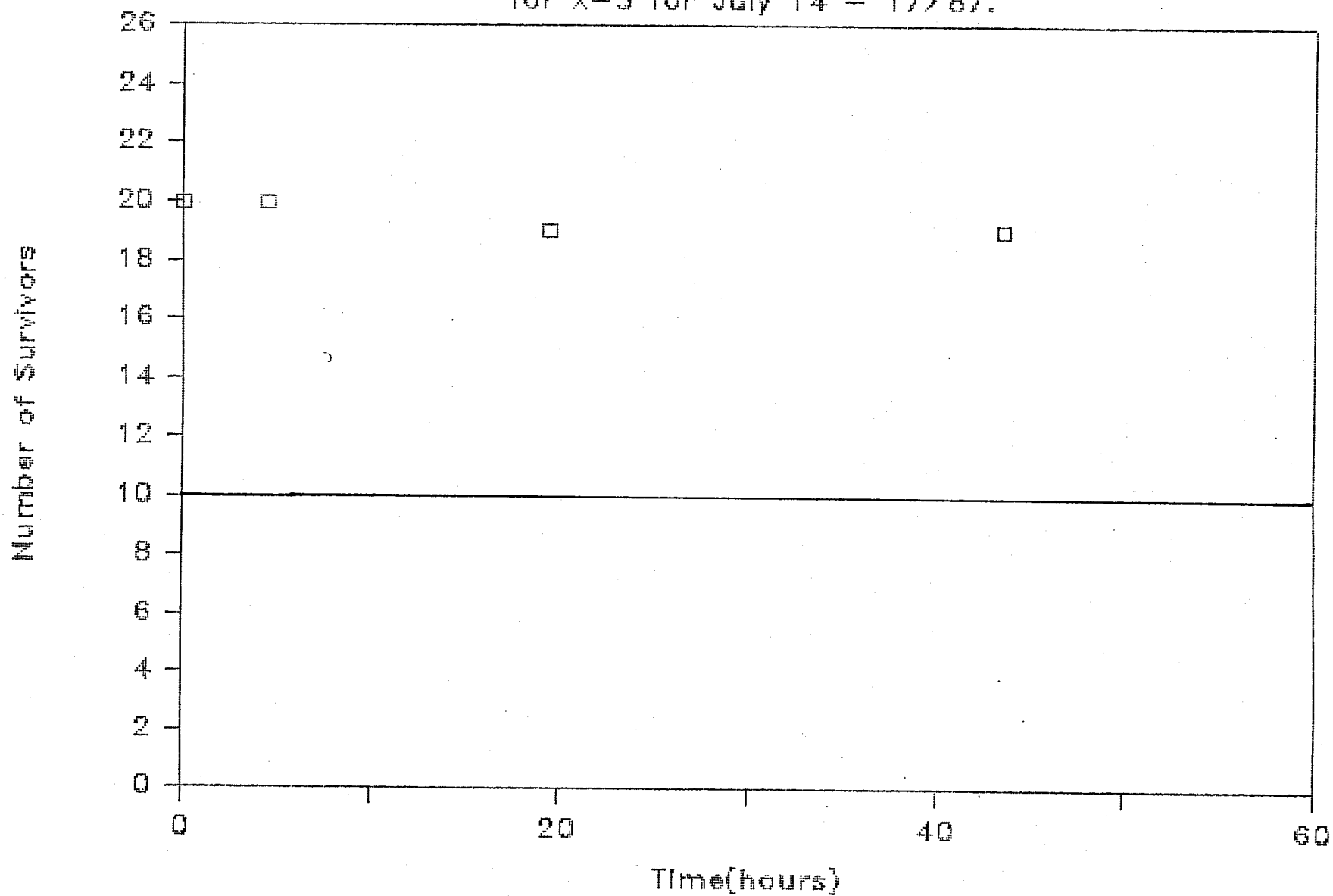
Time(hours)	Survivors
0	20
4.5	20
19.5	19
43.5	19
64.5	19

LT50 = nil

1. Fry collected at 1230 on 14-Jul-87. 500m d/s of the Faro bridge on the Pelly R.
2. Fry length 5.4 cm
3. Live fry released into Pelly R. 0900 on 17-Jul-87.

In Situ Bioassay Survivor Curve

for X-3 for July 14 - 17/87.



Curragh Resources: In Situ Bioassay Results

Station 2(X-5)
Time ON: 2000 13-Jul-87
Time OFF: 1000 14-Jul-87

Time(hours) Survivors*

0	~~14~~ 20 14
14	0

LT50 = 6.8 hr

*6 fry escaped torpedo cage

1. Dead fry appear undamaged, all gills are white in colour.
2. Fry collected from Pelly R. by DFO on afternoon of 13/7.
3. Fry lengths 5.3, 5.4, 5.9, 5.7, 4.9, 5.0, 5.4, 5.6.

Curragh Resources: In Situ Bioassay Results

Station 2(X-5)
Time ON: 1430 14-Jul-87
Time OFF: 1000 15-Jul-87

Time(hours) Survivors*

0	20
5	19
20.5	0

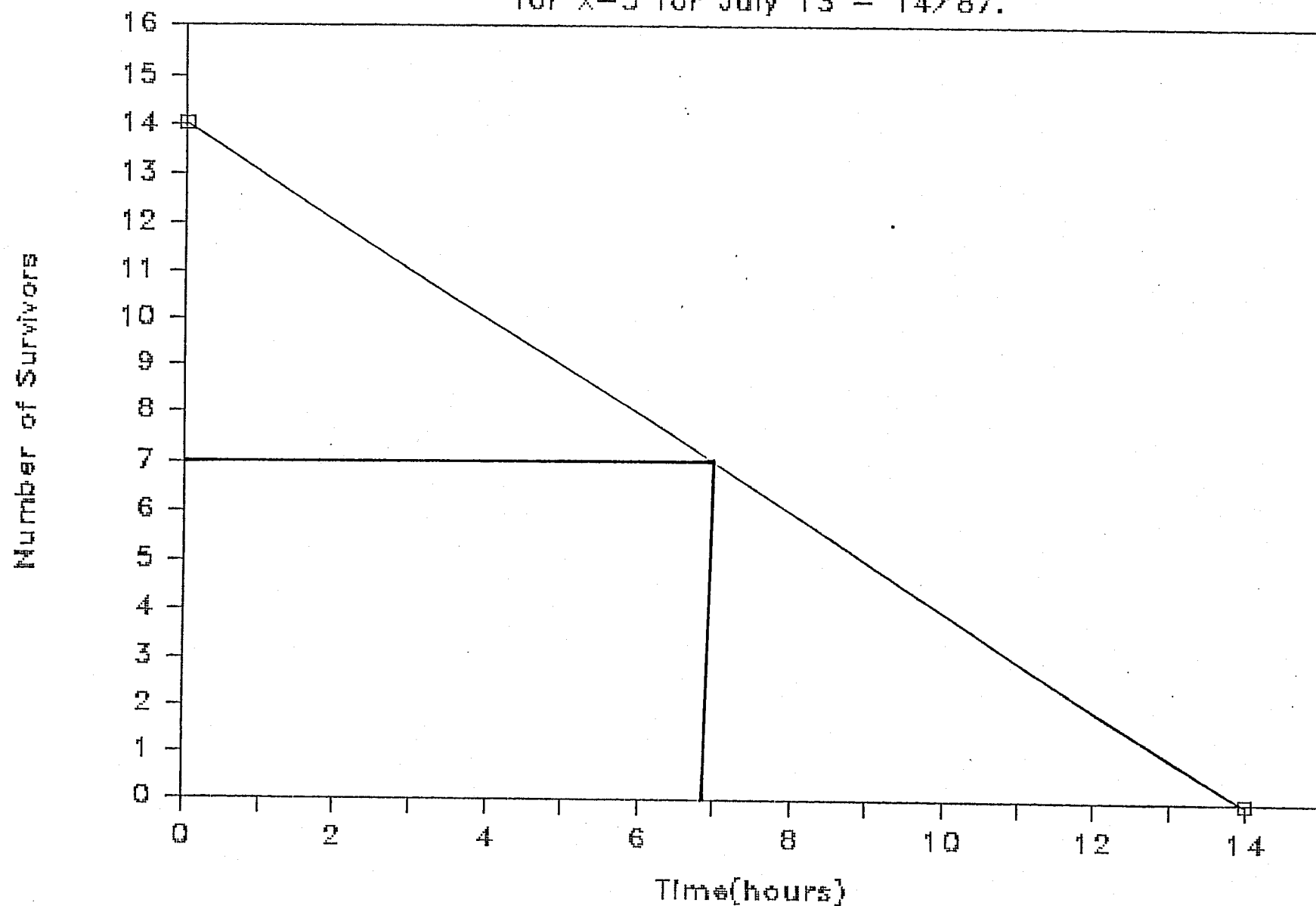
LT50 = 13.2 hr

*2 fry escaped torpedo cage

1. Fry collected at 1230 on 14-Jul-87, 500m d/s of Faro Bridge on Pelly R.
2. Fry lengths 5.9, 6.1, 4.8, 6.0, 5.6, 5.2, 5.0, 5.1, 5.5, 5.3, 5.6, 5.2, 5.7, 5.7, 5.8, 5.9, 6.4, 5.3

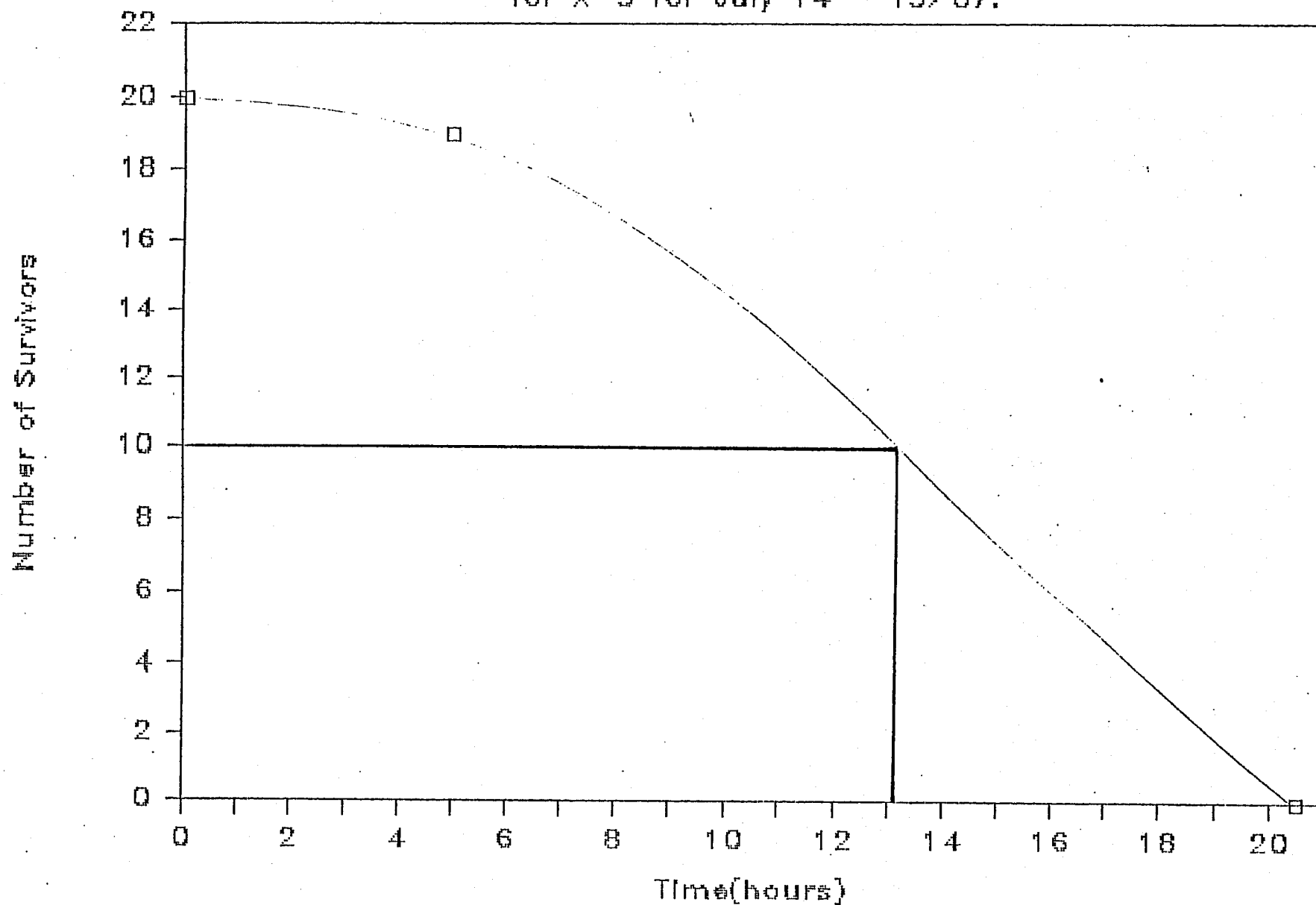
In Situ Bioassay Survivor Curve

for X-5 for July 13 - 14/87.



In Situ Bioassay Survivor Curve

for X-5 for July 14 - 15/87.



Currah Resources. In Situ Bioassay Results

Station 3(X-13)
Time ON: 1930 13-Jul-87
Time OFF: 0830 17-Jul-87

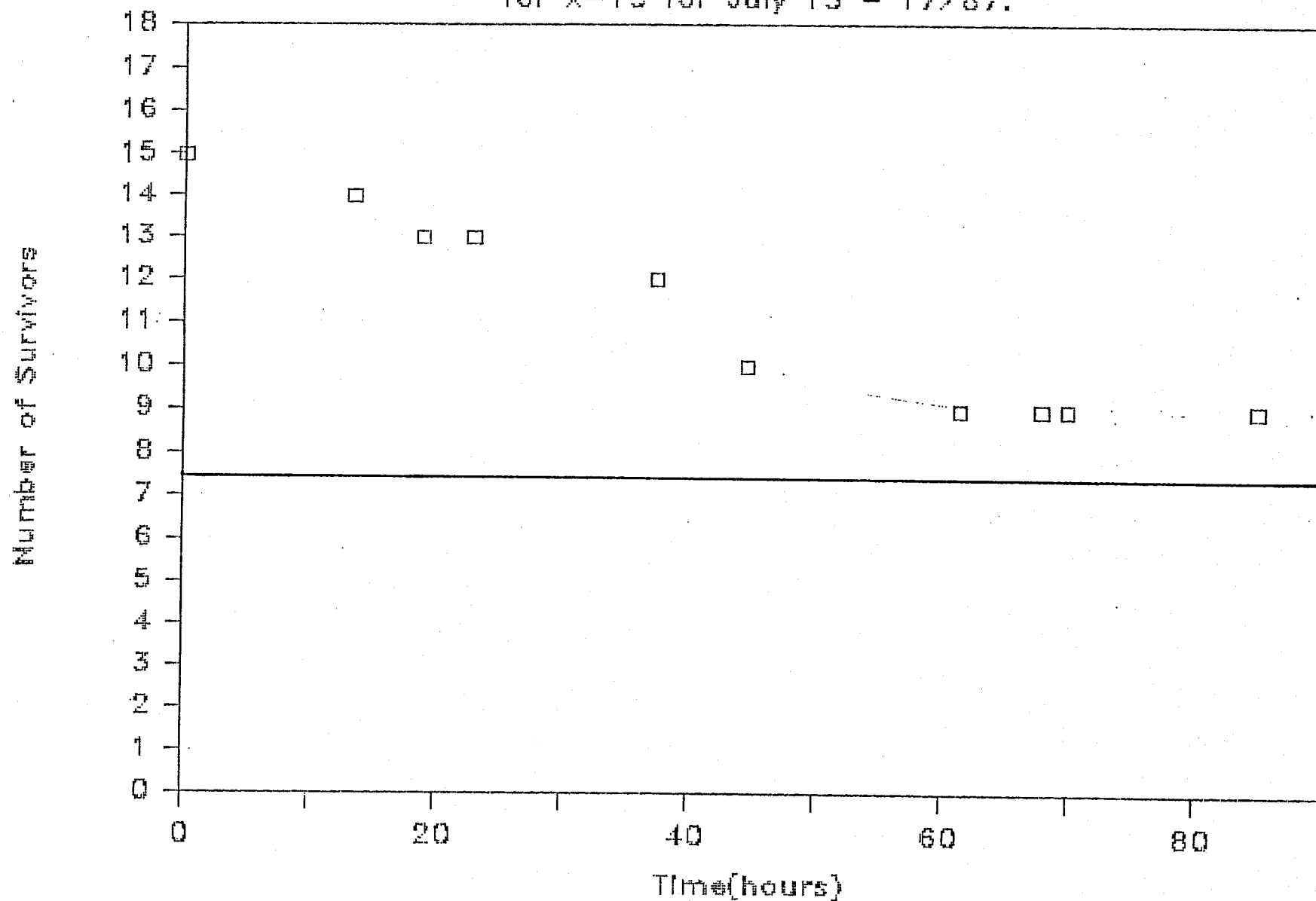
Time(hours)	Survivors
0.0	15
13.5	14
19.0	13
23.0	13
37.5	12
44.8	10
61.5	9
68.0	9
70.0	9
85.0	9

LT50 = nil

1. Chinook fry collected on 13/7 by DFO
(A. von Finster & G. Cronkite) 25m d/s
Faro Bridge on Pelly River.
2. Fish lengths 4.7, 5.0, 5.1, 5.5, 5.6, 5.4
3. Live fry returned to Pelly R. on 17/7 at 0900

In Situ Bioassay Survivor Curve

for X-13 for July 13 - 17/87.



Flow Measurements at Curraoh (1987)

Station	Description	Flow m3/s
X13	d/s side of culvert	1.54
X3	Rose Creek	1.21
X4	25m u/s of confluence with Rose Creek	0.73



file

117 Industrial Rd.
Whitehorse, Yukon Y1A 2T8
Tel: (403) 668-3578
Telex: 036 8359

October 5, 1987

Jack Nickel
Acting Regional Manager
Water Resources
200 Range Road
Whitehorse, Yukon Y1A 3V1

Dear Mr. Nickel:

Enclosed are the results of the acid generation tests performed on the waste rock types to be used for the North Fork drain and for the haul road. This information was requested by Ken Wile at the Technical Advisory Committee meeting in Faro last month, and I have sent a copy of the results to him.

Please note that the two rock types with high acid generation potential are not being used in the drain or the road, but are included for comparative purposes.

Please contact me if you have any suggestions or comments related to these results.

Yours truly,
CURRAGH RESOURCES

Joan Eamer

Joan Eamer
Supervisor of Environmental Relations

enclosure

Joan your copy

Jerry

MEMORANDUM

October 8, 1987

To: Bud McAlpine

From: Gerry Whitley
Administrator, Pollution Control

Subject: Thiocyanate in Curragh groundwater - draft report

On August 25 1987 Dan Cornett sampled groundwater at the toe of the cross valley dam at Curragh Resources. The water quality samples show that tailings water is present in the seepage at the north side of the dam (X11).

STATIONS

Water quality data was collected from 6 stations in the tailings pond area.

Station X4 - Intermediate dam decant

Station X5 - Cross valley dam decant

Station X11 - Seepage from the north toe of the Cross valley dam

Station X11a- Most northerly of the X11 seepage

Station X12 - Seepage from the south toe of the Cross valley dam

Station X13 - Combined seepage flows downstream from the culvert and upstream of the decant confluence

SAMPLE ANALYSIS

Temperature, conductivity, and pH were collected in the field using routine field methods. Flow was estimated using weirs constructed by Curragh Resources.

Cyanide samples were collected in a 1 litre polypropylene sample bottle. Sodium hydroxide and 2 ml of 0.1N sodium arsenite were added as preservatives. Analysis was completed at the EPS laboratory in Vancouver using the Tetracyanonickelate (II) UV colorimetric method.

RESULTS

The preliminary results of the water quality analysis are shown in Table 1. Further results will be available from the lab in November.

Cyanide (total and weak acid dissociable) was present at 0.13 mg/l at station X4 - intermediate decant but was not detected at the other stations. However thiocyanate was found to be 20.50 mg/l at X4 - intermediate dam decant and 17.60 mg/l at the cross valley dam decant. Seepage from the north toe of the cross valley dam (X11) contained 0.70 mg/l while thiocyanate was not detected in seepage from the south side of the cross valley dam. A special sample from the most northerly of the seepage zones (X11a) draining to the X11 weir contained 1.70 mg/l thiocyanate.

TABLE 1
CURRAGH RESOURCES RESULTS OF DIAND WATER SAMPLING 25 AUGUST 1987

VARIABLE	X4	X5	X11	X11a	X12	X13
cyanide mg/l	0.13	-0.03	-0.03	-0.03	-0.03	-0.03
cyanide WAD mg/l	0.13	-0.03	-0.03	-0.03	-0.03	-0.03
thiocyanate mg/l	20.50	17.60	0.70	1.70	-0.50	-0.50
flow cu m/sec m ²			1.27		0.66	~~1.86~~ 7.66
temperature	12.00	13.00	7.00		5.00	5.50
conductivity	800.00	780.00	790.00		449.00	770.00
pH	7.90	7.90	7.60		7.60	7.40

DISCUSSION

The presence of thiocyanate in the seepage from the north seepage zone of the cross valley dam indicates that water from the milling process is present in the seepage. Thiocyanate forms as a result of milling sulphide bearing ores in the presence of sodium cyanide. It is present at the intermediate dam and the cross valley dam decants. Thiocyanate would not be expected in natural surface or groundwater. The detection level of 0.50 mg/l does not allow any conclusion to be drawn about tailings water in groundwater at the southern seepage site.

A thiocyanate survey of seepage sites at the cross valley dam should be carried out. This survey would give a good indication of the source of water and an estimate of the dilution of tailings water with natural ground water.

Conservation & Protection
225, 308 Main Street
Whitehorse, Yukon
Y1A 2B5

4780-37/A293

1987-11-03

Mr. A. vonFinster
Habitat Specialist
Fisheries and Oceans Canada
122 Industrial Road
Whitehorse, Yukon
Y1A 2T9

Dear Al:

Re: Compliance Audit Curragh Resources July 87
In Situ Bioassay Results

Attached is a copy of the results of the In Situ Bioassay test that was conducted during July 13 - 15 at Curragh Resources and the complete package of the effluent quality data.

The results of the test demonstrate that for station X-5 there was 100 % mortality of the chinook fry in less than 24 hours in two separate tests. In addition, a similar test carried out at a point just downstream of station X-13 exhibited 50 % mortality after 44 hours.

On July 30 I discussed the data with Gerry Whitley and we agreed that DIAND would investigate the possible causes of the toxicity. I provided Gerry with the In Situ test results and gave him access to the water chemistry data available at our laboratory in Vancouver. Unfortunately, at that time the analyses had not been completed so Gerry did not have much to go on. During September Gerry advised me that his investigation with Curragh had not identified a specific cause of the toxicity.

I just received the full analytical data package for the effluent monitoring program. The data shows that CN levels were at or below the level of detection (30 ppb) and therefore was not the cause of the toxicity. None of the parameters measured were at high enough levels to be the obvious toxicant.

.../2

page 2 vonFinster

However, Zn(.15-.17 ppm), Cu(.024-.038 ppm) and NH_3 (.15-.43 ppm) are near the toxicity threshold for those parameters. As pH goes up above 7 NH_3 becomes more toxic, however, X-13 had NH_3 levels up to 0.54 and only exhibited slight toxicity(40% mortality after 85 hours). The toxicity may be due to synergism between heavy metals especially Cu and Zn or to unknown contaminants originating from the flotation agents such as MIBC or DOW 1012. It must be emphasized that a continuous flow exposure to these contaminants even at very low concentrations may cause mortality to juvenile salmonids. It is also likely that the same level of toxicants in a static bioassay would not cause mortalities. This would explain why the bioassay tests done by Curragh and DIAND would show no significant mortalities.

I am sending the complete data package to our Aquatic Toxicology Laboratory in North Vancouver and asking their opinion. This exercise may be somewhat academic, however, I am concerned that the results of this test indicate even if Curragh is in compliance with their licence the effluent may be acutely toxic to fish. It does emphasize the need for carrying out in-situ studies and collection of composite samples. Further, with your assistance we intend to conduct similar studies at UKHM and Canamax.

I apologize for the delay in sending this information to your office. I would appreciate any comments you may have on the results of this study.

Sincerely,


K. Wile
Manager, Industrial Programs
Environmental Protection
Yukon Branch

c.c. P. Mehling E.P. Vancouver
R. Watts " "
G. Whitley DIAND
J. Eamer Curragh Resources Inc.

P.A. HARDER & ASSOCIATES LTD.

BIOLOGICAL CONSULTANTS 913 ALEXANDER ROAD, VICTORIA, B.C. V9A 4K6 (604) 384-8796

January 8, 1988.

Ms. Joan Eamer
Curragh Resources Ltd.
117 Industrial Road
Whitehorse, Yukon
Y1A 2T8

RECEIVED JAN 13 1988

Dear Joan:

RE: Assessment of Flow Reduction Impacts in Rose Creek Below the South Fork Confluence.

Further to our conversation of January 8 I have prepared the following cost estimate to conduct the above mentioned assessment.

The assesment would require analysis of historical flow records, proposed flow regimes and available fish distribution data. Primary data sources would include flow records from the mine office, Levertons' earlier fisheries work and our data collected during last spring. Our assessment would be presented in the form of a brief letter report accompanied by graphs and data tables as required.

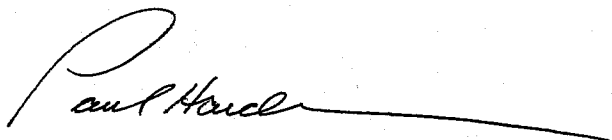
Total costs are estimated at approximately \$400.00. This estimate is based on:

1.) Professional Time of 8.5 hours @ 37.00/hr	= 314.50
2.) Drafting Services of 2.0 hours @ 17.00/hr	= 34.00
3.) Telephone Toll Charges	= 50.00
Total Costs	\$398.50

If you require further information please give me a call. Thank you for your attention.

Yours Truly,

P A. Harder and Associates Ltd.



P. A. Harder
Consulting Biologist

TO
A

Stream Files

FROM
DEAl von Finster
Technical Officer/HabitatSUBJECT
OBJET

ROSE/ANVIL CREEK

*This is final
figure referred to
not yet been prepared.*

SECURITY - CLASSIFICATION - DE SÉCURITÉ

OUR FILE/NOTRE RÉFÉRENCE

YOUR FILE/VOTRE RÉFÉRENCE

DATE

May 16, 1988

A reconnaissance of Rose and Lower Anvil Creek was conducted on July 14, 1987, by DFO District #10 Technical Officer/Habitat Al von Finster. Management Biologist George Cronkite assisted in sampling. The survey was to address the total lack of fisheries information concerning the area below the tailings pond decant. The timing of the survey was determined by DOE Environmental Protection program sampling. Due to restraint, we would not have been able to pay ferry and standby time for the necessary helicopter. By using the machine brought to site by EPS, and limiting blade time to that required to move from sampling location to sampling location, costs were held to an acceptable level. However, it was not possible to type reaches or conduct sampling to the level required for a reconnaissance inventory due to limited blade and sampling time.

The Rose/Anvil system serves as the receiving environment for the Cyprus Anvil/Curragh lead and zinc mine. Over the 20-odd years of mine development and operation, the system has been subject to considerable impact, including but not limited to massive tailings pond failures, chemical spills, production upsets resulting in releases of large quantities of cyanide, periodic toxicity of tailing water decants, and major releases of sediment due to stream diversions, etc.

Anvil Creek enters the Pelly river approximately 60 kilometers downstream of the Faro Bridge. The watershed, of approximately 1 000 square kilometers, is composed of three components of roughly equal area. They are:

1. Rose Creek, with a drainage area of approximately 340 square kilometers;
2. Upper Anvil Creek, with a drainage area of approximately 380 square kilometers; and
3. Lower Anvil Creek, with a drainage area of approximately 380 square kilometers (exclusive of Rose Creek and Upper Anvil Creek watersheds).

The main axis of the system is parallel to, and north of, the Tintina Trench. Approximately 12 kilometers from the confluence with the Pelly, Anvil Creek turns toward the larger river.

There are three major reaches in the section of Anvil/Rose Creek investigated. From the mouth, the first is low gradient, multichannelled, and unconfined. This reach is within the Tintina Trench and flows over and through various alluvial features.

The second reach extends from the valley wall of the Tintina Trench to a point on Rose Creek approximately 4.5 kilometers above the confluence with Anvil Creek. This reach has moderate gradients and is largely confined. Bed rock outcroppings are common in the valley walls. Earth failures are common, and range from minor slips of colluvial material over bed rock to a major slide of lacustrine material. There are two canyon sections, neither of which appears to constitute an obvious obstruction to upstream migration of fish. Substrate is generally coarse, except in a few sections of locally reduced gradient. Side and back channels, while present, are very limited in extent or development.

The third reach extends from the upstream end of the second to the downstream end of the tailings facilities. Gradients range from low to low/moderate, and generally increase toward the lower end of the reach. Bed rock exposures are absent or limited, and the stream is not confined. Side and back channels are common. Substrate ranges from sand to cobble, with occasional boulders.

Four stations were sampled on July 14, 1987, are noted on Figure 1, and described below.

Station 1. At upper end of R1. Main channel was seined with a 2m X 15m beach seine. Water levels were high, clarity good, and temperatures low (7.6 vs. 14 in mainstem Pelly). No fish were captured. A small side channel approximately 100 meters in length was also sampled. Catch was:

burbot (bb) - 41mm length;
bb - 680mm length; stomach empty.

Station 2. In lower R2. Water quantity and quality similar to Station 1. Gradient moderate, stream tumbles over boulders at inside of bend, unbroken and very swift at outside. Inside of bend sampled with electroshocker; no catch. Outside of bend sampled with 2.54mm X 2m X 15m monofilament drift net; no catch. Groundwater fed side channel electroshocked; no catch.

Station 3. In mid R2 (Anvil Creek). Water quantity and quality as above, although temperature rises to 8.1 - 8.3. Gradient lower than in Station 2, but water velocities remain high. Substrate ranges from sand to boulder, but

generally cobble. Seining in main channel results in capture of four Arctic grayling. Side channel also sampled, approximately 75m long, 5m average width, 0.5m depth. Velocity low, substrate cobble to silt. Considerable overhanging vegetation, debris in channel. Sampling conducted with electroshocker. Catch for both locations included:

	<u>Species</u>	<u>Fork Lengths (mm)</u>
18	Arctic grayling	150, 161, 171, 173, 180, 180, 182, 186, 190, 192, 200, 211, 220, 220, 222, 230, 243, 250
2	Round whitefish	213, 215

Station 4. In mid R3 (Rose Creek). Water gin clear. Channel split by stable, vegetated island. One side shallow, constant riffle; other broken, some riffle, pool, overhanging banks, and debris. Substrate varied. Tailings deposits throughout bush and in stream (resulting from mid-1970's pond failure). Much streamside vegetation dead. One sampler noted a strong and disagreeable odor from the tailings. Rocks on stream bottom thickly covered with algae. Sampling carried out with stop nets and electroshocker. One fish seen; none captured.

Sampling of the above stations indicated that fish, while present, were at low densities. This may have been an artifact of both the sampling methods used, the stage of Anvil Creek during sampling, and of a toxic effluent from the tailings facilities.

Three types of sampling equipment were utilized. A Smith-Rootes Mark V electroshocker was used to sample electronically. A full range of settings was tried. In Stations 1 and 3, the machine was effective in capturing burbot, Arctic grayling, and round whitefish. However, the general reaction of the fish was avoidance until they came against the stop nets and could be heavily shocked. Without the stop nets, the majority would have escaped. Small mesh (2.54mm) gill nets were utilized as drift nets at Station 2. This method is usually successful at tangling fish, and the failure to catch fish at this site is a good indication of their absence. A 2m X 15m beach seine was also utilized at Stations 1 and 3, the only stations where these could be used effectively. The high water level of Anvil Creek during sampling made use of this net difficult, and only limited areas could be seined.

The high water levels of Anvil Creek during sampling appeared to be the result of snow melt at high elevations. Water temperatures were consistently colder than the Pelly River. The combination of high velocities and low temperatures may have resulted in avoidance of the main channel for lower velocity areas. The high density of fish in the side channel at Station 3 supports this.

Finally, toxic effluents from the Curragh tailings facilities may be the cause of the low densities of fish noted. There is a long history of problems with this minesite, including;

1. a massive tailings pond rupture on March 19, 1975, which resulted in an estimated 55 X 10 gallons of effluent and tailings slurry released into Rose Creek;
2. a release of sodium cyanide between February 1 and 29, 1976, which resulted in a toxic flow in Anvil Creek to the confluence with the Pelly River;
3. a breach in the tailings pond on December 1, 1979, resulting in a release of between 2.5 and 4 X 10 gallons of effluent and slurried tailings released into Rose Creek;
4. effluent and seepage were, on occasion, toxic throughout the Cypress Anvil operation of the minesite.

The greatly expanded tailings facilities installed by Cypress Anvil and operated by Curragh appear to function much better than the former ponds. However, an insite bioassay (with juvenile chinook salmon) conducted between July 13 - 15, 1987, resulted in all fish dying within 24 hours. The test was repeated with identical results. Avoidance of this toxic effluent may be the cause of the disappointing sampling results in Station 4.

Finally, the following advice is given to future samplers:

1. Sampling would best be conducted in August, preferably during a dry spell;
2. Reach 2 will be difficult to sample due to large substrate, high velocities, a lack of access to land helicopters, etc.;
3. This system should be considered non-navigable;
4. No bears or bear sign was noted.

P.A. HARDER & ASSOCIATES LTD.

BIOLOGICAL CONSULTANTS 913 ALEXANDER ROAD, VICTORIA, B.C. V9A 4K6 (604) 384-8796

June 16, 1988

Joan Eamer,
Curragh Resources Ltd.,
117 Industrial Road,
Whitehorse, Yukon,

Dear Ms. Eamer:

Re: Causeway Crossing of South Fork Rose Creek

Please be advised that we have examined the proposed crossing of the South Fork of Rose Creek and recommend that fish passage requirements not be incorporated into the causeway crossing.

Our rationale is as follows:

1.) The existing road culvert below the causeway is presently a barrier to grayling moving upstream from the reservoir and stream sections downstream of the road crossing. At the time of inspection on June 9, 1988, there was a 1.2 m drop at this 24 m culvert that is installed at a 3% slope.

2.) A resident population of grayling is present in the South Fork upstream of the road crossing. We observed grayling spawning at the outlet of Dickens Lake on June 5, and captured a sub-adult grayling at an electrofishing site located upstream of the road and proposed causeway crossing on June 6 (see attached map). This indicates that grayling are presently utilizing the South Fork upstream of the crossing site. Presumably recruitment to the stream is coming either from the lake population of fish or from residents in this upper section of stream.

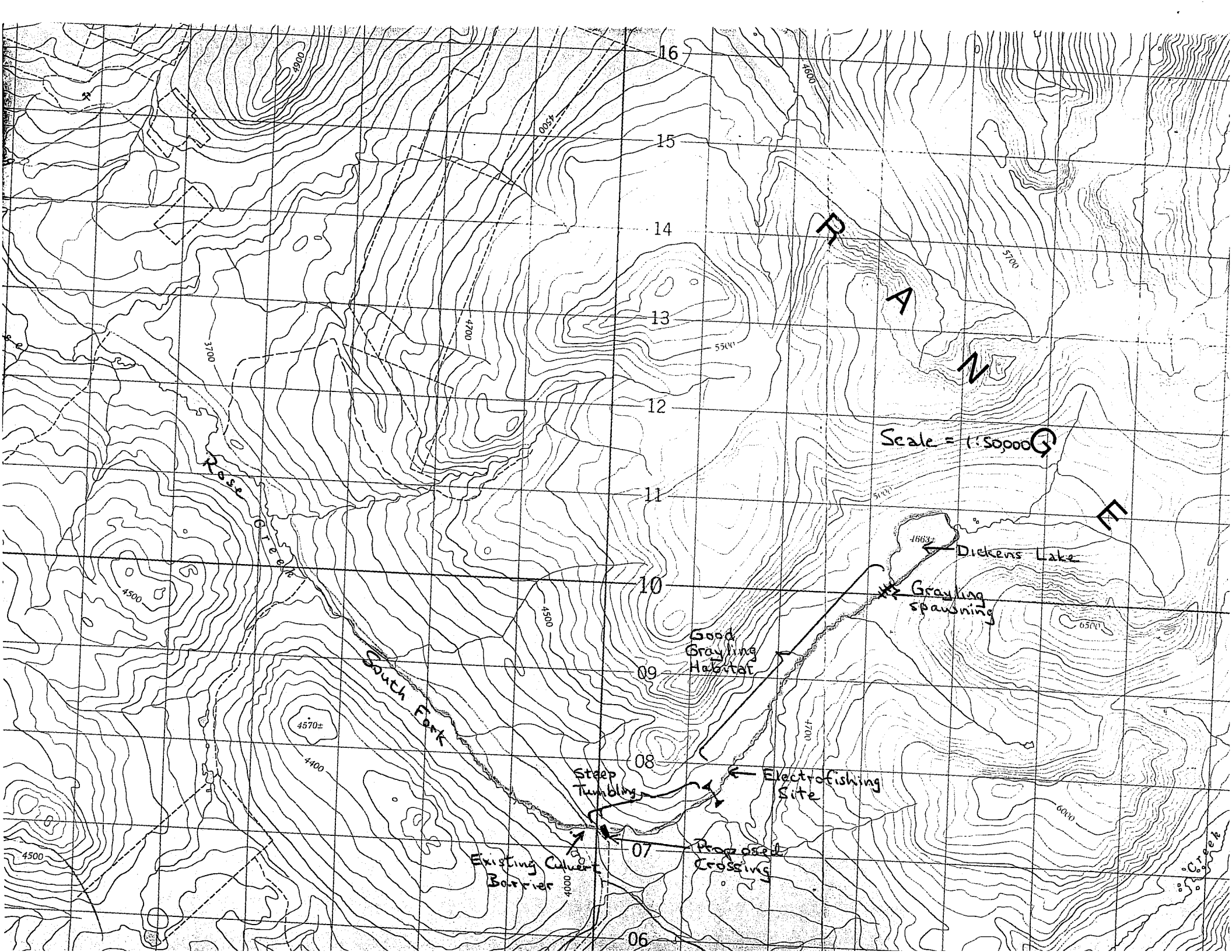
3.) The causeway crossing site is located in a steep gradient section (7%) of the South Fork. Although no barriers were observed in this 1 km section of stream - this steep tumbling section of stream would pose some difficulty to fish migrating from downstream locations. It would be very difficult to incorporate fish passage in a section of stream with such a steep slope.

If we can provide any additional information concerning this crossing site please contact us and we would be pleased to discuss this matter further. The more detailed results of the aerial and ground observations in the South Fork will be incorporated into our report to Curragh Resources following our August sampling in Rose Creek.

Yours truly,

David Bustard

David Bustard





Environment
Canada

Environnement
Canada

Conservation and
Protection

Conservation et
Protection

RECEIVED JUL 14 1988

Environmental Protection
225, 308 Main Street
Whitehorse, Yukon
Y1A 2B5

Your file Votre référence

Our file Notre référence

4780-37/A293

1988-07-07

Mr. J. Moore
General Manager
Curragh Resources Inc.
Box 1000
Faro, Yukon
Y0B 1K0

Dear Mr. Moore:

Re: Environmental Protection Monitoring Curragh Resources
Mine - August 3-5/88

In a telephone conversation with Joan Eamer and Rob McLenehan on July 5, 1988, they were advised that Environmental Protection - Industrial Programs was planning to carry out an effluent monitoring project at the Curragh Resources Mine. The tentative project date agreed to was August 3-5, 1988. This date coincides with the joint benethic survey project with the company and the Environmental Assessment section of Environmental Protection.

The attached is a general outline of the activities that we intend to carry out during the effluent monitoring survey. The primary activity will be the collection of two 8-24 hour composite samples from the final effluent decant of the tailings pond system (X-5) and the final seepage from below the Cross Valley Dam (X-13). Additional activities will include composite sampling for bioassay at X-5 and X-13, conducting inspections at mine water drainages, waste dumps, diversion ditches, Vangorda Haul road crossing, and Vangorda and Grum surface overburden removal. We would also like to carry out an analytical quality assurance exercise by splitting our samples and providing one set for analysis in your analytical laboratory. This aspect of the project was discussed with Rob.

.../2

Canada

Mr. J. Moore
Page 2

If you have any questions or concerns regarding the survey,
please call me at 667-3410.

Yours sincerely,

A handwritten signature in cursive script, appearing to read 'D. Cornett', with a long horizontal flourish extending to the right.

D. Cornett
Industrial Programs Officer
EP - Yukon Branch

cc ~~J.~~ Eamer, Curragh Resources
R. McLenehan, Curragh Resources
G. Whitley, DIAND
A. von Finster, DFO
K. Nordin, YTWB

COMPLIANCE AUDIT PROGRAM

CURRAGH RESOURCES

August 3 - 5 1988

Project #093

NEED B, EFFECT B1

Project Manager: D. Cornett

OBJECTIVES

1. To verify the level of compliance of Curragh Resources Mine final effluent discharge with the effluent objectives in the federal Regulations for the Control of Liquid Effluents from Existing Metal Mines.
2. To provide QA/QC for sampling and analytical procedures (especially cyanide) used by Curragh Resources in carrying out its monitoring requirements under YTWB water licence Y-IN85-05AL.
3. To collect water quality samples at the final effluent decant and final seepage discharge during Environmental Assessment benthic survey program to characterize the effluent with respect to its potential impact on aquatic resources.
4. To conduct the audit program in cooperation with DIAND and DFO to expand the knowledge base for the project and to reduce duplication of government effort.

Sampling Program

Stations -Final tailing pond discharge(1); Final Seepage Discharge from CVD(2); North Toe Cross Valley Dam Seepage(3); North Fork Rose Creek(4); Rose Creek downstream Reservoir(5).

Collection

- Stn 1,2 - Composite samples collected on 2 consecutive days over an 8-24 hr. period .
- Stn 1,2 - 1 Composite sample for static 96 hr LC₅₀ bioassay.
- Stn 1,2,3,4,5 - 2 grab samples collected during the 2 day period.

Parameters

All grab and composite samples will be analyzed for total, dissolved and extractable metals (Ag, As, Cd, Cu, Fe, Hg, Pb, Ni, Se, Zn,) pH, NFR, FR, T. Hardness, T. Alkalinity, Ammonia, Sulfate, Total Cyanide, WAD, CNO, SCN.

Static 96 hr LC₅₀ bioassay samples at Stn 1,2.

In situ parameters will include pH, conductivity, temp, dissolved oxygen, and flow.

Additional Activities

During the sampling period, field personnel will be available for one half day to conduct additional mine surveillance. Priority items include:

1. Surveillance of mine site including mine water drainages, waste dumps, diversion ditches, North Fork Rose Cr. Vangorda haul rd. xing, and Zone II seepages.
2. Inspect Vangorda and Grum surface overburden removal.
3. Update mine operations information.
4. Collect Un Leaded Gasoline samples in Faro to monitor compliance under the Unleaded Gasoline Regs in the Clean Air Act Regulations.
5. Inspect Faro sewage lagoon.



**Curragh
Resources Inc.**

P.O. Box 1000
Faro, Yukon
Y0B 1K0

Tel.: (403) 994-2600
Telex: 0368298

TELECOPIER COVER LETTER

TO: Joan Eamer

TELECOPIER NO. _____

FROM: _____
NAME: Kathy.

CURRAGH RESOURCES INC., Box 1000, Faro, Yukon, Y0B 1K0

TOTAL NO. OF PAGES: 4
(Including cover letter)

DATE: Aug. 12

TIME: 8:35

OPERATOR: [Signature]

We are transmitting from the following:
Xerox FAX 7020 - 24 hours (403) 994-2600 Ext. 159

If you do not receive all pages please call back as soon as possible.

MESSAGE: Recent CN results - re Int dam raising

**ECO-TECH LABORATORIES LTD.****ASSAYING - ENVIRONMENTAL TESTING**

10041 East Trans Canada Hwy., Kamloops, B.C. V2C 2J3 (804) 573-5700 Fax 573-4557

July 20 1988

ANALYTICAL RESULTS - #9441

CLIENT: Curragh Resources
Box 1000
FARO, YUKON
Y0B 1K0

ATTENTION: Rob McLanehen

SAMPLE IDENTIFICATION: 24 water samples received July 18, 1988,
14 Samples for NH₃, 10 for T.Cyanide,
all dated "July 11, 1988"

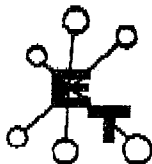
P.O.# D-101637

PARAMETER	CYANIDE	AMMONIA
July 11 x1	0.032	0.84
July 11 x2	-	0.17
July 11 x3	-	0.12
July 11 x4	0.070	1.56
July 11 x4 (weak acid dissociable)	0.010	-
July 11 x5	0.017	0.86
July 11 x5 (weak acid dissociable)	0.008	-
July 11 x9	<0.005	0.68
July 11 x10	-	0.05
July 11 x11	0.107	1.01
July 11 x12	<0.005	0.49
July 11 x13	0.050	0.93
July 11 x13 (weak acid dissociable)	<0.005	-
July 11 x22	-	1.19
July 11 x22A	-	0.23
July 11 x23	-	1.03
July 11 F.C.	-	0.20

NOTE: All results expressed in mg per litre unless otherwise noted.

Ray Woodley
ECOTECH LABORATORIES LTD.
Ray P. Woodley
Laboratory Supervisor

RPW/ga

**ECO-TECH LABORATORIES LTD.****ASSAYING - ENVIRONMENTAL TESTING**

10041 East Trans Canada Hwy., Kamloops, B.C. V2C 2J3 (804) 573-5700 Fax 573-4557

July 27, 1988

ANALYTICAL RESULTS - #9481

CLIENT: Curragh Resources
Box 1000
FARO, YUKON
Y0B 1K0

ATTENTION: Rob McLenehen

SAMPLE IDENTIFICATION: 25 water samples received July 25, 1988,
----- 13 Samples for NH₃, 9 for T.Cyanide,
3 WAD Cyanide, all dated "July 20, 1988"

P.O.# D-101637

PARAMETER	CYANIDE	AMMONIA
July 20 X1	0.108	0.28
July 20 X4	0.050	0.40
July 20 X4 (weak acid dissociable)	<0.005	-
July 20 X5	0.050	0.56
July 20 X5 (weak acid dissociable)	<0.005	-
July 20 X7	<0.005	0.33
July 20 X9	0.026	0.57
July 20 X11	0.150	1.01
July 20 X12	<0.005	0.61
July 20 X13	0.191	0.78
July 20 X13 (weak acid dissociable)	<0.005	-
July 20 X14	0.006	0.22
July 20 X22	-	1.22
July 20 X22A	-	0.14
July 20 X23	-	1.88
July 20 JB	-	1.37

NOTE: All results expressed in mg per litre unless otherwise noted.

Ray Woodley

ECO-TECH LABORATORIES LTD.
Ray P. Woodley
Laboratory Supervisor

RPW/ga

**ECO-TECH LABORATORIES LTD.****ASSAYING - ENVIRONMENTAL TESTING**

10041 KENILTON DRIVE NWY., KAMLOOPS, B.C. V2C 2J2 (504) 575-3700 Fax 575-4887

August 3, 1988

ANALYTICAL RESULTS - #9502

CLIENT: Curragh Resources
Box 1000
FARO, YUKON
Y0B 1K0

ATTENTION: Rob McLenahan

SAMPLE IDENTIFICATION: 21 water samples received July 28, 1988,
11 samples for NH₃, 7 for T.Cyanide,
3 WAD Cyanide; all dated "July 28, 1988"

P.O.# B-101487

PARAMETER	CYANIDE	AMMONIA
July 28 X1	0.130	1.07
July 28 X4	0.083	0.49
July 28 X4 (weak acid dissociable)	0.000	-
July 28 X5	0.036	0.59
July 28 X5 (weak acid dissociable)	0.007	-
July 28 X7	0.044	1.08
July 28 X11	0.084	1.20
July 28 X12	0.008	0.12
July 28 X13	0.179	0.78
July 28 X13 (weak acid dissociable)	<0.005	-
July 28 X22	-	1.38
July 28 X22A	-	0.03
July 28 X23	-	0.41
July 28 JB	-	1.41

NOTE: All results expressed in mg per litre unless otherwise noted.

RPW/ga
FAH

Ray P. Woodley
ECO-TECH LABORATORIES LTD.
Ray P. Woodley
Laboratory Supervisor

STEFFEN ROBERTSON AND KIRSTEN
Consulting Engineers



STEFFEN, ROBERTSON AND KIRSTEN (B.C.) INC.
Suite 801, The Burrard Building
1030 West Georgia Street
Vancouver, B.C., Canada V6E 2Y3
Tel. (604) 681-4196 Telex 04-352578 Facsimile (604) 687-5532
August 9, 1988

Curragh Resources Inc.
Faro Operations
Box 100
Faro, Yukon
Y1A 2T8

Attention: Mr. Robert McLenehan

Dear Mr. McLenehan:

**Project 60606: ON-GOING SUPERVISION AND ASSISTANCE WITH THE TAILINGS COVERS
TEST PLOT PROGRAM AND FARO ABANDONMENT PLAN**

In response to our telephone conversation, I take pleasure in providing a workscope and budget estimate for on-going supervision and assistance with the tailings test plot program and Faro abandonment plan development.

DISCUSSION OF PROGRESS ON ABANDONMENT PLAN DEVELOPMENT

a) Test Plot Program

The test plot program is a very comprehensive and complex test program. Good results are essential if a demonstration of the adequacy of a dry tailings cover over Original and Second tailings Impoundments is to be achieved.

With the change in development plans regarding the Down Valley currently being implemented, it is no longer possible to consider dredging old tailings above the old abandonment level to the Down Valley Impoundment. Thus if the tailings have to be placed under water, a considerably larger tonnage would have to be dredged to the Faro pit at significantly greater cost than envisaged in earlier abandonment evaluations. The cost consequences of not being able to use a dry cover is now considerably increased. The change in tailings disposal plan also brings forward the abandonment plan schedule from 15 or 25 years, to just 4 years from now. This schedule change reduces the time period we have to study the effectiveness and results of the cover placement, consequently our task of demonstrating effectiveness to both ourselves (Curragh) and the regulatory agencies becomes more difficult. The risk of proceeding in an inappropriate manner is considerably greater.

At this time the test plot program is behind schedule and installation procedures and results have been far from satisfactory. The program must be 'recovered' if any value is to be gained from it. It is essential that both adequate resources and resources of an adequate technical skill level are devoted to it.

The original program, as described in Report 60602, provided for a permanent Program Manager who would spend the majority of his time on the program and for regular supervision and assistance from SRK (or any other suitably qualified group). Budget restrictions have limited the resources (both quantity and quality) applied to the program and other duties assigned to the Program Manager have consumed the majority of his time. SRK assistance requests and input have been negligible. As a result it is now necessary to put extraordinary effort into the recovery of the program. The following workscope is, I believe the minimum that is required to get the program back on track with an acceptable technical quality. It assumes that Curragh will ensure that the Program Manager will be devoted almost exclusively to the Test Pit Program (TPP) and the other activities scheduled for 1988 in the Tailings Abandonment Plan development Program (TAPP).

b) Other Tailings Abandonment Plan Programs

The TAPP includes an number of other programs, including:

- Surface water program
- Ground water program
- Foundation soils characterization program
- Tailings characterization program
- Modelling program

These programs were briefly outlined in Report 60602. Detailed interpretation of these programs is currently being done by the Program Manager. It is essential that the details of these proposed programs be reviewed and agreed. These are specialist topics and a full understanding of what is required is not resident in any one person. The details of the proposed programs should be committed to paper and be reviewed by the appropriate specialists. It is also necessary to develop program descriptions for the purposes of review by the Technical Advisory Committee (TAC). The Program Manager must be given sufficient time to adequately prepare these programs. Also these programs must be undertaken by personnel with sufficient expertise such that the results are reliable. While I have had the opportunity to discuss these programs briefly with the Program Manager, no detailed descriptions have been prepared and methodologies, procedures and personnel skills have not been reviewed. I am at this stage unable to comment on the adequacy of the planned programs or the suitability of the program details or that adequate data will result for the modelling work that will be done in the final stages of the TAPP.

The Program Manager has considerable skills and capabilities. Never-the-less there are tasks in the TAPP for which he does not have the technical expertise or experience or both. It is possible that he can be guided through some of these tasks but this may not be cost effective both from time commitment and risk of mistakes view points. Provision was made in the original program for such work to be done by SRK personnel or other specialists. Included in this category are aspects of instrumentation, hydrogeochemistry program definition and interpretation, geotechnical/tailings testing and modelling, groundwater modelling, and overall chemical transport modelling. It appears that Curragh is currently requiring all of this work to be performed by the Program Manager. Given the current work load on the Program Manager I have considerable doubt as to his ability to develop all of the tools, skills and experience to undertake all of the TAPP work with only supervision and guidance. His future work load should be reviewed and a realistic evaluation made of what tasks he can adequately take on. The balance of the tasks should then be assigned to others. I have made only minimal, non-specific allowance in the workscope outlined below for any additional assistance from SRK on specific program tasks.

c) Programs for Faro Mine and Area Abandonment Plan

The Faro Mine and Area Abandonment Plan Program (FAPP) as been developed over the past year, primarily by the Program Manager and other Curragh personnel with input from SRK. There is a considerable program of additional work to be completed as described in the most recent submissions to the Yukon Water Board. This program must be integrated with the TAPP. The same comments as have been made regarding the TAPP generally also apply to the FAPP.

The water quality predictive model, which will be the basis for the ultimate environmental impact assessment of the combined effect of all the abandonment measures, will be a single model for both TAPP and FAPP. SRK is currently developing and implementing such a model for the Brenda Mine Abandonment Plan. The Brenda model will be developed well ahead of the Faro model. Little of this model development will be of direct benefit to Curragh if the Program Manager is required to develop a model independently, though I will do my best to transfer ideas and methods via recommendations and suggestions.

d) Participation In Technical Advisory Committee Meetings

The TAC can serve as a very useful and cost effective forum for Curragh to obtain the support and understanding of the regulatory agencies. I believe it is less likely that DIAND will take a hard line with Curragh if they observe that the proposed measures have the support of EPS, for example. It offers an opportunity to 'negotiate solutions', not easily achieved at Water Board hearings. To gain the greatest benefit from these meetings it is recommended that a strategy be developed of what should be achieved at each meeting, and that adequate preparation be made before each meeting so that the likelihood of achieving these goals are improved.

RECOMMENDED MINIMUM WORKSCOPE

Task 1. Regular Site Visits, Program Reviews and Guidance

Three visits annually by Dr. A Mac G Robertson to Faro to review TPP, TAPP and FAPP results and progress. During these visits the following will be done:

- work plans for proposed programs will be reviewed and agreed.
- sites of completed programs will be visited and progress checked.
- test procedures and results will be reviewed.
- assistance will be provided in the interpretation of results.
- suggestions will be made regarding modifications in test procedures or in the interpretation methods.
- objectives for the next period will be reviewed and agreed.

Time allowances for each trip should be as follows:

Travelling time	- 1 day
Field inspections	- 1 day
TPP review	- 1 day
TAPP review	- 1 day
FAPP review	- 1 day

It is also important that the conclusions of each trip be committed to paper and for this purpose a further day should be allowed.

Task 2. Individual Program Reviews and Technical Support

During the course of the year there will be individual program scopes which will be developed. These must be reviewed and suggestions made. There will also be reports prepared by the Program Manager which must be reviewed and editorial and technical comments and suggestions provided. Allowance should also be made for the provision of some technical tools and information to the program Manager to enable him to perform the work.

I suggest a minimum allowance of 5 days be made for this purpose.

Task 3. Preparation for and Attendance of TAC meeting.

I have assumed only one TAC meeting per year though Curragh may find it beneficial to have two. The allowance for these should be:

Travel time	- 1 day
Preparation time	- 1 day
Attendance time	- 1 day

Task 4. Assistance with Undefined Program Work

I believe an allowance should be made for 10 days of undefined assistance on some of the specific programs. Such assistance may be rendered by myself or other SRK specialists such as Dr. Adrian Smith or Dr. Adrian Chantler.

PERSONNEL

It is anticipated that nearly all of the work defined in this proposal would be done by myself with some assistance in other areas of expertise by specialists such as Dr's Smith and Chantler. This is structured to minimize the involvement and cost to Curragh. However I believe it would be to the benefit of Curragh if a second, intermediate or senior, SRK engineer were involved, particularly if more specific program assistance is required by Curragh.

COST ESTIMATE

Based on the above trip and time estimates, and making allowance for some personnel support in SRK, a budget cost estimate has been prepared as summarized on the attached Cost Estimate Sheet.

If you have any queries, or require any additional information, I would welcome the opportunity of providing these.

Yours Truly,

STEFFEN ROBERTSON & KIRSTEN (B.C.) INC.



A. MacG. Robertson
President

cc. Joan Eamer, Curragh - Whitehorse.

PROJECT ESTIMATE SHEET

PROJECT: Curragh Abandonment Plan Review + Guida

WORK AREA/ DESCRIPTION	PROFESSIONAL TIME (DAYS)								TRAVEL & ACCOMMODATIONS			DISBURSEMENTS				
	Principals/Managers/ Corporate Consultants	Associate Consultants	Project Managers/ Senior Engineers	Project Engineers	Staff Engineers	Tech. Assistants	Drafters	Admin. Assistants/ Clerical	Airfares	Auto Rental & Mileage	Acc/Exp/Per Diem	Computer	Documentation & Printing	Communications	Laboratory Testing	Field Supplies
TASKS.																
Task 1 Visits/Reviews	18							2	1800	900	750		150	300		
Task 2. Program Reviews/ Technical Support.	5				2		1	1					100	150		
Task 3. TAC meeting	3							1	600	100	300		50	50		
Task 4. Undefined Program Work.	10				5		2	3					150	150		
Sub-total	36				7		3	7								
Rate.	640				400		304	256								
Amount.	23040				2800		914	1,792	2400	1000	1050		450	650		
26,240																



RECEIVED AUG 17 1988

STEFFEN, ROBERTSON AND KIRSTEN (B.C.) INC.
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Tel. (604) 681-4196 Telex 04-352578 Facsimile (604) 687-5532

10th August, 1988

Vice President Exploration
Curragh Resources Inc.
117 Industrial Road
Whitehorse, YUKON
Y1A 2T8

Attention: Mr. Greg Jilson

Dear Sirs:

**PROPOSAL FOR GROUNDWATER AND TAILINGS CHARACTERIZATION INVESTIGATION
FOR TAILINGS ABANDONMENT PLAN DEVELOPMENT**

BACKGROUND

The Tailings Abandonment Plan Development Program (TAPP) as described in SRK report 60602 provides for the schedule of programs listed in section 1.8, a copy of which is attached as Addendum A. The 87/88 program comprised:

During year 2 (October 1987 to October 1988)

- Monitoring sampling and testing in trail pits
- Surface and Groundwater baseline investigation
- Tailings and foundation soil characterization

Outlines of the objectives of these programs were included in 60602 and copies of these are included as Addendums B and C.

Report 60602, section 1.9, paragraph (i) states 'This document provides an outline of the proposed program, test facilities and procedures. It is essential that the details of the program be defined considerably more precisely prior to program execution.' The remainder of the text is attached as Addendum D.

More detailed descriptions of the test pit program were prepared prior to initiation of that program. Such details have not yet been developed in respect of the other programs.

This proposal provides for assistance to Curragh to develop the detailed programs for groundwater, tailings and foundation soils characterization and for assistance with the execution of these programs.

The initially developed budget for these programs is provided in sub-sections B and D of Table 1 of Report 60602, attached hereto as Addendum E. This provides for a total of about \$118,000 for the two programs.

PROPOSED WORKSCOPE

The proposed workscope defined in this proposal includes for the engineering and field services to:

- prepare a detailed program plan and description (based on current work done by Robert McLenehan).
- discuss sampling methods and equipment with drillers (drilling to be contracted directly by Curragh).
- supervise the drilling, sampling, piezometer installation and well completions.
- arrange and supervise sample testing (including centrifuge extraction tests, if suitable). Testing to be contracted directly by Curragh.
- Prepare drill hole logs, and maps of the drill hole locations for inclusion in the final interpretive report.
- Prepare summaries of test results for inclusion in the final interpretive report.

Not included in this workscope and cost estimate are the following:

- Review and analysis of previous information (beyond what was done for Report 60601).
- Development of a tailings deposit or foundation soils description.
- Development of a detailed interpretive report of the results.
- Costs for services to be contracted directly by Curragh, including drilling, field supplies, shipment costs, and laboratory testing costs.

The first three items can be completed by SRK, if Curragh so wishes, at a later stage.

COST ESTIMATE

We have prepared a cost estimate of \$18,550 for the completion of the proposed workscope as summarized in the Project Estimate Sheet attached. It is not possible to accurately estimate the time required for the drilling company to complete the drilling, sampling and well completions in conditions not well known to us. Thus the actual time required may vary from that estimated with commensurate changes in the cost of field work.

PERSONNEL

The work will be done, under the guidance of the writer, by a geotechnical engineer with field experience in geotechnical drilling and sampling. Dr Adrian Smith, the specialist hydrogeochemist involved in the development of the program (Report 60602), will review and provide guidance in the planning of the investigations and testing procedures.

SCHEDULE

A geotechnical engineer can be assigned to the work starting in 10 days time. Unfortunately the writer will be on an overseas trip until the 5th of September, and any work done between the 17th August and 5th September will have to be supervised by one of the other senior SRK engineers (John Bridges). To allow the writer to have input to the pre-planning of the investigations we would have to be instructed to proceed by Friday, 11th August.

We thank you for the opportunity of being of service to Curragh, and look forward to your further instructions.

Yours truly,

STEFFEN ROBERTSON & KIRSTEN (BC) INC.

A handwritten signature in black ink, appearing to read 'A. MacG.', with a stylized flourish at the end.

Dr. A. MacG., P.Eng.
President

PROJECT: Faro Abandonment: Assistance with Groundwater
Tailings and Foundations Characterization Program.

WORK AREA/ DESCRIPTION	PROFESSIONAL TIME (HOURS)								TRAVEL & ACCOMMODATIONS			DISBURSEMENTS								REMARKS
TASKS:	A. Robertson / A. Smith Principals/Managers/ Corporate Consultants	Associate Consultants	John Bridges, Project Managers/ Senior Engineers	Project Engineers	Staff Engineers	Tech. Assistants	Drafters	Admin. Assistants/ Clerical	Airfares	Auto Rental & Mileage	Acc/Exp/Per Diem	Computer	Documentation & Printing	Communications	Laboratory Testing	Field Supplies	Subcontractors	Freight	Word Processing	
1. Program planning + description	16		4		24							}								
2. Drilling review with contractor	2				2															
3. Supervise Drilling + fieldwork	2		4		140				600	1400	1400			200	200		200			
4. range and supervise sample testing	6		4		16															
5. Prepare logs and location drawings	2		4		16		16	8												
6. Prepare summaries of test results	6		2		16			8												
Sub-Total	34		18		214		16	16												Summary: Prof. Time = \$14,550
Rate/hour	80		60		45		38	32												Disb. = \$4,000
Amount	2720		1080		9630		608	512	600	1400	1400		200	200		200				TOTAL \$18,550

1.8 Program Schedule

The program schedule is as follows:

First half of year 1 (January to June 1987)

- Design of detailed field trials to evaluate effects of various cover types. This design will be done in consultation with appropriate Regulatory Authorities and any other groups who may contribute to the funding of the test program.

Second half of year 1 (June 1987 to October 1987)

- Construct field trial sections.

Year 2 (October 1987 to October 1988)

- Monitoring, sampling and testing in trial pits
- Surface and Groundwater baseline investigation
- Tailings and foundations solids characterization

Year 3 (October 1988 to October 1989)

- Monitoring, sampling and testing in trial pits
- Surface water and groundwater baseline investigation

Year 4 (October 1989 to October 1990)

- Monitoring, sampling and testing in trial plots
- Acid generation modelling
- Contaminant plume modelling
- Abandonment Plan preparation

Addendum B.

5.2 Groundwater Quality

a) Location and frequency of sampling

The SRK 1986 report discussed the deficiencies of the current, license specified monitoring program with respect to upstream background water quality, (section 7.3, p. 94). It is proposed to construct two background monitoring wells, east of the mine to remedy this deficiency.

Subject to confirmation on the ground, the well locations will be approximately:

- south of North Fork, Rose Creek adjacent to the Mine access road at least 1000 m south east of the creek crossing
- 1 1/2 to 2 km up North Fork, Rose Creek from the Mine access and crossing, above the waste dump areas, subject to finding a suitable location away from the creek.

Both holes will be completed in bedrock and alluvium/till where present. It should be noted that inspection on the ground may dictate a preferential location for these holes.

Both from a logical and expediency viewpoint, the background groundwater sampling frequency will be the same as that for the surface sampling, described in section 5.1, and consistent with the recommendations of the SRK 1986 report (p. 96, section 7.3). This means that a contemporaneous record of surface water and groundwater background quality will be available for both modelling and impact analysis.

b) Collection and Analysis

The problems and constraints have been described in section 5.1(b). For the most part, with the exception of flow measurements, these will apply also to the groundwater program. Once again, a detailed program will be developed by agreement with involved parties.

Addendum C

5.3 Solids Characterization

Baseline solids samples will be collected from the "fresh" tailings to be deposited in the test plots, the existing tailings and the subsite/downstream foundation materials as follows:

Fresh tailings:

During deposition a sample of unsegregated tailings will be taken each day of tailings deposition in a 5 litre plastic bucket and, after decanting the excess water once the tailings have settled, the slurry will be transferred to a double plastic bag in a 5 litre, screw top jar; the bags being sealed to prevent oxygen ingress.

On the completion of the tailings deposition in the test plots, a selection from amongst the tailings samples collected will be made for analysis.

Existing tailings:

Some information is available on existing tailings (Golder Associates, 1986, SRK, 1986). It is proposed to collect further data for basic model calibration purposes by drilling two or more holes through the existing tailings and collecting a composite sample at approximately 3 metre intervals. Samples will be stored in sealed, double polyethylene bags prior to final selection for analysis.

Subsite materials:

Samples for attenuation testing will be taken by selected auger drilling in the proposed sub-surface flow channels downstream of the tailings facility to Rose Creek.

Samples collected above the water table (if this is at all possible) should have not been affected by any past seepage in respect of their attenuation capacity. Samples below the water table will represent the present equilibrium between the solids phase and the groundwater.

In all cases, selection of materials for analysis will be on the basis of a minimum number of samples to represent the lithological and physical variation in the material observed in the sampling process.

b) Analysis and Testing

The methods of analysis will be as follows:

- acidification potential/acid base potential - as for section 3.5(b);
- leaching potential - as for section 3.5(b);
- attenuation testing (subsite materials only) - ASTM or modification of the batch test procedure, plus confirmatory column tests, where attenuation is demonstrated. Samples from the attenuation tests will be analyzed for the parameters in section 3.5(b).

5.4 Report Preparation

A separate report will be produced that will describe:

- the initial background and baseline groundwater and surface water quality;
- the "baseline" tailings leaching characteristics, for both fresh and "in situ" tailings, and the tailings buffering capacity; and
- the potential attenuation capability of the subsite materials.

The success of the program will depend largely on the following factors:

- (i) **Pre-planning of the program:** This document provides an outline of the proposed program, test facilities and procedures. It is essential that the details of the program be defined considerably more precisely prior to program execution. This would require liaison and cooperation with the appropriate regulatory agencies to obtain agreement on the procedures and methodology, detailed field facilities and instrumentation design, identification of testing organizations and facilities, preparation of detailed sampling and testing procedures and specifications, and the preparation of a detailed program work plan.
- (ii) **Program management:** The timely and correct completion of all facility construction, sampling, testing and reporting is essential for the program success. To achieve this it will be necessary for Curragh to provide a qualified project manager. Such a manager should have the appropriate skills to conduct or supervise the field test program and administrate the laboratory testing and data compilation.
- (iii) **Quality Control/Quality Assurance.** A high level of quality control is essential in a program of this nature. Day to day control will be provided by the project manager but periodic quality assurance is required by means of:

- (i) outside laboratory quality assurance testing
- (ii) procedures and methods checks by Curragh's consultants, and
- (iii) procedures and methods checks by Regulatory agencies

The QC/QA procedures should be established prior to program initiation.

TABLE 1
COST ESTIMATE FOR PHASE 1

Task	\$ (thousands)
<u>A. Test Plot Program</u>	
(i) Preparation of detailed program	25
(ii) Test plot installation	400
(iii) Test supervision and sampling ^{1,2} 3 years @ \$50,000/year	150
(iv) Laboratory testing 3 years @ \$30,000/hear ³	90
(v) Supervision, data evaluation and report ⁴ 3 years @ \$20,000/year	<u>60</u>
SUB-TOTAL	725
<u>B. Groundwater Baseline Program</u>	
(i) Installation of two wells (double completion) i.e., 2 x 2 = 4	25
(ii) Sampling 3 years @ \$4,000/year ^{1,2}	12
(iii) Testing 3 years @ \$7,000/year ³	21
(iv) Supervision, data evaluation and report	<u>10</u>
SUB-TOTAL	68
<u>C. Surface Water Baseline Program</u>	
(i) Sampling 3 years @ \$4,000/year ^{1,2} 4 sampling points	12
(ii) Testing 3 years @ \$7,000/year ³	21
(iii) Data evaluation and report	<u>9</u>
SUB-TOTAL	42
<u>D. Tailings and Subsite Soils Characterization</u>	
(i) Drilling and sampling (3 holes)	12
(ii) Testing (including specialist services such as centrifuging, etc.)	30
(iii) Data evaluation and report	<u>8</u>
SUB-TOTAL	50
<u>E. Modelling</u>	
(i) Acid generation modelling	30
(ii) Contaminant migration modelling	<u>50</u>
SUB-TOTAL	80

CURRAGH RESOURCES INC.

INTER-OFFICE MEMORANDUMDATE: August 11, 1988

TO: Rob McLenehan cc: Andy Robertson, Gregg Jilson
FROM: Joan Eamer
SUBJECT: Surface Water Quality Program in relation to TAPDP

Andy Robertson asked me if the current water sampling program covered the requirements in 60602 (attached). I realize that you are working on this, but as I have done some additional sampling related to other programs, I thought I should outline my thoughts on background surface water studies.

1. Upstream sites:

(X2 and X3 continue to be done for licence requirements)

- A site (V14) has been added on Rose Creek (south fork), upstream of the mine road (upstream of the reservoir). This site is sampled monthly with the Vangorda sites. We have 4 samples from 1987 and will have at least 5 from 1988.

- On the North Fork, we have added sites upstream and downstream of the rock drain in conjunction with the seep surveys. A site will be added upstream of Faro Creek when an access road has been built for access to the hydrometric station.

- Faro Creek: upstream samples are being taken with the seep surveys.

2. Receiving water sites:

In terms of the environmental assessment, I think it essential to also characterize water quality at several points downstream of the mine. Eventually we will want to assess impact not only directly below the mine but also at points downstream. We will want to know dilution, buffering and parameters related to metals toxicity (metals, hardness, temp). Data exist for the following sites (benthic invertebrate sites), both from the company and from EPS.

-R3: about half-way from the mine to the confluence with Anvil Cr.

-R4: Rose u/s Anvil
 -R5: Anvil d/s Rose
 -EPS site R7: Anvil u/s Rose. I think we should be adding this to the list of our sites for benthic studies and for water quality - this is unaffected downstream water. For benthics, it provides a control for changes related to natural variation.

I have collected these data (in relation to the benthic invertebrate program) and will put into a logical form and send to you.

Possibly some sampling should be done on lower Anvil also.

This year, we sampled R3, R4, R5 and R7 in early August and will sample them again in September. I suggest that at this time we also collect a sample in lower Anvil. Next year the fisheries study will be in August--we could also collect water samples at these sites at that time.

X14, as the regular downstream site, should be viewed with these and sampled for the same parameters and at the same time.

3. Parameters

CN, Na and NH_3

These parameters are related to operational concerns, not to abandonment and I see no need to sample them for the abandonment plan purposes. For operational purposes, however, we do need data on natural levels and variation in ammonia as well as in its attenuation downstream, so I think it should be tested for.

Flow

We have done few metered flows on these. We have the staff gauge on the North Fork and the two hydrometric stations (in place and coming soon!). Also metered flows on Faro Creek. Some metered flows have been done at the downstream sites. I would think that flows, both for modelling and impact assessment purposes, would be estimated as monthly averages, adjusted by watershed area from the gauge data. More metered readings would likely be helpful as data points to check these estimates. They are difficult and unreliable at many sites, due to high flows and large substrate.

Metals

We have added iron to the suite of metals for most of these sites (in 1988). We routinely measure totals. Dissolved metals should be done when there is any turbidity in the water in order to get some data on the form the metals are in. Possibly for the upstream sites, dissolved should always be done, as that would go into the model (wouldn't it?). However, we definitely should not do dissolved metals if the filtering procedures are contaminating the samples, because we certainly do not want data that falsely indicate high background dissolved metals.

Hardness

As zinc toxicity is strongly related to hardness, I think this parameter (Ca and Mg) should be added to the downstream sites, including to the regular sampling of X14. We have some hardness data (EPS and possibly some DIAND sampling and the August 1988 sampling).

Alkalinity

This has been added to all sites in 1988 and should be continued.

4. QA/QC

We did duplicate sampling at 7 stream sites with EPS in August and will again in Sept. They use ICAP scans, so I don't know how comparable the data will be. Possibly we should do some samples in duplicate or triplicate to gauge how representative the grab samples are. Certainly we should send a lot of these samples out when we have our own lab, as the levels being measured are so low.

4mo.

'88 08/11 10:09

2 604 687 5532

SRK UCR

01

Can show rate down to



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CANON FAX-520
ACCESS NO. (604) 687-5532

PROJECT NO. 60605

DATE 10th August-88 PAGE 1 OF 4

SEND TO Joan Canon FAX NO. (403) 668 6518

LOCATION Curragh Res. - Whitehorse

FROM Andy Robertson

LOCATION SRK Vancouver

COMMENTS Herewith extract from 60602 on Surface water
sampling program. Please review the current program
in the light of this and let me know if the program
requirements are covered. Adrian Smith should approve all
methodologies. Regards.
Andy R.

u/s sites

~~V14~~ - Rose u/s reservoir 1987 - 4 samples
1988 - 5 or 6 samples.

N Fork - u/s + d/s Rock Drain, u/s Fero

Fero Creek

d/s

Anvil u/s Rose, d/s Rose Aug / Sept - 88

Rose u/s ~~d/s~~ Anvil pop. Aug 89

Rose 1/2 way to Anvil.

Parameters: ~~all~~ - added 1988.

flow not done - staff gauge on N Fork

gauge on downstream, will be on N Fork

total metals + dissolved metals

CN, Na not done - will add these - no concern

NH₃ - not done in sep survey - operational concern. Done on others.

QA/QC - duplicate duplicate sampling with EPS last week.
winter?

5.0 BASELINE SOLIDS AND WATER QUALITY SAMPLING AND TESTING PROGRAM

5.1 Surface Water Quality

a) Location and Frequency of Sampling

The Steffen, Robertson and Kirsten (1986) report reviewed the monitoring program for surface water quality at Faro, both for the operational and non-operational condition, (section 7.2). From this report, it can be seen that there are currently background water quality monitoring points (X2, X3 - see Fig. 7.1 from the SRK 1986 report). It is proposed to integrate the baseline water quality program with these sampling points to allow the new data to be compared with historic data collected from these points, where possible.

However, neither sampling point is particularly suitable for establishment of true background conditions and much of the data base variation noted to date may be due to this fact. While it is appreciated that X2 and X3 represent local baseline to some extent, they do not represent background. (For example, Table 7.2.3a from the SRK 1986 report shows that X2 is affected by seepage from the adjacent waste rock dump).

Accordingly, four sampling points will be used to establish background and baseline surface water quality:

North Fork, Rose Creek - local baseline X2
- background (X2a or X26) at a point 1 1/2-2 km upstream of the mine access road.

Rose Creek (mainstream) - local baseline X3
- background (X3a or X27) at a point upstream of the reservoir.

The exact location of X2a/X3a will be determined in the field.

Sampling frequency will be determined by the winter freeze. In essence, it is proposed to be consistent with the currently proposed monitoring schedule for the mine and to take four samples between the thaw in May and freeze again in October.

It is appropriate and desirable that government regulatory control agencies participate in such surface water quality sampling and testing; at least to the extent of performing a QA/QC function.

b) Sample Collection and Analysis

The SRK 1986 review of the monitoring data concluded that sample collection, handling and variation in analytical techniques may have played some part in the problems of collecting a viable baseline water quality data base. As the required analysis determines the appropriate sampling, some mention is necessary of the license-required monitoring parameters and their applicability. These are:

- pH, temperature, flow;
- suspended solids;
- ammonia, sodium, sulphate;
- cyanide (total); and
- copper, lead, zinc, manganese (extractable).

It should be clear how the samples are handled and preserved in order that an understanding of what is actually being measured is gained.

pH, temperature, flow:

on site measurements, which should present no major problem over those normally encountered, in particular

- temperature correction and standardization on pH;
- inherent errors in flow measurements.

suspended solids:

measured in the laboratory, this will be related to season, flow volume and velocity. No particular problems, aside from obtaining a representative sample under high flow conditions, should be encountered for the sample collection and analysis.

ammonia, sodium, sulphate:

these represent "total" dissolved levels in the samples, itself an anomaly. A non-filtered sample which is non-acidified (preserved) will give dissolved species plus that portion of the species which is re-dissolved from suspended material during shipping and holding. Filtering and acidification will give dissolved species only.

A protocol must be agreed by all interested parties as to the collection procedure, so that it is clear as to what is being analyzed and whether the suspended phase is being considered. (This phase varies with discharge.)

cyanide (total):

a separate sample, preserved at pH12 with sodium hydroxide is required and again the problem of the solid phase needs addressing.

More importantly, "total" cyanide includes cyanates, thiocyanates, ferrocyanides, etc., which are not necessary toxic and hence the measurement is not necessarily useful. Again, some discussion is necessary on the appropriateness of total versus "weak acid dissociable", "amenable to chlorination" or "free" cyanide.

metals - copper, lead, zinc and manganese (extractable):

the difference between aquatic protection standards and license standards with respect to "total" versus "extractable" or, perhaps, total recoverable needs to be clarified and an appropriate collection, preservation and handling technique agreed. With respect to analysis, it must be clarified what exact extraction procedure is acceptable to the regulating authorities (e.g., extraction temperature) and the true appropriateness of the extraction reagents, should "extractable" be desired. The relationship between extractable metals and the suspended solids should be appraised. Regulatory authorities should be approached, at an early stage in this program, to obtain a definition of acceptable procedures.

This somewhat long preamble to sampling and analysis is necessary because the objectives and protocols must be clearly defined and agreed, so all parties are clear on what they are trying to establish and why.

It is proposed that a single sampling team collect and distribute the samples, with the necessary trip blanks, duplicates and multi-samples for "spiking" and recovery tests. Samples will be distributed to the participating laboratories who will follow their own QA/QC procedures.

The sampling and analytical variability will be appraised statistically (using the 't' test or similar) and hence the "true" range and variation of the background water quality will be established.

The exact details of the analytical programs and sampling protocols can only be formulated as a result of future discussions with all potentially interested parties.

5.2 Groundwater Quality

a) Location and frequency of sampling

The SRK 1986 report discussed the deficiencies of the current, license specified monitoring program with respect to upstream background water quality, (section 7.3, p. 94). It is proposed to construct two background monitoring wells, east of the mine to remedy this deficiency.

Subject to confirmation on the ground, the well locations will be approximately:

- south of North Fork, Rose Creek adjacent to the Mine access road at least 1000 m south east of the creek crossing
- 1 1/2 to 2 km up North Fork, Rose Creek from the Mine access and crossing, above the waste dump areas, subject to finding a suitable location away from the creek.

Both holes will be completed in bedrock and alluvium/till where present. It should be noted that inspection on the ground may dictate a preferential location for these holes.

Both from a logical and expediency viewpoint, the background groundwater sampling frequency will be the same as that for the surface sampling, described in section 5.1, and consistent with the recommendations of the SRK 1986 report (p. 96, section 7.3). This means that a contemporaneous record of surface water and groundwater background quality will be available for both modelling and impact analysis.

b) Collection and Analysis

The problems and constraints have been described in section 5.1(b). For the most part, with the exception of flow measurements, these will apply also to the groundwater program. Once again, a detailed program will be developed by agreement with involved parties.

5.3 Solids Characterization

Baseline solids samples will be collected from the "fresh" tailings to be deposited in the test plots, the existing tailings and the subsite/downstream foundation materials as follows:

Fresh tailings:

During deposition a sample of unsegregated tailings will be taken each day of tailings deposition in a 5 litre plastic bucket and, after decanting the excess water once the tailings have settled, the slurry will be transferred to a double plastic bag in a 5 litre, screw top jar; the bags being sealed to prevent oxygen ingress.

CURRAGH RESOURCES INC.

INTER-OFFICE MEMORANDUM

DATE: August 12, 1988

TO: Andy Robertson
FROM: Joan Eamer
SUBJECT: Background surface water studies

Andy,

I wonder if, when you discuss this with Adrian Smith, you could get his opinion on another couple of points:

1. What does he think about ICP scans? Are they reliable and sufficiently sensitive? How comparable are the results to AA? The scans are relatively inexpensive and provide a full suite of metals. Is it worth having these extra parameters? Both EPS and DIAND routinely use this method, but it would require a licence change for us to for the regular sites--however, we could be doing scans for Vangorda and for non-licence monitoring.
2. Should we not be collecting some low-flow data as well, in winter and early spring, for upstream and receiving water sites?

Thanks,

Joan

ASCI**ADRIAN SMITH
CONSULTING INC.**
Hydrogeochemists2555 Edgemont Boulevard
North Vancouver, B.C.
Canada V7R 2M9Telephone: 604-984-2524
Telex: 0435 2578
Fax: 604-984-8426

August 16, 1988

Prj. #60606

MEMORANDUM

TO: ANDY ROBERTSON, SRK VANCOUVER

FROM: ADRIAN SMITH, ASCI, VANCOUVER

**RE: FARO TAILINGS ABANDONMENT PLAN:
SURFACE WATER QUALITY MONITORING**

With reference to your memo of August 13, 1988 on the above subject, I have examined the two attached memoranda (Eamer/McLenehan of August 11, 1988 and Eamer/Robertson of August 12, 1988) and have the following observations.

A. Eamer/McLenehan

1. Upstream Sites

- a) V14 - agree; the comparison between this and X3 will be valuable.
- b) North Fork - upstream and downstream of rock drain and future site upstream of Faro Creek diversion; all very valuable, I believe.
- c) Faro Creek - fine, but I would have a permanent sample point on the Faro Creek diversion prior to entering North Fork of Rose Creek.

In addition, occasional samples taken at the Water Supply Reservoir outlet to compare with V14 would be of benefit, in case there are changes in the chemistry during detention in the reservoir.

2. Receiving Water Sites

R3, R4, R5 and EPS R7 all look to be reasonable, but I cannot comment on benthics. I would caution that uniformitarianism does not always hold for upstream versus downstream sites, even under non-impacted conditions.

ASCI

I certainly agree X14 should be combined with the R series data as should be V14 and the sample upstream of the Faro Creek Diversion on North Fork, Rose Creek.

3. Parameters

- a) I would be cautious about deletion of ammonia for abandonment. You may find ammonia coming into the system from the dumps or a flooded pit after abandonment.
- b) Flow - not my field, I'm afraid.
- c) Agree with the addition of Iron and the use of dissolved metal values - very important for evaluation of "true" toxicity.
- d) Hardness should be determined at all sites, where possible but certainly the R series, V14, X14 and the upstream sites.
- e) Alkalinity - agree.

4. QA/QC

Agree with at least a set of triplicates. Then do the following:

send a set of duplicates to your present lab, but as "blind" samples - renumber them all, so the data cannot be immediately compared,

send the 3rd sample to an outside lab to do by ICP, and

compare all 3 answers.

5. Eamer/Robertson**1. ICP Scans**

- a) Good and less expensive than AAS at all but very low levels, where I would trust the AAS data more.

If you wish to use ICP, you will need to calibrate at least 2 data sets with your present AA data by replicate sampling. You will (in my somewhat biased opinion) need to be careful with ICP data on your upstream, low concentration samples.

ASCI

- b) The addition of other parameters from the ICP scans may only produce additional numbers you then have to explain, but they may allow you to pre-empt some future problems.
 - c) Low flow data; these data really are critical for the upstream sites. If you can get any data at low flow conditions, I would. Both upstream and downstream are beneficial, but particularly upstream data.
-

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-

CURRAGH RESOURCES INC.

INTER-OFFICE MEMORANDUM

DATE: August 12, 1988

TO: Andy Robertson
FROM: Joan Eamer
SUBJECT: Background surface water studies

Andy,

I wonder if, when you discuss this with Adrian Smith, you could get his opinion on another couple of points:

1. What does he think about ICP scans? Are they reliable and sufficiently sensitive? How comparable are the results to AA? The scans are relatively inexpensive and provide a full suite of metals. Is it worth having these extra parameters? Both EPS and DIAND routinely use this method, but it would require a licence change for us to for the regular sites--however, we could be doing scans for Vangorda and for non-licence monitoring.
2. Should we not be collecting some low-flow data as well, in winter and early spring, for upstream and receiving water sites?

Thanks,

Joan

CURRAGH RESOURCES INC.

INTER-OFFICE MEMORANDUMDATE: August 11, 1988TO: Rob McLenehan cc: Andy Robertson, Gregg JilsonFROM: Joan EamerSUBJECT: Surface Water Quality Program in relation to TAPDP

Andy Robertson asked me if the current water sampling program covered the requirements in 60602 (attached). I realize that you are working on this, but as I have done some additional sampling related to other programs, I thought I should outline my thoughts on background surface water studies.

1. Upstream sites:
 - (X2 and X3 continue to be done for licence requirements)
 - A site (V14) has been added on Rose Creek (south fork), upstream of the mine road (upstream of the reservoir). This site is sampled monthly with the Vangorda sites. We have 4 samples from 1987 and will have at least 5 from 1988.
 - On the North Fork, we have added sites upstream and downstream of the rock drain in conjunction with the seep surveys. A site will be added upstream of Faro Creek when an access road has been built for access to the hydrometric station.
 - Faro Creek: upstream samples are being taken with the seep surveys.
2. Receiving water sites:

In terms of the environmental assessment, I think it essential to also characterize water quality at several points downstream of the mine. Eventually we will want to assess impact not only directly below the mine but also at points downstream. We will want to know dilution, buffering and parameters related to metals toxicity (metals, hardness, temp). Data exist for the following sites (benthic invertebrate sites), both from the company and from EPS.

 - R3: about half-way from the mine to the confluence with Anvil Cr.

-R4: Rose u/s Anvil
 -R5: Anvil d/s Rose
 -EPS site R7: Anvil u/s Rose. I think we should be adding this to the list of our sites for benthic studies and for water quality - this is unaffected downstream water. For benthics, it provides a control for changes related to natural variation.

I have collected these data (in relation to the benthic invertebrate program) and will put into a logical form and send to you.

Possibly some sampling should be done on lower Anvil also.

This year, we sampled R3, R4, R5 and R7 in early August and will sample them again in September. I suggest that at this time we also collect a sample in lower Anvil. Next year the fisheries study will be in August--we could also collect water samples at these sites at that time.

X14, as the regular downstream site, should be viewed with these and sampled for the same parameters and at the same time.

3. Parameters

CN, Na and NH₃

These parameters are related to operational concerns, not to abandonment and I see no need to sample them for the abandonment plan purposes. For operational purposes, however, we do need data on natural levels and variation in ammonia as well as in its attenuation downstream, so I think it should be tested for.

Flow

We have done few metered flows on these. We have the staff gauge on the North Fork and the two hydrometric stations (in place and coming soon!). Also metered flows on Faro Creek. Some metered flows have been done at the downstream sites. I would think that flows, both for modelling and impact assessment purposes, would be estimated as monthly averages, adjusted by watershed area from the gauge data. More metered readings would likely be helpful as data points to check these estimates. They are difficult and unreliable at many sites, due to high flows and large substrate.

Metals

We have added iron to the suite of metals for most of these sites (in 1988). We routinely measure totals. Dissolved metals should be done when there is any turbidity in the water in order to get some data on the form the metals are in. Possibly for the upstream sites, dissolved should always be done, as that would go into the model (wouldn't it?). However, we definitely should not do dissolved metals if the filtering procedures are contaminating the samples, because we certainly do not want data that falsely indicate high background dissolved metals.

Hardness

As zinc toxicity is strongly related to hardness, I think this parameter (Ca and Mg) should be added to the downstream sites, including to the regular sampling of X14. We have some hardness data (EPS and possibly some DIAND sampling and the August 1988 sampling).

Alkalinity

This has been added to all sites in 1988 and should be continued.

4. QA/QC

We did duplicate sampling at 7 stream sites with EPS in August and will again in Sept. They use ICAP scans, so I don't know how comparable the data will be. Possibly we should do some samples in duplicate or triplicate to gauge how representative the grab samples are. Certainly we should send a lot of these samples out when we have our own lab, as the levels being measured are so low.



STEFFEN ROBERTSON & KIRSTEN
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Suite 801 1030- W. Georgia St.
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ACCESS NO. (604) 687-5532

PROJECT NO. 60605

DATE 10th August-88. PAGE 1 OF 4

SEND TO Joan Camer. FAX NO. (403) 668 6518

LOCATION Curragh Res. - Whitehorse

FROM Andy Robertson.

LOCATION SRK Vancouver.

COMMENTS Herewith extract from 60602 on Surface water
sampling program. Please review the current program
in the light of this and let me know if the program
requirements are covered. Adrian Smith should approve all
methodologies.

Regards.
Andy R.

5.0 BASELINE SOLIDS AND WATER QUALITY SAMPLING AND TESTING PROGRAM

5.1 Surface Water Quality

a) Location and Frequency of Sampling

The Steffen, Robertson and Kirsten (1986) report reviewed the monitoring program for surface water quality at Faro, both for the operational and non-operational condition, (section 7.2). From this report, it can be seen that there are currently background water quality monitoring points (X2, X3 - see Fig. 7.1 from the SRK 1986 report). It is proposed to integrate the baseline water quality program with these sampling points to allow the new data to be compared with historic data collected from these points, where possible.

However, neither sampling point is particularly suitable for establishment of true background conditions and much of the data base variation noted to date may be due to this fact. While it is appreciated that X2 and X3 represent local baseline to some extent, they do not represent background. (For example, Table 7.2.3a from the SRK 1986 report shows that X2 is affected by seepage from the adjacent waste rock dump).

Accordingly, four sampling points will be used to establish background and baseline surface water quality:

- North Fork, Rose Creek
 - local baseline X2
 - background (X2a or X26) at a point 1 1/2-2 km upstream of the mine access road.
- Rose Creek (mainstream)
 - local baseline X3
 - background (X3a or X27) at a point upstream of the reservoir.

The exact location of X2a/X3a will be determined in the field.

Sampling frequency will be determined by the winter freeze. In essence, it is proposed to be consistent with the currently proposed monitoring schedule for the mine and to take four samples between the thaw in May and freeze again in October.

It is appropriate and desirable that government regulatory control agencies participate in such surface water quality sampling and testing; at least to the extent of performing a QA/QC function.

b) Sample Collection and Analysis

The SRK 1986 review of the monitoring data concluded that sample collection, handling and variation in analytical techniques may have played some part in the problems of collecting a viable baseline water quality data base. As the required analysis determines the appropriate sampling, some mention is necessary of the license-required monitoring parameters and their applicability. These are:

- pH, temperature, flow;
- suspended solids;
- ammonia, sodium, sulphate;
- cyanide (total); and
- copper, lead, zinc, manganese (extractable).

It should be clear how the samples are handled and preserved in order that an understanding of what is actually being measured is gained.

pH, temperature, flow:

on site measurements, which should present no major problem over those normally encountered, in particular

- temperature correction and standardization on pH;
- inherent errors in flow measurements.

suspended solids:

measured in the laboratory, this will be related to season, flow volume and velocity. No particular problems, aside from obtaining a representative sample under high flow conditions, should be encountered for the sample collection and analysis.

ammonia, sodium, sulphate:

these represent "total" dissolved levels in the samples, itself an anomaly. A non-filtered sample which is non-acidified (preserved) will give dissolved species plus that portion of the species which is re-dissolved from suspended material during shipping and holding. Filtering and acidification will give dissolved species only.

A protocol must be agreed by all interested parties as to the collection procedure, so that it is clear as to what is being analyzed and whether the suspended phase is being considered. (This phase varies with discharge.)

cyanide (total):

a separate sample, preserved at pH12 with sodium hydroxide is required and again the problem of the solid phase needs addressing.

More importantly, "total" cyanide includes cyanates, thiocyanates, ferrocyanides, etc., which are not necessary toxic and hence the measurement is not necessarily useful. Again, some discussion is necessary on the appropriateness of total versus "weak acid dissociable", "amenable to chlorination" or "free" cyanide.

metals - copper, lead, zinc and manganese (extractable):

the difference between aquatic protection standards and license standards with respect to "total" versus "extractable" or, perhaps, total recoverable needs to be clarified and an appropriate collection, preservation and handling technique agreed. With respect to analysis, it must be clarified what exact extraction procedure is acceptable to the regulating authorities (e.g., extraction temperature) and the true appropriateness of the extraction reagents, should "extractable" be desired. The relationship between extractable metals and the suspended solids should be appraised. Regulatory authorities should be approached, at an early stage in this program, to obtain a definition of acceptable procedures.

This somewhat long preamble to sampling and analysis is necessary because the objectives and protocols must be clearly defined and agreed, so all parties are clear on what they are trying to establish and why.

It is proposed that a single sampling team collect and distribute the samples, with the necessary trip blanks, duplicates and multi-samples for "spiking" and recovery tests. Samples will be distributed to the participating laboratories who will follow their own QA/QC procedures.

The sampling and analytical variability will be appraised statistically (using the 't' test or similar) and hence the "true" range and variation of the background water quality will be established.

The exact details of the analytical programs and sampling protocols can only be formulated as a result of future discussions with all potentially interested parties.

5.2 Groundwater Quality

a) Location and frequency of sampling

The SRK 1986 report discussed the deficiencies of the current, license specified monitoring program with respect to upstream background water quality, (section 7.3, p. 94). It is proposed to construct two background monitoring wells, east of the mine to remedy this deficiency.

Subject to confirmation on the ground, the well locations will be approximately:

- south of North Fork, Rose Creek adjacent to the Mine access road at least 1000 m south east of the creek crossing
- 1 1/2 to 2 km up North Fork, Rose Creek from the Mine access and crossing, above the waste dump areas, subject to finding a suitable location away from the creek.

Both holes will be completed in bedrock and alluvium/till where present. It should be noted that inspection on the ground may dictate a preferential location for these holes.

Both from a logical and expediency viewpoint, the background groundwater sampling frequency will be the same as that for the surface sampling, described in section 5.1, and consistent with the recommendations of the SRK 1986 report (p. 96, section 7.3). This means that a contemporaneous record of surface water and groundwater background quality will be available for both modelling and impact analysis.

b) Collection and Analysis

The problems and constraints have been described in section 5.1(b). For the most part, with the exception of flow measurements, these will apply also to the groundwater program. Once again, a detailed program will be developed by agreement with involved parties.

5.3 Solids Characterization

Baseline solids samples will be collected from the "fresh" tailings to be deposited in the test plots, the existing tailings and the subsite/downstream foundation materials as follows:

Fresh tailings:

During deposition a sample of unsegregated tailings will be taken each day of tailings deposition in a 5 litre plastic bucket and, after decanting the excess water once the tailings have settled, the slurry will be transferred to a double plastic bag in a 5 litre, screw top jar; the bags being sealed to prevent oxygen ingress.

MEMO

August 16, 1988

TO: K. Galovich
cc. J. Moore, K. Barrowman, G. Jilson,

FROM: R. McLenehan

SUBJECT: WORK COMMITMENTS - 1988.

The 1988 field season is rapidly drawing to a close, and a considerable amount of work remains to be done before freeze-up. The availability of manpower and heavy equipment, together with the time-consuming nature of most of these projects will govern whether or not our commitments to the government for 1988 are met. This situation has been further complicated by the need to raise the Intermediate Tailings Dam this fall.

Commitments for 1988.

1. TAILINGS ABANDONMENT PLAN DEVELOPMENT PROGRAM

1. Tailings Covers Test Facility

- The five covers must be placed in the pits of the Tailings Test Facility. Progress is being made, but difficulties have been encountered in actually placing the covers. The back-hoes that are available have in-sufficient reach, and final placement must be made using a crane and clam-bucket. This step has been arranged and cover placement should be complete by Friday, August 26.
- Approximately one day of Tailings Facility berm grading and road access maintenance is required upon the completion of covers placement.
- Two instrument tanks still require some clean-up work before freeze-up. Two labourers are required for a period of three to five days.
- Ladders and platforms must still be installed in two of the six instrument tanks, and all platforms still require planking. Each tank also must be insulated. (Northland's).
- Sump pumps must be installed in each of the six instrument tanks.
- All the instruments in each of the six tanks must be read or sampled. This is a very time consuming process, requiring up to three weeks of time. Also some instruments will need repair work.

ii. Tailings in-situ sampling (Drilling Program)

- . This drilling program, which is detailed in SRK Report 60602, is scheduled for the 1988 field season.
- . This work encompasses two budget items; groundwater and tailings/ subsoils characterization. The total budget estimate is \$66,000, which is inclusive of drilling, sampling, laboratory testing and data evaluation.
- . This work is scheduled to start AUGUST 24, 1988. This date corresponds to the termination of the dam/dike structural investigation drilling program currently in progress.
- . Specifics of the program are:
 - . drilling company: Midnight Sun
 - . drill rig: CME 750
 - . estimated time: 9 days
 - . drill locations: 5
 - . estimated drilling costs: \$ 26,000
 - . drilling supervision, instrument installation, logging, sampling (SRK): \$ 20,000
 - . The remaining \$28,000 is required for instrumentation purchase, laboratory analysis, special testing services (ie. centrifuging).
- . Authorization to proceed is required as soon as possible to both hold the drilling company and to arrange necessary support from Steffen, Robertson, and Kirsten (SRK).

2. FARO PIT AND WASTE ROCK DUMP PROGRAM

i. Groundwater Drilling/ Monitoring Program

- . This work is a part of the commitment made to the Yukon Water Board on July 20, 1988.
- . The work, in part, is scheduled to start on September 2, 1988. CME 750 drilling time is estimated at five days. The remainder of the work is scheduled to start at the completion of J. Huntley's Vangorda/ Grum drilling program. (Some of this program requires the Schramm drill rig, which John will be using).
- . Require access to sites. Cat work.
- . Specifics of the program are:
 - . drilling company: Midnight Sun
 - . drill rig: CME 750
 - . estimated time: 5 days
 - . drill locations: 7
- . The total cost of the program including access road construction, drilling costs, well casing, instruments, and supervision is \$33,100.

- . Authorization to proceed is required as soon as possible to hold the drilling company.

ii. Installation and calibration of water level gauging station on North Fork Rose Creek

- . Total cost is estimated at \$16,000.
- . The instrument purchase will be submitted for approval by August 26, 1988.
- . Installation is scheduled for the end of September/ first week of October.

iii. Seep surveys

- . One of six surveys left for the 1988 season. Scheduled for the end of September.
- . Estimated cost for analysis is \$30,000.

iv. Construction of lower east wall interceptor ditch (north of Zone II).

- . No plans at moment. Estimated cost of \$30,000.

3. FARO TAILINGS STRUCTURES

- . This is a twelve day drilling program involving Midnight Sun and Golder Associates. This program is designed to investigate the stability of the Fresh Water Dam, the Intermediate Dam, the Rose Creek Diversion Dike, and the Cross-Valley Dam. The program cost is estimated at \$66,000 and is in its eighth day of progress.

4. RAISING OF THE INTERMEDIATE TAILINGS DAM

- . Preliminary budgeting and scheduling are complete. Contracts are presently being sent to Pelly Construction (contractor) and Yukon Engineering Services (surveying). Partial mobilization is expected on August 22, and full mobilization by September 1.
- . Golder Associates will have preliminary designs completed by August 19, and final dam designs completed by August 26.
- . Water pumping (2 of 3 pumps) started August 16. Full pumping will commence on August 17. Discharge water sampling frequency will be increased this week to ensure water quality standards are maintained.
- . Upon commencement of dam construction, tailings will be routed through the original tailings ponds in an attempt to maintain

acceptable discharge standards. The method to do this must still be implemented. The necessary work will be initiated no later than August 22.

. Concerns:

- . screening (for drain material).
- . hauling of till from EXL.

5. VANGORDA SAMPLING (MANPOWER)

- . Vangorda sampling is currently being done by a part-time person employed by the Whitehorse office. Whitehorse would like Faro staff to take over this sampling again this fall.
- . Vangorda sampling involves water sampling, sample preparation, some on-site analysis. Piezometers must also be read monthly.
- . Time commitment: 2 days every 2 weeks. (Winter period).

6. FARO TAILINGS DAMS/ DIKES: BI-ANNUAL REVIEW

- . Inspection and report on structures by Golder Associates. Water License requirement. Requires site inspection and reading of instruments (piezometers, thermistors, inclinometers, settlement monuments).
- . Survey required for settlement monuments.
- . Estimated cost of consultant for field work and report is \$14,000.

7. FARO ANNUAL GROUNDWATER SAMPLING AND REVIEW

- . Water license requirement.
- . All piezometers (stand-pipe variety) must be read and sampled.
- . Time estimate: 2 weeks.

8. FARO WATER LABORATORY AND WEEKLY WATER SAMPLING

- . Water laboratory construction is still not complete. The exhaust fan for the fume hood is being installed August 17. Also, the air cleaning unit is not on site as yet. Time to completion: 2 weeks (???).
- . Preliminary on-site cyanide analysis is starting August 17. An estimate of two weeks will be required to fine tune the procedure. (Government personnel are providing assistance.)
- . Weekly water sampling is being conducted as required by our water license. At present, the sampling, sample preparation, shipment preparation, on-site analysis, data evaluation, and

report preparation require 3 days per week.

9. PART-TIME HELP REQUIREMENT

- . Demands on our time (fall/winter):
 - . Sampling
 - . weekly water sampling
 - . tailings test pit sampling
 - . seep surveys
 - . groundwater sampling
 - . Vangorda sampling
 - . point sampling due to raising of intermediate dam
 - . Projects
 - . tailings test facility
 - . raising of intermediate dam
 - . three drilling programs
 - . water laboratory
 - . Reports
 - . reference Whitehorse submission (J. Eamer)
- . SUGGESTION
 - . Employ a part-time person (Alternate weeks: 2 days/ week then 3 days/ week) to help alleviate sampling work load. This will free up some of K. Waybrant's time to:
 - . properly set up procedures for the water laboratory
 - . devote more time to laboratory analysis
 - . help with tailings test facility sampling/ analysis
 - . do data evaluation.
 - . develop emergency treatment procedures
 - . write reports
 - . This will also free up more of my time to devote to project planning and development, and data analysis and evaluation.
 - . Possibility: Val Holmes has a degree in micro-biology and has had working experience in a chemistry lab. She is very interested in this type of work and if it is possible to split her time between some other department and technical services, (ie. like maintenance planning) she would be an ideal choice. At the moment Val would prefer to have full time work if it is possible.

MEMORANDUM

TO: Jim Moore

cc. R. McLenehan

FROM: Gregg Jilson

DATE: 1988 08 17

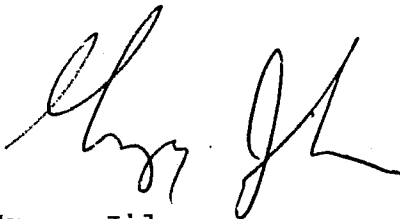
RE: INSURING PROGRESS ON THE TAILINGS TEST PROGRAM

Robert McLenehan will be shortly presenting you with a proposal for an engineer to assist with the groundwater and related phases of the Tailings Project. The proposal is by SRK and totals approximately \$19,000.

I have requested SRK to prepare this proposal and discussed it at length with Kresho Galovich and Robert McLenehan. The requirement is brought on by the assignment of Rob to the tailings dam project which does not leave adequate time for him to sit on a drill rig for 12 hours per day.

The correct collection, description and preservation of samples from this work is critical to the success of the project. I strongly support getting this help for Robert.

A second proposal for an instrumentation technician to help with the test pit instruments will also be forthcoming shortly. This will be for a smaller amount of money (about half) and is equally urgent. The concern here is that the instruments are working before freeze up. I am fully in support of this proposal as well.



Gregg Jilson

/cm

C U R R A G H R E S O U R C E S I N C .

DATE: August 17, 1988

TO: Ken Nordin

FROM: Joan Eamer

SUBJECT: Water quality, June, 1988

Enclosed is the monthly report for June, 1988. While I was reviewing this report, I noted the following comments on the month's water quality:

1. The effluent was nontoxic, with 80% survival in the tailings pond decant and 100% survival in the seepage from the Cross Valley dam.
2. Cyanide levels were very low in the decant. We continued to measure slightly high total cyanide concentrations in one of the seep sites from the dam--we suspect that this is an artefact of the analysis technique, as DIAND analyses consistently show low levels at this site and as our weak acid dissociable cyanide measurements continue to be very low. We will soon have on-site analysis for cyanide.
3. The high zinc load from pit dewatering during the spring had little impact on the effluent quality and zinc levels in the decant and the seeps remained well below the limit. This indicates that treatment for zinc in the tailings system is very effective.
4. Ammonia concentrations in the effluent were at and above the effluent standard. This is not considered to be a serious concern for the following reasons.
 - a. This does not indicate a trend. Ammonia levels tend to fluctuate widely, both in the effluent and at the upstream and downstream Rose Creek sites. Ammonia is partially from natural sources, and the measured concentrations at the upstream sites have on occasion approached the effluent limit.
 - b. Ammonia at the levels measured downstream of the mine poses no threat to aquatic life. In fact the recommended guideline for aquatic life for total ammonia is much higher than the licence limit for mine effluent. (Curragh's licence limit is 1.0 mg/L total ammonia; the recommended standard for aquatic life is 2.4 mg/L at pH 7.5 and temperature 5° (Canadian Water Quality Guidelines, CCREM, 1987, p. 3-19).)

STEFFEN ROBERTSON AND KIRSTEN
Consulting Engineers



RECEIVED OCT 20 1988 *File 440*

STEFFEN, ROBERTSON AND KIRSTEN (B.C.) INC.
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1030 West Georgia Street
Vancouver, B.C., Canada V6E 2Y3
Tel. (604) 681-4196 Telex 04-352578 Facsimile (604) 687-5532

October 17, 1988
File #60607

V.P. Exploration
Curragh Resources Inc.
117 Industrial Road
Whitehorse, Yukon
Y1A 2T8

Attention: Mr. Gregg Jilson

Dear Sirs:

Re: Evaluation and Report for 1988
Summer Field Studies for Faro
Tailings Abandonment Program

The field and laboratory work in the test pit program for the tailing covers has been substantially caught-up. The field programs for the characterization and investigation of the groundwater regime and sampling has also been completed. This data should now be developed in a form that can be readily assimilated and then presented, analyzed and described in an appropriate manner for inclusion in the next phase of the program.

To allow adequate interaction during the data presentation and evaluation it is recommended that Robert McLennehan should spend a week to 10 days in SRK's offices in Vancouver where he can work closely with myself. During this period his winter testing and evaluation tasks will also be developed and agreed.

Yours truly,

STEFFEN ROBERTSON & KIRSTEN (B.C.) INC.

e. m. robertson
for Dr. A. MacG. Robertson, P.Eng.
President

cc. Mr. Robert McLennehan - Faro Mine, Faro

STEFFEN ROBERTSON AND KIRSTEN
Consulting Engineers



STEFFEN, ROBERTSON AND KIRSTEN (B.C.) INC.
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Date: January 30, 1989
To: Andy Robertson
From: Allister Brown
Re: Environmental Audit for Curragh Resources

Further to our recent discussions concerning an environmental audit for Curragh Resources, I believe the following will provide a basic outline of the requirements and a work program to complete the first phase of this audit.

The environmental audit is to be undertaken in order to identify present and future liabilities arising from environmental, pollution, emergency response and occupational health and safety issues. The scope of the work will include an evaluation of pertinent legislation (to include current, draft and future changes) as such legislation applies to Curragh Resources operation at Faro. The audit will be directed towards obtaining information for several areas of the mine, mill and related operations as indicated in the attached table. Note that with each physical area, I have identified several possible concerns or considerations which come to mind immediately.

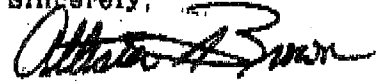
The purpose of an environmental audit is to identify, by a selective sampling of data, those processes, waste handling procedures, health and safety procedures and emergency response/contingency planning procedures requiring further investigation. As implied above, we are suggesting that the audit for Curragh Resources be carried out in two phases. The first phase will be primarily an on-site review of records and procedures. This process can be achieved most efficiently with two representatives from SRK and the cooperation of Curragh personnel on site. The SRK representatives will collect all necessary information and return to Vancouver where those individuals with the appropriate expertise will review and comment for the final report. A tentative work plan and schedule is attached. I anticipate that Phase I will require approximately 4 to 5 man weeks.

The phased approach has several advantages which include the following:

- ♦ Phase I provides a broad scope evaluation of all aspects of the operations and future liabilities;
- ♦ Phase II can be focused on those areas which require further attention;
- ♦ project costs are lower and efforts are targeted to areas requiring attention.

Your comments on the proposed work program and scope of work would be appreciated.

Sincerely,



Allister Brown

Table

OPERATIONAL AREAS AND ISSUES FOR ENVIRONMENTAL AUDIT

<u>Operational Area</u>	<u>Issues</u>
Pits	- Acid generating potential - Water quality exiting pits - Regulatory requirements, Northern Inland Water Act - Pit wall stability - Inspection and compliance
Mill	- Chemicals used (inventory, storage areas, <u>etc.</u>) - Chemical handling, spills, spill response - Chemical consumption rates - Disposal of waste chemicals including solvents, paints, thinners, oils, lubricants - Worker health and safety (Canada Labour Code, WHMIS, Yukon Legislation) - Regulatory restrictions, permits - Inspection, compliance, records
Coarse Waste Rock Dumps	- Slope stability - Reclamation, closure plans, progress to date - Acid generating potential - Leachate issues other than acid leachate - Requirements for treatment - Inspection, records
Tailings Dam	- Surface water quality - Acid generating potential - Leachate issues other than acid leachate - Reclamation/closure - Dewatering of tailings - Leachate control and treatment - Contingency plans/emergency response - Water licence requirements - Monitoring, inspection, compliance
Concentrate Handling	- Loading practices and concentrate control - Spills and ground contamination - Worker health and safety - Reclamation/remediation - Long term water quality/leachate quality - Water licence requirements - Future considerations for DIAND, or Canadian Environmental Protection Act

Operational AreaIssues

Transportation

- Spill response and cleanup for concentrate
- Chemical spill response
- Environmental fate of lead
- Washdown of trucks and control of concentrate
- Yukon TDG Act, other pertinent regulations
- Records, monitoring, inspection

Solid Waste Handling

- Disposal practices/locations for industrial and hazardous waste
- Leachate control for land disposal
- Inventory of materials to disposal
- Yukon Environmental Protection Act
- Canadian Environmental Protection Act
- Records, inspections

Occupational Health
and Safety

- Worker safety training and procedures
- Protective clothing and equipment
- Protective controls (dust control, splash control, chemical handling)
- Safety committees and inspections
- Safety records
- Yukon worker safety regulations and compliance

Chemical Control

- Transportation and receiving procedures
- Spill control and containment
- Inventory control
- Mixing, dilution, discharge, effluent control
- Spill contingency plans and emergency response
- Worker protection
- Applicable legislation

Closure Plans

- Pit stabilization, drainage
- Leachate treatment/control
- Tailings, dewatering, leachate control, reclamation
- Records, inspections
- Water licence requirements

PROJECT SCHEDULE

Currage Resources Inc.
P.O. Box 1000
Faro, Yukon, Y0B 1K0

Environmental Audit
C22.101
Project Mgr: Allister Brown

Time 17:20:49 ** 01-30-1989

page 1

MM	2	2	2	3	3
DD	13	20	27	6	13
YY	89	89	89	89	89

ON-SITE INSPECTION
Environmental Records
Inspec. of Health & Safety Rcrds.
Transportation & Loading
Water Licence
Pit/Tailings Areas
Concentrate Handling
Chemical Control

REGULATORY REQUIREMENTS
Meet with DIAND
Meet with Yukon Water Board
Meet with Environment Canada

PIT CLOSURE PLAN
Pit Closure Plan
Mill Process & Effluent Control
Tailings Closure Plan
Concentrate Handling & Transport
Solid Waste Disposal
Occupational Health & Safety
Chemical Control

REPORT
On-Site Debriefing Report
Phase I Audit Report

CURRAGH RESOURCES INC.

Inter-Office Memorandum

490?

TO: Kresho Galovich
Chief Mine Engineer
Faro Office

DATE: 1989 02 21

FROM: Gregg Jilson
Vice-President, Exploration
Whitehorse Office

RE: Hydraulic Capacities of Structures in the Tailings Area

Robert McLenahan has conveyed to me a copy of a letter from Golder Associates requesting guidance on the design capacity for the next increment of intermediate dam construction. Obviously the decision on capacities is an engineering matter and should rest with the engineering group at Faro. There are, however, constraints imposed by our Water License. The specific quotations on our Water License are:

Part B - Section 3, Subsection D

"The Licencee shall channel the waters of Rose Creek around the tailings facility and shall ensure that the diversion canal has the hydraulic capacity to carry a 1 in 500 year flood flow."

Part B - Section 3, Subsection E

"Prior to March 24th, 1983, the Licencee shall, on the basis of data collected under Schedule C of this license, construct a flood contingency overflow structure to channel flows in excess of the one in 500 year return flood out of the diversion."

Part B - Section 3, Subsection F

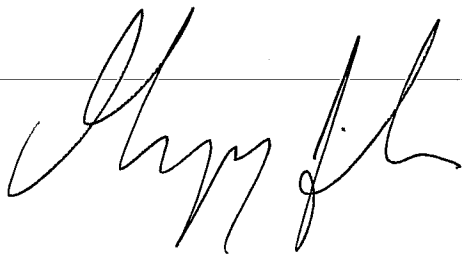
"The Licencee shall ensure that the spillways on the intermediate dam and the cross valley dam have the hydraulic capacity to carry 1 in 500 year flood flow of Rose Creek."

Several estimates of flows for specific return periods have been made. Comparison of the results show that the design of the diversion and spillways is very conservative, using the best (Jancowicz/DIAND) method of calculating returns, the diversion canal can easily handle a 500 year flood flow.

Our License makes it clear what the requirements for the intermediate and cross valley dam spillways are. It must have the hydraulic capacity to carry the 500 year flood flow of Rose Creek. This is 65 cubic meters per second based on the Jancowicz /DIAND method. Presumably such a spillway design would incorporate sufficient freeboard to account for standing waves that would develop at such high flows in order to be claimed to have the hydraulic capacity to carry the flood. The Water Board, has, however, accepted zero freeboard designs in the past.

The stipulations in the License raise some interesting questions about the diversion design in relation to the License limits. The diversion canal can carry flows well in excess of the 500 year flood; however, the license requires us to provide a spillway to ensure that flow in excess of the 500 year flood goes into the tailings facility. This is obviously nonsense and we should have this section amended. When amending that section it would be appropriate to reconsider the requirement for the 500 year Rose Creek flood capacity for the spillways in subsection F of the License quoted above. However, until that is done, we have no real choice but to live within our License.

I recommend we use the above quotes from our License as guides to this years construction and make application for amendment to our License at renewal time, later this year, to clarify this ridiculous situation regarding the flow capacity of the canals and diversions and the spillways. My suggestion is, rather than dealing in terms of recurrence intervals, to deal in terms of flows and freeboards. Then convert this to reassurance with respect to a specific method. I believe this will allow much more reasonable design criteria and help set the stage for reasonable abandonment design criteria.

A handwritten signature in cursive script, appearing to read "J. H. H.", is written across the page.

FAX COVER SHEET

Fax Number: (403) 668-6518
Telex Number: 036-8359
Telephone: (403) 668-3578

DATE: Feb 28/89

TO: Kresho Salovich
FROM: Gregg Wilson

Number of Pages 4 including Cover Page.

Circulation and/or Comments:

If all pages were not received, please contact: _____

TRANSMISSION REPORT

THIS DOCUMENT (REDUCED SAMPLE ABOVE)
COULD NOT BE SENT

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3

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received
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NO	REMOTE STATION I. D.	START TIME	DURATION	#PAGES	COMMENT
1	Faro Mine	2-28-89 3:44PM	4'42"	4	4: 1 E205/ OK

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XEROX TELECOPIER 7020

Reprocessing Plan for the Material being backhauled from Skagway to the Mine

1. Quantity

Starting on Dec. 12 1988, approximately 14,000 tonnes of material was backhauled from Skagway to Faro. Backhaul was carried out from 12 Dec. 1988 to 19 Jan. 1989. The backhaul was suspended from 19 Jan. 1989 to 22 Feb. 1989 due to weather conditions. The last leg of the backhaul started on 22 Feb. 1989 and was finished on 27 Feb. 1989.

2. Location and Manner of Storage

The material is stored at the Faro mine site in the low grade stockpile. The material is dumped on top of the so called oxide stockpile and is stored in the same manner as any other comparable ore stockpile.

3. Reprocessing Plan

The reprocessing of this material will be in the Faro Mill as it currently exists or as modified to accommodate the Vangorda Plateau ore feed. It will be treated exactly the same as any other low grade stock pile thus it is scheduled in small quantities with other low grade stockpile material towards the end of mine life. At the present time there are no plans to make any changes to the milling procedure to accommodate this material and no significant change in the tailings composition is expected to result. This is only one of several options for reprocessing and other options will be examined.

4. Analyses of Material

The material consists of ore concentrates contaminated by sand and gravel. The concentrate component of the material would have a composition similar to that described previously, a copy of our letter with this information is attached.

5. Environmental Impact of Material

The environmental impact of this material must be examined in three stages.

(1) Transport of material from Skagway to Faro

The environmental impact of material is negligible as it remains in the containers in which it is transported. The impact of the spill would be less significant than a spill of the forehauled concentrate itself as the spill would be cleaned up following the same procedure and any residual lead or zinc or other contamination to the environment would be minimal.

(2) Environmental Impact of Storage

This material amounts to 14,000 tonnes in the midst of stockpiles which currently total 400,000 tonnes will grow to 5 million tonnes of material with a higher lead zinc content. The incremental impact of the storage of the material returned for reprocessing is insignificant.

(3) Environmental Impact of Reprocessing

Material would be added to the mill feed in a gradual fashion so that it never dominates the mill feed. Consequently the incremental impact from reprocessing would be insignificant.

6. Plan to Monitor the Environmental Impact of this Material During Storage

We feel it is impractical to devise a program to monitor the incremental environmental impact of this material in the context of the storage site and relative amounts of materials; therefore, no such program is planned.

STEFFEN ROBERTSON AND KIRSTEN
Consulting Engineers



STEFFEN, ROBERTSON AND KIRSTEN (B.C.) INC.
502 Kapilano 100
West Vancouver, B.C. V7T 1A2
Telephone (604) 925-2323
Facsimile (604) 925-1360

March 16, 1989

Curragh Resources Inc.
117 Industrial Road
Whitehorse, Yukon
Y1A 2T8

Attention: G. Jilson, Vice President

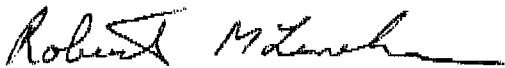
Dear Gregg:

Please find enclosed estimates of the time requirements to complete the "Seep Survey Report" and the 1988 "Tailings Abandonment Development Technical Progress Report". There is a considerable amount of data which is associated with each task, and analysis is expected to be quite time consuming. Approximately 13 and 21 days of time are required respectively. Costs are estimated at \$5,800 and \$9,200 respectively for each report.

I can begin the "Seep Report" immediately, and could have both reports completed by no later than the end of May.

Sincerely,

STEFFEN, ROBERTSON AND KIRSTEN



Robert McLenehan

RM:aa

Enclosure

Table 1A
SEEP SURVEYS

	RM	AB	AA	WP	
1. Data Entry			1.5		
2. Data Manipulation	8				
3. Data Analysis	48	3			
4. Drafting/Graphics/Tables				20	
5. Report Writing	16				
6. Typing			4		
7. Report Review/Revision		5			
Total Hours	72	8	5.5	20	100
Rate	\$55	\$85	\$35	\$38	
Costs - Labour	\$3,960	\$680	\$193	\$760	\$5,583
Costs - Other (Report copies, FAX, phone)					<u>200</u>
TOTAL					\$5,800

Table 1B

1988 ANNUAL PROGRESS REPORT - TECHNICAL

	RM	AB	AA	WP
1. Data Entry			13	
2. Data Manipulation	16			
3. Data Analysis	48	8		
4. Drafting/Graphics/Tables	24		8	
5. Report Writing	32			
6. Typing			8	
7. Report Review/Revision		8		
Total Hours	120	16	30	165
Rate	\$55	\$85	\$35	
Costs - Labour	\$6,600	\$1,360	\$1,050	\$9,010
Costs - Other (Report copies, FAX, phone)				<u>200</u>
TOTAL				\$9,200

STEFFEN ROBERTSON AND KIRSTEN
Consulting Engineers



RECEIVED JUL 28 1989

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502 Kapilano 100
West Vancouver, B.C. V7T 1A2
Telephone (604) 925-2323
Facsimile (604) 925-1366

Curragh Resources Inc.
117 Industrial Road
Whitehorse, Yukon
Y1A 2T8

July 25, 1989

Attention: Mr. Gregg Jilson

Dear Gregg,

**Reference: Faro Site Visit – Tailings Test Facility
(July 15–19, 1989) (SRK #60618)**

As per your request, I spent three days with Eric Soprovich at Faro, showing him how to sample or monitor the various instruments in the tailings covers test facility. Chuck Hubert, and the two summer students, Les, and Karen were also present.

On Sunday, July 16, we spent most of the day collecting and assembling the necessary sampling apparatus. A minimum one day preparation time is required as various solutions must be made up. I had previously made arrangements to set up a quality control/ quality assurance program as well as arrange commercial laboratory time for sample analysis. Levels of detection must be stated for chemical analysis of samples from this program.

On July 17 and July 18, we concentrated on sampling the unsaturated composite pit #4. The following were sampled or monitored:

AIR/ WATER SAMPLERS:

Water samples were extracted under vacuum (using a peristaltic pump), and pumped through an in-line 45 micron millipore filter. Under continuous flow, pH, Eh, conductivity, and temperature were measured for 10 minutes or until steady state was achieved. Approximately 100 mL of sample was collected for on-site determinations of alkalinity and acidity. A 250 mL sample was collected for dissolved metal analysis. The dissolved metal

samples were stabilized to a pH of less than 2.0 through the addition of hydrochloric acid. A 250 mL sample was collected for anion analysis. This sample was not fixed. All samples were stored at 4 degrees Celsius until shipment.

LYSIMETERS:

Samples were extracted using vacuum. Sample volumes, as expected were small, and so field measurements were limited to pH, Eh, conductivity, and temperature. Alkalinity and acidity were not determined. A minimum sample of 40 mL is required for chemical analysis. Each lysimeter will have to be sampled on consecutive days to obtain the necessary volume. Instructions were provided regarding lysimeter operation and sampling.

THERMISTERS:

All thermistors in all the test pits were read on Monday, July 17.

PIEZOMETERS:

All piezometers in all the test pits were read on Monday, July 17. The proper gauge (0 to 15 psi scale) is not functioning properly and a higher pressure gauge was used instead. I believe that the readings were below the sensitivity of this gauge, and are not accurate. As soon as the proper unit is repaired, the piezometers should be read again.

SOLIDS SAMPLERS:

We tried to sample one unit in test pit #4 on Tuesday, July 18. Sampling procedures were provided. The sampler, however, required further modification in the welding shop. Eric will be informing me regarding the success of the modification. If not successful, a smaller diameter sampling unit will have to be purchased. It is essential that one set of solids samples be obtained this year; however, it should not matter whether the samples are extracted now or during the fall sampling period.

In addition to sampling, the instruments in each tank were re-labelled using a more secure long term method. The original labelling was showing signs of wear.

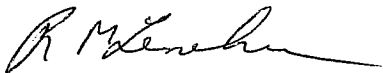
I believe that three days was sufficient to instruct Eric and his assistants in the test facility sampling procedures. There is nothing extremely complex in the sampling procedures; however, it does require proper care and is very time consuming.

The test facility, in general, appears to be in fairly good shape. Eric has informed me that he has ordered sump pumps for the individual tanks. The tanks, with the exception of the water cover tank, should be kept drained. This is especially important in the late fall; otherwise, ice build-up occurs in the tanks and spring tank access is delayed. The water cover tank can be left flooded for the summer.

Of concern are the window access panels in the test tanks. The windows are made of two thicknesses of 3/4 inch plywood but even so are showing signs of bowing. I have discussed this with Andy Robertson and we both feel that angle iron should be welded across the openings. Four pieces of 1/2 inch angle iron should suffice for each window. This should be done as soon as possible to prevent window failure and increase safety for personnel working in the tanks.

I would be happy to answer any further questions you may have regarding my July site visit.

Sincerely,

A handwritten signature in dark ink, appearing to read 'R McLenehan', with a long, sweeping horizontal stroke extending to the right.

Robert McLenehan



Curragh
Resources
Inc.

YUKON TERRITORY
WATER BOARD

SEP 7 7 51 AM '89

REC'D BY:

APPL. NO: 1289001

117 Industrial Rd.
Whitehorse, Yukon Y1A 2T8
Tel: (403) 668-3578
Telex: 036 8359

1989 09 06

Yukon Territory Water Board
200 - 4114 - 4th Avenue
Whitehorse, Y.T.
Y1A 3B2

Dear Sirs:

RE: 6 Month Progress Report
Tailings Abandonment Development Program

Activities associated with the Tailings Abandonment Development Program have progressed closely to expected scheduling. Reconstructive maintenance occurred in May/June to repair damages caused by winter conditions. Outstanding is a chronic leakage in the instrumentation panel for tank #6/Pit#6 (water cover). Three successive repair methods have failed to completely seal this panel: thus requiring a reassessment of the long-term viability of using Pit #6 for research purposes. Pits #1 through #5 are in satisfactory condition for Curragh's research purposes.

Robert McLenehan, consultant with S.R.K., was on site late June/early July for technical guidance. An initial sample set was initiated at this time and included sampling of lysimeters, air-water samplers, and bottom drain sampling. All samples were transported to B.C. Research for analysis. An attempt was made to extract a solid sample: however, the Shelby sampling tube failed and thus is being re-designed and constructed for the more important second sampling set yet to occur.

Installed instrumentation - pneumatic piezometers and thermistors - were initially monitored in early June and late June/early July. Instrumentation has been read bi-weekly since late July/early August. Many piezometer tips were cracked after this past winter and hence required replacement. As a result, those readings taken prior to repairs made will have to be reviewed to assess what degree of accuracy can be placed upon each initial result.

Supplementary meteorologic data has been collected at the tailings facility on a constant basis since mid-July. Included in this data set is maximum - minimum temperature, precipitation, and evaporative rate.

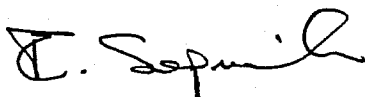
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Yukon Territory Water Board
1989 09 06
Page 2

A second full set of sampling (including lysimeters, air-water samples, bottom drain samples and solid samples) is planned for September/October to span two full weeks. Commensurate with recent receipt of replacement parts for Curragh's Nova 300B CO₂/O₂ analyzer, the CO₂/O₂ characterization component will be initiated. There is also intent to sample old tailings, and test for the presence of Thiobaccillus ferrooxidans. Installed instrumentation will continue to be monitored, and meteorologic data collected on a timely basis.

Yours truly,

CURRAGH RESOURCES INC.



Eric Soprovich
Environmental Engineer

YUKON TERRITORY
WATER BOARD
SEP 7 11 AM '89
REC'D BY: 
APPL. NO: 1589001



Curragh
Resources
Inc.

117 Industrial Rd.
Whitehorse, Yukon Y1A 2T8
Tel: (403) 668-3578
Telex: 036 8359

1989 09 06

Grant Livingston
Chairman
Yukon Territory Water Board
200 - 4114 - 4th Ave.
Whitehorse, Y.T.

Deaar Mr. Livingston:

RE: Progress Report - Schedule D

1. Seep Surveys

This project is intended to address the question of acid mine drainage by determining the sources and extent of seep waters and metals leaching

Initial analysis of 1988 season seep surveys complete and draft of results released.

Requirements for 1989:

- i) first survey initiated/complete in July, 1989;
- ii) second survey planned for completion in September.

Objectives for 1989: To add to the current data base for those seeps previously delineated as potential acid mine drainage generators, as well as background seeps. This objective is 50% complete.

2. Waste Dump Stability Assessment

The rationale for this assessment is to monitor the stability of Curragh's waste dumps thus enabling the company to place confidence in the integrity of it's structures.

Annual inspection of waste dumps is being coordinated with Glen Gilchrist of Golder Associates.

Objectives for 1989: To enable the company to place on-going confidence in our structures. Timing for completion is fall, 1989.

3. Waste Rock Characterization

Project 3 is designed to evaluate the potential net impact of waste rocks placed in waste rock dumps upon the local hydrogeochemical regime.

Samples of representative waste rock types have been selected and transferred to a contracting laboratory for static acid-base accounting tests. Dynamic testing methods will be considered once results of initial static test results are received.

Surface mapping of old dumps has been initiated, with the greatest concentration of effort planned for September/October, 1989. Trenching targets will be picked-up commensurate with observations derived from the surface mapping component.

Part v) and vi) are dependent upon progress and results from the earlier components and hence Part v) and vi) will be completed as earlier results become available; thus defining the end-point of project 3.

Objectives for 1989: To initiate and establish baseline data from which can be assessed the potential role waste rocks in waste dumps will play upon the local hydrologic regime. This project is approximately 20% complete at present.

4. Groundwater Studies

The aim of groundwater studies is to assess the potential for transport of metals leached from the pits and dumps via groundwater to Rose Creek.

Piezometer nets were installed in 1988 and monitored throughout the 1989 field season. Development for sampling was delayed until late summer due to equipment malfunction/shortage; however, a full sample set was complete late July/early August. A second sample period is planned for late September/early October. Test pit development for shallow groundwater sampling has not yet been initiated.

Objectives for 1989: To initiate the collection of baseline data for hydrogeochemical assessment and forecasting. This objective has approximately a 70% completion for 1989.

5. Assessment of the loss of Flow from Faro Creek

Rationale for this project is to assess the impact of the loss of flow from Faro Creek for a period of 7-9 years upon the Rose Creek hydrologic regime.

Weirs established in the Faro Creek diversion channel were destroyed during spring freshette. Flow measurements were conducted in late May, July and August 1989. Flow measurements

will continue at the indicated stations monthly until freeze-up.

Objectives for 1989: To supplement present data so that future projections can be made of the possible effects of loss of flow from Faro Creek upon Rose Creek hydrologic regime. This objective has been complete to the 60% level for 1989.

6. Assessment of compacted Phyllite as a Dump Cover

Characterization and in-site permeability tests are designed to assess those physical characteristics which affect the suitability of compacted phyllite as a sulphide waste dump cover.

A surface characterization competency survey was initiated on an existing compacted phyllite surface and the primary survey completed. Survey points remain on-site for spring 1990 reference and re-survey. Modified falling head tests have been conducted with partial completion of survey points/samples.

Objectives for 1989: Primary characterization of those physical properties of compacted phyllite which lead it to be a best candidate for a sulphide waste cover. This objective is complete to the 70% level for 1989.

7. ~~Assessment of Water Quality in the Faro Pits~~

This project is designed to assess the impact upon the near surface and groundwater regime due to filling of the Faro pits with water.

The Zone II well was installed in 1988. Equipment shortfalls have caused a delay in sampling from the well until receipt of necessary equipment from the manufacturer. Piezometric readings have been recorded for the summer 1989 field season.

Objectives for 1989: Initial accumulation of data characterizing in-pit groundwater (levels and quality). Approximately a 50% completion has been attained for this objective.

8. North Fork Rock Drain

The annual inspection is intended to monitor the performance of the rockdrain and hence contribute to the confidence Curragh places in it's structures. Water sampling is undertaken to monitor possible ancillary effects of rock placement across a stream channel.

A performance inspection is scheduled for fall 1989. The geotechnical engineer conducting this inspection will be Glen Gilchrist of Golder Associates. Photographs have been taken in 1989 indicating the maximum crest stage of the impoundment behind the drain.

Water samples were taken in conjunction with seep surveys upstream and downstream of the rock drain. Testing for suspended solids was omitted from the earlier data set, yet will be included with the survey set planned for September, 1989.

Objectives for 1989: Performance monitoring of this structure including possible effects upon water quality downstream of the rock drain. This objective is 50% complete for the 1989 field season.

9. Freshwater Reservoir

The intent of this project component is to provide Curragh with meaningful information such that we can maintain on-going confidence in our structures.

The annual inspection of the freshwater reservoir dam is being coordinated with Glen Gilchrist of Golder Associates.

Objectives for 1989: So that Curragh can continue to place confidence in the integrity of its structures. Timing for completion for this year is fall, 1989.

10. Development of a Water Quality Model

The intent of this model is to predict the potential impact upon Rose Creek water quality from the various components of Faro pit and area, and to assess abandonment options.

Preliminary model parameters have been formulated and an initial model developed. This model will be updated annually and enhanced as data becomes available.

Objectives for 1989: To collect information/baseline data which will enable the development of such a model, and to draft a preliminary model from such suitable data.

11. Hydrology

Rationale for this project is to enhance the local database for flood level prediction and streamflow estimates; thus contributing to Curragh's knowledge of design constraints for structures and for the purpose of impact assessment.

A continuous flow monitoring station has been established in North Fork Rose Creek above the Faro Creek diversion channel; present equipment promises to extract high maintenance requirements and thus will be replaced with lower maintenance equipment. The Rose Creek diversion flow recorder has been operable since late spring.

Objectives for 1989: To enhance Curragh's streamflow database for the purpose of flood level prediction and thus allow an assessment of design constraints impacting upon structures.

Installations are complete; on-going maintenance and stream channel characterization is required. Approximately 70% complete for 1989.

12. Assessment of Rose Creek Water Quality

A benthic invertebrate investigation, including a water quality component, was complete in 1988 as an even-year study. Additional stream water quality samples were taken on lower Rose Creek and Anvil Creek in August 1989. Other stream water quality sites include:

- i) North Fork Rose Creek upstream from Faro Creek Diversion;
- ii) South Fork Rose Creek upstream from Haul Road;
- iii) South Fork rose Creek Southwest of Freshwater Reservoir.

Objectives for 1989: To add to baseline water quality data for lower Rose Creek and Anvil Creek. This objective is approximately 90% complete.

13. Fisheries Studies

The intent of this project is to delineate impacts of present operations upon the fisheries resource as well as to explore possible opportunities for enhancement to fish habitat. These project components have been undertaken by Fisheries Biological Consultants, P.A. Harder & Associates.

Poor weather in 1988 caused a delay in completion of fisheries studies. Fisheries studies were re-initiated in the summer of 1989 and successfully completed. Results of these studies will be released as they become available.

Objectives for 1989: To complete outstanding research from 1988; evaluating the fisheries resource in the Rose Creek/Anvil Creek watershed. This objective is 90-100% complete.

14. Assessment of Toxicity of Potential Contaminants Following Mine Abandonment.

A literature survey has been completed. Curragh Resources has begun discussions with Dr. Alderdice (ret.) on Vangorda Creek Studies and may expand the scope of these investigations to include Rose Creek.

Objectives for 1989: To initiate supplementary studies on Toxicity effects pending recommendations of consultant.

15. Assessment of Impact of Faro Mine following Abandonment

This assessment has not yet been undertaken. Suitable timing for this project is when appropriate data has been gathered.

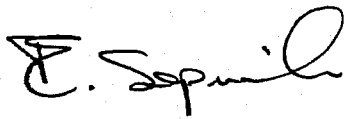
Objectives for 1989: Initiation of this project if required data is optimized.

16. Setting of Abandonment Plan Design Standards

There has been no net movement here; pending receipt of appropriate baseline data and subsequent direction. Discussions are currently underway with Curragh's Consultants concerning this project's direction.

Yours truly,

CURRAGH RESOURCES INC.

A handwritten signature in dark ink, appearing to read "E. Soprovich". The signature is fluid and cursive, with a large loop at the end.

Eric Soprovich
Environmental Engineer



Northern Affairs Program
200 Range Road
Whitehorse, Y.T. Y1A 3V1

November 10, 1989

Your file Votre référence

Our file Notre référence

Mr. Ken Nordin
Technical Advisor
Yukon Territory Water Board
302, 4114 - 4th Avenue
Whitehorse, Y.T.

Dear Ken:

Curragh Resources Public Hearing: Metals Data

I have reviewed the data from our files on extractable and total metals. Total metals are generally higher than extractable as one would expect. If the percentage difference is calculated by multiplying the result of the extractable divided by the total by 100 then the mean percent difference is 94%.

The samples are collected into a 100 ml plastic bottle. One-half ml of concentrated nitric is added to the sample which is shipped to the Environment Canada lab in Vancouver B.C. The lab reports extractable and total ICAP metals on the sample.

I prepared the attached Lotus spreadsheet using the ten samples DIAND has collected between 1987 and the present. The % difference was calculated as stated above. Mean, max and min recoveries were calculated using the % difference column and the Lotus function. I can provide the spreadsheet on floppies if you wish.

The recoveries of zinc, lead and copper were taken from the spreadsheet and are summarized below:

Recoveries of Zinc, Lead, and Copper at X5.

Metal	Mean	Min	Max
Zinc	94	69	112
Lead	88	60	104
Copper	80	42	100

The difference between extractable and total zinc, lead, and copper is not as significant as it would first appear when the following factors are considered.

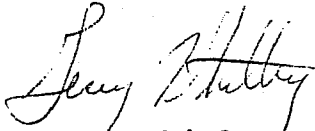
Canada

1. The maximum concentration allowed under the licence is 0.50 mg/L zinc, 0.20 mg/L lead and 0.20 mg/L copper. These low values are subject to other errors which may be of similar size to the recoveries.
2. The standards chosen for the licence allow for a variety of circumstances.
3. The data used to determine the standards displays variation.
4. The grab sampling method employed does not provide high quality samples and nothing is known about the variation of the sampling location. Thus allowance must be made for sampling error.

Extractable metals is most useful test when lab contamination is likely, for example in a dusty mining lab. Results will vary due to variation in the extraction of metal from the solids in the sample. Total metals is a better test as this source of variation is eliminated by the complete digestion of the sample.

The data presented here supports the use of the total metals test over the extractable metals method.

Yours truly,



Gerry Whitley
Administrator, Pollution Control
Water Resources Division

cc: Mr E. Sopravich,
Curragh Res.Inc. Faro, Yukon

cc: Mr D. Cornett
Environmental and Protection,
DOE, Whitehorse, Yukon



MEMORANDUM NOTE DE SERVICE

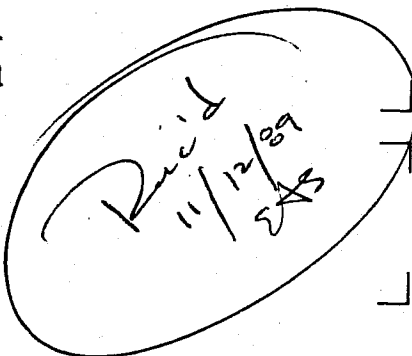
*For Mine
Env
Water Quality
- Conresp.*

TO
A

Ken Nordin
Technical Advisor
Yukon Water Board

FROM
DE

Gerry Whitley
Administrator
Pollution Control



SECURITY - CLASSIFICATION - DE SÉCURITÉ
OUR FILE — N / RÉFÉRENCE
YOUR FILE — V / RÉFÉRENCE
DATE November 27/89

SUBJECT
OBJET

RE: Ammonia in Curragh Resources Tailing Pond Effluent
2BC-X5

I have attached a FAX from Curragh Resources dated 10 Nov 1989. Curragh reports one cyanide result at 2BC-X13 exceeding licence limits. This may be the an analytical problem as previously reported.

Ammonia is reported as exceeding the 1 mg/l licence limit twice in October 1989 particularly at 2BC-X5. I took the time to review previous Curragh results and present them in order to place this data in context.

The Curragh ammonia at 2BC-X5 is shown in table 1 from 28 November 1986 to 28 August 1989. These values are displayed as a graph in figure 1. There appears to be a general improvement from 1987 to 1989 although the licence level is exceeded more than once each year.

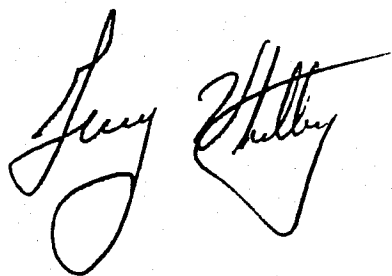
The number of times the licence limit was equalled or exceeded each month is shown in table 11. The limit was equalled or exceeded 22 times in 1987, 13 times in 1988 and (so far) 3 times in 1989. Thus 1989 has been a good year for ammonia. This data is plotted as a stacked bar chart in figure 11. Note that the summer exceedence peak is common to 87, 88, and 89 whereas the winter peak is not.

My analysis of this information is that ammonia values at 2BC-X5 generally increased from 1986 to the winter of 87-88 then declined slowly. The summer peak is most likely due to spring runoff and summer rains washing ammonia into the tailings pond or via pit pumping to the tailing pond. The background value is determined by the ammonia washed from the ore during grinding and is relatively constant. This simple approach does not show a change in ammonia loss in the tailings

pond from summer to winter. The major event is the movement of ammonia from the pit to the tailings pond.

The present level of ammonia in the tailings effluent 2BC-X5 is not unusual compared to 1987 and 1988. Curragh Resources has no means of changing the amount of ammonia entering the tailings pond under the current licence as the ammonia observed is derived from the ammonium nitrate used in blasting. There does not appear to be a seasonal variation in ammonia concentration due to summer and winter weather conditions.

cc Eric Soprovich, Curragh Resources
cc Dan Cornett, Environment and Protection
cc Tony Polyck, Water Resources

A handwritten signature in black ink, appearing to read "Tony Polyck". The signature is stylized with a large, looped initial "T" and a cursive "Polyck".

INDEXED _____

RECEIVED Nov 14/89 MW

TO: _____

Reg 1 Mgt. Water Resources	YOB 1KO
Admin Water Rights	
Project technologist	Tel: (403) 994-2600
Chief Water Mgmt. Officer	Telex: 036829
Water Management Officer	
Hydrologist	
Water Resources Tech	
Admin Pollut.	
Water Quality Techn	
Planner	
Office Mgr	
Water	
Secretary	
YOB	

TELECOPIER COVER LETTER

GERRY WHITLEY, ADMINISTRATOR, POLLUTION CONTROL

WATER RESOURCES, TIAND

TELECOPIER NO. (403) 668-4070

FROM: NAME: ERIC SOPKOVICH

CURRAGH RESOURCES INC., Box 1000, Faro, Yukon, YOB 1KO

TOTAL NO. OF PAGES: 3 DATE: 10/11/89 TIME: _____ OPERATOR: _____

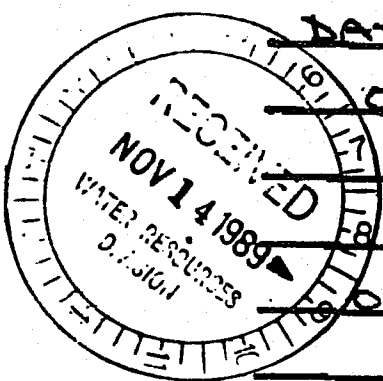
(Including cover letter)

We are transmitting from the following:
 Xerox FAX 7020 - 24 hours (403) 994-2600 Ext 139 - 2664

If you do not receive all pages please call back as soon as possible.

MESSAGE: HI !

A FEW RESULTS HAVE JUST ARRIVED FROM
 ELO TECH. NOTE THAT ELO TECH REPORTS
 SAMPLING DATE OF OCT. 02/89 FOR RUN
 #881 SHOULD BE REPORTED AS OCTOBER 16.
 REPORTED VALUES WHICH APPEAR IN EXCESS OF
 OUR LICENCE INCLUDE THE FOLLOWING STATIONS,
 DATES AND PARAMETERS:



OCTOBER 10/89 - X5; AMMONIA @ 1.06 mg/l
 X13; CN @ 0.085 mg/l
 AMMONIA @ 1.18 mg/l
 OCTOBER 16/89 - X5; AMMONIA @ 1.08 mg/l
 X13; AMMONIA @ 1.15 mg/l

I AM MAKING INTERNAL INQUIRIES AS TO THE
 REASON FOR THESE EXCESS DISCHARGES. THIS FAX
 MESSAGE PLUS ATTACHED RESULTS ARE TO INFORM
 YOU OF OUR EXCESS DISCHARGES OF CN & NH3.
 PLEASE FORWARD RELEVANT COPIES TO YOB 1KO



November 7, 1989

ANALYTICAL RESULTS - #681

CLIENT: Curragh Resources
Box 1000
FARO, YUKON
Y0B 1K0

ATTENTION: Erik Soprovich

SAMPLE IDENTIFICATION: 24 water samples received October 23, 1989

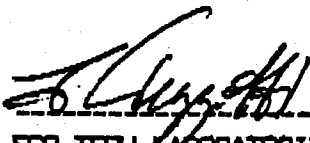
8 Samples for T Cyanides, 3 samples for WAD CN
13 Samples for Ammonia (as N)

P.O. # 120664

PARAMETER	CYANIDE	AMMONIA (as N)
Oct.02/89 x1	0.208	**
Oct.02/89 x2	-	0.07
Oct.02/89 x3	-	0.07
Oct.02/89 x4	0.063	1.62
Oct.02/89 x4 (weak acid dissociable)	0.027	-
Oct.02/89 x5	0.023	1.08
Oct.02/89 x5 (weak acid dissociable)	<0.005	-
Oct.02/89 x7	0.018	3.12
Oct.02/89 x10	-	0.04
Oct.02/89 x11	0.299	1.44
Oct.02/89 x12	<0.005	0.34
Oct.02/89 x13	0.042	1.15
Oct.02/89 x13 (weak acid dissociable)	<0.005	-
Oct.02/89 x14	0.056	0.40
Oct.02/89 x22a	-	0.07
Oct.02/89 x23	-	0.12

NOTE: All results expressed in mg per litre unless otherwise noted
< = less than

FJP/ga
Fax: Curragh, Faro


EDO-TECH LABORATORIES LTD.
FRANK J. PEZZOTTI, A. SC. T.

b.
x.
16/89
Sorted
DATE
8/6

October 30, 1989

ANALYTICAL RESULTS - #871

CLIENT: Curragh Resources
Box 1000
FARO, YUKON
Y0B 1K0

ATTENTION: Erik Soprovich

SAMPLE IDENTIFICATION: 20 water samples received October 18, 1989
***** 7 Samples for T Cyanides, 3 samples for WAD CN
10 Samples for Ammonia (as N)

P.O. # 120664

PARAMETER	CYANIDE	AMMONIA (as N)
Oct.10/89 x1	0.043	1.51
Oct.10/89 x4	0.067	1.09
Oct.10/89 x4 (weak acid dissociable)	0.023	-
Oct.10/89 x5	0.007	1.06
Oct.10/89 x5 (weak acid dissociable)	<0.005	-
Oct.10/89 x9	0.420	2.42
Oct.10/89 x11	0.160	1.86
Oct.10/89 x12	0.038	0.44
Oct.10/89 x13	0.085	1.18
Oct.10/89 x13 (weak acid dissociable)	0.039	-
Oct.10/89 x22	-	<0.01
Oct.10/89 x22a	-	1.70
Oct.10/89 x23	-	1.28

NOTE: All results expressed in mg per litre unless otherwise noted
< = less than

FJP/ga
Fax: Curragh, Faro

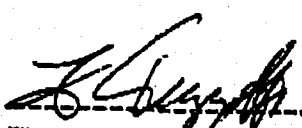

ECC-TECH LABORATORIES LTD.
FRANK J. PEZZOTTI, A. SC. T.

TABLE I

Curragh Resources Ammonia at 2BC-X5

	Date	AMMONIA_MG	licence = 1	1 mg/l
Nov-86	28-Nov-86	1.000	1	
Dec-86	31-Dec-86	0.720	1	
Jan-87	07-Jan-87	0.860	1987	
	15-Jan-87	0.760	1	
	20-Jan-87	0.550	1	
	28-Jan-87	0.670	1	
Feb-87	03-Feb-87	0.380	1	
	10-Feb-87	0.450	1	
	17-Feb-87	0.260	1	
	24-Feb-87	0.600	1	
Mar-87	10-Mar-87	0.510	1	
	17-Mar-87	0.550	1	
	24-Mar-87	0.800	1	
Apr-87	01-Apr-87	0.620	1	
	07-Apr-87	0.800	1	
	14-Apr-87	1.000	1	
	20-Apr-87	0.760	1	
	28-Apr-87	1.300	1	
May-87	05-May-87	1.060	1	
	12-May-87	0.940	1	
	19-May-87	0.800	1	
	26-May-87	0.840	1	
Jun-87	04-Jun-87	0.900	1	
	11-Jun-87	0.930	1	
	16-Jun-87	0.780	1	
	26-Jun-87	1.090	1	
	30-Jun-87	0.860	1	
Jul-87	06-Jul-87	0.920	1	
	13-Jul-87	1.010	1	
	20-Jul-87	1.030	1	
	28-Jul-87	1.320	1	
Aug-87	04-Aug-87	1.520	1	
	11-Aug-87	1.330	1	
	18-Aug-87	1.170	1	
	25-Aug-87	1.200	1	
Sep-87	01-Sep-87	1.070	1	
	08-Sep-87	1.320	1	
	15-Sep-87	1.210	1	
	21-Sep-87	0.970	1	

Curragh Resources Ammonia at 2BC-X5

Oct-87	02-Oct-87	0.890		1
	06-Oct-87	0.760		1
	13-Oct-87	1.040		1
	20-Oct-87	1.130		1
	27-Oct-87	1.020		1
Nov-87	03-Nov-87	0.930		1
	10-Nov-87	1.040		1
	17-Nov-87	0.980		1
	24-Nov-87	0.930		1
Dec-87	01-Dec-87	0.880		1
	09-Dec-87	1.090		1
	15-Dec-87	1.700		1
	23-Dec-87	1.590		1
	30-Dec-87	1.540		1
Jan-87	05-Jan-88	0.800	1988	1
	12-Jan-88	1.260		1
	19-Jan-88	1.180		1
	27-Jan-88	1.100		1
Feb-88	02-Feb-88	1.170		1
	10-Feb-88	1.750		1
	17-Feb-88	0.280		1
	24-Feb-88	0.850		1
	02-Mar-88	0.720		1
Mar-88	09-Mar-88	0.740		1
	16-Mar-88	0.850		1
	23-Mar-88	0.920		1
	29-Mar-88	0.910		1
	05-Apr-88	0.510		1
Apr-88	12-Apr-88	0.580		1
	20-Apr-88	0.420		1
	25-Apr-88	0.610		1
	04-May-88	0.520		1
May-88	11-May-88	0.950		1
	19-May-88	1.330		1
	25-May-88	1.570		1
	01-Jun-88	0.860		1
Jun-88	07-Jun-88	1.330		1
	16-Jun-88	1.520		1
	23-Jun-88	1.450		1
	28-Jun-88	0.730		1

Curragh Resources Ammonia at 2BC-X5

Jul-88	06-Jul-88	0.370		1
	11-Jul-88	0.860		1
	20-Jul-88	0.560		1
	27-Jul-88	0.590		1
Aug-88	04-Aug-88	0.670		1
	04-Aug-88	0.430		1
	10-Aug-88	0.850		1
	16-Aug-88	0.850		1
	23-Aug-88	1.090		1
	24-Aug-88	1.070		1
	26-Aug-88	0.870		1
Sep-88	09-Sep-88	0.650		1
	13-Sep-88	0.740		1
	22-Sep-88	0.640		1
	29-Sep-88	1.000		1
Oct-88	06-Oct-88	0.990		1
	14-Oct-88	0.970		1
Nov-88	14-Nov-88	0.920		1
	21-Nov-88	0.810		1
	30-Nov-88	0.820		1
Jan-89	06-Jan-89	0.780	1989	1
	10-Jan-89	0.890		1
	17-Jan-89	0.880		1
Feb-89	03-Feb-89	0.760		1
	07-Feb-89	0.800		1
	13-Feb-89	0.810		1
	27-Feb-89	0.690		1
	27-Feb-89	0.850		1
Mar-89	08-Mar-89	0.670		1
	14-Mar-89	0.750		1
	20-Mar-89	0.860		1
	27-Mar-89	0.750		1
Apr-89	03-Apr-89	0.730		1
	10-Apr-89	0.680		1
	17-Apr-89	0.680		1
	26-Apr-89	0.750		1
May-89	02-May-89	0.790		1
	08-May-89	0.550		1
	23-May-89	1.230		1
	29-May-89	0.570		1

Curragh Resources Ammonia at 2BC-X5

Jun-89	05-Jun-89	1.030	1
	12-Jun-89	0.460	1
	20-Jun-89	0.760	1
	26-Jun-89	0.390	1
Jul-89	03-Jul-89	0.670	1
	10-Jul-89	0.720	1
	17-Jul-89	0.600	1
	25-Jul-89	0.760	1
Jul-89	31-Jul-89	0.590	1
	07-Aug-89	0.600	1
	14-Aug-89	0.740	1
	21-Aug-89	0.910	1
	28-Aug-89	1.040	1

TABLE II

Analysis of ammonia exceeding licence limit of 1 mg/l
Based on Curragh Resources Inc. reported values for 2BC-X5
Sampled weekly

Month	1986	1987	1988	1989
1			3	
2			2	
3				
4		2		
5		1	2	1
6		1	3	1
7		3		1
8		4	2	
9		3	1	
10		3		
11	1	1		
12		4		
total	1	22	13	3

prepared by G. Whitley 16 Nov 1989

FIGURE I
Ammonia at 2BC-A5

Curragh Resources Data

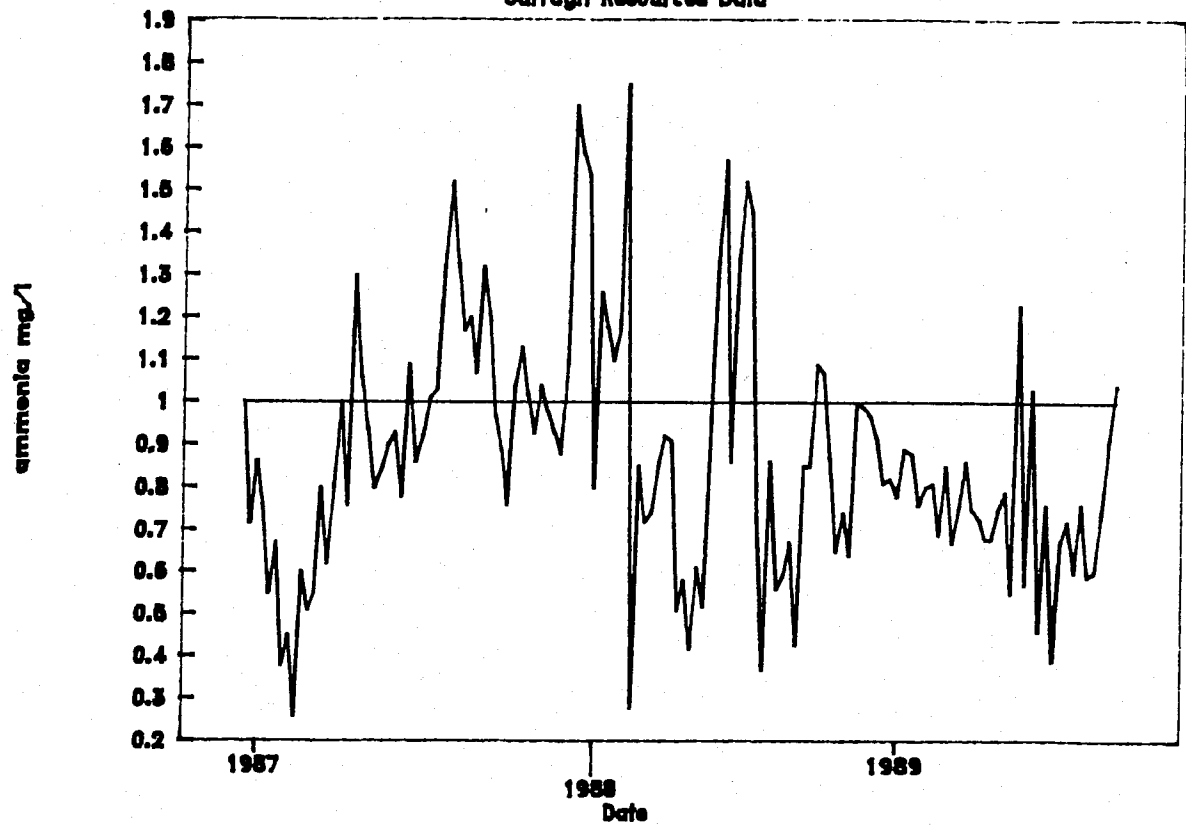
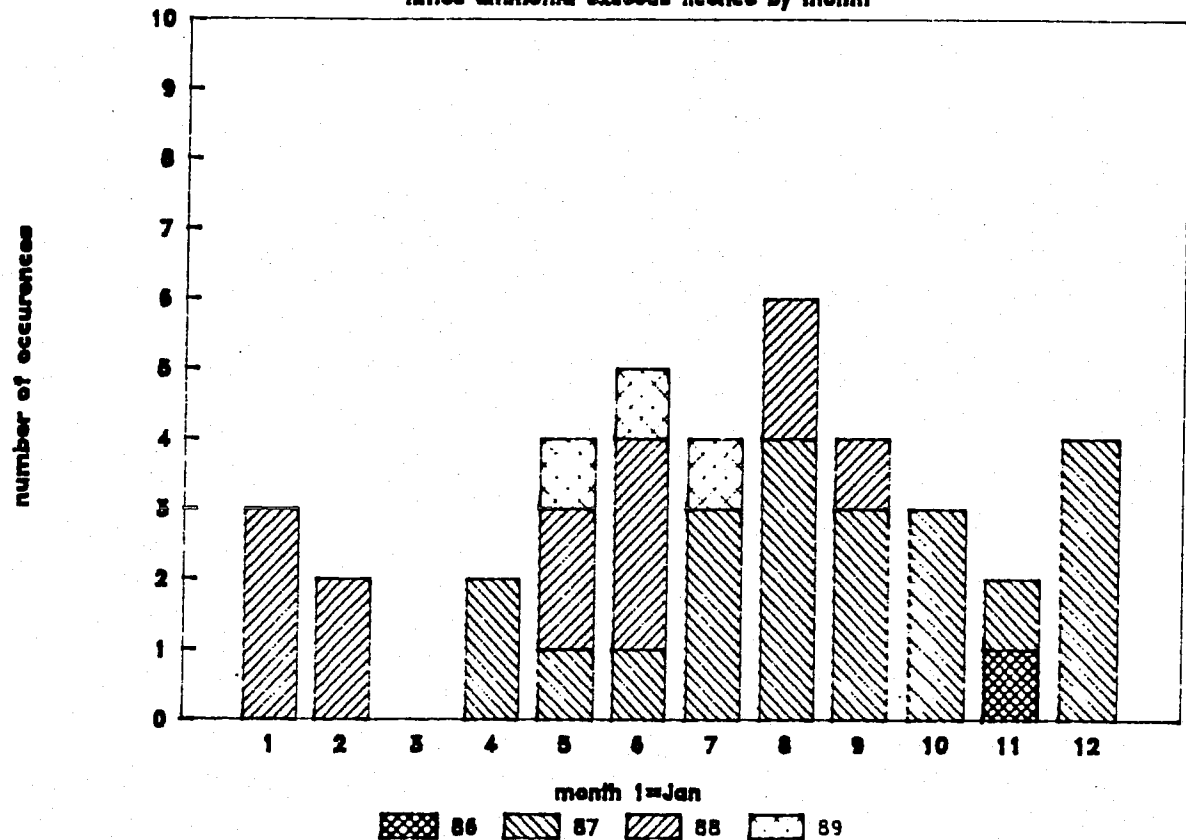


FIGURE II
Curragh Resources Inc.

times ammonia exceeds licence by month





Curragh
Resources
Inc.

117 Industrial Rd.
Whitehorse, Yukon Y1A 2T8
Tel: (403) 668-3578
Telex: 036 8359

February 15, 1990

Mr. Grant Livingston
Chairman
Yukon Territory Water Board
#302, 4114 - 4th Avenue
Whitehorse, Yukon Territory
Y1A 4N7

Dear Mr. Livingston:

**RE: FARO MINE - WATER LICENCE
TAILINGS TEST PIT PROGRAM**

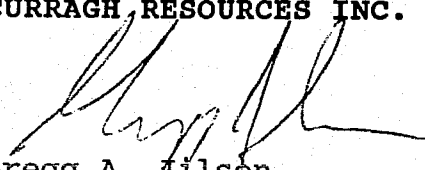
Enclosed you will find our Progress Report on the Tailings Test Pit Program, part of the research program leading to the development of a Tailings Abandonment Plan for the Faro Mine.

This is a report on research outlined in Steffen Robertson Kirsten's Report #60602 which, although no longer requested in our water license, is provided for your information.

The project is progressing satisfactorily. Results are beginning to come in but are not provided here as they are very preliminary at this time. It appears that the test facility will be on its way towards producing an answer in the expected time frame. This may not be by 1991, however we are confident that sufficient limiting data will be available within the coming year that the 1991 closure plan will not be delayed.

Yours very truly,

CURRAGH RESOURCES INC.


Gregg A. Jilson
Vice-President, Exploration

GAJ*geb

Enclosures: Progress Report dated February, 1990

**CURRAGH RESOURCES INC.
PROGRESS REPORT
FEBRUARY, 1990**

TAILINGS TEST FACILITY

1.0 SUMMARY

1989 represents year three of Phase I of the Faro Mine Tailings Abandonment Plan Development Program (APDP). Field activities during 1989 centred around sampling of tailings pore water and monitoring installed piezometers and thermistors. CO_2/O_2 gas monitoring was also carried out on those air/water samplers which were not saturated in October. Site 7 was treated similarly to the tailings test facility for instrumentation monitoring.

Poor ground conditions combined with instrumentation failure caused a cancellation of the combined Thiobacillus ferrooxidans: CO_2/O_2 gas characterization in in-situ tailings until the 1990 field season.

1990 field activities are designed to complement the existing tailings test facility data base, as well as to improve upon Curragh's understanding of the chemical nature of in-situ tailings for the hydrogeochemical component of the Faro Mine Tailings Abandonment Program (APDP).

2.0 MAINTENANCE REQUIREMENTS

Initial activities associated with the tailings test facility were centred around reconstructive maintenance to repair damage from the 1988/89 winter season. Standing water in tanks was pumped out, and in some cases pumping continued into July as ice in

tank bottoms continued to melt on a gradual basis. A majority of the ABS bottom-drain pipes required replacement as they had cracked during the previous cold. The remainder of tailings left from construction were removed from the base of Tank #3.

The condition of Tank #6, although sound in the spring, degenerated throughout the summer due to a chronic leakage problem. Three successive attempts with different materials and methods failed to rectify water leakage through the tank instrumentation panel. This leakage combined with a dry summer made it difficult to maintain a suitable water cover on Pit #6 thus casting doubt upon including this pit for remaining study.

Close inspection of installed piezometer instrumentation revealed that a majority of the coupler tips were cracked or otherwise damaged from being frozen into the ice in the tank bottoms the previous winter. New Piezometer couplers were ordered and arrived on-site during late August for installation.

In order to improve upon over-wintering performance of the installed instrumentation couplers and sampling tubes; they have been attached to moveable panels and hung well above flooded level and hence ice formation in the tanks.

3.0 WATER SAMPLING

Two water sampling events occurred during the summer of 1989; the first spanned from July 16-29, while the final ran from October 04-November 03.

3.1 Physical Sampling

The July sampling was particularly successful; producing 54 samples from air/water samplers and 17 from lysimeters. Five of the six tanks produced 2 samples each (one fixed, one not fixed) from bottom drains. 10 duplicate water samples from the air water samplers were also obtained.

Air/water samplers which were in-operative for the first sampling period include samplers 1-3, 1-5 and 3-2.

Air/water samplers were less productive during the second sampling period. Forty water samples were extracted from air/water samplers from October 04-18; including 3 quality control duplicates. Air/water samplers which were non-responsive during this time period include: 1-5, samplers in Pit #3, 5-4, 5-5, 6-1, 6-3 and 6-4.

Eighteen water samples were obtained from ten of the back-up lysimeters. Tanks 1,2,4 and 6 provided water samples from the bottom drains.

3.2 Parameters Measured/Sampling Methodology

Tailings water from the air/water samplers was measured at one minute intervals for pH, Eh, conductivity and temperature; for a period of ten minutes or until readings stabilized. A sealed flow-through cell was utilized for these measurements. An additional parameter was the level of dissolved oxygen in the tailings water, measured after other parameters stabilized. Water samples

were collected using a variable speed peristaltic pump. All samples were filtered in the field using 0.45 micron millepore filters. Those samples destined for cation analysis were immediately acidified to a pH of less than one using concentrated HCl. All water samples were refrigerated until analysis.

Alkalinity and acidity was determined in the field by titration with standardized H_2SO_4 and NaOH. A quick on-site analysis was chosen for these parameters in order to limit the effects of iron oxidation and hydrogen ion generation upon analysis.

Water samples were transferred to Curragh's contracting laboratory, B.C. Research, for analysis. Filtered and acidified samples were analyzed for: Fe, Pb, Zn, Cu, Mn, Cd, Co, Ag, Ca, Na, K, As, Se, Ni and Cr. The filtered and non-acidified samples were analyzed by the contracting lab for: Cl, SO_4 , F, NO_3 , total inorganic carbon and pH. A quality assurance program was instituted in-house to complement duplicate samples received from the field.

4.0 SOLIDS SAMPLING

Sampling of the solid tailings component was conducted during the 1989 field season. The original sampling system, a Shelby sampling tube, was tested in July without success. The solids sampling methodology and equipment was redesigned for the second sampling period, and solid tailings samples were successfully extracted from Pits 2,3,5 and 6. A duplicate solid sample was retrieved from Pit 5/Tank 5 for quality control considerations.

5.0 INSTRUMENT MONITORING

5.1 Thermistors

Thermistors were successfully monitored on a monthly basis throughout the summer and fall of 1989. Two monitoring periods were additionally established for July and for August: two readings were taken in mid-July; thermistors were read in mid-August and late August.

Two installed thermistors were in-operative in 1989: Thermistor 1-3 and 4-6. Thermistor 4-9 was not responsive during July monitoring.

5.2 Piezometers

Pore water pressure has been monitored throughout this program. Couplers damaged during previous winters were replaced in August and pneumatic piezometers continued to be monitored. Results from subsequent monitoring indicate that the piezometers are returning pore pressure values very near the resolution capacity of the read-out instrumentation.

5.3 CO₂/O₂ Samplers

Repairs required for the Nova 305B CO₂/O₂ analyzer delayed CO₂/O₂ characterization until late in the field season. Those air/water samplers which did not provide a water sample in October were monitored during October 25 to 27 for CO₂/O₂ character.

5.4 Meteorologic Baseline

Maximum and minimum temperatures as well as precipitation were recorded at the tailings site from mid-July through mid-September. Evaporative

rates were also monitored at the tailings test area during August and September.

HYDROGEOCHEMISTRY

6.0 1989 FIELD COMPONENT

Testing of in-situ tailings for presence/absence of *Thiobacillus ferrooxidans* was planned in conjunction with CO_2/O_2 characterization for 1989. Unfortunately, a combination of poor ground conditions and equipment failure has delayed this component until the 1990 field season.

1990 FIELD AGENDA - BOTH PROGRAMS

The following component field activities are suggested for the 1990 field season:

A. TAILINGS TEST FACILITY

- i) Two complete water sampling events to include air/water samplers, lysimeters, bottom-drain samplers;
- ii) one solid tailings sampling event during late summer/ early fall;
- iii) monitoring of piezometers and thermistors, and CO_2/O_2 samplers on a monthly basis including Site 7 (bi-weekly during the summer); and
- iv) meteorologic baseline monitoring during the summer months.

B. HYDROGEOCHEMISTRY

- i) Two groundwater sampling events, one early and the second very late in the field season; and
- ii) in-situ monitoring of CO_2/O_2 gasses in conjunction with sampling for presence/absence of *Thiobacillus ferrooxidans*.

faro\tailings.es



Curragh
Resources
Inc.

117 Industrial Rd.
Whitehorse, Yukon Y1A 2T8
Tel: (403) 668-3578
Telex: 036 8359

1989 09 06

*Sept 6
or
June 9 ? assume Sept 6*

Yukon Territory Water Board
200 - 4114 - 4th Avenue
Whitehorse, Y.T.
Y1A 3B2

Dear Sirs:

RE: 6 Month Progress Report
Tailings Abandonment Development Program

Activities associated with the Tailings Abandonment Development Program have progressed closely to expected scheduling. Reconstructive maintenance occurred in May/June to repair damages caused by winter conditions. Outstanding is a chronic leakage in the instrumentation panel for tank #6/Pit#6 (water cover). Three successive repair methods have failed to completely seal this panel: thus requiring a reassessment of the long-term viability of using Pit #6 for research purposes. Pits #1 through #5 are in satisfactory condition for Curragh's research purposes.

Robert McLenehan, consultant with S.R.K., was on site late June/early July for technical guidance. An initial sample set was initiated at this time and included sampling of lysimeters, air-water samplers, and bottom drain sampling. All samples were transported to B.C. Research for analysis. An attempt was made to extract a solid sample: however, the Shelby sampling tube failed and thus is being re-designed and constructed for the more important second sampling set yet to occur.

Installed instrumentation - pneumatic piezometers and thermistors - were initially monitored in early June and late June/early July. Instrumentation has been read bi-weekly since late July/early August. Many piezometer tips were cracked after this past winter and hence required replacement. As a result, those readings taken prior to repairs made will have to be reviewed to assess what degree of accuracy can be placed upon each initial result.

Supplementary meteorologic data has been collected at the tailings facility on a constant basis since mid-July. Included in this data set is maximum - minimum temperature, precipitation, and evaporative rate.

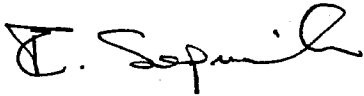
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Yukon Territory Water Board
1989 09 06
Page 2

A second full set of sampling (including lysimeters, air-water samples, bottom drain samples and solid samples) is planned for September/October to span two full weeks. Commensurate with recent receipt of replacement parts for Curragh's Nova 300B CO₂/O₂ analyzer, the CO₂/O₂ characterization component will be initiated. There is also intent to sample old tailings, and test for the presence of Thiobaccillus ferrooxidans. Installed instrumentation will continue to be monitored, and meteorologic data collected on a timely basis.

Yours truly,

CURRAGH RESOURCES INC.



Eric Soprovich
Environmental Engineer

TAILINGS ABANDONMENT PLAN DEVELOPMENT PROGRAM

PROGRESS REPORT

-OCTOBER 31, 1988

by Curragh Resources Inc.
Faro, Yukon

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TAILINGS ABANDONMENT PLAN DEVELOPMENT PROGRAM
PROGRESS REPORT OCTOBER 31, 1988

by Curragh Resources Inc.
Faro, Yukon

SUMMARY

This report describes the progress on the 1988 Tailings Abandonment Plan Development Program (APDP) for the Curragh Resources mining operation at Faro, Yukon.

The APDP was initiated in June of 1987 to develop a tailings abandonment plan capable of:

providing adequate protection to the environment, and in particular to the water quality of Rose Creek in both the short and long term;

reducing maintenance in the long term to the minimum realistically achievable with the available technology and financial resources reasonably available. (SRK, Rpt 60602).

The 1987 field season was primarily dedicated to constructing a tailings covers test facility. The purpose of the 1988 season was to get this facility fully operational, to conduct the first of a series of monitoring and analysis events, and to complete a drilling program. The drilling program was designed to characterize the in-situ tailings and the subsite soils and groundwater flow conditions, as well as to install instrumentation necessary for the development of a groundwater quality baseline evaluation.

The major objectives for the 1988 field season have been achieved, and the program to date is within the intended time schedule as outlined in Steffen Robertson and Kirsten Report 60602.

Chemical analysis and data evaluation will proceed during the 1988/89 winter season as the results become available. Preliminary results and evaluations will be reported in the March 1989 Progress Report. A program schedule for the 1989 field season will also be presented at that time.

1.0 INTRODUCTION

The second field season of the four year Tailings Abandonment Plan Development Program (APDP) as described in Steffen Robertson and Kirsten (SRK) Report 60602 was completed October 31, 1988.

Figure 1 shows the project area and the locations of 1988 program activities. Major activities centered around the Tailings Test Facility. Locations of the holes drilled during 1988 are also indicated.

Planned activities for the 1988 field season have been substantially completed, and scheduled progress has been achieved.

The Tailings Test Facility is now completely operational and one sampling event has been concluded. Instrumentation for the covers testing has worked well. Chemical analysis results for the 1988 season should be available by mid-December, 1988, and a preliminary evaluation of the test facility will be prepared for the March, 1989 progress report.

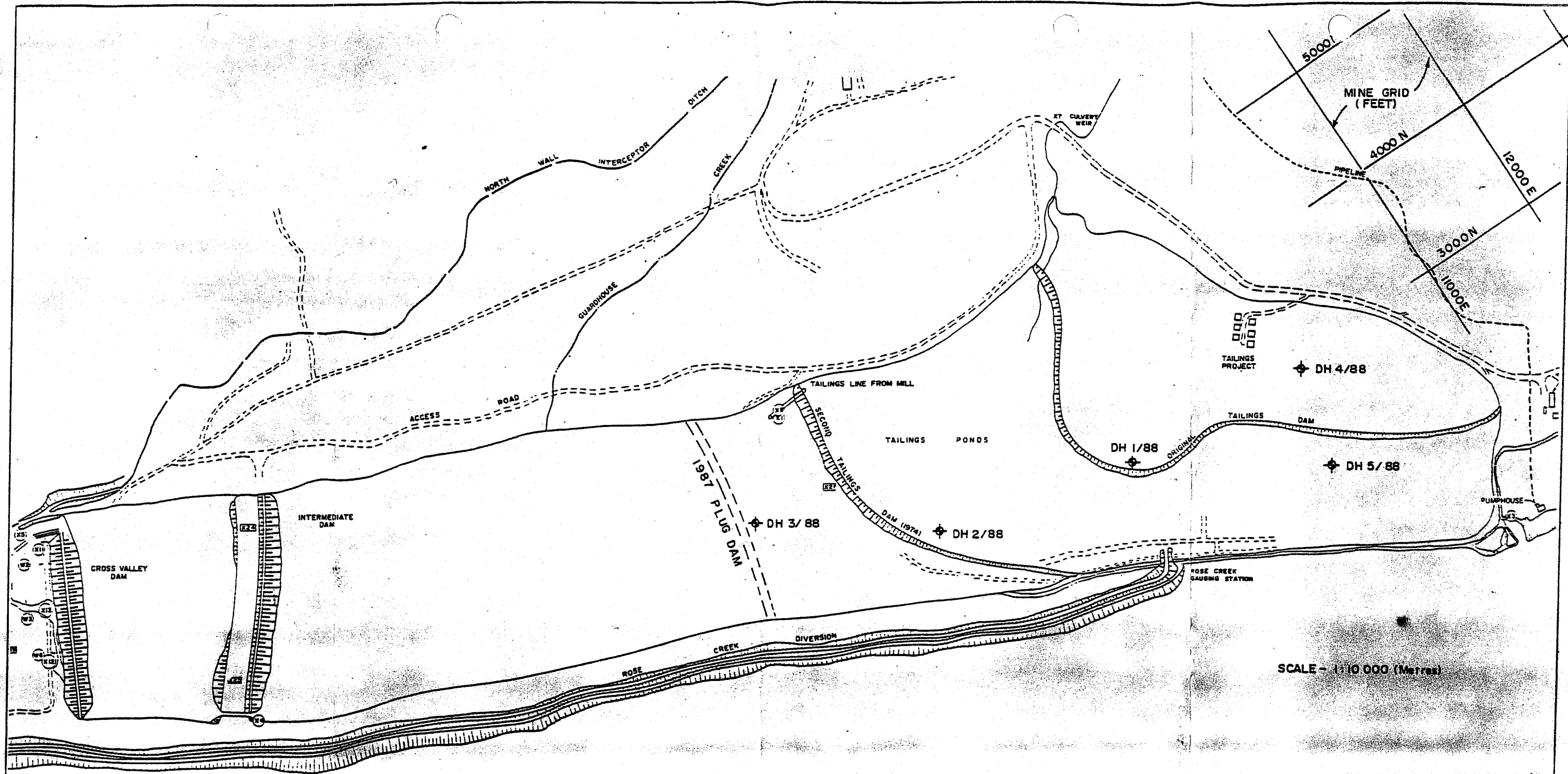
The drilling program designed to characterize in-situ tailings and subsite soils has also been completed. The piezometers and groundwater samplers required for the groundwater baseline evaluation are also in place. Chemicals results for the tailings and subsoil characterization should be available by mid-January, 1989, and a results summary will be included in the March, 1989 progress report.

2.0 TAILINGS TEST FACILITY

2.1 1987 Activities Summary

Implementation of the Tailings Abandonment Plan Development Program (APDP) was started in July, 1987. By year-end, the following tasks were substantially complete:

- . excavation of six tailings test pits with dimensions of approximately 22 x 22 x 5 meters.
- . construction of berms around the test pits.
- . placement of instrumentation access tanks into each test pit.
- . installation of high density polyethylene liners in each pit.
- . installation of instrumentation in each test pit.
- . construction of tailings pipeline to the test facility.
- . placement of tailings in each of the test pits.
- . chemical analysis of the tailings discharged into the tailings test facility.



LEGEND

+
 DH 2/88 1988 DRILL HOLE
 (Approx. location)

CURRAGH RESOURCES — FARO MINE

FARO MINE TAILINGS IMPOUNDMENT AREA

DATE OCT. 1988

PROJ. NO. 60606

APPROVED

NO.

1

2.2 1988 Activities Summary

In 1988, the tailings covers test facility installation was completed and the covers testing program was initiated. A plan view of the Tailings Test Facility is shown in Figure 2.

Work completed in 1988 entailed the following:

- . the instrumentation tanks were cleaned. Tailings which had leaked into the tanks through the instrumentation access windows during 1987 tailings placement was removed.
- . instrumentation access windows were re-sealed.
- . working platforms and ladders were installed in each instrumentation access tank.
- . experimental tailings covers were placed in the test pits. A schematic vertical profile of the covers and test pits is shown in Figure 3. The covers, as placed, are:
 - PIT 1. 0.5 m tailings slimes/ 0.5 m glacial till/ 0.5 m calc silicate rock (till saturated).
 - PIT 2. 0.5 m bog/ 0.5 m sawdust (organic carbon layer)/ 0.5 m tailings.
 - PIT 3. CONTROL (no cover placement)
 - PIT 4. 0.5 m tailings slimes/ 0.5 m glacial till/ 0.5 m calc silicate rock (till unsaturated).
 - PIT 5. 0.5 m glacial till (compacted).
 - PIT 6. 0.5 m water.
- . instrumentation was inspected and repaired where necessary.
- . instruments were monitored and sampled.

2.3 1988 Monitoring and Sampling Program

2.3.1 General

The instrumentation in the Tailings Test Facility was monitored and sampled from September 19 to October 5, 1988. D. Blowes (University of Waterloo) was engaged for this sampling period to provide expert advice and assistance.

2.3.2 Monitoring Program

Thermistors

Forty-three thermistors were installed in 1987.

Readings were obtained from 41 of the 43 thermistors in 1988. thermistors 1.3 and 4.6 are not functional.

All the thermistor string switch boxes were corroded and had to be by-passed. This procedure did not affect the operation or reliability of the thermistor readings. These switches will be replaced in 1989.

All of the thermistors were read twice during this sampling period, and will be read monthly from this time.

Piezometers

Twenty pneumatic piezometers were installed in 1987.

Nineteen of the twenty were operational in 1988. Piezometer 1.3 was not functional due to a cracked coupler. This unit may be repairable.

Each piezometer was saturated prior to a pressure reading. Two pressure readings were obtained for each piezometer.

Pressure readings are typically low and the accuracy of these small pressure readings may be questionable. These readings approach the limits of the detection gauge.

Water Samplers

Two types of water samplers were installed in 1987; lysimeters and air/ water samplers.

Suction lysimeters are designed to extract water from the vadose or unsaturated zone above the water table. Because the water table in each test pit was above the shallowest suction lysimeter, and because lysimeters provide small sample volumes very slowly, the air water samplers were used in preference to the lysimeters for water sample collection. Air/ water samplers provide larger samples more quickly.

Water samples were collected from all but three of the thirty air/ water samplers which were installed in 1987. Samplers A/W1.6 and A/W3.2 were not operational, but will be tested again in 1989.

Three suction lysimeters, L1.1, L1.2, and L1.3 were sampled to obtain a comparison between air/ water and lysimeter analytical results. The remaining lysimeters provide back-up to the air/ water samplers and have been left until 1989 to be sampled.

Pit drain water samples were also collected from pits 1, 2, 3, and 4. The drain in pit 5 is broken and could not be sampled. This drain will be repaired as soon as possible. Pit 6 is not drained and so no sample is available.

For each water sample, the following sampling procedures were utilized:

pH and Eh

The pH and Eh of the tailings water from the air/ water samplers and the lysimeters were measured in a sealed flow through cell which isolated the tailings water from atmospheric oxygen during measurement. (pit drain samples were not measured using this flow-through system, but were instead measured directly on drain overflow water.

Measurements were made on unfiltered samples at one minute intervals over a ten minute period or until readings stabilized.

A liquid filled combination pH electrode (Orion Ross) and a combination platinum electrode (WJF Instrumentation) were used to determine the Ph and Eh respectively.

The pH electrode was calibrated using 4.0, 7.0, and 10.0 buffers maintained at tailings water temperatures.

The Eh electrode was checked regularly using Zobell's solution.

Water Samples

Water Samples were collected using a variable speed peristaltic pump. All samples were filtered through 0.45 micron millipore filters in the field.

Samples for cation analysis were acidified immediately to a pH of less than one using concentrated HCl. Anion and cation samples were refrigerated until analysis.

Alkalinity and acidity were determined by titration with standardized H_2SO_4 and NaOH. These titrations were done in the on-site laboratory as quickly as possible after sample collection to limit the effects of iron oxidation and hydrogen ion generation.

For each water sampler, two 250 ml samples were collected. The filtered and acidified samples were sent to a commercial laboratory (Chemex Laboratories) to be analyzed for:

Fe/ Pb/ Zn/ Cu/ Mn/ Mg/ Cd/ Co
Ag/ Ca/ Na/ K / As/ Se/ Ni/ Cr

The filtered and non-acidified samples were sent to a commercial laboratory (Chemex Laboratories) to be analyzed for:

Cl/ SO₄/ F/ NO₃/ total inorganic carbon (check to see if alkalinity if carbonate alkalinity).

Spikes were made on-site and sent with the samples. Ten percent of the samples were duplicates and were sent to a second laboratory (B.C. Research). These procedures are designed to ensure quality control.

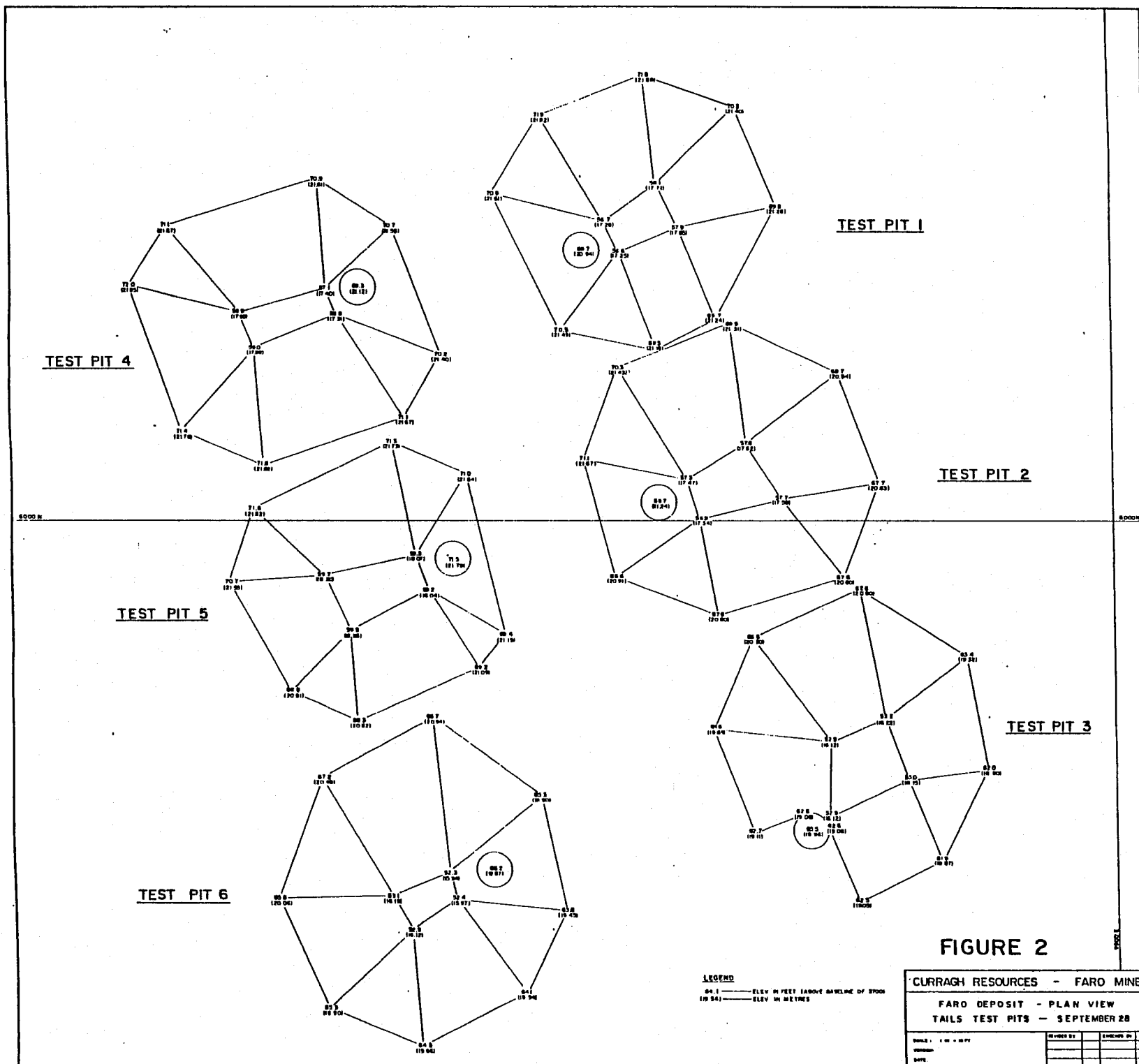
Solids Samplers

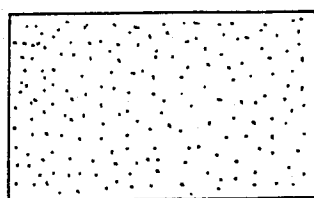
The tailings in the test pits at the time of the 1988 sampling was only one year old and was not expected to display significant acid generating characteristics. Therefore, solids sampling and chemical analysis were not undertaken. All solids samplers will be sampled at least once in 1989.

One solids sampler was tested. The concept of the samplers works; however, the extraction device requires re-design. The ball valve designed to maintain a sample in the extractor while under suction is not suitable. This device will be modified by the 1989 sampling season.

2.3.3 Sampling Results and Data Interpretation

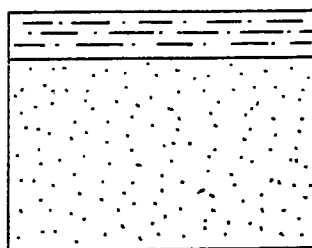
The chemical analysis results are expected to be available by mid-December. Data results and preliminary evaluations will be presented in the March 1989 detailed progress report.





1.97 m TAILINGS

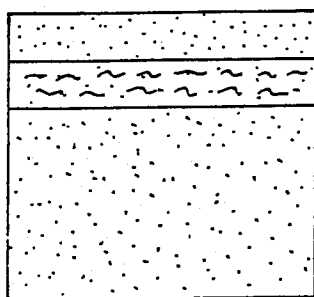
TEST PIT # 3



0.5 m WATER

2 m TAILINGS

TEST PIT # 6

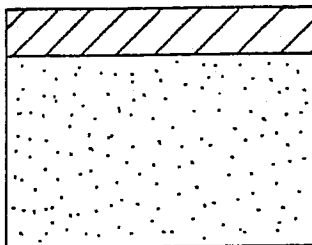


0.5 m TAILINGS

0.5 m PEAT & SAWDUST

2 m TAILINGS

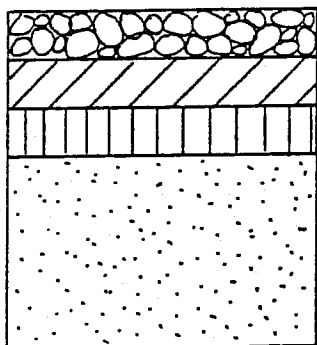
TEST PIT # 2



0.5 m TILL

2 m TAILINGS

TEST PIT # 5



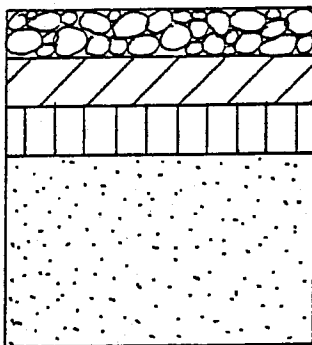
0.5 m ROCK

0.5 m TILL

0.5 m TAILINGS SLIME

2 m TAILINGS

TEST PIT # 1
(Saturated)



0.5 m ROCK

0.5 m TILL

0.5 m TAILINGS SLIME

2 m TAILINGS

TEST PIT # 4
(Unsaturated)

CURRAGH RESOURCES - FARO MINE

DATE OCT. 1988

PROJ. NO. 60606

APPROVED

NO.

3

TAILINGS TEST FACILITY
SCHEMATIC OF VERTICAL PROFILES
OF TAILINGS AND COVERS IN TEST PITS

3.0 1988 TAILINGS and GROUNDWATER DRILLING and TESTING PROGRAM

3.1 General

The 1988 drilling program was designed to characterize in-situ tailings and subsite soils. Piezometers and groundwater sampling tubes were also installed as a part of the groundwater baseline development program. The consulting firm of Steffen Robertson and Kirsten was engaged to provide drilling supervision.

3.2 1988 Activities Summary

The drilling program was conducted from August 31 to September 15, 1988 using a rotary CME750 drilling rig (Midnight Sun Drilling Ltd.).

Five sites were drilled in the tailings. Drill locations are shown on Figure 1.

Samples were taken every half meter until a tailings paste pH of 5.0 was encountered. Sampling was then conducted every meter for two meters, and then every two meters until the bottom of the hole. Samples were stored in nitrogen gas.

A brief description of the drill site locations, hole depths and the instrumentation installations is provided in Table 1.

TABLE 1: DRILL SITE, HOLE DEPTHS, AND INSTRUMENTATION

HOLE NUMBER	LOCATION	OBJECTIVE	NUMBER OF HOLES DRILLED	DEPTH OF TAILINGS	BOTTOM OF HOLE	NUMBER OF STANDPIPE PIEZOMETERS INSTALLED	PIEZOMETER SCREEN INTERVALS
DH1/88	immediately upstream of Original tailings dam and directly over old Rose Creek channel.	tailings and subsite soils invest.	1	23.0 m	34.0 m	3	21.0 - 23.0 26.5 - 28.5 32.0 - 34.0
DH2/88	immediately upstream of Second(1974) tailings dam and over old Rose Creek channel.	tailings and subsite soils invest.	2	23.0 m	32.0 m	3	7.5 - 9.0 18.5 - 20.0 21.0 - 24.0 29.0 - 34.0
DH3/88	immediately upstream of 1987 Plug dam	tailings and subsite soils invest.	1	4.5 m	15.0 m	3	4.6 - 5.2 5.0 - 6.5 13.0 - 14.0
DH4/88	upstream of Original tailings dam and southeast of tailings test facility	tailings soils invest.	3	17.0 m	20.5	1	15.5 - 17.5
DH5/88	upstream of second (1974) tailings dam and south of tailing test facility	tailings soils invest.	1	13.0	16.0	1	11.0 - 13.0

NOTE: DH4/88 ALSO HAD THERMISTERS AND CO2/ O2 INSTRUMENTS INSTALLED.

THERMISTER DEPTHS: 0.0/ 0.3/ 0.6/ 1.0/ 1.5/ 2.0/ 2.5/ 3.0/ 3.5/ 4.0

CO2/O2 DEPTHS : 0.0/0.3/ 0.6/ 0.9/ 1.2/ 1.5/ 1.8/ 2.1/ 2.4/ 2.7/ 3.0/ 3.3/ 3.6/ 3.9

3.3 Chemical Analysis Program

Each drill sample was stored in nitrogen and sent to B.C. Research for chemical analysis. Ten percent of the samples were duplicated and are being sent to Chemex Laboratory. This procedure should ensure quality control. A summary of chemical tests is provided in Table 2.

Samples were taken separately for the determination of the presence of thiobacillus ferrooxidans. These samples were stored at four degrees Celsius until shipped.

TABLE 2: CHEMICAL ANALYSIS - TAILINGS AND SUBSITE SOIL CHARACTERISTICS

Chemical Test	Number of Samples
grain-size analysis	28
acid/ base potential	28
column leach tests	18
attenuation tests	10
presence/ absence of T. Ferrooxidans	30
Solids: total sulphides -- leach -- sulphates	38
Fe/ Pb/ Zn/ Cu	38
Mn/ Ni/ Cd/ As/ Al	28
Ag/ Au	8
Pore Water: Fe/ Pb/ Zn/ Cu/ SO4	54
K/ Na/ Ca/ Mg/ Mn/	
Cl/ Ni/ Al/ Cd/ CO3/ HCO3	37
Hg/ Sb/ Mo/ Se/ As	34

3.4 Sampling Results and Data Interpretation

The Chemical analysis results are expected to be available by mid-January. Data results and preliminary evaluations will be presented in the March 1989 detailed progress report.

4.0 1989 PROGRAM SCHEDULE

Steffen Robertson and Kirsten Report 60602 will be used as a basic guide for the development of the detailed 1989 field season program. Full details of the 1989 program, including analysis and evaluation procedures, will be provided by March, 1989.

PROGRESS SUMMARY REPORT

1987 FARO TAILINGS ABANDONMENT

PLAN DEVELOPMENT REPORT

by

R. McLenehan
Environmental Engineer
CURRAGH RESOURCES INC.

March, 1988

RM/nn

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- III. Instrumentations / Supplier / Price - Lists
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Figure 2: Tailings Cover Test Facility ~~/~~ as-built Construction Drawings

1987 FARO TAILINGS ABANDONMENT PLAN DEVELOPMENT PROGRAM
PROGRESS REPORT

SUMMARY

The first year of the Faro Mine Abandonment Plan Development program is complete. A description of the work completed in the 1987 field season is provided. In general, the objectives for this year have been achieved. The test plots were excavated and the instrumentation tanks and liners were installed. This work was followed by installation of the instrument sensors and the placement of new tailings in each of the six test plots. The only major deviation from the implementation schedule as provided in SRK Report 60604 resulted from tailings leakage through the window seals and into the instrumentation tanks. Removal of this material in the spring^{will} results in added expenditure to the project, but should have a negligible effect on the function and operation schedule of the tailings cover test facility.

(Steffen Robertson and Kirsten 1987)

1987 FARO TAILINGS ABANDONMENT PLAN DEVELOPMENT PROGRAM PROGRESS REPORT

1.0 INTRODUCTION

This report is intended as a progress summary report inclusive of all the activities which have occurred in 1987 with respect to the Faro Mine Tailings Abandonment Plan Development Program.(APDP). Activities and plans for the 1988 season are also presented. The major emphasis of this report, however, is placed on detailing the construction activities related to the implementation of the Tailings Cover Experimental Test Facility. Appendix I provides a detailed time-table of events for the APDP during 1987. Further information detailing the early developmental stages of this project is available in Steffen, Robertson and Kirsten (SRK) Report 60601 (Nov. 1986), SRK Report 60602 (Jan. 1987) and SRK/Curragh Report 60604 (June 1987).

2.0 BRIEF REVIEW OF PRE-CONSTRUCTION ACTIVITIES

In February, 1987, Curragh Resources made a commitment to the Yukon Water Board to develop and implement a tailings abandonment plan development program as described in SRK Report 60602. As of April 14, 1987, Curragh Resources retained Robert McLenehan in the capacity of Project Manager for the APDP, and the first phase of the four year development program was initiated.

During April and May of 1987, Mr. McLenehan arranged the details necessary for the construction of the tailings cover test facility. Complete drawings and construction specifications for the original test facility design as described in SRK Report 60602 were completed May 14, 1987. Preliminary activities were directed and aided by Dr. A. MacG. Robertson (SRK), and Dr. Adrian Smith.

Requests for tenders, based on the original test facility design, were issued to three Yukon construction firms, and bids were received by May 21, 1987. A 100 percent cost increase existed between bids received and preliminary estimated costs of construction based on rough quotes from the same contractors. Hence, the design of the tailings cover test facility was modified, and Curragh Resources elected to construct the test facility using mine equipment and staff. R. McLenehan was given the responsibility for construction supervision.

On June 8th., 1987, the first Technical Advisory Committee (TAC) meeting was held in Whitehorse. Individuals present and their affiliations are given in Appendix II. The purpose of this first TAC meeting was to provide government groups and interested individuals the opportunity to review the APDP and to help Curragh in the identification of weaknesses, omissions, or concerns. Program implementation followed this TAC review.

3.0 CONSTRUCTION OF THE TAILINGS COVER TEST FACILITY

In the program for Abandonment Plan Development, the period extending from June, 1987 to October, 1987 was designated for the construction of the tailings cover test facility. This facility was specifically designed to facilitate the monitoring and evaluation of various tailings cover types with respect to their effects on acid and contaminant generation from Faro tailings. Each test plot, with its respective tailings cover, will be monitored to determine such factors as:

- i. temperature gradient
- ii. oxygen diffusion rate
- iii. acid geration rate
- iv. infiltration rate
- v. moisture content gradient
- vi. rate of advance of oxidation front
- vii. rate of advance of acid solution and contaminants.

The facility design comprises six test pits, of which one is a control pit. Instrumentation access is facilitated through three meter diameter, five meter high tanks placed in each test plot. Cover types being evaluated are:

Test Pit #1: COMPOSITE	Test Pit #4: COMPOSITE
0.6m rock	0.6m rock
0.6m unsaturated till	0.6m saturated
0.6m tail slimes	till
	0.6m tail
	slimes
Test Pit #2: GEOPOLYMER	Test Pit #5: TILL
0.6m geopolymer/tail	0.6m glacial till
mixture	
Test Pit #3: CONTROL	Test Pit #6: WATER
no cover	0.6m water

A test area containing tailings deposited over 10 years ago is also a part of the test facility. Tests within this area are designed to indicate oxidation products of the tailings after

extended oxidation.

Much of June, 1987, was required to research and order the various instruments and sensors required for each of the six test plots. Also, the equipment generally required special ordering with a minimum delivery time of two months. A complete equipment list together with suppliers and costs is provided in Appendix III. Some sensors were assembled on site by R. McLenehan and details of assembly as well as the justification to assemble rather than purchase are provided in Appendix III.

Site selection was limited to the 'Original' Tailings and 'Second' Tailings Impoundment areas. An adjacent test area containing at least ten year old tailings was the constraining factor. One major concern in choosing a site on tailings, however, was the possibility of encountering undrained, saturated clayish tailings beneath the oxidized hardpan existing at the surface. Such material is unworkable, and will not support equipment. Equipment vibrations result in a liquification type of condition and so such tailings had to be avoided.

The tailings impoundment areas remained very wet and inaccessible to equipment throughout June. On July 2, the tailings had dried sufficiently to allow the site selection to proceed. Four test pits were excavated within the Original and Second Tailings Impoundment areas to a maximum depth of 4 meters. In each pit, tailings profiles were logged and representative tailings samples were taken. A brief description of each excavation is provided in Appendix IV. The field investigation together with moisture contents determined from the samples revealed that possible test facility locations were limited. The site finally selected for the Tailings Cover Test Facility was located at 583 150 mE 6913 100mN. Site selection was based upon;

- i. the existence of relatively dry, sandy material to a depth in excess of the 3.5 m excavation depth required for the test plot instrumentation tanks.
- ii. Accessibility to an existing road. (60 m).
- iii. Accessibility to the main power line.
- iv. Accessibility to the main tailings line discharge drop box. (775 m).

The site survey was completed by July 13. The facility boundaries and original ground elevations were determined, and the necessary slope stakes required for excavation were installed. Construction of the earth works and instrumentation chambers commenced on July 15, and was completed August 7, 1987. Appendix V. contains details of construction progress, together with a summary of equipment and labour requirements.

Construction of the test facility, including instrument tank placement and berm finishing, required a total of 15 working days

of a two cubic yard back-hoe, four days of H8 cat, five days of 980 loader, and nine days of labourer time. All construction, up to the installation of the pit liners, utilized mine equipment and labour. R. McLenehan supervised the construction operations.

Some difficulties were encountered during the earthworks construction phase. One of the most serious problems resulted from the fact that the excavation area was covered with a one meter thick oxidized hardpan which proved to be exceedingly difficult to excavate. Once the material was broken up and removed by the back-hoe, the material quickly lost its oxidized bonding and became a fine sandy material. Not only was this fine material difficult to compact, but also the associated volume reduction resulted in a shortage of excavated material for the construction of berms. A considerable amount of extra equipment time was required to move and place the extra volumes of tailings required to complete the earthworks.

The next phase of the test facility construction involved the placement of high density polyethylene liners in each pit. Nilex Geotechnical Products Inc. was contracted to supply both the liner and the technical expertise for liner installation. Full liner specifications are provided in Appendix VI. Curragh Resources Inc. provided four labourers for the duration of the period and a 980 loader when necessary. Liner installation covered the period from August 11 to August 29, which was the scheduled contract period.

One technical problem was encountered during liner installation. The instrumentation tanks were placed in a side slope of each test pit and the standard method of sealing tanks from pits was not capable of maintaining liner integrity under the anticipated stresses. The tanks, however, had to be sealed from the test pits to satisfy the basic concepts of the experimental design. The solution, although simply in concept, was time consuming and required considerable skill on the part of the Nilex technicians. Basically, the tanks were fitted with pre-formed sleeves. Then a large sheet from which exact ovals had been cut were fitted over the tanks and sealed to the tank sleeves. Stresses were thus shifted to a larger surface area and liner integrity was ensured. Details of this procedure are included in Appendix VII.

With the completion of liner installation, all major test facility construction was completed. Two labourers were retained to make the final preparations for instrumentation installation. These preparations entailed cleaning the pits, installing perforated base drains, placing base drain gravel, installing instrument mesh hangers, and installing the 1.5 inch thick plywood tank windows. A week, extending from August 30, was scheduled for the completion of these tasks; however, these jobs were not finished until September 20th. A significant amount of rain during this period, and in combination with water pump failures and an electrical

failure, resulted in this delay.

Instrumentation installation commenced September 21 and was completed September 30. R. McLenahan, G. Pratt, and J. Demchuk tested and installed all instrument sensors. The instruments were cable tied to a vertical nylon meshing suspended from aviation cable. Instrument positions were determined relative to the top of the instrument tank windows. Appendix VIII. provides details of instrument positioning within each test plot. In addition to the instruments shown, vertical pvc pipe access tubes were also installed in each pit. These tubes provide access for a nuclear densometer probe from which moisture content and density over time can be recorded.

From October 1 to October 3, final adjustments were made in instrument positions, and nylon settlement indicators were attached to selected sensors. The instrument meshing was then suspended from horizontal pvc pipes, which in turn were suspended from the aviation cable by means of rubber hangers. This procedure was necessary to ensure uniform instrument settlement. Window seals were also installed during this period. Particular restraints were imposed on the sealing mechanisms allowed, the most important being that instruments at the point of penetration into the tanks had to have the capability to settle at the same rate as the tailings. Long slots were cut in the plywood windows for this purpose, but then became a problem to seal. The selected method was to use overlapping plastic shingles covered with a pleated polyethylene sheeting. At the time of installation, the probable deficiency in this design was noted; however, further project delay could not be tolerated if the project was to be continued in 1987. With the sealing system used, leakage was expected to occur but within tolerable limits. Appendix IX. details the window seal design.

Concurrent with the instrumentation installation, a tailings pipe line was constructed from the main tailings discharge line of the mill to the test facility. Connection to the main 20 inch line occurred at the drop box located at the tailings-line / road crossing, and was immediately reduced to an eight inch line. Approximately 840 meters of line were required to reach the tailings test facility, and over this length the eight inch line was further reduced to a six and then a four inch diameter.

The tailings pipe line was completed by October 3; however tailings placement did not commence until October 10. Separation of tailings was occurring at the splitting junction with the main tailings line and tailings placement could not proceed until representative tailings could be achieved and maintained. Despite numerous attempts to correct the in-place system, tailings separation persisted. The solution required the installation of a 20 inch valve and spool coupler in the main line, which could only be achieved during a scheduled mill shut-down. This work was

completed October 9th, and tailings placement began the next day.

To establish a relationship between each test plot, tailings were placed in daily lifts. Placement covered the period from October 10 to October 30, and followed the schedule provided in Appendix X. In general, two to four hour discharge events were rotated between the six test pits. The discharge was taken from the four inch supply line through a three and one-half inch flex hose. This flex hose was required so that discharge locations could be varied and excessive single point beach build-up avoided. The tailings discharge rate varied considerably with time, as is indicated in Table 1.

TABLE 1: TAILINGS PLACEMENT

TEST PLOT	VOLUME (cubic m)	TIME REQUIRED (Hours)	DISCHARGE RATE (cubic m/min.)
1.	110	35.5	0.05
2.	217	37.0	0.10
3.	240	35.5	0.11
4.	126	36.5	0.06
5.	197	38.0	0.09
6.	165	35.0	0.08
TOTAL	1055	217.5	-

A total of 217.5 hours at an average discharge rate of 0.08 cubic m/min. was required to fill the test pits. Two full time assistants were required during this entire period to ensure proper lift placement and to conduct regular tailings sampling.

Typical tailings from the mill is discharged in a composition ratio of approximately 30 percent solids to 70 percent water. During tailings placement, the decant water was pumped off the tailings solids at a location exterior to the instrumentation tanks. When tailings placement commenced, the window seals were immediately noted to be leaking at a high volume flow rate. Attempts were made to seal off these flows from the interior of each tank by applying a tar-based material. Any success, however, was very short-term. The alternative of flooding the tanks with decant water was considered more practical in that water pressure differences between the interior and exterior

of the tanks would be considerably reduced. Ultimately, though, this procedure had little effect in preventing the higher density tailings fines from flowing into the tanks.

During tailings placement, a regular tailings sampling schedule was followed. Appendix XI. provides details of the types of samples taken, together with their sampling time. Of this group of samples, 31 representative samples were shipped to B.C. Research for chemical analysis. Appendix XI. also provides a summary of on-site analyses, as well as a list of analysis requirements. Appendix XII. provides background information on ore types and typical tailings. Intensive sampling of these tailings is required to establish a detailed background chemical composition. Future changes in chemical composition in each test plot can then be compared and evaluated. Also, tailings used within the test plots can be compared to tailings being discharged from the main tailings line. Providing that a compositional relationship exists, results from the test facility can be interpolated in predicting reactions in the tailings impoundment areas as a whole.

With the completion of the tailings placement, attempts were made to remove tailings which had seeped into the tanks. Slurry pumping, using both submersible and air-diaphragm pumps, was tried. However, cold weather, a lack of a clean water source, and unsuitable pumps led to little success. From November 5 to November 14, four labourers were hired to manually 'muck' out the tanks using buckets, but cold weather reduced efficiency to an unacceptable level. Table 2. indicates the volumes within each tank which must be removed in the spring of 1988.

TABLE 2: INSTRUMENTATION TANKS AND TAILINGS VOLUMES TO BE REMOVED.

PIT	TANK DIAMETER M ²	TAILINGS DEPTH m	TAILINGS VOLUME m ³
1.	7.1	2.4	17.0
2.	7.1	0.0	0.0
3.	7.1	2.8	19.9
4.	7.1	2.5	17.8
5.	7.1	1.0	7.1
6.	7.1	2.4	17.0
TOTAL	7.1	11.1	78.8

The influx of tailings into the instrumentation tanks is the only major short-coming in project implementation in 1987, and the effects, besides inconvenience and extra expenditure in the spring, are considered minor. Drainage and settlement of the tailings in each test plot is delayed until spring; however, this is more typical of natural tailings in the Faro tailings ponds. Also, during the winter months, chemical reactions are naturally impeded. The most serious effect results from the delay in being able to test the instrumentation. Planning for replacement of any faulty equipment will be under a major time constraint. The final tasks associated with actual implementation of the tailings cover test facility will be completed by late winter/ spring. This is necessary to ensure the Tailings Abandonment Plan Development Program stays within its time schedule. These tasks, some of which were planned for this period, are:

1. Place tailings covers. Materials required are:

i. Rock (calc-silicate)	380 cubic meters
ii. Till	420 cubic meters
iii. Tailings Slimes	200 cubic meters
iv. Geopolymer/ Tailings mix	200 cubic meters
v. Water	150 cubic meters
2. Remove 79 cubic meters of tailings from the six instrumentation tanks. Arrangements must be made to acquire steam equipment by which the tailings in the tanks can be thawed. The method of removal will be investigated in more detail, especially the possibility of slurry pumping using a proper solids slurry pump with a fresh water supply.
3. Install ladders, working platforms and wall insulation in each tank.
4. Install surface drains in each test pit.
5. Test all instrumentation.

4.0 FIELD WORK: 1988

The preceding overview of abandonment development is intended to integrate and guide development of the various abandonment components over the following 2 to 4 years. A considerable amount of investigative work, though, will be done in 1988 and the details follow.

4.1 TAILINGS TEST COVER FACILITY

1. Place tailings covers on respective test plots. This work will be scheduled for April, 1988. {The geopolymer will be placed in May/June.} ~~Requirements:-~~
2. Remove tailings from interior of instrumentation tanks. Work scheduled for April/May.
3. Install ladders, working platforms, and wall insulation in instrumentation tanks. Work scheduled to follow immediately after removal of tailings from tanks.
4. Install surface drains in each test pit. Work scheduled for May.
5. Test all instruments.
6. Initiate sampling program. Scheduled for late May/June.

4.2 OTHER 1988 INVESTIGATION PROGRAMS

Other programs are in-situ investigations of the tailings impoundments and Rose Creek valley. These include:

1. Tailings (in-situ) and Foundation Soils Characterization.
2. Surface Water Characterization.
3. Groundwater Characterization.

Each program entails sampling, analysis and data evaluation. However, the major field phase of the above programs involves the installation of two wells (double completion) to facilitate the development of the groundwater baseline program and the drilling and sampling of three holes for the purpose of characterizing the tailings and subsite soils. The surface water characterization program will just be an extension of the present effluent sampling program,.

A major component of the work for 1988 will be the evaluation of the hydrology and hydrogeology in the Faro and Rose Creek valleys. The field work scheduled for the summer of 1988 is designed to remedy deficiencies in chemical and physical parameters of these flow regimes. The proposed work schedule is presented in Appendix XIII.

23 March 1990

GREGG: F.Y.I.

STZ
10/04/90

Mr. Eric Sopovich,
CURRAGH RESOURCES INC.,
P.O. Box 1000,
Faro, Y.T.
YOB 1KO

Dear Eric:

Please find accompanying this letter my proposal for the benthic monitoring program on Rose and Anvil Creeks for 1990. I warned you that it would be expensive and the total comes to \$14,618.00 but I think this figure can be reduced.

I have allowed four days per field trip which includes travel time from Whitehorse. If there is no waiting around for helicopters and all runs smoothly, less time may be taken and you'll be invoiced accordingly. I've calculated that it'll take about a week (7 days) to interpret the data and write the report which I will do myself.

The biggest cost is for the helicopter although I doubt I'll use six hours. But if Trans North charges 1/2 hour to fly from Ross River to Faro, that is one hour per field trip right there. It probably won't take two hours to fly to the sites but I am not sure if I'll be charged down-time as it does take considerable time at each site to set and retrieve the traps.

As discussed with you on the phone, if I were to rent a truck from Norcan and Curragh was charged directly, the cost would be significantly less as Curragh has a deal where they rent at special prices and do not pay a kilometer charge. Likewise, if we can stay in the guest house in Faro like I did in 1988, then there would be no accomodation costs.

I have included no costs for lab analyses as you have already something in place with Bondar-Clegg and I could not get the samples analyzed any cheaper, therefore this cost will be billed directly to Curragh. I have not included any costs for sample bottles either, as I assume I can get them directly from you or else Bondar-Clegg issues them free of charge to you in return for having your analyses done there.

In 1988, I arranged the purchase of 18 artificial substrate samplers and assume they are still in the basement of the Whitehorse office. I think I can manage to get hold of three more with no problem.

The licence does not stipulate any field analysis (Schedule B, 3a) but if you would like me to do pH, temperature, conductivity

and dissolved oxygen while I'm there, I'll be glad to comply if you can supply the meters. (Personally, I think this is important information and am surprised it is not included)

If you have any comments, questions or wish to discuss this further, you can write to me at the address below. We have acquired a radio phone and our call sign is 2M4599 on the Laberge channel. I monitor daily from 4pm to 7pm.

I'm looking forward to hearing from you soon.

Yours truly,

A handwritten signature in cursive script, appearing to read 'Bonnie Burns'.

Bonnie Burns,
P.O. Box 5111,
Whitehorse, Y.T.
Y1A 4S3

CURRAGH RESOURCES INC.

- BIOLOGICAL MONITORING PROGRAM -

Benthic Fauna Monitoring Program - 1990

Introduction

Pursant to the Northern Inland Waters Act and Regulations of the Yukon Territory Water Board, Curragh Resources Inc. is required to conduct a benthic fauna sampling program every two years. Results of this sampling program will be used to assess the downstream effects of effluent from the mills tailings ponds.

Study Objectives

Under the terms of the Yukon Territory Water Licence, a benthic fauna sampling program must be undertaken. The Yukon Territory Water Board recommends that three replicate benthic samples be collected from seven different sampling locations. The samples are to be collected using artificial substrate samplers and each sampler must remain in situ for a duration of five weeks. Organisms are then to be removed, identified and enumerated. In addition water samples are to be collected and analyzed for total hardness, alkalinity, sulphate, suspended solids, ammonia and total and dissolved metals: copper, lead, iron and zinc. Also water samples to be analyzed for total cyanide are to be collected from R2, R3, and R4.

The seven sampling stations are located:

- R1 Above the confluence of the North Fork and South Fork of Rose Creek
- R2 In the mixing zone downstream of the intersection of the Rose Creek diversion canal
- R3 Rose Creek about one-half way to Anvil Creek
- R4 Rose Creek just above Anvil Creek
- R5 Anvil Creek just below the confluence of Rose Creek
- R6 Anvil Creek immediately upstream of Rose Creek
- R7 North Fork of Rose Creek upstream of the confluence with the Faro Creek diversion.

Study Duration

Approximate sampling starting date:	July 30, 1990
Approximate sampling termination date:	Sept. 4, 1990
Final Report:	Dec. 31, 1990

Estimated Person Days

	RA	BB
1. Data Collection	8	8
2. Data Analysis		4
3. Report Preparation	—	<u>3</u>
TOTAL	8	15

RA Research Assistant
BB Bonnie Burns, Project Manager

Estimated Study Costs

Professional Services

B. Burns	120 hr @ \$35.00/hr	\$4200.00
Research Assistant	64 hr @ \$30.00/hr	<u>\$1920.00</u>
	SUBTOTAL	\$6120.00

Disbursements

Absolutes:

Helicopter Rental (Trans North)	\$675.00/hr + \$63.00/hr fuel @ 6 hr	\$4428.00
Sample Identification (Victoria, B.C.)	21 samples @ \$90.00/sample	1890.00
Meals	4 days @ \$32.00/days x 2 persons	256.00
Miscellaneous	film, shipping, preserving materials, rope etc	250.00
Petrol for vehicle	\$125.00/trip x 2 trips	<u>250.00</u>
	SUBTOTAL	\$7074.00

Subject to Alteration

Truck rental	\$54.00/day x 8 days	432.00
Transportation	750 km @ \$0.28/km x 2 trips	420.00
Accomodation (Redman's Motel)	6 nights @ \$50.00/night x 2 persons	<u>600.00</u>
	SUBTOTAL	\$1424.00
	TOTAL	\$14,618.00

Notes to Bentley

- 1/ helicopter charge too low
- 2/ no amt. for vehicle rental
- 3/ meals for only 4 days
- 4/ lab costs
- 5/ nothing for accommodation

1/ helicopter s.b. 4 or 5 days

$$\begin{aligned} \therefore 5 \text{ days @ min. charge } 4 \text{ hrs. / day} \\ = 20 \text{ hrs.} \times \$675 \text{ (rental)} + 20 \text{ hrs} \times 63 \text{ (fuel)} \\ = \$14,760 \end{aligned}$$

$$(14,760 - 4428 = \$10,332)$$

$\therefore 4 \text{ days}$

$$\begin{aligned} * &= 16 \times 675 + 16 \times 63 = \$11,808 \\ &= (11,808 - 4428 = \$7,380) \end{aligned}$$

$$2/ 8 \text{ days} \times \$150 / \text{day} = \$1,200$$

$$3/ 4 \text{ days} \times \$32 / \text{day} \times 2 = \$256$$

$$4/ \text{ next pg } (\$2805.00)$$

WATER QUALITY TESTING

TOTAL HARDNESS

$$\begin{aligned} (\text{Ca, Sr, Mg}) &= \$24.50 \times 7 \text{ SITES} \times 2 \text{ EVENTS} \\ &= \underline{\$343.-} \end{aligned}$$

$$\text{SO}_4 = \$16.20 \times 7 \times 2 = \underline{\$226.80}$$

$$\text{SUSP. SOLIDS} = \$9.00 \times 7 \times 2 = \underline{\$126.-}$$

$$\text{NH}_3 = \$22.00 \times 7 \times 2 = \underline{\$308.-}$$

$$\text{TOTAL METALS (Cu, Pb, Fe, Zn)} = \$31.50 \times 7 \times 2 = \underline{\$441.-}$$

$$(\text{DISSOLVED Cu, Pb, Fe, Zn} = \underline{\$441.-})$$

$$\text{CN (TOTAL)} = \$35.- \times 3 \times 2 = \underline{\$210.-}$$

$$(\text{CN (WAD)} = \underline{\$210.-})$$

$$\underline{\underline{\$2,305.80}}$$

5/ ACCOMMODATION

$$3 \text{ NIGHTS} \times 2 \text{ PERIODS} \times \$110 / \text{NIGHT} = \underline{\$660.-}$$

$$\text{TOTAL EXTRA} = \underline{\underline{\$13,001.80}}$$

Board, especially in regard to the North Fork rock drain, would have serious consequences for the licensing process for the Vangorda Plateau development as well as for the upcoming Water Board hearing related to the Faro mine abandonment plan.

BREAKDOWN OF ITEMS AND EXPENSES

Expenses will be incurred during June and August field trips and during data collation and report writing in the autumn. These expenses are itemized below.

1. Professional Fees			
Biologists (@ 260.00/day)	332 [✓]	68.5 days	17,810.00 [✓]
Technician (@ 175.00/day)	100 [✓]	18.0 days	3,150.00 [✓]
			20,960.00
2. Disbursements			
Airfare	590 [✓]		1,296.00 [✓]
Vehicle Rental	341 [✓]		4,455.00 [✓]
Food and accommodation	590 [✓]		3,990.00 [✓]
Air freight	316 [✓]		328.00 [✓]
Helicopter charter	349 [✓]		4,390.00 [✓]
Equipment rentals	341 [✓]		2,650.00 [✓]
Fish scale analysis	411 [✓]		250.00 [✓]
Telephone	550 [✓]		300.00 [✓]
Maps, air photos, courier, film	399 [✓]		148.00 [✓]
Drafting, report production	364 [✓]		700.00 [✓]
			18,257.00

TOTAL STUDY BUDGET

\$39,217.00

39467



Golder Associates Ltd.

CONSULTING ENGINEERS

April 11, 1990

Ref. No. 892-2406

Curragh Resources Inc.
P.O. Box 1000
Faro, Yukon
Y0B 1K0

VIA FAX (403) 994-2664

Attention: Mr. Eric Soprovich, Environmental Engineer

RE: ROSE CREEK DIVERSION CHANNEL- EFFECT OF ICING

Dear Sir,

In confirmation of our conversation yesterday we have examined the survey data you provided concerning ice level in the canal as it may affect flow capacity.

The results of the survey indicate that the channel still has a minimum of 2 metres of available flow depth. On this basis, and using the channel design grade and making adjustments for the very smooth ice surface compared with the roughness of riprap, the channel would still convey its design capacity.

Another consequence of the channel icing is that the weir cascade is perhaps also heavily glaciated. Should this be the case, the energy dissipating function of each weir will be substantially compromised and the flow velocity will increase with distance downstream in this reach of the canal.

Because high velocity flows could damage the exposed sideslopes it would be wise to inspect the weir cascade section to determine if our concern is justified. Should the justification be warranted, you might consider ripping and angle dozing a shallow channel in the centre of the channel just upstream of the first weir. Its purpose would be to encourage the flow toward the centre of channel as it starts down the cascade, and hopefully to melt the ice down the centre of the cascade section, hence to discourage flow along the walls of the channel.

The upstream end of the second cascade of weirs should be similarly viewed but, in this case the ice surface pilot ditch should extend all the way through the flat section between the two weir cascades. In this regard I recall that Cyprus Anvil raised the right dyke along this section because the channel was entirely filled with ice in the

Faro Mine
Env
Rose Creek
T. Y. I.
E.

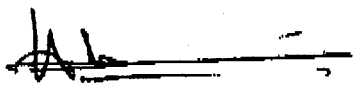
GREEN:

spring of 1983. Part of their strategy was also to cut a pilot channel in the ice surface.

I would think that the timing for any ice ditching should be to do it as late as possible because premature activity could well induce snow trapping and an acceleration of ice accretion, particularly if the activity collapses the flow conduit beneath the ice.

I hope this has been helpful concerning your preparation for the spring runoff.

Yours truly,
GOLDER ASSOCIATES LTD.


H.G. Gilchrist, P.Eng.

P.A. HARDER & ASSOCIATES LTD.

BIOLOGICAL CONSULTANTS 2718 AVEBURY AVENUE, VICTORIA, B.C. V8R 3W4 (604) 592-8019

G. Jilson
RECEIVED JUN - 8 1990
Faro Mine
Env
Water Supply

June 5, 1990

Mr. Eric Soprovich
Environmental Control
Curragh Resources Inc.
P.O. Box 1000
FARO, YUKON
Y0B 1K0

Dear Eric:

RE: Rose Creek Reservoir Bathymetry

I have recently sent five copies of a bathymetry map of the reservoir to your office under separate cover.

This map was produced on the basis of six sonar sounding transects conducted in August 1989. Our objective was to obtain some information on potential surface areas and water depths of the reservoir following modification of the dam at mine closure. A number of crude estimates of total water volume at given depth contours were made from digitized measurements. These are presented on the map. Relationships between water depth and reservoir volume and surface area are presented on the attached two figures.

I hope that this information will be useful to you and the mine staff. Please call me if you have any questions or would like additional copies.

Yours truly,

P.A. Harder and Associates Ltd.

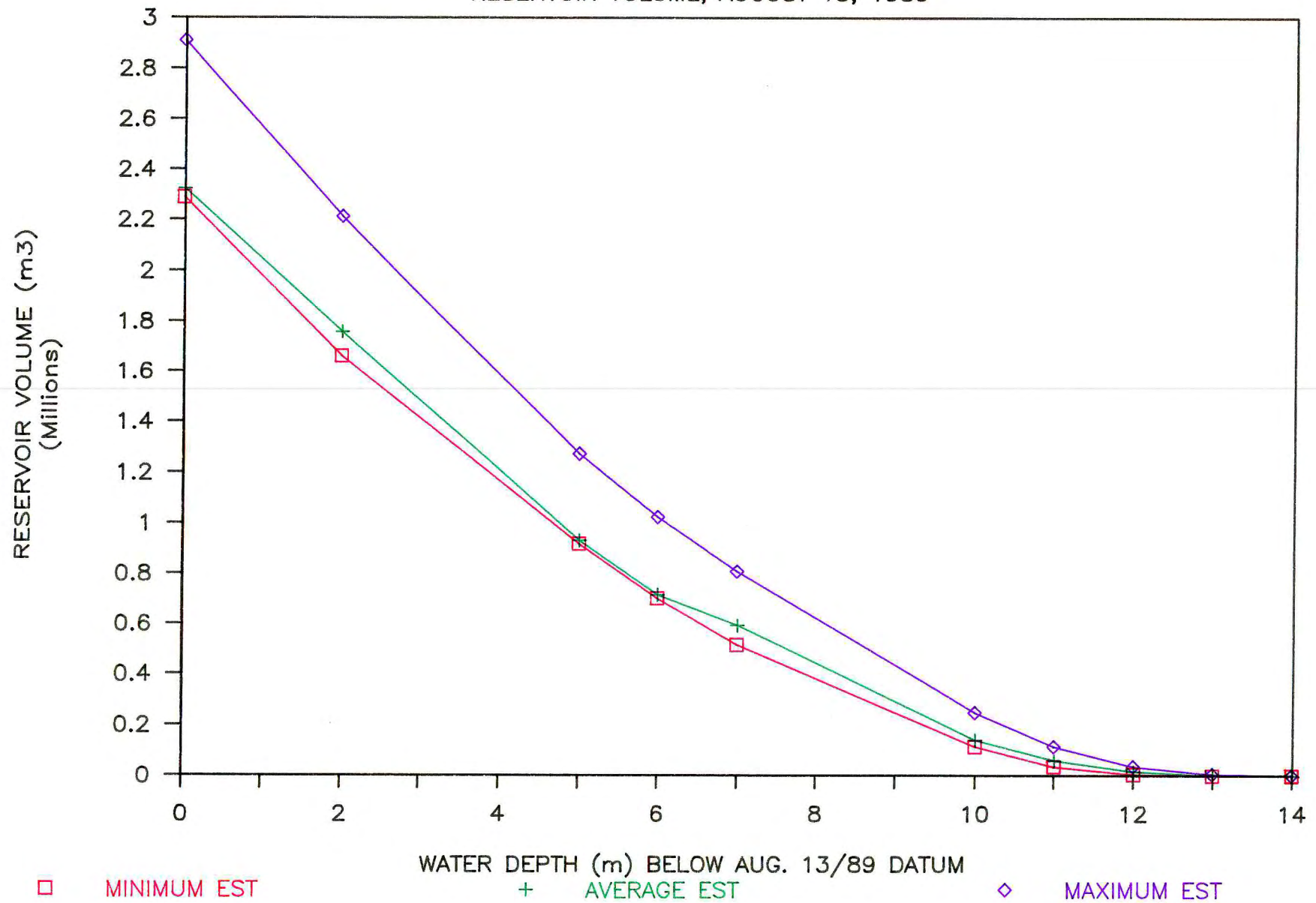
PAH

P.A. Harder
Consulting Biologist

cc. Mr. G. Jilson (letter only)

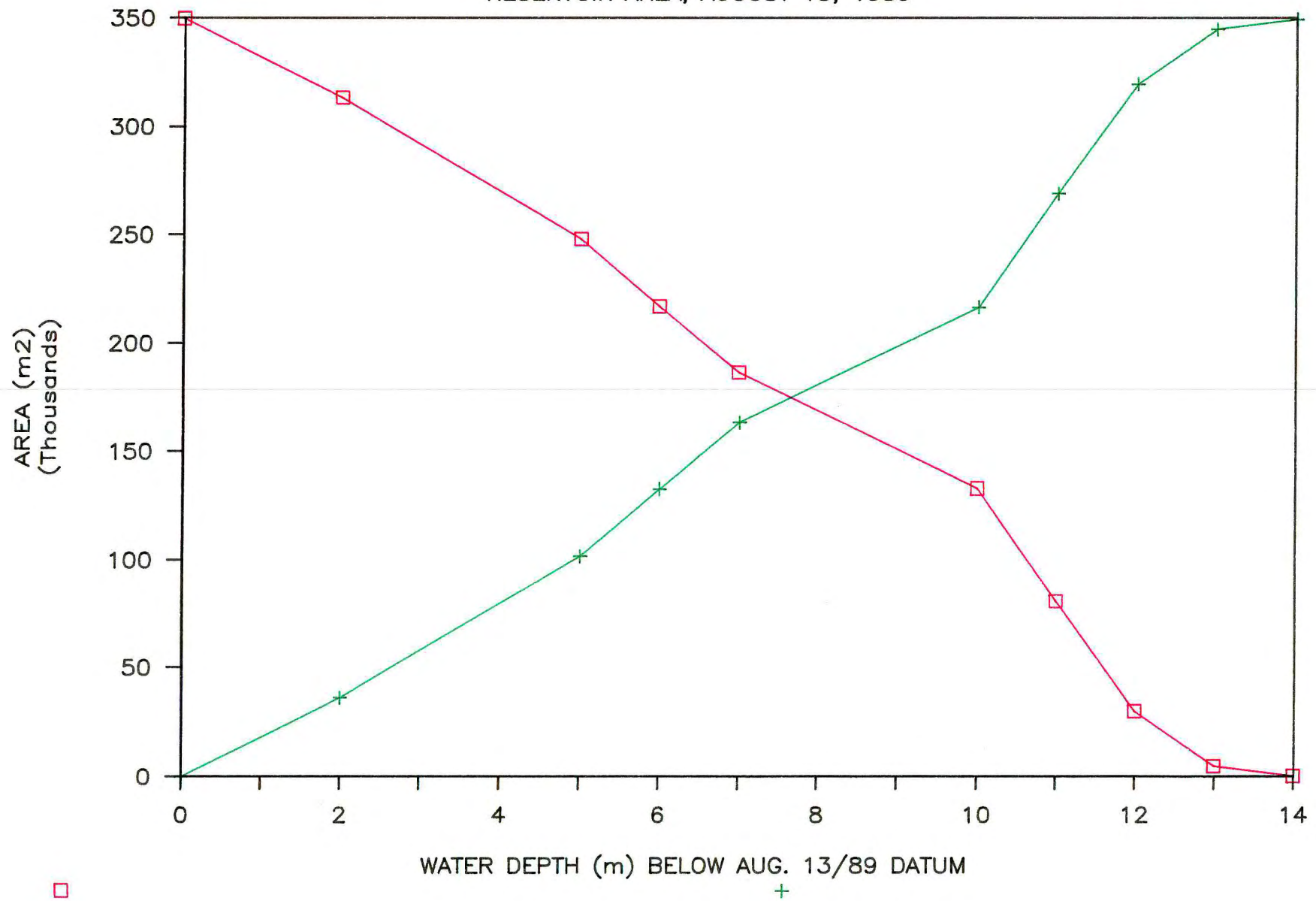
ROSE CREEK RESERVOIR

RESERVOIR VOLUME, AUGUST 13, 1989



ROSE CREEK RESERVOIR

RESERVOIR AREA, AUGUST 13, 1989





**Curragh
Resources Inc.**

Faro Mine
EW
Waste Disposal
P.O. Box 1000
Faro, Yukon
Y0B 1K0
Tel.: (403) 994-2600

June 8, 1990

Mr. Ernst Bichler
Plant Superintendent
Metafina Chemicals
221 McQueston Road
Faro, Yukon
Y0B 1K0

Green:
F.Y.I.
Σ

HAND DELIVERED

Dear Sir:

Curragh Resources is reviewing second-party access to the Faro Mine property. This includes Metafina's request for access to the mine tailings area for disposal of degraded xanthate product and by-product.

It is the intent of Curragh to assist Metafina, where possible, with the disposal of denatured xanthate and xanthate by-product in an environmentally safe and responsible manner. Curragh Resources needs to know the composition, amount, and timing of future proposed xanthate product disposal by Metafina in the tailing pond area.

To best enable the safe disposal of degraded xanthate and by-product, the following program is proposed:

- 1) Metafina will contact Eric Soprovich at 994-2600 (ext. 245), or in his absence the General Manager at 994-2600 (ext. 230), with their intent.
- 2) Metafina will collect a sample representative of the material proposed for disposal under the observation of a Curragh Representative. The sample will be divided and a portion sent to a qualified laboratory for analysis at Metafina's expense. The remaining portion of the sample will become the property of Curragh Resources.
- 3) Metafina will provide Curragh Resources with a true copy of the statement of analysis which will bear the signature and seal of the analyst. Curragh Resources will use this information and the results of its own inquiries to determine if, where and under what conditions disposal within the tailing pond system will be allowed.
- 4) Except in accordance with the above three conditions and the full consent of Curragh Resources, Metafina shall not enter Curragh property for the purpose of waste disposal.

Cont'd.../2

Mr. Ernst Bichler
June 8, 1990

Page 2

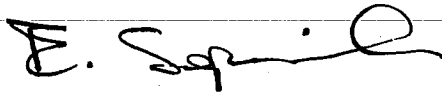
The intent of Curragh Resources is that the disposed material would be "neutralized" or otherwise made inert so that it would not be a liability to Curragh Resources.

Again, I would like to stress that Curragh wishes to assist Metafina Chemical in any way possible with the safe and responsible disposal of the denatured xanthate and by-product.

I would like to discuss this matter further with you and seek your comments and improvements. Please call me at 994-2600, extension 245.

Yours truly,

CURRAGH RESOURCES INC.

A handwritten signature in dark ink, appearing to read 'E. Soprovich', with a stylized flourish at the end.

E. Soprovich
Environmental Engineer

ES/rc

cc: W.J. Weymark

RECEIVED JUL 23 1990

Faro Mine
FW
Water Pump

TELEFAX TRANSMISSION

CURRAGH RESOURCES INC.

Telephone: (403) 668-8021
Telecopier: (403) 668-8518

TO: FAX #: Faro Minesite

Eric Soprorich

FROM: Gregg A. Jilson

Vice-President, Exploration

WHITEHORSE OFFICE

DATE/TIME: July 4, 1990 @ 1:55 p.m.

SUBJECT: COMMENTS ON YOUR MAY MONTHLY REPORT TO
Y.T.W.B.

1. Why did pH of X22A drop to 4.14?
2. Are PW4 & 5 wells shut off for the summer now? *Yes*
3. X2 has cooled off but is the load actually the same, has anything been done to trace back to the source of this load and to stop it? What is going on to lower water levels in Zone 2? *→ looking for pump for 4" well*
4. X3 likewise has cooled off - I presume this is due to stopping flow from wells - is anything being done to contain the well water or replace it? What is the status of this issue? *SAFE in for signatures ~ 3 mos. delayed*
5. Analytical suite for X22, X22A should include zinc.

→ has been implemented?

jilson\sopytwb.fax

If all pages are not received, please contact Geraldine at 668-8034

THIS TRANSMISSION CONSISTS OF ONE PAGE
(including cover page)

TO: GREGG JILSON
V.P. of EXPLORATION

FROM: E. SOP
ENV. ENG.

RE: MAY MONTHLY REPORT TO Y.T.W.B. -
ANSWERS?

1.0 NOT SURE WHY X22A PH DECREASED
SUDDENLY. AARNO HAD NOTICED A
DISTINCT "RUSTY" COLORATION TO THE
DISCHARGE WATER BUT NEVER
MENTIONED SAME. POSSIBILITIES FOR
HIGH Fe Cu , HIGH SUSP. SOLIDS, LOW PH:

SOME TYPE/REASON FOR
1/ MAYBE A AGITATION WITHIN 4030
LEVEL SUMP CAUSING
SUSPENSION OF SETTLED
PARTICLES / PRECIPITATED
COMPONENT;

2/ PH ANOMALY? PH IN
JUNE @ 7.35 (SEEP SURVEY).

~~2.0~~

2.0 YES - WELLS ~~SH~~ TURNED - OFF MARCH/
APRIL.

3.0 LIKELY INFLUENCE OF SURFACE
WATER FLUSHING. A COUPLE OF
STAINED POOLS NEAR A.F. ROSE CR.

RECENTLY SAMPLED - NO ANALYSIS RESULTS YET. - SHALLOW GROUNDWATER WILL HELP DEFINE.

LOOKING FOR PUMP FOR 4" WELL - IF SUCH A HIGH CAP / LOW DIA. PUMP IS AVAILABLE.

4.0 CONTAINMENT / CONTROL IS THE PLAN OF ATTACK. CONTAINMENT OF PW4 / PWS INTO PUMPHOUSE STILLING WELL & CONTROL OF FLOW OUTPUT FROM WELLS FROM REMOTE (MILL) STATION. AFE WAS PREPARED & SUBMITTED BY MILL ^(MARCH/APRIL). ACCORDING TO JERRY O'BRIEN; THEY ARE STILL AWAITING APPROVAL.

5.0 THIS WAS DISCUSSED WITH AARNO MID-MAY. FULL SUITE (AS PER SEEP PROGRAM) ^{WAS} ~~BEING~~ ~~BE~~ RENEWED FOR MID-JUNE SAMPLE SET.

DR. ~~PIGAGE~~ WILL BE MOORE SPOKE TO THAN ~~WELCOME~~ MID-LATE HIM. ~~JUST~~ AT HIS CONVENIENCE. ARRANGED ~~THANKS~~ — E. MID AUG.

Anderson:

July 20

4.0 - talked to Jerry O'Brien
today

↳ AKE was submitted March 1998
& is not yet signed

↳ Jerry feels if not done
this summer then this
project may have to
wait until next yr.

- Possible to do some
work on operating
budget

↳ note: AKE for water
conservation studies
also not signed
∴ nothing done here
yet

- Jerry has suggested he will
review priority AKE's with
Eric B. next week &
is aware of the
requirement vis Axis Inc.

new file -> i am under Plot
Benthic Invertebrate
Faro Mine

cc. Eric Soprovich

P.A. HARDER & ASSOCIATES LTD.

BIOLOGICAL CONSULTANTS 2718 AVEBURY AVENUE, VICTORIA, B.C. V8R 3W4 (604) 592-8019

MEMO TO: Bonnie Burns
C/O Geraldine Brownlee

Date: July 11, 1990
From: Paul Harder

Subject: Benthic Invertebrate Work

A few last minute notes regarding your up-coming field project.

- Chris Perrin is booked on the Canadian Air flight arriving in Whitehorse on July 17 at 10:20 am. Could you please pick him up at the airport. Chris can be reached at (604) 222-3577 and he has Geraldine's number as a contact for you.
- I purchased 11 sample baskets. Chris is bring 3 of them, while the others are being shipped by bus to Whitehorse. Geraldine will be notified when they are in (probably Monday or Tuesday)
- Please contact Eric Soprovich when you arrive in Faro as he will be providing some help for Chris and needs to be informed of the sample collection procedure for the algae work.
- Could you please pick up a townhouse key for Chris from the Curragh office. Please call Chris next week and see if there is a need to purchase any materials in Whitehorse before his arrival.
- There is some overlap in reporting responsibilities between you and Chris Perrin. I will discuss this with you in August.

Thanks very much. Hope all goes well. I will be back in my office on July 31 and will be in Whitehorse on August 7.



CURRAGH RESOURCES INC.

Inter-Office Memorandum

TO: Leo Hwodyk
Project Super.
Faro Minesite

FROM: Gregg A. Jilson
Vice-President, Exploration
Whitehorse Office

cc: Eric Soprovich
Environmental Engineer
Faro Minesite

RE: **WATER TREATMENT PLANT CLARIFICATION POND**

DATE: 08 14 1990

Eric Soprovich and others have advised me that the south corner of the clarificatoin pond shows signs of instability (longitudinal cracking).

This is of concern in that there is yet no water in the pond and I would presume that the situation will worsen as the pond fills. A failure of this pond would be a major problem for the company. I suggest that this instability be investigated and if there are construction deficiencies that the contractor be required to correct them before the pond is operational.

CURRAGH RESOURCES INC.

Inter-Office Memorandum

TO: Bill Dunn
Chief Engineer
Faro Minesite

FROM: Gregg A. Jilson
Vice-President, Exploration
Whitehorse Office

cc: Eric Soprovich
Environmental Engineer
Faro Minesite

RE: **PELLE POND WATER**

DATE: 08 14 1990

Recent analyses show that water in the Pelle Pond is not suitable for discharge to the environment due to high total lead. Since we have not yet discharged to date the water level is rising to the point where stability is a concern, especially if there were a sudden rainfall event.

I suggest that our contingency plan of lime or soda ash treatment to elevate pH and precipitate metals be implemented so that Pelle Pond water can be discharged or used for dust suppression. It is important that the pond water level be kept low enough so that the pond has some surge capacity. If treatment succeeds in depressing metal levels in the pond water, then it seems reasonable that not only the pond water but also seepage collected in the contractor's sump in Little Creek would be suitable for release to the environment if suspended solids levels are acceptable.

Terry Lee will be responding on the best way to implement the contingency treatment. It should be possible to rig together a circulating system with lime slurry injection into the water line and in-line mixing, possibly helped along with in-line mixers. If flocculents are needed it may be possible to inject them too, however this may prove to be too elaborate. Such an operation could be worked part-time and the water decanted after an allowance of time for settling the precipitate. As the parts could be used for other things afterwards, this will probably be cheaper than the launder box concept proposed by Rescan. Once the treatment plant is connected there will be no need for this scheme.

...../2

Memorandum
Bill Dunn
August 14, 1990
Page Two

Please contact me if you have any questions or concerns.

I agree that it would be appropriate to confirm the lead and zinc levels at an outside laboratory as the lead results do seem strangely high for waters of this pH.

*Vangold
Rose
Creek*

CURRAGH RESOURCES INC.

Inter-Office Memorandum

TO:

FROM: Gregg A. Jilson
Vice-President, Exploration
Whitehorse Office

RE:

DATE: 08 27 1990

Last year Environmental Protection Service of Environment Canada prepared a report summarizing compliance with the Federal Metal Mine Liquid Effluent Regulations at a number of mines. This report indicated periods of exceedance of discharge standards, the mines who that exceeded and indicated the reasons. The report was forwarded to The Mining Association of Canada who asked all member companies to review the report and review their compliance.

Our compliance has generally been good. You will note in the report that in 1986 Curragh was indicated - though not cited - as having exceed the Metal Mine Liquid Effluent Regulations due to discharges from Zone 2. After reviewing the monthly reports to the Water Board on the water quality analysis at Station X2 (the north fork Rose Creek at the Haul Road crossing) and the water level records in the Zone 2 monitoring well. It is quite apparent that Zone 2 has filled up and is leaking apparently due to percolation through its walls so that contaminated water is discharging into Rose Creek. Ground water wells confirm the leakage with waters up to 139 mg/l having been detected in shallow groundwater.

Currently the levels in Rose Creek are exceeding the guidelines for the protection of the adequate environment recommended by the Canadian Council of Environment Ministers. It is imperative that something be done to bring the water level in Zone 2 down so that this seepage of contaminated water ends. There appear to be two options:

1. Try to draw down the water through a drain pipe placed in Zone 2 before it was backfilled; and
2. Drill a well with a diameter suitable for a large capacity pump to be placed in it into the deep part of Zone 2.

- 2 -

The second option would appear to be more practical from a long term point of view, however it will likely to be more expensive. I strongly recommend that these options be examined and some action taken on this situation.

Fas Mine
Gm
Corresp.

CURRAGH RESOURCES INC.

Inter-Office Memorandum

TO: Bill Weymark
Vice-President and General Manager
Faro Office

FROM: Gregg A. Jilson
Vice-President, Exploration
Whitehorse Office

RE: Environmental Audit

DATE: 08 28 1990

I have arranged for Rescan Environmental Services to prepare a proposal for carrying out an environmental audit of our western Canadian operations and development projects. They will be forwarding a proposal shortly with a budget schedule and outline for the audit. Should we proceed, I anticipate that the audit could be carried out around mid-September so that the results could be reviewed with the Mine and Project Management prior to November.

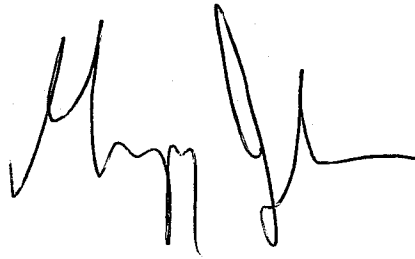
Prior to this audit it may well be worth while to cover off a few items which we know are weak points. These include training related to contingency plans, zinc contamination from Zone 2, lack of a water license for the Grum and Vangorda Project, the culvert in Vangorda Creek, the lack of suitable screening and licensing for possible activities in the Hundere Project.

An environmental audit is an essential step in establishing due diligence on behalf of the directors and officers of the Company. The Canadian Environmental Protection Act and up and coming legislation, which more directly affects mining, require that Curragh must be in a better position to demonstrate due diligence. The Company has also made strong arguments in support of its contention that our good environmental record does not require bonding to re-enforce our performance on the Vangorda Plateau Project. The record of Curragh is well established, however inevitably making references to our record in this fashion will cause someone to try and take a pot shot at us.

The environmental audit will help identify the points where we may need some improvement of our environmental performance and allow us to continue to trade on our good record of compliance and honouring of commitments in future negotiations with Government.

- 2 -

I would like to meet with you, and our new Environmental Manager, Gerry Acott, to discuss this in relation to the Faro operation on September 7 at Faro if you are available.

A handwritten signature in black ink, appearing to be "M. J. Acott", written in a cursive style.

CURRAGH RESOURCES INC.

Inter-Office Memorandum

TO: Bill Weymark
Vice-President and General Manager
Faro Office

FROM: Gregg A. Jilson
Vice-President, Exploration
Whitehorse Office

RE: Zone 2 Water Level

DATE: 08 28 1990

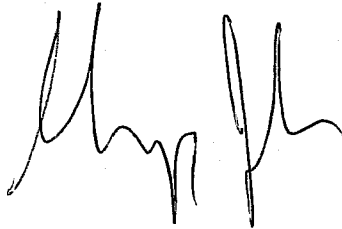
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Our compliance has generally been good. In the report Curragh was indicated - though not cited - as having exceed the Metal Mine Liquid Effluent Regulations in 1986 due to discharges from Zone 2. After reviewing the monthly reports to the Water Board on the water quality analysis at Station X2 (the north fork Rose Creek at the Haul Road crossing) and the water level records in the Zone 2 monitoring well. It is quite apparent that Zone 2 has filled up and is leaking apparently due to percolation through its walls so that contaminated water is discharging into Rose Creek. Ground water wells confirm the leakage with waters up to 139 mg/l having been detected in shallow groundwater.

Currently the levels in Rose Creek are exceeding the guidelines for the protection of the aquatic environment recommended by the Canadian Council of Environment Ministers. It is imperative that something be done to bring the water level in Zone 2 down so that this seepage of contaminated water ends. There appear to be two options:

1. Try to draw down the water through a drain pipe placed in Zone 2 before it was backfilled; and
2. Drill a well with a diameter suitable for a large capacity pump to be placed in it into the deep part of Zone 2.

The second option would appear to be more practical from a long term point of view, however it will likely to be more expensive. I strongly recommend that these options be examined and some action taken on this situation.

A handwritten signature in black ink, consisting of several loops and a long horizontal stroke at the end.

Attachments: EPS report

CURRAGH RESOURCES INC.

117 Industrial Road
Whitehorse, Yukon
Y1A 2T8

Tel: (403) 668-8021
Fax: (403) 668-6518

TELEFAX TRANSMISSION

TO: Bill Weymark, Vice-President and General Manager

FARO OFFICE

FROM: Gregg A. Jilson, Vice-President, Exploration

WHITEHORSE OFFICE

DATE: 28 August 1990 **TIME:** 3:00 pm PST

SUBJECT: Memos as attached:

1. Environmental Audit

2. Zone 2 Water Level

If all pages are not received, please contact Geraldine at 668-8034

**THIS TRANSMISSION CONSISTS OF 5 PAGE(S)
(including cover page)**

CURRAGH RESOURCES INC.

117 Industrial Road
Whitehorse, Yukon
Y1A 2T8

Tel: (403) 668-8021
Fax: (403) 668-8518

TELEFAX TRANSMISSION

TO: Bill Weymark, Vice-President and General Manager
FARO OFFICE

FROM: Gregg A. Jilson, Vice-President, Exploration
WHITEHORSE OFFICE

DATE: 28 August 1990 TIME: 3:00 pm PST

SUBJECT: Memos as attached:

1. Environmental Audit
2. Zone 2 Water Level

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(Including cover page)

TRANSMISSION REPORT

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1	GENERAL MANAGER	8-28-90 3:31PM	2'42"	5	

TOTAL 0:02'42" 5

XEROX TELECOPIER 7020



STEFFEN ROBERTSON AND KIRSTEN (B.C.) INC. Consulting Engineers
Suite 800, 580 Hornby Street, Vancouver, B.C. Canada V6C 3B6
Phone: (604) 681-4186 Fax: (604) 687-5532

MEMORANDUM

TO: Eric Soprovich - Curragh Resources

DATE: October 17, 1990

FROM: Dave Harpley

PROJECT NO: 60626

RE: Faro Tailings Impoundment Decommissioning:
Tailings and Potential Cover Materials Hydraulic Tests

I refer to our letter to Gregg Gilson dated July 18, 1990 which sets out the tasks and budgets for the Faro Tailings Impoundment Decommissioning Investigation Program. Task E of this program consists of the modelling of various decommissioning options, which principally includes a number of tailings cover alternatives, and the resulting impact this has on the groundwater and ultimately the surface water.

Having reviewed the objectives and content of the modelling program in detail, including the methodology and approach to the modelling of acid generation in the tailings as a function of cover type, we find that we are lacking an essential component of the database. This component consists of the response of tailings and cover materials to infiltration and drainage cycles in terms of moisture content. The rate of acid generation is largely a function of oxygen and water supply to sulphides. Oxygen diffusion through covers and tailings is mostly dependent on moisture content, the higher the saturation the lower the diffusion.

There are two fundamental relationships which determine the ability of a material to adsorb/transmit water:

- capillary pressure (h_c) vs. degree of saturation (θ)
- relative permeability (k_r) vs. degree of saturation (θ)

With the former relationship and the saturated hydraulic conductivity (K), the latter relationship can be reliably estimated. Accordingly, we wish to supplement the existing database by submitting a number of tailings and potential cover material samples for laboratory testing. The estimated cost of this exercise which is additional to existing budgets is as follows:

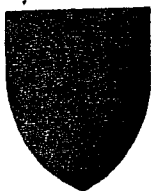
laboratory testing	-	13 samples for h_c vs. θ , K	650
	-	4 samples for same plus compaction	600
professional time	-	3 days at \$560/day	1 680
TOTAL			\$2 930

cc.

G. Gilson

G Acott





Curragh Resources Inc.

117 Industrial Rd.
Whitehorse, Yukon Y1A 2T8
Tel.: (403) 668-8021
Fax: (403) 668-6518

VIA COURIER

October 29, 1990

Kilborn Limited
2200 Lakeshore Blvd W.
Toronto, Ontario
M8B 1A4

Attention: **Mr. John Goode**
Vice-President, Metallurgy

Dear Sirs:

The Faro Division of Curragh Resources Inc. have recently extended their operational life as a result of successful application through regulatory agencies for extension into the Vangorda and Grum Area. Some 47 million tonnes of ore are available for development with additional future expansion potential within the Dy and Swim Areas. The Faro Division is now facing some immediate decisions for short and long term tailings disposal, process water recycling and mine closure/reclamation. We would invite your firm to submit a proposal, based on the following terms of reference, to assist us in the identification of various options toward the resolution of these questions.

1.0 TAILINGS DISPOSAL

For the foreseeable future, the plant will operate at an average of 13,000 tonnes per day for a projected mine life of 9.9 years based on current proven reserves. Tailings will be produced at an average rate of 11,400 tonnes per day for a total life-of-mine projection of 41.2 million tonnes. Assuming future development will add reserves estimated at 35% of the current base, a life-of-mine tailings disposal option should accommodate 55 - 60 million tonnes of consolidated tailings solids.

Surface operations within the Faro Pit are expected to be completed in early 1991. An underground mining operation has been developed from the pit bottom and is currently producing at 2,300 tonnes per day. The underground mine poses a constraint on tailings disposition as there is limited space below the portal. It is possible that this operation may be terminated as early as October 1991 to allow in pit tailings disposal however, it is anticipated that

mining will extend through the end of 1991. The current tailings disposal facility in Rose Creek Valley is approaching maximum capacity for the design phase and it appears that the Faro Pit should be utilized for this purpose as soon as it is available. It will be to Curragh's advantage to prolong the use of Rose Creek Valley as long as possible in order that underground mining in and from the Faro Pit can be maximized.

To fulfil the scope of the study, the following items should be considered:

1.1 Options available to extend the life of the current tailings disposal facility by:

- (i) raising the Intermediate Dam by one meter increments from its current 1078 m elevation through to design capacity of 1083 m. To assess this option it is necessary to quantify the additional tailings volume gained by each increment, and the additional time available, versus the cost of dam construction as a total and on a cost per tonne of tailings basis. Reliable information on this relationship is not currently available.
- (ii) moving the tailings discharge location closer to the Intermediate Dam thereby taking advantage of the unused capacity adjacent to the dam. Again there is missing information needed to assess this option.
- (iii) constructing additional "plug" dams at the current tailings entry point to build a higher beach area at the upper end of the pond.
- (iv) depositing tailings below the Intermediate Dam in the area currently maintained as a polishing pond for final water treatment above the Cross Valley Dam.
- (v) various combinations of (i) through (iv).

A comprehensive assessment of water quality related to each of the above options will be an integral part of this discussion. Should additional water treatment be required, the cost of that treatment should be included in the cost of the option.

1.2 Options available for tailings consolidation and disposal

- (i) disposal of tailings in the same form as it currently exits the mill (i.e. 8.5% solids).
- (ii) thicken the tailings to higher solids content to minimize pumping costs. Evaluate the possible degrees of thickening which could be achieved by various currently available technologies and the pumping alternatives which would be employed. Consider the possibilities of thickening at locations other than the mill. The proposal must consider cold weather operating conditions and maintenance requirements for any remote installations.
- (iii) splitting the components of the tailings between coarse and fine and directing the slimes to the existing tailings facility. The capping of current tailings with slimes may have final closure advantage as they will restrict percolation and limit the rate of oxygen transport and thus oxidation.

In each case, the consultant will provide a costing evaluation of the capital and operating expenditures required for the option. Where appropriate, these costs should be balanced against savings in future pumping or reclamation expense. Costs will also be presented on a "per tonne" of tailings basis.

2.0 VOLUME DETERMINATIONS

Through discussion with the Engineering and Processing Groups, develop a more accurate schedule of future tailings volumes. Characterize the tailings of Vangorda and Grum in comparison with those of the Faro Pit and estimate any differences in bulk density, settling and compaction characteristics, corrosion potential or composition. Comment on any expected differences in water quality which may be caused by the various reagent schemes for Faro and Vangorda Plateau ores or the tailings themselves and any mitigative measures which may be required should water quality deteriorate.

Air photography will be made available for the tailings pond area for three time periods: 1) before any construction (1964); 2) before operations of Curragh in 1985 (pond flooded but no tailings in it yet); and 3) on September 19, 1990. These resources are available to compare the calculated volume of tailings deposition over that time period with production records and thereby

arrive at a more accurate assessment of bulk density for tailings discharged. This may require a field bathymetric survey for the submerged tailings adjacent to the Intermediate Dam. Bulk density estimates should also be derived for the products of thickening as discussed within Section 1.2.

Through volume calculation of the Faro Pit as provided by Mine Engineering, taking into account final in-pit waste dumps, determine the time required to fill the Faro Pit with consolidated tailings solids. Applying each of the options within Section 1.2 and the historical groundwater/surface water pit inflows, predict the time of initial overflow of the Faro Pit assuming no water recycle to the mill.

3.0 RECYCLING OF PROCESS WATER

At present, process effluent is not recycled in the concentrator process nor is there any internal reclaim. The question of water availability in a dry year as well as environmental considerations have inspired an interest in an economically feasible water recycle system. Through a comprehensive review of current water balance, assess the volumes of water currently required for milling operations and offer recommendations for reduction of water consumption.

- (i) identify the modifications (circuit and reagents) to the current metallurgical flowsheet which are anticipated for the processing of future ore supplies - including potential for tonnage increases due to lowering cutoff grade.
- (ii) determine the quantity of recycle water which is amenable to the process; this will likely be variable for specific parts of the process and ancillary services (reagent mixing, etc.).
- (iii) identify potential sources of water for recycling including the Cross Valley Dam, Intermediate Dam, Faro Pit or internal clarification/direct recycle.
- (iv) identify potential sources of make-up water should improved water quality be required within certain facets of the milling process or for potable/fire protection requirements.

- (v) assess the anticipated difference as a result of these recycle options on discharged water quality.
- (vi) if appropriate, evaluate a series of recycle vs. freshwater percentages for plant feed.

4.0 OTHER

4.1 Faro Pit

A number of additional issues must be considered due to the geometry and topography of the area.

- (i) options to divert pit overflow away from the Zone II area where exposed sulphides have caused elevated zinc levels in the water volumes contained within the voids of the rock fill.
- (ii) options to dewater Zone II and maintain a permanent level below seepage escapement to Rose Creek.
- (iii) alternatives to periodically move the discharge location of tailings discharge to the pit to maximize filling, if required, and offer the most efficient closure situation in terms of reduced production of acid mine drainage and percolation to groundwater through sealing of the pit walls.
- (iv) scheduling and specifics of the diversion of Faro Creek into the pit following completion of operations to provide an effective oxygen barrier to deposited tailings and exposed pit wall sulphides.

5.0 MINE CLOSURE IMPLICATIONS

Steffan, Robertson and Kirsten (B.C.) Inc. ("SRK") have been contracted to produce a tailings closure plan to be submitted to the Yukon Territory Water Board by March 31, 1991. The study specified in Sections 1 through 4 will have obvious impacts in the final closure plan. Kilborn should include, within the budget, adequate funds to subcontract the services of SRK to provide background environmental information, to validate the environmental acceptability of the proposed options to assess closure implications of the

options and to quantify and cost the selected options from a mine closure perspective. Additionally, SRK should be consulted on the following specific items:

- (i) to perform the comprehensive water quality assessment of each of the options available to extend the life of the current tailings disposal facility as outlined in Section 1.1.
- (ii) in the event that the selected disposal option is either of the alternatives offered in Section 1.1 (ii) or (iv), assess the problems related to water quality discharged and the potential need for water treatment facilities.
- (iii) to evaluate the benefit of slimes disposal at the current tailings facility from a mine closure perspective as discussed within Section 1.2.
- (iv) To provide background and historical water quality data and to predict any significant change in water quality as a result of the processing of Vangorda/Grum ore as discussed in Section 2.0.
- (v) to evaluate the effect of water recycling process on discharged water quality as discussed in Section 3.0.
- (vi) to provide, if available, all water balance information obtained within the process system and for the site in general.
- (vii) to assess the impact of reduction of flow in Rose Creek as the Faro Pit fills with respect to downstream water quality, fisheries and benthic macroinvertebrate communities.
- (viii) to provide details on meteorological or hydrological conditions at the site.
- (ix) to calculate cost differentials related to mitigative measures required for environmental protection of all recommended options.
- (x) generally, to provide the environmental input to what is essentially an engineering and metallurgical study on the part of Kilborn.

SRK has a vast background in environmental issues involved with the Faro operation and any duplication of this effort is to be judiciously avoided by working together with them. Kilborn will assume responsibility for administration and co-ordination of the team effort. We have attached SRK's work plan for completion of the March 31 tailings closure plan for clarification of their involvement.

Similarly, Golder and Associates Ltd. have been intimately involved with dam construction projects, specifically the Down Valley Facility, and geotechnical assessment of those structures. Golder continue to serve the Faro Division through annual inspections of these facilities and in the design and installation of the instrumentation required to conduct this monitoring. Kilborn should draw on the expertise available from this source in co-ordinating the design and construction of similar facilities should those options be appropriate. Earthwork designs should incorporate the horizontal acceleration factors associated with a 1:475 year seismic event.

Kilborn should also investigate and assess the possibility of reprocessing the current tailings in Rose Creek Valley in terms of recovery of latent volumes of gold and copper. Rehandling of the tailings in this regard may provide sufficient revenues to justify the cost of relocating the tailings, with their inherent acid mine generation potential, to the Faro Pit which would theoretically solve the mine closure question.

On each of the options discussed in the preceding Sections, Kilborn will be expected to provide a cost estimate comparison which includes capital and operating expenditures as well as manpower requirements. Selection of a preferred option within each subject area will be largely dependent on this cost/benefit analysis although the more intangible environmental costs will become very important where a potential impact is predicted. Upon selection of the preferred options, Kilborn will prepare detailed costing and design including but not necessarily limited to all:

- pumping and pipeline facilities
 - tailings
 - recycled water
- thickening facilities
 - cyclones
 - conventional thickeners

- dam or impoundment structures
 - raising of Intermediate Dam
 - construction of plug dams
 - dams within the Faro Pit to preclude seepage through Zone II
- overflow, diversion or spillway structures
- water treatment facilities

Additionally, design of the above facilities must consider the implications of cold weather operation. Operating manuals will be prepared for all new equipment. Contingency plans in the event of the failure of the recommended facilities should be provided.

The study will be managed by a Steering Committee of Curragh Resources Inc. representatives including:

From the Faro Office: 403-994-2600

Bill Weymark, Vice-President and General Manager	ext. 230
Eric Beaumont, Manager of Processing	ext. 220
Dino Basso, Manager of Mining	ext. 254
Eric Soprovich, Environmental Engineer	ext. 245

From the Whitehorse Office: 403-668-8021

Gerry Acott, Manager, Environmental Affairs	ext. 40

From the Toronto Office: 416-363-7111

Colin Benner, Executive V.P., Operations

George Whyte, Vice Chairman

Marvin Pelley, Executive V.P. Corporate Development and Engineering

Godfrey McDonald, Vice-President Metallurgy

The primary Steering Committee contacts will be Bill Weymark and Gerry Acott. The consultant is to maintain the confidentiality of all information collected during the study and no direct contact with regulatory agencies will be permitted.

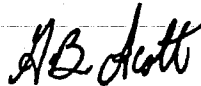
The proposal to be submitted by Kilborn will include the scope of the study, a detailed and comprehensive budget and a listing (complete with curriculum vitae) of all consultant team members and the roles they will play in the study; all of the above will incorporate the SRK/Golder interaction. The

budgeting should include an allotment of four days time for the principal participants of the consulting team to appear at a Water Board Hearing expected 8 - 10 weeks following the submission of the final report. Kilborn will also, as part of the proposal, prepare a time schedule which accomplishes a March 31, 1991 completion date and offers a verbal progress report to the Steering Committee members at the Faro minesite on January 4, 1991 and February 15, 1991. A draft final will be submitted for review by March 15, 1991. The final report will be submitted in fifteen (15) copies in addition to two (2) reproducible copies. All figures and maps within the camera-ready copy will be reproducible mylars and negatives will be provided for any photographs.

We would like to thank you, in advance, for the preparation of this proposal and look forward to your response by November 16, 1990.

Yours very truly,

CURRAGH RESOURCES INC.



G.B. Acott, P. Biol.
Manager, Environmental Affairs for;
Steering Committee on
Tailings Disposal Options

cc: with enclosure
Andy Robertson, SRK
Steering Committee Members

GBA:bb

Enclosure: Steffen Robertson Kirsten Status Report
dated: 12/22/89



December 22, 1989
Project Number 60602

Curragh Resources Inc.
117 Industrial Road
Whitehorse, Yukon
Y1A 2T8

Attention: Gregg Jilson

Dear Gregg;

We have recently reviewed the Faro mine Tailings Abandonment Plan Development Program (APDP) as described in Steffen Robertson and Kirsten Report 60602 (January, 1987). A summary of the Phase I progress review is provided below. Further, work programs which are scheduled for completion during 1990 are identified and detailed. Cost summaries have been included.

The Faro mine Tailings APDP was designed in four phases of which Phase I is currently being implemented. The four APDP phases include:

Phase I:	Investigation and Basic design of Abandonment Plan.
Phase II:	Implementation of Pre-Close-Out Measures and Re-Evaluation of Abandonment Plan.
Phase III:	Implementation of Final Abandonment Plan
Phase IV:	Monitoring and Maintenance

Phase I was planned as a four year program and was initiated in 1987. Expenditures for each year of the program were estimated as follows:

Year 1	Apr/87 to Apr/88	\$ 425,000
Year 2	Apr/88 to Apr/89	\$ 164,000
Year 3	Apr/89 to Apr/90	\$ 164,000
Year 4	Apr/90 to Mar.91	\$ 319,000
TOTAL		<u>\$1,072,000</u>



The phase I program was further detailed for the four year period by task. The task outline together with estimated task costs are as follows:

A. Test Plot Program	\$ 725,000
B. Groundwater Baseline Program	\$ 68,000 ←
C. Surface Water Baseline Program	\$ 42,000 ←
D. Tailings and Subsite Soils Characterization	\$ 50,000
E. Modelling	\$ 80,000 ←
F. Preparation of Abandonment Plan	\$ 75,000
Contingency	\$ 32,000
 TOTAL	 <u>\$1,072,000</u>

PHASE I REVIEW

The purpose of the following review is to determine the extent to which Phase I tasks have been completed, delineate deficiencies in task completion, and detail work remaining to be completed. The last scheduled sampling of the test facility is the summer of 1990; thus, all data requirements for the APDP must be satisfied by the fall of 1990. The remainder of 1990 and the first few months of 1991 will be required to establish a data base, evaluate collected data, model the results, and prepare a detailed abandonment plan.

TASK A: Test Plot Program

The testing of five tailings covers was initiated in 1987. The primary objective of this program is to identify appropriate technology and stabilization measures which will ensure the long term protection of the water quality in Rose Creek. Of the five tailings covers being tested, four tests are still considered valid. The fifth tailings cover being tested was a shallow water cover. As the water cover was not continuously maintained, test results for the water cover must be treated with doubt.

In 1987, the tailings as placed into the test facility were chemically analyzed. Subsequent to cover placement, water quality analysis was conducted in the test facility in October, 1988, July, 1989, and October, 1989. Solids sampling and analysis was conducted in October, 1989. Two remaining water quality sampling and analysis events are scheduled: one in July, 1990, and one in October, 1990. One solids sampling and analysis event is scheduled for October, 1990.

Water quality sampling and analysis has been successfully undertaken to date. One type of sampler, the air/water sampler, has proven to be particularly successful and free from mal-function. The back-up lysimeters, which to date have not been required, have not functioned well. Sample extraction has proven to be difficult, and sample volumes have been small. Small volumes create difficulties in in-situ and laboratory analysis.

Solids sampling was not successful in 1988. The sampler unit had inherent design problems. In July, 1989, efforts were made to modify the sampler. The sampler was subsequently abandoned and a new sampling method introduced. To date, the success of this sampler is not known. Should this sampler also prove to be unsatisfactory, arrangements will have to be made to collect samples from surface using a small hand auger. Changes in solids chemistry is critical to analysis and samples must be collected in 1990. *

Pore water pressure can be monitored by pneumatic piezometers installed at various depths throughout each test pit. Pore water pressures were determined in October, 1988; however, by July, 1989, most of the brass adapter fittings at the end of the instrument leads had cracked. These fittings must be replaced if further pore water pressure readings are to be obtained. *

Temperature profiles can be determined in each test pit through access to thermistor strings. Temperatures were monitored in 1987, in 1988 and several times during 1989. These instruments continue to function well; however, in 1990, the frequency of readings must be increased to once every two weeks throughout the year beginning. *

Oxygen and carbon dioxide gas profiles have not been determined to date. These in-situ tests should be undertaken at monthly intervals through 1990. *

With respect to outstanding tasks scheduled for 1990/ 91, these include up-dating and refinement of the data base, evaluating the data, and reporting on the final results of the tailings covers tests. (Item A.(v): estimated cost = \$ 60,000).

TASK B: Groundwater Baseline Program

The necessary installations to supplement existing instrumentation were completed in September, 1988. A complete sampling of all groundwater monitoring stations was scheduled for 1989. One more sampling event is scheduled for 1990. *

The major tasks for 1990/ 91 include developing a data base, evaluating the data and preparing a report which summarizes the findings. (Item B.(iv): estimated cost = \$ 10,000).

TASK C: Surface Water Baseline Characterization

*Chuck
could do
this*

The surface water within the immediate vicinity of the mine site has been monitored regularly since mining began in Faro in 1969. The major task involved with surface water baseline characterization is completing the data base. A data base was partly developed in 1987, and has since been updated on a regular basis. However, data prior to 1987 has not been entered into the computer data base. Results from 1982 to 1987 have been organized for easy access. Data prior to 1982 has not been reviewed in detail.

In addition, sampling above the confluence of Faro and North Fork Creeks should be undertaken monthly. Water quality results from this sample location should help to determine background water quality for the Faro mine area. Sampling should begin as soon as possible, and continue through 1990. *

Data entry is the major component of this program. Besides this, the major work remaining for 1990/ 91 are data evaluation and report compilation. (Item C.(iii): estimated cost = \$ 9,000).

TASK D. Tailings and Subsite Characterization

The drilling and sampling was completed in September, 1988. The laboratory analysis was completed by spring, 1989.

In-situ monitoring of oxygen and carbon dioxide gases must be done in 1990. Equipment problems prevented this component of the program to be initialized in 1989. The in-situ investigation program should entail a transect from old to new tailings. Paste pH should also be determined during instrument installation. *

In-situ permeability tests should be done in 1990 at locations in the proximity of the CO₂/ O₂ monitoring installations. *

Samples should be collected in 1990 along a transect from old to new tailings for analysis for the presence of the bacteria, *Thiobacillus Ferroxidans*. Samples should be taken approximately every 0.3 meters to a depth at which the paste pH is greater than 5.5. Samples taken during 1988 for this purpose were lost in transit. *

Supplementary weather data was collected during 1989 at the tailings facility. Maximum and minimum temperatures, precipitation and evaporation rates were measured. This program should be continued throughout 1990.

*Check
can
do this*

This investigation has generated a lot of data, which must be entered into a data base, summarized and then evaluated. The data has been organized and presented in SRK Report 60613. This work is scheduled for 1990/ 91. (Item D.(iii): estimated cost = \$8,000 which does not include remaining test work which must be completed).

TASK E. Modelling

The approach to and the type of modelling to be undertaken must be determined in early 1990. Two modelling systems are required: acid-generation modelling and contaminant migration modelling. (Item E.(i & ii): estimated cost = \$ 80,000).

TASK F: Preparation of Abandonment Plan

This task entails evaluating acid abatement options, evaluating stabilization options, and preparing the abandonment plan. Preliminary organizational work should be started early in 1990. (Item F.(i,ii, & iii): estimated cost = \$ 75,000).

SUMMARY OF 1990/ 91 PHASE I WORK

Tasks and estimated costs of completion for 1990/ 91 program year are provided below.

A.	Test Plot Program	\$ 60,000	
B.	Groundwater Baseline Program	\$ 10,000	*
C.	Surface Water Baseline Program	\$ 9,000	*
D.	Tailings & Subsite Soils Characterization	\$ 8,000	*
E.	Modelling	\$ 80,000	
F.	Preparation of Abandonment Plan	\$ 75,000	

*} our staff
could do*

TOTAL \$ 242,000

We would like to emphasize the importance of planning the 1990/ 91 programs, and the importance of an early start date for the remaining work in each of the phase I programs. Should you require any further information, please contact either A. Robertson, R. McLenehan or myself.

Yours very truly,

STEFFEN, ROBERTSON AND KIRSTEN (B.C.) INC.

A handwritten signature in dark ink, appearing to read 'Andy MacG. Robertson', enclosed within a large, loopy oval flourish.

Andy MacG. Robertson, P. Eng.
Principal

AMR/cs

- dam or impoundment structures
 - raising of Intermediate Dam
 - construction of plug dams
 - dams within the Faro Pit to preclude seepage through Zone II
- overflow, diversion or spillway structures
- water treatment facilities

Additionally, design of the above facilities must consider the implications of cold weather operation. Operating manuals will be prepared for all new equipment. Contingency plans in the event of the failure of the recommended facilities should be provided.

The study will be managed by a Steering Committee of Curragh Resources Inc. representatives including:

From the Faro Office: 403-994-2600

Bill Weymark, Vice-President and General Manager	ext. 230
Eric Beaumont, Manager of Processing	ext. 220
Dino Basso, Manager of Mining	ext. 254
Eric Soprovich, Environmental Engineer	ext. 245

From the Whitehorse Office: 403-668-8021

Gerry Acott, Manager, Environmental Affairs	ext. 40

From the Toronto Office: 416-363-7111

Colin Benner, Executive V.P., Operations

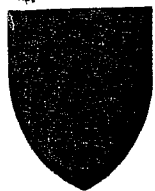
George Whyte, Vice Chairman

Marvin Pelley, Executive V.P. Corporate Development and Engineering

Godfrey McDonald, Vice-President Metallurgy

The primary Steering Committee contacts will be Bill Weymark and Gerry Acott. The consultant is to maintain the confidentiality of all information collected during the study and no direct contact with regulatory agencies will be permitted.

The proposal to be submitted by Kilborn will include the scope of the study, a detailed and comprehensive budget and a listing (complete with curriculum vitae) of all consultant team members and the roles they will play in the study; all of the above will incorporate the SRK/Golder interaction. The



**Curragh
Resources Inc.**

117 Industrial Rd.
Whitehorse, Yukon Y1A 2T8
Tel.: (403) 668-8021
Fax: (403) 668-6518

VIA COURIER

October 29, 1990

Kilborn Limited
2200 Lakeshore Blvd W.
Toronto, Ontario
M8B 1A4

Attention: **Mr. John Goode**
Vice-President, Metallurgy

Dear Sirs:

The Faro Division of Curragh Resources Inc. have recently extended their operational life as a result of successful application through regulatory agencies for extension into the Vangorda and Grum Area. Some 47 million tonnes of ore are available for development with additional future expansion potential within the Dy and Swim Areas. The Faro Division is now facing some immediate decisions for short and long term tailings disposal, process water recycling and mine closure/reclamation. We would invite your firm to submit a proposal, based on the following terms of reference, to assist us in the identification of various options toward the resolution of these questions.

1.0 TAILINGS DISPOSAL

For the foreseeable future, the plant will operate at an average of 13,000 tonnes per day for a projected mine life of 9.9 years based on current proven reserves. Tailings will be produced at an average rate of 11,400 tonnes per day for a total life-of-mine projection of 41.2 million tonnes. Assuming future development will add reserves estimated at 35% of the current base, a life-of-mine tailings disposal option should accommodate 55 - 60 million tonnes of consolidated tailings solids.

Surface operations within the Faro Pit are expected to be completed in early 1991. An underground mining operation has been developed from the pit bottom and is currently producing at 2,300 tonnes per day. The underground mine poses a constraint on tailings disposition as there is limited space below the portal. It is possible that this operation may be terminated as early as October 1991 to allow in pit tailings disposal however, it is anticipated that

mining will extend through the end of 1991. The current tailings disposal facility in Rose Creek Valley is approaching maximum capacity for the design phase and it appears that the Faro Pit should be utilized for this purpose as soon as it is available. It will be to Curragh's advantage to prolong the use of Rose Creek Valley as long as possible in order that underground mining in and from the Faro Pit can be maximized.

To fulfil the scope of the study, the following items should be considered:

1.1 Options available to extend the life of the current tailings disposal facility by:

- (i) raising the Intermediate Dam by one meter increments from its current 1078 m elevation through to design capacity of 1083 m. To assess this option it is necessary to quantify the additional tailings volume gained by each increment, and the additional time available, versus the cost of dam construction as a total and on a cost per tonne of tailings basis. Reliable information on this relationship is not currently available.
- (ii) moving the tailings discharge location closer to the Intermediate Dam thereby taking advantage of the unused capacity adjacent to the dam. Again there is missing information needed to assess this option.
- (iii) constructing additional "plug" dams at the current tailings entry point to build a higher beach area at the upper end of the pond.
- (iv) depositing tailings below the Intermediate Dam in the area currently maintained as a polishing pond for final water treatment above the Cross Valley Dam.
- (v) various combinations of (i) through (iv).

A comprehensive assessment of water quality related to each of the above options will be an integral part of this discussion. Should additional water treatment be required, the cost of that treatment should be included in the cost of the option.

1.2 Options available for tailings consolidation and disposal

- (i) disposal of tailings in the same form as it currently exits the mill (i.e. 8.5% solids).
- (ii) thicken the tailings to higher solids content to minimize pumping costs. Evaluate the possible degrees of thickening which could be achieved by various currently available technologies and the pumping alternatives which would be employed. Consider the possibilities of thickening at locations other than the mill. The proposal must consider cold weather operating conditions and maintenance requirements for any remote installations.
- (iii) splitting the components of the tailings between coarse and fine and directing the slimes to the existing tailings facility. The capping of current tailings with slimes may have final closure advantage as they will restrict percolation and limit the rate of oxygen transport and thus oxidation.

In each case, the consultant will provide a costing evaluation of the capital and operating expenditures required for the option. Where appropriate, these costs should be balanced against savings in future pumping or reclamation expense. Costs will also be presented on a "per tonne" of tailings basis.

2.0 VOLUME DETERMINATIONS

Through discussion with the Engineering and Processing Groups, develop a more accurate schedule of future tailings volumes. Characterize the tailings of Vangorda and Grum in comparison with those of the Faro Pit and estimate any differences in bulk density, settling and compaction characteristics, corrosion potential or composition. Comment on any expected differences in water quality which may be caused by the various reagent schemes for Faro and Vangorda Plateau ores or the tailings themselves and any mitigative measures which may be required should water quality deteriorate.

Air photography will be made available for the tailings pond area for three time periods: 1) before any construction (1964); 2) before operations of Curragh in 1985 (pond flooded but no tailings in it yet); and 3) on September 19, 1990. These resources are available to compare the calculated volume of tailings deposition over that time period with production records and thereby

arrive at a more accurate assessment of bulk density for tailings discharged. This may require a field bathymetric survey for the submerged tailings adjacent to the Intermediate Dam. Bulk density estimates should also be derived for the products of thickening as discussed within Section 1.2.

Through volume calculation of the Faro Pit as provided by Mine Engineering, taking into account final in-pit waste dumps, determine the time required to fill the Faro Pit with consolidated tailings solids. Applying each of the options within Section 1.2 and the historical groundwater/surface water pit inflows, predict the time of initial overflow of the Faro Pit assuming no water recycle to the mill.

3.0 RECYCLING OF PROCESS WATER

At present, process effluent is not recycled in the concentrator process nor is there any internal reclaim. The question of water availability in a dry year as well as environmental considerations have inspired an interest in an economically feasible water recycle system. Through a comprehensive review of current water balance, assess the volumes of water currently required for milling operations and offer recommendations for reduction of water consumption.

- (i) identify the modifications (circuit and reagents) to the current metallurgical flowsheet which are anticipated for the processing of future ore supplies - including potential for tonnage increases due to lowering cutoff grade.
- (ii) determine the quantity of recycle water which is amenable to the process; this will likely be variable for specific parts of the process and ancillary services (reagent mixing, etc.).
- (iii) identify potential sources of water for recycling including the Cross Valley Dam, Intermediate Dam, Faro Pit or internal clarification/direct recycle.
- (iv) identify potential sources of make-up water should improved water quality be required within certain facets of the milling process or for potable/fire protection requirements.

- (v) assess the anticipated difference as a result of these recycle options on discharged water quality.
- (vi) if appropriate, evaluate a series of recycle vs. freshwater percentages for plant feed.

4.0 OTHER

4.1 Faro Pit

A number of additional issues must be considered due to the geometry and topography of the area.

- (i) options to divert pit overflow away from the Zone II area where exposed sulphides have caused elevated zinc levels in the water volumes contained within the voids of the rock fill.
- (ii) options to dewater Zone II and maintain a permanent level below seepage escapement to Rose Creek.
- (iii) alternatives to periodically move the discharge location of tailings discharge to the pit to maximize filling, if required, and offer the most efficient closure situation in terms of reduced production of acid mine drainage and percolation to groundwater through sealing of the pit walls.
- (iv) scheduling and specifics of the diversion of Faro Creek into the pit following completion of operations to provide an effective oxygen barrier to deposited tailings and exposed pit wall sulphides.

5.0 MINE CLOSURE IMPLICATIONS

Steffan, Robertson and Kirsten (B.C.) Inc. ("SRK") have been contracted to produce a tailings closure plan to be submitted to the Yukon Territory Water Board by March 31, 1991. The study specified in Sections 1 through 4 will have obvious impacts in the final closure plan. Kilborn should include, within the budget, adequate funds to subcontract the services of SRK to provide background environmental information, to validate the environmental acceptability of the proposed options to assess closure implications of the

options and to quantify and cost the selected options from a mine closure perspective. Additionally, SRK should be consulted on the following specific items:

- (i) to perform the comprehensive water quality assessment of each of the options available to extend the life of the current tailings disposal facility as outlined in Section 1.1.
- (ii) in the event that the selected disposal option is either of the alternatives offered in Section 1.1 (ii) or (iv), assess the problems related to water quality discharged and the potential need for water treatment facilities.
- (iii) to evaluate the benefit of slimes disposal at the current tailings facility from a mine closure perspective as discussed within Section 1.2.
- (iv) To provide background and historical water quality data and to predict any significant change in water quality as a result of the processing of Vangorda/Grum ore as discussed in Section 2.0.
- (v) to evaluate the effect of water recycling process on discharged water quality as discussed in Section 3.0.
- (vi) to provide, if available, all water balance information obtained within the process system and for the site in general.
- (vii) to assess the impact of reduction of flow in Rose Creek as the Faro Pit fills with respect to downstream water quality, fisheries and benthic macroinvertebrate communities.
- (viii) to provide details on meteorological or hydrological conditions at the site.
- (ix) to calculate cost differentials related to mitigative measures required for environmental protection of all recommended options.
- (x) generally, to provide the environmental input to what is essentially an engineering and metallurgical study on the part of Kilborn.

SRK has a vast background in environmental issues involved with the Faro operation and any duplication of this effort is to be judiciously avoided by working together with them. Kilborn will assume responsibility for administration and co-ordination of the team effort. We have attached SRK's work plan for completion of the March 31 tailings closure plan for clarification of their involvement.

Similarly, Golder and Associates Ltd. have been intimately involved with dam construction projects, specifically the Down Valley Facility, and geotechnical assessment of those structures. Golder continue to serve the Faro Division through annual inspections of these facilities and in the design and installation of the instrumentation required to conduct this monitoring. Kilborn should draw on the expertise available from this source in co-ordinating the design and construction of similar facilities should those options be appropriate. Earthwork designs should incorporate the horizontal acceleration factors associated with a 1:475 year seismic event.

Kilborn should also investigate and assess the possibility of reprocessing the current tailings in Rose Creek Valley in terms of recovery of latent volumes of gold and copper. Rehandling of the tailings in this regard may provide sufficient revenues to justify the cost of relocating the tailings, with their inherent acid mine generation potential, to the Faro Pit which would theoretically solve the mine closure question.

On each of the options discussed in the preceding Sections, Kilborn will be expected to provide a cost estimate comparison which includes capital and operating expenditures as well as manpower requirements. Selection of a preferred option within each subject area will be largely dependent on this cost/benefit analysis although the more intangible environmental costs will become very important where a potential impact is predicted. Upon selection of the preferred options, Kilborn will prepare detailed costing and design including but not necessarily limited to all:

- pumping and pipeline facilities
 - tailings
 - recycled water
- thickening facilities
 - cyclones
 - conventional thickeners

- dam or impoundment structures
 - raising of Intermediate Dam
 - construction of plug dams
 - dams within the Faro Pit to preclude seepage through Zone II
- overflow, diversion or spillway structures
- water treatment facilities

Additionally, design of the above facilities must consider the implications of cold weather operation. Operating manuals will be prepared for all new equipment. Contingency plans in the event of the failure of the recommended facilities should be provided.

The study will be managed by a Steering Committee of Curragh Resources Inc. representatives including:

From the Faro Office: 403-994-2600

Bill Weymark, Vice-President and General Manager	ext. 230
Eric Beaumont, Manager of Processing	ext. 220
Dino Basso, Manager of Mining	ext. 254
Eric Soprovich, Environmental Engineer	ext. 245

From the Whitehorse Office: 403-668-8021

Gerry Acott, Manager, Environmental Affairs	ext. 40

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Colin Benner, Executive V.P., Operations
George Whyte, Vice Chairman
Marvin Pelley, Executive V.P. Corporate Development and Engineering
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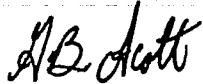
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We would like to thank you, in advance, for the preparation of this proposal and look forward to your response by November 16, 1990.

Yours very truly,

CURRAGH RESOURCES INC.



G.B. Acott, P. Biol.
Manager, Environmental Affairs for;
Steering Committee on
Tailings Disposal Options

cc: with enclosure
Andy Robertson, SRK
Steering Committee Members

GBA:bb

Enclosure: Steffen Robertson Kirsten Status Report
dated: 12/22/89



STEFFEN ROBERTSON AND KIRSTEN (B.C.) INC. Consulting Engineers

Suite 800, 580 Hornby Street, Vancouver, B.C. Canada V6C 3B6
Phone: (604) 681-4196 Fax: (604) 687-5532

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Tailings Aband.*

PROGRESS REPORT NO. 1

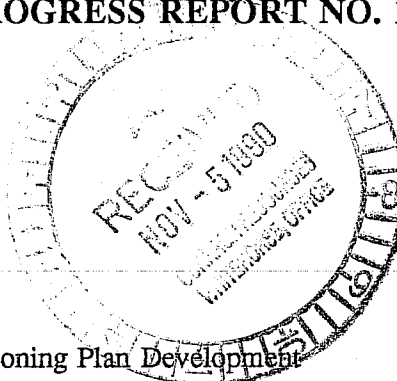
TO: G Jilson
INFO: G Acott, E Soprovich

DATE: November 1, 1990

FROM: R Olauson, D Harpley

PROJECT NO: 60635

RE: Faro Tailings Decommissioning Plan Development



1.0 TASK SPECIFIC PROGRESS

1.1 Task A - Test Plot Program

Robert McLenehan has been compiling the 1990 data now available from the Test Plot Program. The complete water quality data set is expected to be available by November 2, 1990. Chemical analysis of the solids samples extracted from the test plots and from tailings in the pre-1976 tailings impoundment areas are expected to be available by no later than November 19, 1990.

During the week of November 5, 1990, evaluation of all of the test data, inclusive of 1987, 1988, 1989, and 1990 will be initiated. Concurrent with data evaluation, a draft report will be prepared which will present summaries of the results, an evaluation of the data, a discussion of test plot results, and a summary of program conclusions. The draft report is expected to be completed by December 7, 1990.

1.2 Task B - Groundwater Baseline Program

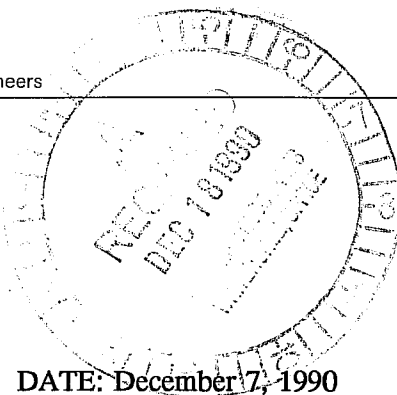
Dave Harpley conducted a site visit on September 19 and 20, and met with Curragh's Environmental Engineer, Eric Soprovich. Inspections of the tailings facility were made, specifically to review monitoring borehole locations, dam structures and seepage, weir and decant/diversion flows.

Existing data has been compiled, and will be completed once collar and water-level elevation data for the SRK 88 Series boreholes have been retrieved. The extraction, tabulation and write-up of the database is in progress.





STEFFEN ROBERTSON AND KIRSTEN (B.C.) INC. Consulting Engineers
Suite 800, 580 Hornby Street, Vancouver, B.C. Canada V6C 3B6
Phone: (604) 681-4196 Fax: (604) 687-5532



PROGRESS REPORT NO. 2

TO: Gerry Acott
INFO: Gregg Jilson, Eric Soprovich

DATE: December 7, 1990

FROM: Dave Harpley

PROJECT NO: 60635

RE: Faro Tailings Impoundment Decommissioning Plan

We have pleasure in presenting our second progress report on this project.

1.0 TASK SPECIFIC PROGRESS

1.1 Task A - Test Plot Program

Evaluation of all test data has been completed. A draft report is being prepared which will present summaries of the results, an evaluation of the data, a discussion of test plot results, and a summary of program conclusions. The draft report is expected to be completed by December 14, 1990.

1.2 Task B - Groundwater Baseline Program

Available data has been tabulated, and a draft report is being completed. Completion date is set for December 14, 1990.

1.3 Task C - Surface Water Baseline Program

Data extraction and statistical analysis has been completed and results tabulated. A draft report is being compiled and should be complete by December 14, 1990.

1.4 Task D - Tailings and Subsite Characterization

A draft report has been started on summarizing the data tabulated. The deadline for completion is scheduled for December 21, 1990.



1.5 Task E - Modelling

First estimates were made regarding rates of seepage to the groundwater. Modelling was subsequently initiated to firm these estimates, and provide information on the interaction of the tailings impoundment with the underlying groundwater regime. Model results are available and are being studied before proceeding further with groundwater modelling.

Further data specific to tailings and cover materials saturation profiles is being generated by laboratory tests underway at present. Some results are available, more will be available on December 11, with the remainder one week later. Till compaction tests are also being performed, and samples taken from these tests will permit an assessment of the likely hydraulic performance of till covers.

Dr Marie Collin arrived on December 1, and her cover model has been loaded and is in operation. Trial runs with input data synthesized from Faro site data are being performed to verify model operation and to familiarize SRK personnel with model operation. Specific impoundment cover scenarios will now be modelled, and input data and simulation results will be compared as more laboratory data becomes available.

1.6 Task F - Preparation of Decommissioning Plan

A detailed outline for the final report has been generated, and some sections have been completed.

A list of figures and drawings required has been made, some are complete, others are being prepared, and the remainder await receipt of the new topographic detail in hard copy and digital form.

1.7 Task G - Overall Impact Modelling

The spreadsheet mass balance/dilution model has been verified for current operating conditions. Modifications to the model are presently being made to incorporate losses and gains from the groundwater. The model will then be ready to accept results from the modelling in task E.

2.0 BUDGETS

An invoicing and budgets summary for the period ending November 20 is presented in Table 1. No particular variances are worthy of note for this period.

3.0 TIME SCHEDULE

A revised time schedule for project activities is attached.

4.0

SUMMARY OF OUTSTANDING REQUESTS

The following requests have been made and remain outstanding:

- the new topographic detail for the tailings impoundment in hard copy and digital form;
- details on tailings characteristics (see copy of fax attached);
- collar elevations and water-levels for SRK 88 Series boreholes.

IMPOUNDMENT DECOMMISSIONING FARO TAILINGS PLAN																
Task	1990				1991											
	DEC				JAN				FEB				MAR			
	08	15	22	29	05	12	19	26	02	09	16	23	02	09	16	23
A. Test Plot Program																
B. Groundwater Baseline Program																
C. Surface Water Baseline Program																
D. Tailings and Subsite Characterization																
E. Tailings Modelling																
- Compile Database																
- Acid Generation Modelling																
- Acid Equilibrium Modelling																
- Groundwater & Solute Transport																
F. Preparation of Decommissioning Plan																
- Cover selections																
- Run-off control																
- Contaminant release																
- Stabilization of Interm. Dam																
- Stabilization of Rose Creek																
Preliminary Design																
- Covers																
- Spillways and sediment control																
- Diversions																
Stability analyses																
Costing																
Report																
G. Overall Impact Modelling																
- Model Calibration																
- Model Predictions																
H. Layman's Report (AMR)																

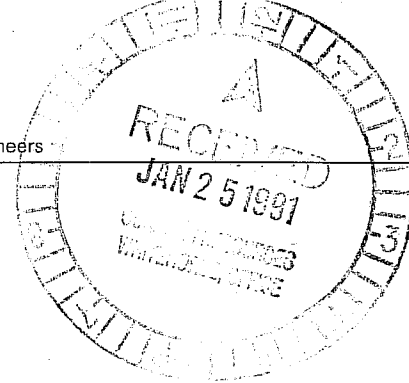
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TABLE 1
FARO TAILINGS IMPOUNDMENT DECOMMISSIONING PLAN
PROJECT EXPENDITURE SUMMARY

TASK	SRK PROJECT NUMBER	AMOUNT INVOICED				TOTAL INVOICED	INITIAL BUDGET ESTIMATE	REVISED BUDGET ESTIMATE	REMAINING
		Aug. 20	Sept. 20	Oct. 20	Nov. 20				
A - Test Plot Program	60631		\$1,915.53	\$1,440.00	\$4,002.26	\$7,358	\$30,020	\$30,020	\$22,662
B - Groundwater Baseline	60632		\$3,058.00	\$1,743.50	\$0.00	\$4,802	\$10,050	\$10,050	\$5,249
C - Surface Water Baseline	60633		\$5,611.31	\$7,740.77	\$1,520.31	\$14,872	\$8,970	\$14,970	\$98
D - Tailings and Subsite Characterization	60634		\$0.00	\$120.00	\$1,170.00	\$1,290	\$7,920	\$7,920	\$6,630
E - Tailings Modelling	60626	\$2,972.68	\$2,684.23	\$6,660.81	\$6,800.27	\$19,118	\$90,000	\$92,930	\$73,812
F - Preparation of Abandonment Plan	60635		\$225.07	\$5,532.49	\$6,423.99	\$12,182	\$75,130	\$75,130	\$62,948
G - Overall Impact Modelling	60628		\$16,256.90	\$764.96	\$5,195.87	\$22,218	\$29,920	\$29,920	\$7,702
TOTALS		\$2,972.68	\$29,751.04	\$24,002.53	\$25,112.70	\$81,839	\$252,010	\$260,940	\$179,101



STEFFEN ROBERTSON AND KIRSTEN (B.C.) INC. Consulting Engineers
Suite 800, 580 Hornby Street, Vancouver, B.C. Canada V6C 3B6
Phone: (604) 681-4196 Fax: (604) 687-5532



PROGRESS REPORT NO. 3

TO: Gerry Acott
INFO: Gregg Jilson, Eric Soprovich

DATE: January 21, 1991

FROM: Dave Harpley

PROJECT NO: 60635

RE: Faro Tailings Impoundment Decommissioning Plan

The third progress report on this project is presented. This provides factual information, but is otherwise brief in view of our meeting shortly during which we will apprise you fully of progress.

1.0 TASK SPECIFIC PROGRESS

1.1 Task A - Test Plot Program

The draft report has been completed, and was submitted via courier last week. Cover modelling is now in progress and will utilize data from the test plot program. The intention is to obtain some form of model calibration with test plot data.

1.2 Task B - Groundwater Baseline Program

A draft report has been completed.

1.3 Task C - Surface Water Baseline Program

A draft report is nearing completion. Certain additional information is being reviewed and added.

1.4 Task D - Tailings and Sub-site Characterization

A draft report has still to be completed summarizing the data tabulated.



1.5 Task E - Modelling

Tailings and cover materials saturation laboratory tests have been completed. Till compaction tests are also complete, and all results are available. Cover modelling using the Collin model has been initiated.

Seepage and groundwater flow components have been estimated and incorporated in the surface water balance model.

1.6 Task F - Preparation of Decommissioning Plan

Some sections of the plan report have been completed, although many analyses and the relevant report text are behind schedule owing to the delay of the new topographic detail. A digital version of the topography is expected in a few days.

The main decommissioning options are being formulated and approximate cost estimates for some elements are being generated. These will be available for review.

1.7 Task G - Overall Impact Modelling

Modifications to the model have been made to incorporate losses and gains from the groundwater.

2.0 BUDGETS

An invoicing and budget summary for the period ending December 31 is presented in Table 1.

3.0 TIME SCHEDULE

A revised time schedule for project activities is attached.

4.0 SUMMARY OF OUTSTANDING REQUESTS

No requests are outstanding.

Table 1: FARO TAILINGS IMPOUNDMENT DECOMMISSIONING PLAN, SRK INVOICE SUMMARY

TASK	SRK PROJECT NUMBER	AMOUNT INVOICED (\$)					TOTAL INVOICED (\$)	INITIAL BUDGET ESTIMATE	REVISED BUDGET ESTIMATE	BUDGET REMAINING (\$)
		Aug. 20	Sept. 20	Oct. 20	Nov. 20	Dec. 31				
A - Test Plot Program	60631		1915.53	1440.00	4002.26	4705.25	12063.04	30020.00	30020.00	17956.96
B - Groundwater Baseline	60632		3058.00	1743.50	0.00	3665.00	8466.50	10050.00	10050.00	1583.50
C - Surface Water Baseline	60633		5611.31	7740.77	1520.31	700.00	15572.39	8970.00	14970.00	-602.39
D - Tailings and Subsite	60634		0.00	120.00	1170.00	4425.45	5715.45	7920.00	7920.00	2204.55
E - Tailings Modelling	60626	2972.68	2684.23	6660.81	6800.27	14173.52	33291.51	90000.00	92930.00	59638.49
F - Preparation of Abandonment Plan	60635		225.07	5532.49	6423.99	7416.10	19597.65	75130.00	75130.00	55532.35
G - Overall Impact Modelling	60628		16256.90	764.96	5195.87	3235.40	25453.13	29920.00	29920.00	4466.87
TOTALS		2972.68	29751.04	24002.53	25112.70	38320.72	120159.67	252010.00	260940.00	140780.33

Please note that GST is payable on the total budget remaining. This will amount to \$9854.62, giving a revised total of **\$150634.95**.

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FARO TAILINGS IMPOUNDMENT DECOMMISSIONING PLAN												
TIME SCHEDULE - 1991												
TASK	JAN				FEB				MAR			
	05	12	19	26	02	09	16	23	02	09	16	23
A. Test Plot Program												
D. Tailings and Subsite Characterization												
E. Tailings Modelling												
- Acid Generation Modelling												
- Acid Equil. Modelling												
- Groundwater & Solute Transport												
F. Preparation of Decommissioning Plan												
- Background data												
- Develop options												
- Cost estimates												
- Evaluate water quality impacts of options												
- Evaluate and incorporate engineering considerations												
- Conceptual designs												
- Closure and monitoring schedule												
- Decommissioning Plan Report												
G. Overall Impact Modelling												
- Model Calibration												
- Model Predictions												
H. Layman's Report (AMR)												

Yukon Conservation Society



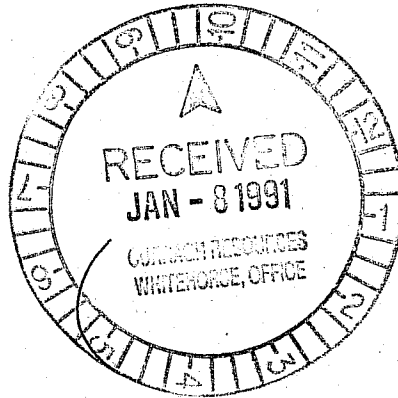
INC. 1968

Box 4163

Whitehorse, Yukon

Y1A 3T3

Phone: (403) 668-5678



January 7, 1991

Curragh Resources Inc.
117 Industrial Rd.,
Whitehorse, Yukon

The Yukon Conservation Society is concerned with your request for a delay in the filing of the abandonment plan for the Down Valley Tailings project. While we can understand the need to co-ordinate the tailings disposal, water recycle and abandonment plans, YCS feels that the waiting period for an abandonment plan has already been too long. An existing abandonment plan was removed from the water licence through an emergency amendment when the licence was transferred to Curragh in September 1985. A new plan was to be in place by Dec. 31, 1986. This deadline was missed and the company was given five years to provide an abandonment plan. A delay until the requested date will almost certainly mean losing the 1991 construction season.

The water recycle and tailings deposition plans are part of the amended Faro water licence, issued Sept. 1989. The company could have proceeded with these studies at any time after this date. YCS is aware of the fact that a Vangorda water licence was not issued until Oct. 1991, but given the amount of work the company had done on the site in anticipation of the licence, it could have proceeded with these studies earlier. These studies are a requirement of the Faro licence, and as such are mandatory whether or not the Vangorda project went ahead.

In past hearings, Curragh has stated it would not discuss the funding of abandonment until a hearing on a proposed abandonment plan. To postpone this discussion further would be irresponsible and allow an unacceptable situation to continue. It is vital to have an abandonment plan, with funding mechanisms, legally in place as soon as possible.

On the subject of the toe berm, YCS is concerned that any delay will mean the loss of the 1991 construction season. If the request for submission delays is accepted, by the time an amended licence is issued it will be not be possible to install the berm until spring 1992.

Yours Truly,
Bob Van Dijken
Bob Van Dijken
Acting President

cc Yukon Territorial Water Board



CURRAGH RESOURCES INC.

Inter-Office Memorandum

TO: Bill Dunn, Chief Mine Engineer
Gerrit Vos, Senior Engineer
Faro Office

FROM: Gerry Acott
Manager, Environmental Affairs
Whitehorse Office *Gerry*

cc: Colin Benner, Executive VP, Operations
Jim Moore, General Manager, Faro Operations
Dino Basso, Manager of Mining, Faro Operations
Eric Soprovich, Environmental Engineer

RE: Sulphide Dump - East Faro Pit

DATE: 01 31 1991

I have received the plans for the sulphide dump from Gerrit and have reviewed them in comparison to the terms of our Water Licence.

Section 8(a) of Part B specified that the Licensee shall dispose of all waste rock in accordance with the 1988 Faro Mine Abandonment Plan. This document discusses the placement of sulphide waste below final water elevation in the Faro pit beginning in 1989. However, final water elevation is identified at 3920 feet. Current plans are to flood the pit to 3970 feet to permit gravitational overflow to the Down Valley Tailings area.

I spoke to the Technical Advisor of the Water Board and we agreed that the intent of the Licence condition was to ensure that potential acid generating waste rock

was placed below eventual water elevation in the pit. He suggested that we contact Indian and Northern Affairs to see if they would petition the Board for an amendment. I am somewhat reluctant to do this for fear of rejection; I am of the understanding that the waste dump is required immediately.

Upon filing of the Tailings Deposition Study, currently underway by Kilborn, the Board will be made aware of our plan to use the Faro Pit for tailings disposal to a new final water elevation of 3970. This will require a licence amendment which will subsequently cover the current plans to deposit sulphide waste, however, this will not occur until late 1991.

I would suggest that we proceed with the plan and, if questioned by a regulatory authority, we refer the Part D 3(vii) of the licence. It refers, upon permanent cessation of mining, to disposing of sulphide - rich waste rock in a manner such that oxidation and leaching are unlikely to occur. Although this is somewhat vague, I believe it is sufficient to cover our bases until we discuss pit/waste dump amendments later this year with the regulatory agencies.

Please bear in mind, however that by proceeding with this plan it commits us to the construction of a South Dam which will require careful geotechnical supervision to ensure maximum impermeability and, thereby, minimize seepage to Zone II. If tailings deposition to Faro Pit begins in October of 1991 as

MEMORANDUM

PAGE 3

currently envisioned, Kilborn estimates the pit will fill to maximum water elevation in 400 days. Therefore, South Dam construction will have to commence no later than July of 1992.

CURRAGH RESOURCES INC.

117 Industrial Road
Whitehorse, Yukon
Y1A 2T8

Tel: (403) 668-8021
Fax: (403) 668-6518

TELEFAX TRANSMISSION

TO:

Lisa / Regina

FROM:

Bette Boyd, Executive Secretary

WHITEHORSE OFFICE

DATE:

Jan 31 1991

TIME:

SUBJECT:

*Please distribute as
per attached listing*

If all pages are not received, please contact Bette at 668-8034

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NO	REMOTE STATION I. D.	START TIME	DURATION	#PAGES	COMMENT
1	Faro Mine	1-31-91 1:02PM	2'03"	4	

TOTAL 0:02'03" 4

XEROX TELECOPIER 7020

CURRAGH RESOURCES INC.

Inter-Office Memorandum

TO: Jim Moore
General Manager
Faro Office

FROM: Gerry Acott
Manager, Environmental Affairs
Whitehorse Office

RE: Water Quality at Tailings Pond Discharge

DATE: 03 12 1991

As you recall, discussion on the above subject was initiated in our February 15 meeting. A concern was raised that due to the increased volume of recent pumping from the Faro pit coupled with the Zone II discharge, dissolved zinc loadings contributed to the tailings pond may exceed its capacity to buffer the flow and precipitate the zinc.

At that time we discussed some possible solutions:

- i) directing the pit dewatering to the mill for use as process water - this was rejected due to the potential for oil/grease and other contaminants to disrupt the mill circuits;
- ii) construct a lime treatment facility at the pumping source - this was rejected due to cost of a separate facility and the requirement of a dedicated individual to operate it;
- iii) run a line for lime slurry from the mill to X23 for direct treatment of pit dewatering - this remains as a possible solution;
- iv) add extra lime to the mill effluent and allow mixing in the tailings system.

Option iv was chosen as the preferred solution and the Environmental Group were to offer their assistance in monitoring the effectiveness of this technique.

In discussion with Eric Soprovich, Environmental Engineer, I understand that water quality at the tailings outflow continues to decline to the point where we could, in the future, have difficulty achieving our licence limits. These concerns may be aggravated during the upcoming freshet when pumping may be at its maximum and residence time in the tailings system at its minimum.

Perhaps the reason option iv has had limited success is due to incomplete mixing within the pond. The two waste streams do not meet until they are well into the tailings system. At this point, much of the lime in the mill effluent has settled out with the solids and is not available to buffer the pit dewatering. I would suggest some measure to achieve better inflow mixing, for example, rerouting the pit dewatering to the outflow of the tailings line. If this is not possible, option iii should be implemented immediately.

A secondary but related problem is the fact that short circuiting is occurring in the Cross Valley Pond. Significant flows through the Intermediate Dam Spillway are released directly toward the Cross Valley outflow and retention time is much reduced from design. If liming is to be effective then there must be improved settling capacity in the tailings system. This problem was identified and discussed during the field investigation at the February 15 meeting. Immediate action was taken to increase volume of flow through the siphon to reduce the problem. I

understand that flow through the siphon was increased again subsequent to that time.

If it is not possible to dramatically reduce flow volume through the spillway by increasing the siphon (inflow volumes exceed siphon capacity), we should look at other alternatives to limit the short circuiting within the Cross Valley Pond.

One option which worked well for us in the coal mining industry was a floating baffle system to direct waster through the pond and take advantage of all available surface area. This can be done as simply as suspending tarps from a floating boom. I have enclosed some information on a commercially available product for your perusal.

I understand that the mine are continuing their efforts to address this potential water quality problem and trust that these comments may be of some assistance.

cc: Colin Benner
Leo Hwozdyk
Eric Soprovich



Facsimile Transmission

Fax No. (815) 838-8336

From: Steve Winters

To: Jerry Acott

Date: March 13, 1991

Reference: Floating Baffles

Dear Mr. Acott:

The following transmission contains product information on Environetics' Director™ Floating Baffle system for your tailings pond project.

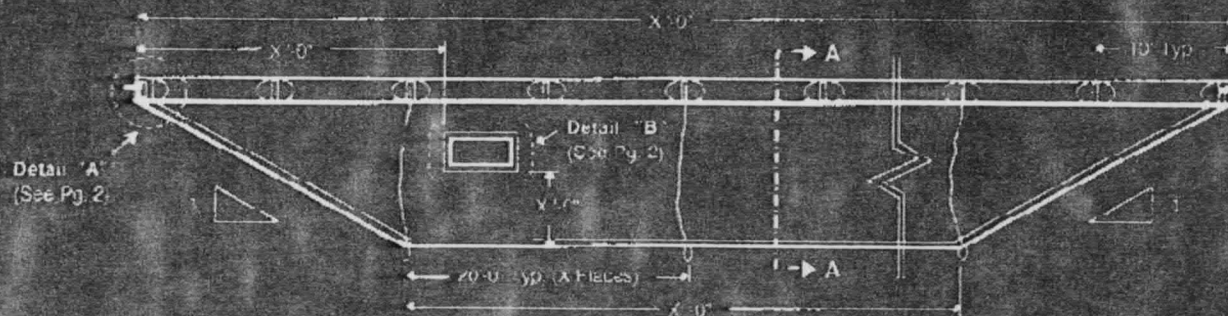
I will send additional information including detail drawings, product specifications and material samples by mail.

If there are any questions, or additional information is required, please do not hesitate to contact me or Mr. Cliff McGillivray at (815) 838-8331.

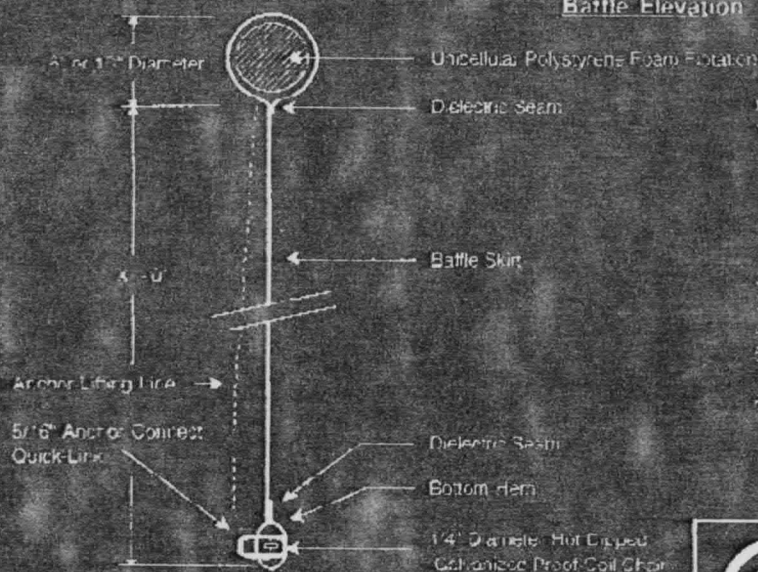
If you do not receive all pages, or have problems with this transmission, please call (815) 838-8331. Thank you.

The Director™

Floating Baffle System



Baffle Elevation



Section A-A'

Notes

1. Engineer To Select Baffle Skirt And Flotation Collar Check Material:
 - a. ENV-4502-12 45 MI White Hypalon (Collar)
 - ENV-3602-12 36 MI Black Hypalon (Skirt)
 - b. ENV-3004-12 30 MI Black XF-5 (Both)
 - c. ENV-2202-12 22 MI Black PVC (Both)
2. Hardware To Be Alumin. Galvanized or Stainless Steel.
3. Engineer To Provide Wall Slope Ratio.
4. 10' Flotation Required With Skirt Depths Greater Than 15' (1)
5. Standard Environetics fabrication methods & materials shall be used in all areas not detailed.
6. **ALL DIMENSIONS AND LOCATIONS TO BE CHECKED AND VERIFIED BY CUSTOMER PRIOR TO FABRICATION.**

Standard Director™ Floating Baffle System



ENVIRONETICS, INC.

1201 Commerce Street
Evanston, IL 60120
Tel: (815) 838-8336
Fax: (815) 838-8336

SKU 900705-1
Date: 07/05/90
Drawn By: CHM
Scale: Not To Scale

Copyright 1990, Environetics, Inc.

Floating Baffle Design Manual

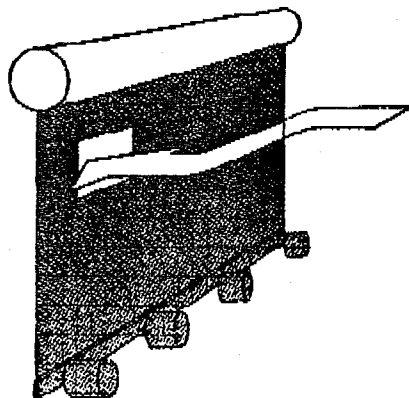


Figure 1... With normal wind and water loads, the Director diverts flows through windows at specified locations.

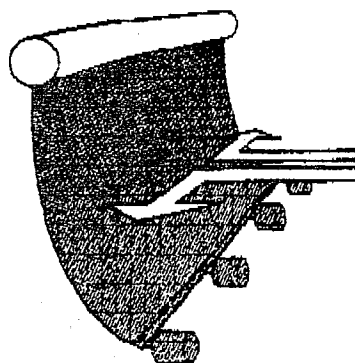


Figure 2... The Director floating baffle system transfers heavy loads to concrete anchor points along the bottom of the lagoon.

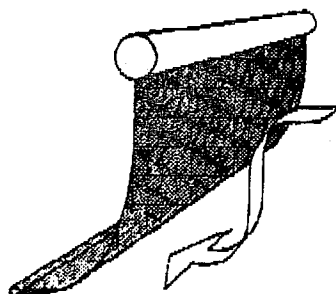


Figure 3... Without Environetics unique ballast system, high loads can short-circuit under a non-anchored curtain.

The Director™ ... Floating Baffles by Environetics

The originator of the floating baffle, Environetics, introduces the Director Series Floating Baffle System... a prefabricated, factory engineered hydraulic diversion curtain specifically developed for waste treatment operations. The Director Series offers...

- Superior bottom anchored flow directing design.
- Corrosion resistant construction.
- Widest choice of Baffle materials in the industry.
- Most cost-effective flow diversion product.
- Useful life of up to 20 years.

The Director™ ... Most Effective Baffle Design!

Bottom anchored for maximum resistance to hydraulic flows and wind forces, Environetics' Director system transfers loads in two directions. Here's how it works:

Under normal conditions the Environetics floating baffle's position is maintained by a slight amount of tension along the length of the flotation collar which transfers loads to the shore anchor points (Figure 1).

When the baffle encounters forces from winds or liquid flow, the baffle skirt is placed under tension between the buoyant flotation collar and the anchored bottom ballast chain. Stresses are transferred from the baffle skirt to the closest anchor point... either the concrete anchors at specified intervals across the bottom of the lagoon or the shore anchors. Independent tests conclude a bottom weighted and secured baffle is the most efficient style available (Figure 2).

Other systems relying primarily on a tensile member at the top of the curtain can only transfer loads at the two shore anchoring points. High flows short-circuit under the non-anchored lower edge of the curtain, severely reducing the diversion function (Figure 3).

The Director

Floating Baffle System

Floating Baffle Advantages

Director Floating Baffles create efficient flow patterns and improve retention time which...

- Reduces BOD, COD and Suspended Solids
- Directs Flow to Improve Efficiency
- Minimizes Short Circuiting
- Prevents Channeling
- Creates Quiescent Zones
- Improves Mixing
- Captures Surface Scum and Debris

Floating baffles provide cost and design advantages over earthen berms and wood or fiberglass fence alternatives. Director Floating Baffles cost less to install and are easily relocated or fine-tuned for any lagoon design change. The Director's sophisticated design also allows simple, quick installations without heavy equipment in either operating or dewatered lagoons. Directing flow through the lagoon in the most efficient pattern, Director Floating Baffles can increase effective treatment area to 98% of the lagoon's total area.

45/36 Hypalon® Construction

Our 45/36 construction maximizes baffle performance by using two unique grades of Hypalon selected to meet the demanding requirements placed on the surface and submerged areas of a floating baffle.

45 Mil. Hypalon Collar

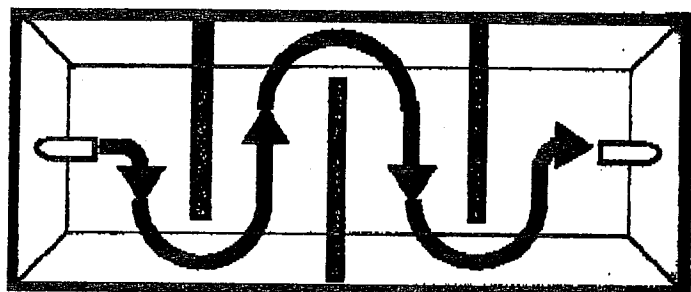
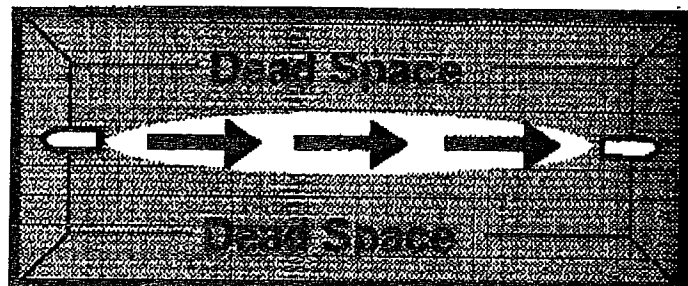
Covers and protects the flotation elements at the lagoon surface.

- 50% thicker than any other material on the market.
- Unparalleled protection against floating debris abrasion.
- White color to reduce solar heat gain.
- Superior resistance to UV light and temperature extremes.

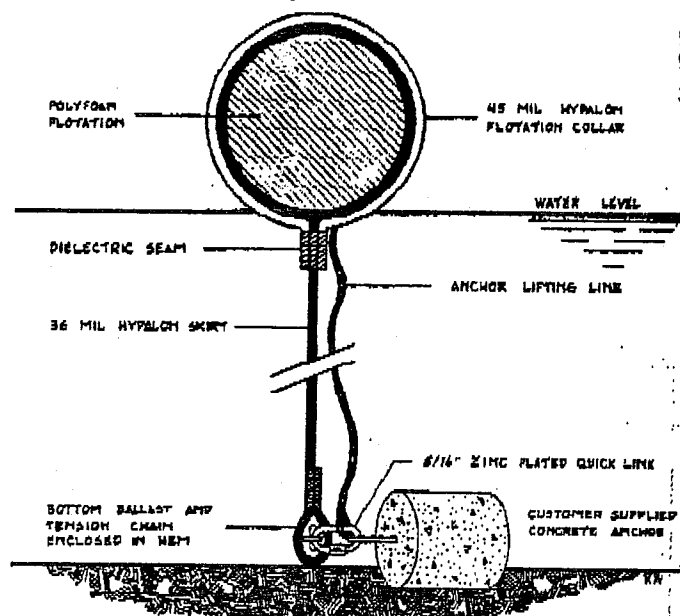
36 Mil. Hypalon Skirt

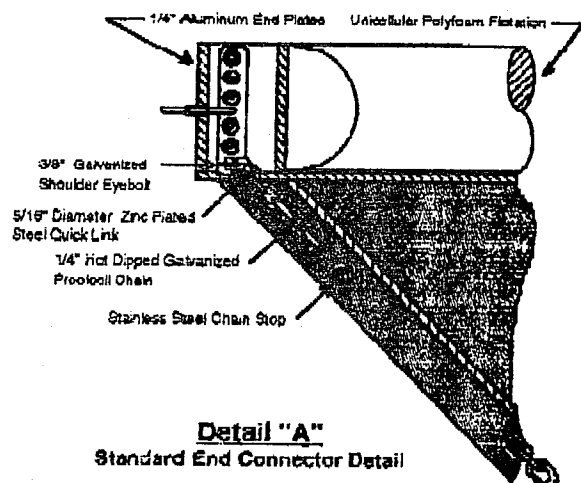
Forms the submerged flow diversion barrier.

- High elongation provides elastic response to surge loads.
- Standardized material offers economical advantages without sacrificing performance.
- Compounded for maximum resistance to fluids encountered in industrial & municipal environments.

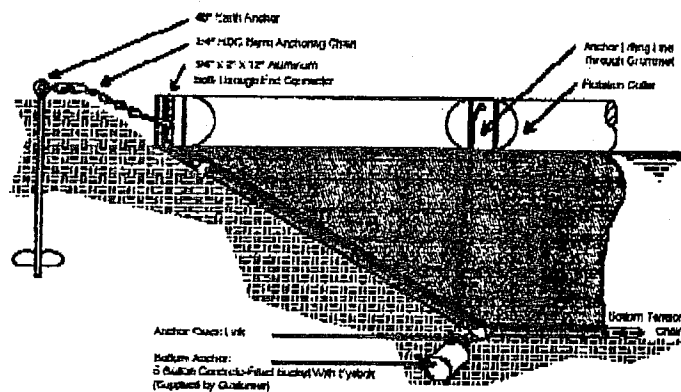


The Director floating baffle system increases effective treatment area by directing flow in more efficient patterns, eliminating dead space.

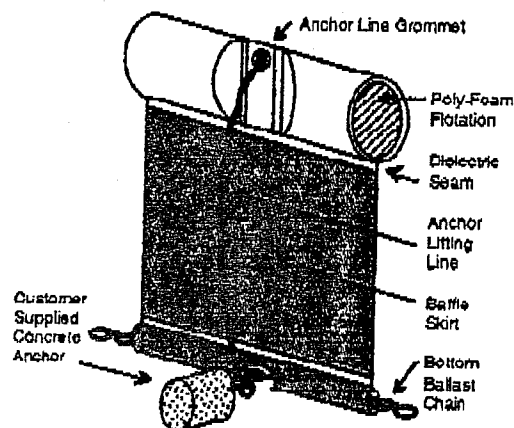




Detail "A"
Standard End Connector Detail



Standard Berm Anchoring Detail



The Director™ Components

Bolt Through End-Connects

Director Floating Baffle ends are reinforced with aluminum plates bolted on opposite sides of the flotation collar material. Polypropylene ribs are permanently welded into the outer edge of the flotation cover material to prevent end connect plate movement. Shoulder eyebolts are provided to transfer loads from the bottom tension member through the end-connect plates to the shore anchors. Quick links are included to simplify shore anchor connections.

Flotation Collar

Polyfoam logs provide buoyancy of more than 60 lbs. per cubic foot. Available in 6" and 10" diameters, the logs are 8' long for economical shipment. Skirt depths of less than 15' generally require the 6" diameter flotation. The logs are sealed inside the flotation cover material during fabrication and present minimum surface wind exposure. No mechanical attachment hardware or spare parts are required.

Shore Anchors

Complete shore anchoring hardware even includes a screw type earth anchor... sufficient for permanent use for most installations. For larger installations or unstable soil conditions, the earth anchor can be set in concrete or replaced with an anchor post.

Bottom Ballast & Tension Member

Standard Director construction utilizes 1/4" chain for bottom ballast and tension. The bottom ballast and tension member is attached to the end connect plates and is dielectrically sealed into the bottom edge of the baffle material to provide continuous shore to shore tension. The standard tension member has a 5200 lb. breaking strength and provides .72 lbs. per foot ballast.

Bottom Anchor Points

When easily fabricated 5 gallon concrete anchors are attached at specified intervals across the entire base of the baffle skirt, total ballast weight is increased to 3.5 lbs. per foot... more than two times the closest competitors recommended ballast weight. Quick link connectors are provided at cut-out points along the bottom for easy anchor attachment and removal.

The Director

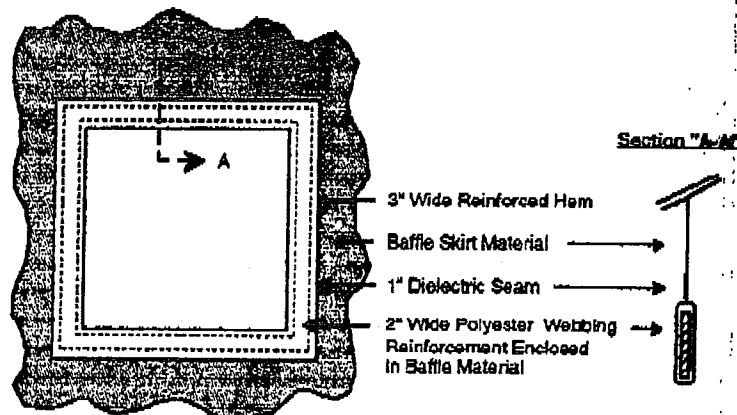
Floating Baffle System

Anchor Lifting Lines

To allow anchors to be attached or removed easily, polypropylene anchor lifting lines extend from each bottom anchor point to grommets located at intervals in the flotation collar.

Flow-Through Windows

Flow-through windows provide the desired liquid flow diversion patterns. Daily volume of liquid through the lagoon determines the size of windows required. A maximum of four (4) cubic feet (30 gallons) of liquid through one (1) square foot of opening per minute is recommended. Heavy duty woven polyester webbing (2500 lb. tensile strength) is sealed into the edges of each window opening for resistance to hydraulic pressure assuring retention of window shape under varying flow rates and overload conditions.



Reinforced flow through window detail

Director™ Options

Mid-lagoon Anchor System

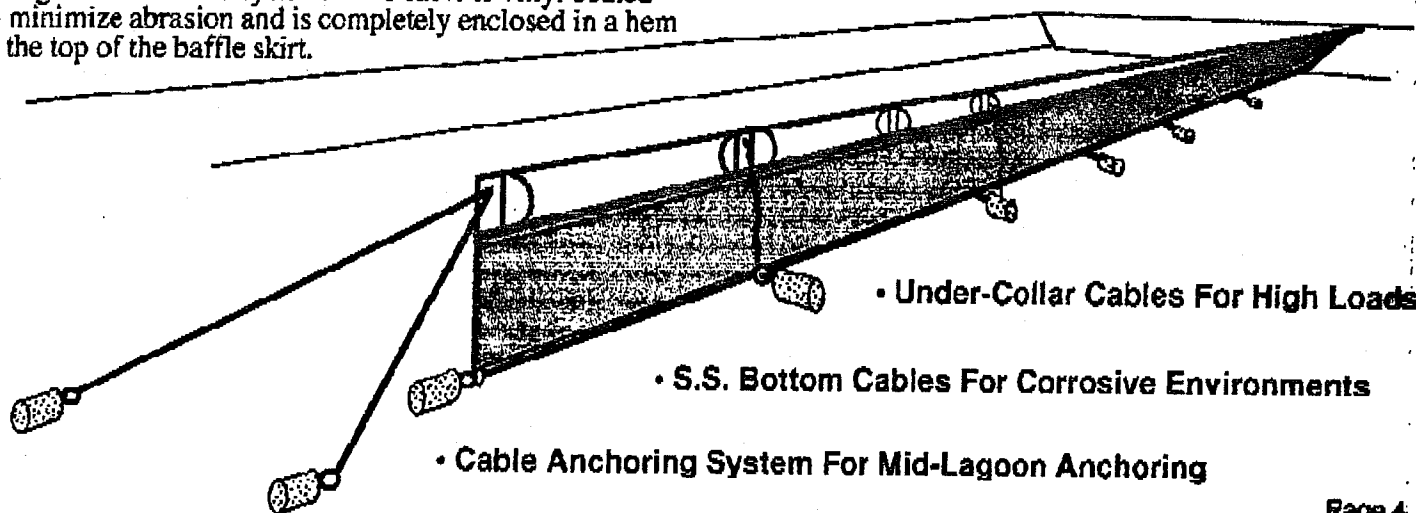
Director floating baffles can be terminated before the opposite shore to create a serpentine flow pattern.

Under-Collar Cable

For installations with high flow rates or high wind conditions, an under collar cable system reduces lateral movement of the flotation collar and increase total tensile strength of the baffle system. This cable is vinyl coated to minimize abrasion and is completely enclosed in a hem at the top of the baffle skirt.

Bottom Cable

For extremely corrosive environments, the bottom ballast and tension chain can be replaced with a stainless steel cable. Environetics Director system can offer this option due to its unique ability to maintain the curtain's position by increasing the concrete ballast weight at the bottom anchor points.





Material Specifications

Physical Property	Hypalon®	XR-5®	PVC
Thickness	45 Mil.	30 Mil.	23 Mil.
Weight/Sq. Yd.	43.2 Oz.	30 Oz.	22 Oz.
Base Fabric	Polyester	Polyester	Polyester
Scrim Weight	3.2 Oz.	6.5 Oz.	5 Oz.
Coating Weight	40 Oz.	23.5 Oz.	17 Oz.
Tongue Tear	90 Lbs.	125 Lbs.	190 Lbs.
Grab Tensile	250 Lbs.	425 Lbs.	325 Lbs.
Hydrostatic Resist.	250 Lbs.	500 Lbs.	500 Lbs.
Dimensional Stability	1%	2%	2%
Coating Adhesion	10 Lbs.	10 Lbs.	10 Lbs.
Cold Crack	-45° F	-30° F	-40° F
Weathering	4 Million Langley† No Effect	10,000 Hrs. Minor Effect	2000 Hrs. 80% Strength

Widest Range Of Materials

Hypalon® Synthetic Rubber*

- Non-plasticised compound will not get brittle after extended exposure to UV light
- Superior resistance to heat and cold cycles... remains flexible to -40° F.
- 30 year performance record in industrial & municipal environments.
- Polyester reinforcement scrim will not absorb moisture like nylon.
- Resistant to 95% of all substances encountered in industrial treatment operations.
- Factory seam exceeds strength of parent material.
- Balanced tensile strength and elongation allows elastic response under surge loads.

XR-5® Ethylene Interpolymer Alloy**

- Excellent tensile strength for high stress environments.
- Highly resistant to a broad range of chemicals.
- Superior oil resistance for petroleum based applications.
- 10 year performance record.

PVC - Reinforced Polyvinyl Chloride

- Polyester reinforcing fabric minimizes delamination potential.
- Fabric is coated, not laminated, for superior adhesion.
- Economical for short term applications.

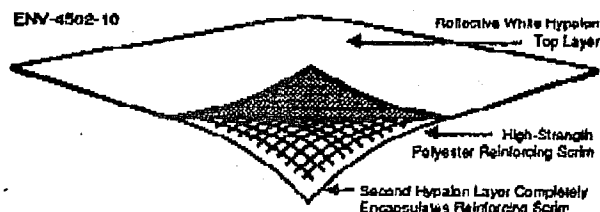
Consult Environetics, Inc. for material selection assistance and complete geomembrane specifications.

*Hypalon is a registered trademark of Du Pont.

**XR-5 is a registered trademark of Seaman Corporation.

†Total radiant exposure measured in EMMAQUA® accelerated weathering test. Equivalent to 15.34 years natural exposure in Arizona sunlight.

◇ Carbon Arc Atlas Weather-O-Meter.



45 mil white Hypalon collar material resists UV light and abrasion.

The Director

Floating Baffle System

Environetics...

Environetics, Inc. was formed in 1970 to design and manufacture quality products for the maintenance and protection of our environment.

Using advanced materials and manufacturing processes, Environetics has developed specialized products providing practical solutions for pollution control and prevention. Environetics holds several U.S. and Canadian patents on products designed for:

- Agricultural, Municipal & Industrial Waste Treatment And Recycling
- Liquid Storage and Containment

You will receive superior performance and value from our products. Our quality approach has attracted thousands of customers ranging in size from the family farmer to the Fortune 500 corporation.

We welcome the opportunity to apply our expertise in thermoplastic fabrication and system manufacturing to your application.

General Specifications

Warranty

Environetics, Inc. Director Floating Baffles are warranted for one year to be free of defects of materials or workmanship at time of delivery. Environetics offers an exclusive 10 year warranty on floating baffle systems utilizing 45/36 Hypalon® construction. An extended product warranty is available. Please consult Environetics for details.

ENVIRONETICS does not design or engineer systems. When properly installed, our products will perform satisfactorily.

Maintenance And Repair

Maintenance is seldom necessary. Occasional cleaning with mild detergent suited to the soil to be removed may be desirable. Kits for minor material repairs are available at nominal cost.

Installation

The Director's design allows trouble-free installation in dry or operating lagoons. Most installations require less than one day to complete. To assist in proper start-up procedures, Environetics can provide an Installation Supervisor to direct and certify the installation.

Shipping

Environetics Floating Baffles are manufactured in sections of up to 350'. Actual baffle section lengths depend on skirt depth and flotation size. Floating Baffles exceeding standard length limitations are manufactured in sections and shipped for on site assembly with bolt through connectors at the section ends.

Satisfied Customers...

Air Products & Chemicals
Alcoa
Allegheny Power Systems
Argonne National Lab
Army Corp of Engineers
Atlas Steel
Borden, Inc.
Jim Beam Distilleries
Cargill, Inc.
Chevron, USA
Citgo Refinery
Commonwealth Edison
Conoco
Corning Glass
Data General
Dow Chemical
DuPont
Eaton Corp.
Federal Paper
Flambeau Paper Co.
Ford Motor Co.
General Motors
Georgia-Pacific
Great Lakes Steel
Great Southern Paper
International Harvester
International Paper Co.
Kimberly-Clark
Kaiser Aluminum
Kodak
Monsanto Co.
Northern Illinois Gas
Purdue University
Ralston Purina
Standard Oil of Indiana
U.S. Army
U.S. Dept. of Interior
Union Camp
University of Wisconsin
Westinghouse
Weyerhaeuser

The Director

Floating Baffle System

Floating Baffle Quote Request Worksheet

Project Information

Company Name _____
 Mailing Address _____
 City, State, Zip Code _____
 Installation Location _____
 Person to Contact _____
 Phone No. _____
 Fax No. _____

Product Information

1. Number Of Floating Baffles (Identical) _____
2. Floating Baffle Length (At Maximum Water Level) _____
3. Maximum Water Level _____
4. End Type
 Side One 2:1 _____ 3:1 _____ Vertical _____ Other _____
 Side Two 2:1 _____ 3:1 _____ Vertical _____ Other _____
5. Flow through Windows
 a. Maximum Flow Rate _____
 b. Number Of Windows _____ Height _____ Width _____
6. Material
☐ ENV-45/36 Hypalon Construction (45 mil White Collar / 36 mil Black Skirt)
☐ ENV-3004-12 (30 mil Black Ethylene Interpolymer Alloy)
☐ ENV-2201-12 (22 oz. Black PVC)
7. Special Requirements
 a. Exposed Geomembrane Lagoon Liner Yes _____ No _____
 b. All Stainless Steel Hardware Required Yes _____ No _____
 c. Other _____



Environetics, Inc.

1201 Commerce St., Lockport, Illinois 60441
 Telephone: (815) 838-8331 Fax: (815) 838-8336

Environetics, Inc.

120 Commerce Street
Lockport, Illinois 60441
(815) 838-8331
(815) 838-8336 - FAXManufacturers of
Environmental Control
Systems

ENV-3602-12 & ENV-4502-12: Industrial Grade Hypalon® Chlorosulfonated Polyethylene (CSPE)

Description: A polyester supported synthetic rubber membrane, designed as a liquid barrier for above ground or in-ground applications. The membrane is a 3 ply construction completely encapsulating the scrim within two layers of Du Pont Hypalon compound. The formulation shall contain a minimum of 45% by weight of Hypalon polymer as the sole elastomer.

<u>Physical Properties:</u>	<u>Test Method</u>	<u>Type 036</u>	<u>Type 045</u>
Gauge, Nominal (mil)	-	36	45
Plies Reinforcing, 10 x 10 1000d polyester	-	1	1
Thickness (mil min.)	ASTM D751		
1. Overall		34	41
2. Over Scrim	Optical Method	11	11
Breaking Strength, Fabric (lbs. min.)	ASTM D751 Method A	200	250
Tear Strength (lbs. min.)	ASTM D751 Modified		
1. Initial		80	90
2. After Aging		35	35
Low Temperature (°F)	ASTM D2136 1/8 in. mandrel, 4 hrs - Pass	-40	-40
Dimensional Stability (max. % change each direction)	ASTM D1204 212°F, 1 hr	2	2
Volatile Loss, 30 mil sheet (% loss max.)	ASTM D1203 Method A	0.5	0.5
Resistance to Soil Burial (% change max. from original values)	ASTM D3083, para. 9.5		
a. 30 mil unsupported sheet	1. Breaking Strength	5	5
	2. Elongation at Break	20	20
	3. Modulus at 100% Elongation	20	20
b. Membrane Fabric Breaking Strength	ASTM D751 Method A	25	25
Hydrostatic Resistance (psi min.)	ASTM D751 Method A, Proc. 1	250	250
Ply Adhesion	ASTM D413 Machine Method	8	8
(min. lbs./in. each direction)	ASTM D413 Modified Method	10	10
Water Absorption	ASTM D741, 30 mil sheet		
(% weight gain max.)	14 Days @ 70°F	1.5	1.5
	30 Days @ 70°F	2.0	2.0
	14 Days @ 158°F	30.0	30.0
	30 Days @ 158°F	30.0	30.0



Curragh
Resources Inc.

117 Industrial Rd.
Whitehorse, Yukon Y1A 2T8
Tel.: (403) 668-8021
Fax: (403) 668-6518

April 5, 1991

Environment Canada
Environmental Protection Service
Box 6010
Whitehorse, Yukon
Y1A 5L7

ATTN: Mr. Daniel Cornett,
Fisheries Act Inspector

Dear Sir:

This will serve to acknowledge our receipt of your letter of March 27/91. We would request that future letters include a copy to Mr. Colin Benner, Executive Vice-President, Operations and remove the copy to Mr. Jim Hendry, Vice-President, Engineering. Mr. Benner is directly involved in the Faro Operations but is based at the same address as Mr. Hendry.

Difficulties of maintaining water quality from October through December of 1990 were identified by the company and reported to the Department of Indian Affairs and Northern Development (DIAND) both immediately upon discovery and within the monthly reports.

We have been actively working with DIAND throughout the said period; however, and in view of your letter, we now write to directly apprise you of the causes of the water quality problems and the remedial steps which have been taken.

Water quality problems experienced from October through December were a result of three major contributing factors. Firstly, surface and underground mining within the Faro Pit was concentrated near pit bottom which required maximum dewatering effort to maintain dry working conditions. The result was an increased volume of pumping to the tailings pond area of waters containing a very high zinc loading which, in turn, seriously taxed the ability of the mill discharge to elevate the pH sufficiently to precipitate the dissolved zinc. Secondly, the mill discharge and the pit dewatering were entering the tailings pond at separate locations; flows were not mixing until they reached the small pond immediately upstream of the Intermediate Dam by

Mr. Dan Cornett
April 5, 1991
Page 2

which time the lime solids in the mill discharge had been largely deposited. The third and final factor related to a problem experienced in early October in which visible suspended solids levels in the X4 siphon discharge from the Intermediate to the Cross Valley Pond caused us to believe that solids were being drawn from the bottom of the Intermediate Pond. To prevent a possible metals discharge problem related to suspended solids, the siphon was choked down to permit the pond to operate at maximum capacity; in so doing, an inadvertent overcorrection occurred resulting in high flows through the spillway into the Cross Valley Pond and a subsequent short circuiting problem. The flows were proceeding directly through the pond without gaining the benefit of the retention for settling and ageing normally afforded by the Cross Valley Pond.

The following actions were taken to address these problems. Initially, the pH of the mill discharge was elevated through the addition of soda ash. This proved to be only of marginal benefit, in terms of water quality improvement at the Cross Valley (X5) discharge location, as a result of the inadequate mixing problem within the Intermediate Dam. Consequently, a small lime pipeline was installed from the mill to the original Faro Creek channel (approx. March 18) where the pit dewatering flows could be directly treated. Although this appears to have been a successful remedy to the problem as evidenced by the recent reduced readings of zinc in our onsite monitoring (March 15 through 26), the mill has experienced a continual problem in keeping the pipeline from clogging as the lime tends to deposit in the line. On March 27, a backhoe was employed to excavate a ditch from the Faro Creek inflow to the Original Tailings Pond to the X1 location (near the current tailings discharge point). Upon completion on March 29, the pit dewatering was redirected to mix with the tailings at the outflow of the pipe and take full advantage of the high pH discharge. Should higher pH be required to totally precipitate the dissolved metals, the option then exists to add lime or soda ash to the tailings. Finally, the siphon at the Intermediate Dam was reactivated with the intent of matching approximately 95% of the inflow volume; this would allow a very small flow to be maintained through the spillway to ensure the pond operated at maximum capacity but did not create a short circuiting problem within the Cross Valley Dam. Most importantly, an individual from the mill has been assigned the responsibility of tailings pond operation and ensuring that the siphon volume is controlled and monitored on a regular basis.

In the event that water quality problems continue to occur, the following additional options are available.

1. The pit dewatering could be collected within an excavated sump in the original channel of Faro Creek (immediately east of the mill) and pumped into the mill for direct treatment.
2. Floating baffles are commercially available or could be constructed onsite to ensure that flows through the Intermediate Dam spillway do not short circuit through the Cross Valley Dam.

We trust that this information serves to apprise you of the problems which have been recently encountered at the Faro Mine and of the significant effort has been expended (prior to your

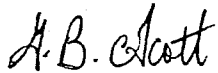
Mr. Dan Cornett
April 5, 1991
Page 3

correspondence) in remedial action. Sampling frequency has been increased since March 13 as per the attached schedule. Results since that date have shown an encouraging trend toward minimal zinc levels.

We very much appreciate the constructive and co-operative approach taken by DIAND in addressing these difficulties and, should any further problems be encountered, we would also appreciate the timely benefit of your department's expertise toward assisting in the resolution of those problems.

Yours very truly,

CURRAGH RESOURCES INC.



G.B. Acott, P.Biol.
Manager, Environmental Affairs

Enclosures: 2

cc. Gerry Whitley, DIAND

SUMMARY OF FIELD HACH KIT ZINC SAMPLING
March 15 - 26, 1991

X5 - outflow from Cross Valley Dam

March 15/91	-	0.21 mg/l
March 18/91	-	0.20 mg/l
March 20/91	-	0.18 mg/l
March 22/91	-	0.14 mg/l
March 25/91	-	0.14 mg/l
March 26/91	-	0.03 mg/l

TAILINGS WATER & ZONE II MONITORING PROGRAM

SAME FREQUENCY: Three times weekly (Monday, Wednesday, Friday)

SAMPLE LOCATIONS: Zone II Pipeline
Faro Sampling Site X7
Faro Sampling Site X4 (Siphon Decant)
Faro Sampling Site X4-North (if overflowing)
Faro Sampling Site X5

SAMPLE PARAMETERS:

Field *	Temperature, flow, pH (for comparison)
**	Static Water Level (Zone II monitoring well)
In-House *	pH, Conductivity, Alkalinity (Acidity if required)
	Zinc (Hach kit)
	may require dilution (eg X7/Zone II @ 1:50, 1:100, 1:200)
Contract	X7 (weekly)
	Cu, Zn, Pb (Dissolved)
	Sulphate
	Zone II (monthly)
	Multi-element, Option Full (Total & Dissolved)
	Sulphate
	X4 (weekly)
	Cu, Zn, Pb (Total & Dissolved)
	X5 (weekly)
	Cu, Zn, Pb (Total & Dissolved)

* on three times weekly samples

** every second week

CURRAGH RESOURCES INC.

Inter-Office Memorandum

DRAFT, FOR DISCUSSION ONLY

TO: Colin Benner
Executive Vice-President, Operations
Toronto Office

FROM: ✓Gerry Acott
Manager, Environmental Affairs
Whitehorse Office *Gerry*

CC: Gregg Jilson, VP, Exploration
George Whyte, Vice-Chairman & Secretary
Marvin Pelley, Executive VP, Corporate Development & Engineering

RE: **Current Plans and Schedule Toward Implementation of an Environmental Auditing Program**

DATE: 05 24 1991

1. Overview

Environmental audits (EA) are an excellent management tool in assisting industry to reduce or eliminate potential environmental liability. Current Regulations such as the Canadian Environmental Protection Act and Fisheries Act have incorporated wording which assigns direct responsibility to senior management and Board of Directors to ensure that environmental precautions are an integral part of day to day operations. Defense against an environmental infraction is largely based on establishing due diligence. An environmental audit is a very important step which will serve to identify potential problems and outline mitigative measures.

It will be necessary to conduct separate EA at each site including Faro, Sa Dena Hes, Westray and Stronsay.

2. Actions Currently Underway

The primary function of an EA is to evaluate current operating methods and compliance levels and to identify potential areas of weakness. If an EA were conducted today at Faro, one key area which would arise as a glaring weakness would be the handling/storage of hazardous materials and the contingency plans for emergency action in the event of a spill.

Mr. Eric Soprovich, Environmental Engineer at Faro, has applied and has been granted a six month leave of absence to undertake practicum research toward completion of a Masters Degree in Natural Resources Management. It appears that I have been successful in persuading him to adopt this subject as the basis of his research and to draft a policy manual for Curragh which will be applicable to all sites.

If this subject area is formally accepted by his Review Committee, a draft of the manual could be expected by October of this year.

3. **Develop a Corporate Environmental Policy**

It is necessary to develop a brief but concise corporate environmental policy for all Curragh employees, agents and operators. It must provide clear direction as to the expectation of Curragh Senior Management with regard to environmental matters and embark on a program to inform all employees of those expectations.

4. **Develop an Audit Program**

There are many ways that an EA may proceed. Various questions must be addressed including

i) *Is it desirable to conduct the audit in such a manner as to attempt to ensure the confidentiality of the results?*

If so, the audit must be initiated at the outset by legal counsel operating at arms length to protect the information under attorney-client privilege.

I would suggest that this would be in our best interest to pursue. A claim of solicitor-client privilege may be structured in one of three ways. Firstly, claim may be made under the "Work Product Rule" where the materials are being prepared in contemplation of litigation. As Curragh does not foresee the possibility of charges for environmental infractions, this approach is not considered further. A second possibility is Self Evaluation Privilege. This is a broad form of protection developed or evolved in the United States to cover issues similar to EA's; as the system currently has no precedent in Canada, it will not be an option.

The third and most applicable, claim for solicitor-client privilege is under the provision of "Legal Advice". The elements of this claim;

- client must request legal counsel to provide advice (in this case an EA).
- the matter must be strictly confidential; privilege is waived if the document is widely distributed within the company or sent to third parties.

- solicitor must receive all communication from the auditor and pass it on to ourselves.

These elements may be difficult to achieve but could be accomplished through the use of numbered copies of reports and written communication, strict control of distribution and setting in place a procedure for communication between auditor and solicitor.

I would suggest that Anton, Campion, Macdonald & Phillips of Whitehorse would be the primary candidate to handle this matter on our behalf as they have a good understanding of the Yukon operations of Curragh and have previously represented us in numerous environmental regulatory negotiations.

ii) Who will be assigned to the audit team?

It is generally accepted that auditors external to the company bring with them valuable experience from audits done for other clients. Additionally, they offer impartiality. The selection of a consultant to perform this service is critical; the scope of the audit must be well within their technical capabilities, training and experience and they must have a very thorough understanding of current laws and regulations.

Auditors from within the company have the advantage of familiarity with operations, policies, technical issues and site specific regulatory requirements.

The optimum situation is a combination of both. I would suggest a three man audit team consisting of:

- an environmental consultant with auditing experience and a background in environmental compliance and knowledge of the mining industry
- a legal consultant with experience in environmental auditing and familiarity with the mining industry
- a Curragh employee familiar with environmental requirements and past experience with EA's; most probably myself.

A legal opinion is required to assess whether the placement of a Curragh employee on the audit team will invalidate solicitor-client privilege.

iii) What subject areas will the audit encompass?

The scope of the audit can be very limited and specific to a certain area

of concern in certain instances. This is often the case if an audit is focused on one specific issue such as the acquisition of a new property.

As Curragh has potentially four operating mines, at different locations within Canada and different mining/preparation techniques, ours will be of larger scope and more general in its' approach. It would be advisable to start with the initial EA at a relatively low level, for example to interview key personnel at each site to ensure that responsibilities for each duty required to protect the environment is clearly assigned to a specific individual and that a superior is aware of his responsibility to ensure that duty has been performed. It may be possible at a later date to expand the scope to evaluate subjects such as environmental compliance, risk assessment, loss control or health and safety issues depending on the wishes of the company.

5. **Review the Development of the Audit Program with Senior Management**

Senior Management of Curragh will be intimately involved in the development of the auditing program as it will involve a substantial time commitment for all employees and bear a tangible cost. **It must be clearly understood, before an audit program is initiated, that it will unveil many areas of environmental weaknesses that must be immediately addressed. The worst thing a company can do, from a liability perspective, is to identify problems for which they do not demonstrate immediate action to mitigate or rectify. This, of course, will necessitate a financial commitment whose magnitude is unknown at the outset of the audit.**

6. **Request for Quotes**

Once the objectives and scope of the EA have been defined, it will be necessary to case the consulting market for suitable candidates and send request for proposals. The consultant should be asked to review and comment on the terms of reference and suggest any improvements or modifications he may have. The proposal should identify past experience in EA with a reference list. An hourly remuneration rate for the auditor should also be part of the response.

Curragh personnel would then be in a position to select an audit team and more clearly define the costs associated with conducting an EA.

To protect the claim of client attorney privilege, all contact beginning with the request for quotes would have to be through legal counsel and strict

confidentiality would be a condition of the contract.

7. **Final Proposal to Senior Management to Undertake the EA**

With the information from consultants, a final audit scope, cost and schedule could be developed. Senior Management would then be in a position to make a final commitment to proceed with the program.

8. **Implement the EA**

The audit team would visit each site for about a 3 to 5 day period. The visit would involve a pre-inspection visit with on-site management to review the structure of the program and the agenda. The team would then proceed to schedule interviews with key personnel, review records and conduct site investigations.

Upon completion of the on-site visit, a meet with on site management will be arranged to advise of findings and make some preliminary recommendations. Although this would be the most productive approach, it requires a legal opinion as to whether or not this would violate the claim to attorney-client privilege.

9. **Formal Report**

The audit team would complete the audit by providing a comprehensive final report which details the object and scope of the audit, the findings and recommendations.

10. **Follow Up**

This is the most important step in the entire audit program. **Curragh, should it decide to initiate an EA, must be prepared to immediately address the problems identified and the recommendations made.** This will involve immediate action on some items while other, less pressing issues may be scheduled for remediation at a later date (ie seasonal field projects). It is imperative that all identified problems be dealt with in some manner and this will involve a commitment of personnel and finances at each site. **If these issues are not dealt with, Curragh has developed a much greater environmental liability than existed prior to EA implementation.**

11. **Future EA**

EA's should be conducted on a regular basis similar to financial audits to ensure past problems have been adequately dealt with and that subsequent issues continue to be addressed in a timely manner.

The initial EA can be expected to identify the majority of the problems with future audits being somewhat reduced. This factor may allow the expansion of scope in future EA into other subject areas such as risk assessment and employee health and safety.

12. **Board of Directors**

In many large companies, the Board of Directors play an active role in the EA process. This may be desirable to Curragh as well. One area which I would suggest that the Board of Directors consider, is the appointment of one of the members as an Environmental Advisor. The primary responsibility of this position is to keep abreast with environmental issues as they relate to the company and the regulatory framework and report to the remainder of the Board.

CURRAGH RESOURCES INC.
SCHEDULE FOR IMPLEMENTATION OF AN ENVIRONMENTAL AUDIT

1991

1992

A M J J A S O N D J F M A M J J A S

XXXXXXXXXXXXXXXXXXXXX

2. Actions Currently Underway

- Waste Management/Spill Response Policy Manual

3. Develop a Corporate Environmental Policy

- G. Acott to draft
- Senior Management Review
- Meetings with Employees at each site office

xxx

xxxx

xxxx

4. Develop an Audit Program

- Preliminary Meetings with legal counsel
- select components of Audit Team
- Objectives & Subject Areas for first EA

xxxx

xxxx

xxxx

5. Senior Management Review & Program

Finalization

xxx

6. Request for quotes

- identify potential candidates
- request for quotes & selection of audit team

xxx

xxx

7. Final Proposal

- present for acceptance of Senior Management
- implementation planning

xx

xx

8. Implementation

- Faro
- Sa Dena Hes
- Stronsay
- Westray

		1
x		
x		
x		
x		

} must be done during
} snow free months to
} permit an effective
} site investigation

9. Formal Report

- all operations

x

10. Follow Up

- ongoing

XXXXXXXXXXXXXXXXXXXXX →→



Indian and Northern
Affairs Canada

Affaires indiennes
et du Nord Canada

Northern Affairs Program
200 Range road
Whitehorse, Yukon
Y1A 3C9

30 May 1991

Curragh Resources Inc.
117 Industrial Road
Whitehorse, Yukon
Y1A 2T8

Attention: G. B. Acott, Manager, Environmental Affairs

Dear Sir: *Jimmy*

Site visit-Curragh Faro Operations-30 April 1991

I have attached a copy of my report in regard to my site visit on 30 April 1991 for your files. The sample analysis results from my one two-litre X5 sample are not available and I will endeavour to get you the results as soon as possible.

It was a pleasure to meet you and I would like to thank you and Messrs. Beaumont, Hwozdyk, and Soprovich for the courtesy and cooperation extended during the visit.

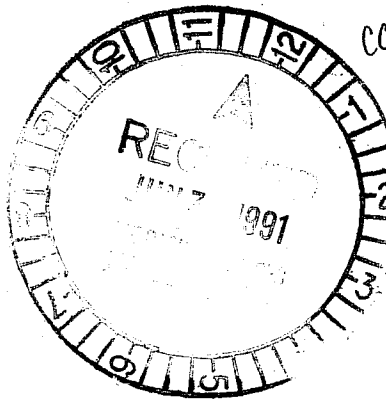
As you can see from the inspection report, I have outlined my concerns and recommendations as a result of on-site observations. These were discussed in forum with you and the above-noted gentlemen in Mr. Beaumont's office.

I am not sure what the protocol is in this case, however I did promise Mr. Beaumont a copy of the inspection report. I would be pleased if you could forward him a copy for his files.

Please contact me if you have any questions regarding the above at 667-3227.

Yours truly,

J. A. Polyck
Chief Water Management Officer
Water Resources Division



Faro / Envir. Inspections
cc. Jim Moore
Eric Beaumont
Leo Hwozdyk
Eric Soprovich
Rafael Odu
me
Your file Votre référence
Our file Notre référence



TO
A File

FROM
DE

Chief Water Management Officer

SUBJECT
OBJET

Site Inspection 30 April 1991- Curragh Resources Faro, Grum & Vangorda minesites

On the above date, J. A. Polyck (Chief Water Management Officer) conducted a general site inspection of the Faro, Grum and Vangorda mining operations. The Mine is currently undergoing a Strike. The following are comments regarding the site visit:

1. A brief meeting was held in the Curragh Faro office of E. Soprovich (Environmental Engineer Curragh). Present were: Polyck, E. Soprovich, E. Beaumont (Acting mine manager), L. Hwozdyk (Project Superintendent), G. Acotte (Manager Environmental Affairs) and R. Odie (Environmental Technician);
2. Mr. Acotte advised that the Faro mine abandonment plan was filed 29 April (yesterday) at the office of the Yukon Territory Water Board;
3. Mr. Beaumont outlined the three proposed baffles for the intermediate dam impoundment. The first baffle (previously referred to as a plug dam) was being installed during the previous DIAND inspection conducted 06 March 1991 and is approx. 3m in height. The next baffle will be installed downstream above the intermediate dam, with the final one installed between the two other baffles. He also discussed the ditch recently re-installed to direct pit water along the north wall of old tailings dam (called 1974/79 dam) to discharge with mill tailings at X9. The mill tailings are presently beached behind the installed baffle. the baffle now runs the full width of the impoundment and has a spillway adjacent to the south wall at the Rose Creek diversion. Current mill concentrate production rate is 60% or 7,500 tonnes/day;

.../2

SECURITY - CLASSIFICATION - DE SÉCURITÉ
OUR FILE - N / RÉFÉRENCE
Curragh Faro
YOUR FILE - V / RÉFÉRENCE
DATE
6 May 1991

4. The intermediate dam is scheduled to undergo a lift of approx. 3 metres (to elevation 1049.3m) this field season along with the construction of the toe drain/berm below the crossvalley dam. Mr. Beaumont indicated a construction window of july/september. This construction will go ahead despite the Strike, as this work is related to environmental & safety issues that are not affected by the Strike. Plans are presently being developed for submission to the Yukon Territory Water Board.

One siphon pipe at station X4 is operating with 2 others shut down (all were not running until recently- the syphon effect was lost- the Mine advised possibly due to a vortex). The effluent from the intermediate dam is still spilling over the emergency spillway at the north end of the dam. The siphons at X5 on the crossvalley dam are not operating, with effluent overflowing the crossvalley dam spillway on the north end of the dam at X5. The effluent visually appeared low in NFR when a two litre sample was taken at the X5 station.

5. The Mine hopes to direct the tailings water back to the Faro pit by October, however Beaumont indicated all schedules (other than above constructions) would be dependent on the length of the strike.

6. Mr. Hwozdyk advised 6 test holes will be drilled this season in the Rose creek diversion dike and 8 holes in the intermediate dam as part of the geotechnical investigation program.

7. A tour of the Faro mine water supply reservoir and downvalley tailings pond was conducted (Acotte, Soprovich, Hwozdyk and Polyck). The area of glaciation on the 1974/79 tailings dam was inspected and two areas of overtopping of the dam crest were observed. There is minimum freeboard on the 74/79 impoundment. In the last few years pit water was not channelled along the north side of the impoundment and until recently, some drainage collected at the dam center crest, glaciated in winter and overflowed in the spring. The first area of overtopping was on the south part of the dam facing to the rose diversion (see diagram) some crest material had eroded due to overtopping. This should be dressed up by heavy equipment this season. The second area of overtopping is located near the center of the dam (this area was inspected in the spring of 1990 and flow over the dam observed in a well- entrenched channel cutting through the dam crest).

A backhoe had recently been on site to trench from the center dam crest area (pond side) of the dam to the north abutment to promote drainage to station X9. The dam shell should be dressed at the second overtopped location also. The problem should be alleviated with the installation of the north drainage ditch.

8. The tour continued along the rose diversion to near X10 and proceeded to X5 below the crossvalley dam. The decant flow over the dam spillway was braided with no well-defined channel observed. This area should receive some attention to dress up the spillway and channelize flow at X5.

9. The tour proceeded to the north side of the downvalley tailings adjacent to the intermediate dam spillway. Gullying along the valley wall at this location was observed, with deposition of eroded material at the toe of the slope, in and near the spillway channel. Although the problem appears minor at this time, this area should be monitored and dressed up if required this season.

10. The next item observed was the Zone 2 Waste dump pumping site. The well and pump (50 HP and 350 igpm) were installed on or about 16 March 1991. Zone 2 water is running at 230 ppm Zn. The pump was not operating as the area was apparently drawn down (Soprovich).

11. It was observed that no work had been done recently at Grum.

12. The Vangorda creek diversion structure was inspected and found to be operating as designed. A problem observed was erosion at the road ditch on or near the Blind creek road crossing (both at the road culvert north side and on the south side ditching. Proper drainage control could alleviate this problem.

13. The Vangorda pit was observed and pumping operations to and from Pelly pond to the little creek pond are continuing. Little creek impoundment water is then pumped at 360 igph by two 25Hp pumps to the treatment plant. No problems were observed either at this location or at the treatment pond site. The perimeter waste dump dike was inspected. The current dike lift (as previously observed on 06 March) is still incomplete at the south east end. No problems were observed at this location.

The inspection tour ended with a brief meeting in the office of Mr. Beaumont to discuss observations and concerns. These were addressed to Mr. Beaumont as follows:

1. The two areas of overtopping on the 74/79 dam need remedial work;
2. The X5 spillway and channel need dressing up;
3. The valley wall at the intermediate dam spillway may need dressing to remove sediment and gully problem;
4. Erosion susceptible areas identified at or near the Vangorda diversion should receive remedial work.

J. A. Polyck



Environment
Canada

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Conservation and
Protection

Conservation et
Protection

ENVIRONMENTAL PROTECTION
100 Hamilton Blvd.
Box 6010
Whitehorse, Yukon
Y1A 5L7

cc: Gregg Wilson
Brian A. Hogg
John Hogg
Eric Sopronich
Leo Hogg
Colin Banner

Your file / Votre référence

Our file / Notre référence

Faro Mine
Env
Waste Mgmt

17 July 1991

4484-37/A293

Gerry Acott
Manager, Environmental Affairs
Curragh Resources Inc.
117 Industrial Road
Whitehorse, Yukon
Y1A 2T8

Re: Toxicity at the Cross Valley Dam Decant - Station X5

Dear Mr. Acott:

As you are aware, a bioassay sample collected by our staff on 25 June 1991 yielded an LC_{50} of 88%. We understand that the bioassay carried out on a split of that sample for Curragh yielded an LC_{50} of 93%.

Further, you are aware that a May 8, 1991 bioassay sample collected by DIAND was toxic at an LC_{50} of 75.7%.

Failure to achieve an LC_{50} of 100% has been successfully used as evidence of a breach of the general provisions of the Fisheries Act.

We are very concerned that these results may be indicative of persistently poorer quality effluents being discharged out of the tailings system at X5.

The evidence suggests that the tailings system has reached some kind of capacity limit. It would be useful to identify what the limiting factors are in terms of the primary toxicants.

Our analytical results for those effluent components which are generally associated with toxicity at Faro station X5, do not indicate that they were present at levels which are known to result in acute toxicity to fish.

At our request, you have provided a list of all the reagents in use in the mill and the rate at which they are used. You have also stated that the same reagents were in use a year ago with the exception of potassium amyl xanthate and that there are no significant changes in the rate of use except for cyanide and lime.

Canada

Several of the reagents in use have been shown to exhibit toxicity at levels around 10 ppm or less. These include the Xanthates and the Aerofloat R242. There are several other components which we still lack toxicity information on.

Based on the information Curragh has provided, the only significant change which is apparent over the last year is a gradual loss of retention time in the Down Valley tailings system and some related problems this has created for the siphons. This means that toxic reagents, which in the past have degraded in the tailings ponds, are now more likely to be discharged into the receiving waters.

Environmental Protection is requesting the co-operation of Curragh Resources in carrying out the following measures to assess and eliminate the toxicity at X5:

- 1) to expedite the raising of the intermediate dam and to provide us with your current schedule for completing the design work and implementing the lift. The implementation of this lift should be viewed as an urgent need. As well, we understand that the tailings are too close to the siphon intake on the intermediate dam and tailings can be carried over with that flow. The use of the spillway as an alternative significantly increases short circuiting. This problem should also be addressed.
- 2) to increase Curragh's program of bioassay monitoring to bi-weekly at X5 in order to verify the persistence of the toxicity and whether there are any trends. This should continue until the 100% LC_{50} standard is achieved consistently for a six week period.
- 3) to undertake to determine what is the primary toxic agent(s) and in particular whether any of the mill reagents are significant contributors and, if so, whether substitutes with lower toxicity could be used.
- 4) to provide Environmental Protection with analytical methods and toxicity information for the reagents which are used.
- 5) to provide Environmental Protection with an estimate of the retention time in the system based on field measurements.



1400 007 7562 EP - WHITEHORSE 84

We expect and welcome suggestions Curragh may have to improve the effectiveness of the program. However, we would like to have confirmation of your intentions as soon as possible and would be pleased to meet with you to discuss our requests at your earliest convenience.

Respectfully,



Vic Enns P. Eng.
Manager, Pollution Abatement

c. A. von Finster - DFO
J. Nickel - DIAND
J. Doering - YTWB



Environment
Canada

Environnement
Canada

Canada



August 7, 1991

Indian and Northern Affairs
Northern Affairs Program
Mining and Infrastructure Directorate
Ottawa, Ontario
K1A 0H4

Attention: Mr. Martin Barnett
Senior Advisor

Dear Sir:

With regard to DIAND participation through MEND in our tailings covers research for which I have previously forwarded Steffan, Robertson & Kirsten Report 60631 entitled "1990 Report on the Tailings Covers Test Facility", thank you for your expression of interest in the continuation of the program.

I have asked the Environmental Engineer at the site, Mr. Eric Soprovich, to prepare a summary of the activities to be undertaken during 1991 complete with schedule and budget. Attached is his response. You will note that the program has been initiated with the routine instrument monitoring being collected on a monthly basis.

The total budget for 1991 activities amounts to \$59,620. I realize that your proposed funding is in the amount of twenty thousand dollars but would encourage you to consider contributing and equal share with Curragh in the amount of \$29,810.

Again, thank you for your support of this project. I will await your decision on level of funding and some direction on how the funds will be delivered.

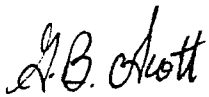
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Mining and Infrastructure Directorate
August 7, 1991
Page 2

If you have the opportunity, we would be more than willing to accompany you on a field tour of the project.

Yours truly,

CURRAGH RESOURCES INC.

A handwritten signature in cursive script, appearing to read "G.B. Acott".

G. B. Acott, P. Biol.
Manager, Environmental Affairs

GBA*blb

cc: Eric Soprovich, Faro
Al Waroway, DIAND, Whitehorse
Grant Feasby, CANMET

CURRAGE RESOURCES INC.

Memorandum

TO: Gerry Acott
Manager of Environmental Affairs

FROM: Eric Soprovich
Environmental Engineer

SUBJECT: Research Program at the Faro Tailings Test
Facility

DATE: August 01 1991

I have proposed the following research program for activities at the Faro Tailings Test Facility and related to the Tailings Abandonment Development Program (TADP). Please note that the scope of work for 1991 is highly dependent upon availability of both funding and personnel.

1. INSTRUMENT MONITORING

- . Routine monitoring of thermistors, CO2/O2 samplers, and standpipe piezometers; installed in Test Pits 1-6 plus Site 7. Frequency will be on a minimum monthly basis year-round with extra readings taken during the warm months (technician time-availability dependent).
- . Daily measurements of maximum and minimum temperatures plus rainfall and evaporative potential at the Test Facility during the summer months.

2. SAMPLING PROGRAM

- . Sampling of water and solids from the test pits will take place beginning mid-September (Sept. 16) and carry through until October. Based upon previous years' experience; the time commitment required for this program is approximately 200 hours.

EAS/ttf1

2.1 WATER SAMPLING

The number of water samples will be approximately 60 + 10 duplicates. Water samples will be collected using a variable speed peristaltic pump. All samples will be filtered through 0.45 micron millipore filters in the field.

Samples for cation analysis (70) will be preserved immediately and refrigerated until analysis by a contracting laboratory for:

Fe	Pb	Zn	Cu	Mn	Mg	Cd	Co
Ag	Ca	Na	K	As	Se	Ni	Cr

Filtered and non-acidified samples (70) will be refrigerated until analysis for anions:

Cl, SO₄, F, NO₃, total inorg. carbon, and pH.

2.2 SOLIDS SAMPLING

A minimum of 6 + 1 duplicate solids samples will be extracted from sampling tubes installed in the test pits. Samples will be preserved with nitrogen and analysed by a contracting laboratory for:

acid/base potential
sulphur species
Fe Pb Zn Cu Mn Ni Cd As Al

Additional analyses (s.a. presence/absence of T. Bacillus) may be conducted upon solids material depending upon technical and other factors.

2.3 QUALITY CONTROL

Approximately 10 duplicate water samples and 1 duplicate solids sample will be taken and shipped along with other water and solids samples. Duplicates will be numbered sequentially: the true identity of duplicates will remain on-site.

A QC/QA program involving standard solutions, spikes, and blanks will be implemented by the contracting laboratory for the analysis program.

3. MAINTENANCE

The severe environmental/climatic conditions experienced at the mine site exact a yearly toll upon long-term performance of the Tailings Test Facility. Ideally, the following maintenance projects are under consideration for 1991:

- . inspection and repair to tank bottom drains
- . reinforce instrument panels in all tanks
- . repair and extend thermistor cabling to surface
- . repair leakage through instrument panel for pit 6 (water cover)
- . design & install sump pumpage system

. Additionally, the Nova 305B CO2/O2 meter requires completion of repairs initiated earlier this season to correct for a malfunctioning O2 detection cell.

. The availability of labour and materials may require that I prioritize maintenance projects; with the most important maintenance items being completed during the 1991 field season.

4. PROGRAM COSTS

. Program costs for the various components of the 1991 Tailings Test Facility Program are appended.



Eric A. Soprovich
Environmental Engineer

cc: Bill Dunn
file

EAS/ttf3

TAILINGS CLOSURE PLAN - ESTIMATED EXPEDITURES

PROJECT / TYPE	SUPPLIES & EQMT.	CONTR. TECH.	CONTR. CONSULT.	WAGES/ LABOUR	TOTAL
A. TEST PLOT SAMPLING	2200	28000	13840		49040
B. TEST PLOT MAINTENANCE	1900			2300	4400
C. REPORTING (YR. END)			6180		6180
TOTAL PARTS A. TO E.	4100	28000	25020	2500	59620

CURRAGH RESOURCES INC.

117 Industrial Road
Whitehorse, Yukon
Y1A 2T8

Tel: (403) 668-8021
Fax: (403) 668-6518

TELEFAX TRANSMISSION

TO:

Martin Barnett

819-994-6419

FROM:

Bette Boyd, Executive Secretary

WHITEHORSE OFFICE

DATE:

Aug 7/91

TIME:

ORIGINAL TO FOLLOW:

YES ☒

NO ☐

SUBJECT:

If all pages are not received, please contact Bette at 668-8034
THIS TRANSMISSION CONSISTS OF 7 PAGE(S)
(including cover page)

TRANSMISSION REPORT

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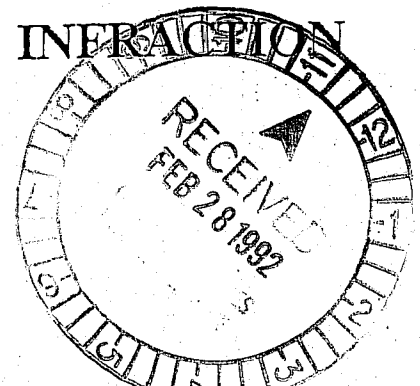
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XEROX TELECOPIER 7020

RESPONSE TO VIOLATION MESURE PRISE A LA SUITE D'UNE INRACTION

Warning
Avertissement

Environmental Protection
Conservation & Protection
Box 6010
Whitehorse, Yukon
Y1A 5L7



OUR FILE: 4484-37/A293

BY HAND

27 February 1992

Curragh Resources Inc.
117 Industrial Road
Whitehorse, Yukon
Y1A 2T8

Attention: Mr. Gerry Acott, Manager, Environmental Affairs

Dear Mr. Acott:

The purpose of this letter is to serve notice to Curragh Resources Inc., 117 Industrial Road, Whitehorse, Yukon Territory, that inspection of your Station X-5 Faro mine site water quality report for the month of December, 1992 gives reasonable and probable grounds to believe that Curragh Resources Inc. is in violation of Section 36(3) of the Fisheries Act, R.S.C. 1985, as amended by Statutes of Canada 1991, c.1.

Section 36(3) states that:

"...no person shall deposit or permit the deposit of a deleterious substance of any type in water frequented by fish or in any place under any conditions where the deleterious substance or any other deleterious substance that results from the deposit of the deleterious substance may enter any such water."

That paragraph is qualified by section 36(4) which allows such deposits if they are permitted under another federal statute or under regulations issued pursuant to section 36(5) the Fisheries Act. In this instance, mining effluent deposits are authorized under the Metal Mining Liquid Effluent Regulations (MMLER), SOR/77-178, subject to the limitations specified in section 5.(1) of that regulation and the applicable Schedules. Copies of the Regulations and the Fisheries Act have been provided to you previously.

... 2



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Canada

Inspection of the above-noted report indicates that at Station X-5 effluents were discharged containing a monthly arithmetic mean concentration of zinc in excess of levels permitted under the MMLER contrary to section 5.(1)(a) of the above-noted regulations. Furthermore, 96 hour LC₅₀ bioassay results of 56.4% on December 4, 1992 and 62.7% on December 30, 1992 were reported for Station X-5. Such releases constitute offences under section 40(2) of the Fisheries Act. Penalties under the Fisheries Act for these offences include fines of up to \$300,000.

We are aware of your efforts to address these problems. We request by March 13, 1992, a report documenting Curragh's efforts and timeframes for achieving Fisheries Act compliance. This information will be assessed by DOE/DFO, in consultation with DIAND, and a further response formulated at that time.

This warning and the incidents to which it refers will form part of the Curragh Resources Inc. compliance history and will be taken into account in the event of any future violations. If you have any questions or require clarification you may contact Mr. Vic Enns of this office at (403) 667-3403.

Yours truly,



Vic Enns P. Eng.
Fisheries Act Inspector
Pacific & Yukon Region

Enc.

cc: Mr. Colin Benner, President - Base Metals
Curragh Resources Inc.
Suite 2100, Scotia Plaza
40 King Street W
Toronto, Ontario
M5H 3C2

Mr. John Hogg
General Manager Faro Operations
P.O. Box 1000
Faro, Yukon
Y0B 1K0

Office of Investigations, Pacific and Yukon

A. von Finster, DFO

Manager, Water Resources, DIAND

STORE & FORWARD REPORT

DATE/TIME
LOCAL TERMINAL ID.
LOCAL NAME
COMPANY LOGO

2-28-92 11:30AM
6686518
CURRAGH WHITEHORSE

No.	REMOTE STATION	START TIME	DURATION	#PAGES	MODE	RESULTS
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055	SA DENA HES	11:19AM	2'33"	6/ 6	EC SF	COMPLETED 9600
002	GENERAL MANAGER	11:27AM	2'28"	6/ 6	EC SF	COMPLETED 14400

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NOTE:

No. : DIRECTORY NUMBER 48 : 4800BPS SELECTED EC : ERROR CORRECT G2 : G2 COMMUNICATION
PD : POLLED BY REMOTE SF : STORE & FORWARD RI : RELAY INITIATE RS : RELAY STATION
MB : SEND TO MAILBOX PG : POLLING A REMOTE MP : MULTI-POLLING RM : RECEIVE TO MEMORY

cc - by hand to John Hegg

*Beitke:
original file*

CURRAGH RESOURCES INC.

Inter-Office Memorandum

TO: Eric Soprovich ✓ **REVISED**
Environmental Engineer,
Faro Division

CC: Bill Dunn, Chief Engineer ✓
John Hogg, General Manager ✓
Godfrey MacDonald, VP Metallurgy ✓
Terry Mudder, SRK, Seattle ✓
Walter Brandl, Quanta Trace ✓

FROM: Gerry Acott
Manager, Environmental Affairs
Whitehorse Office 

RE: **Proposed Bench Testing Program - Phase II**

DATE: 1992 03 4

As you are aware, the bench testing program which was described in my February 14/92 memo has been completed and was unsuccessful in that copper remained in solution. Two additional tests were undertaken:

- Ferric chloride, in the same three concentrations used earlier, was added to X4 sample and, after 2 hours of reaction time, pH was re-adjusted to 9.5; the supernatant was then run for copper content; no significant reduction in copper was apparent

- TMT, in the same three concentrations used earlier, was added to X4 sample and, after 2 hours of reaction time, the supernatant was filtered to 45 micron and analyzed for copper (it was suggested that the TMT was removing the complex but forming a colloidal particle which could be removed by filtration or flocculation); again, no significant reduction in copper was apparent

It appears that the complexing agent will have to be completely destroyed to allow the copper to be removed from solution. Our next set of jar tests will be conducted using the following procedure:

1. Quanta Trace will receive, by air freight on Wednesday March 4, a 20 litre sample of X4 effluent; analyze a sample for nitrate, nitrite, ammonia, total and WAD cyanide, cyanate, thiocyanate and a complete total and dissolved metal scan
2. Extract two 1.5 litre samples of X4 effluent; to one add 20 mg/l hydrogen peroxide and to the second add 40 mg/l; after 2 minutes of fast mix, allow 2 hours slow continuous mixing to complete the reaction
3. Raise pH to 9.5 (preferably using soda ash)
4. Split each sample into three 500ml subsamples;
 - run one for dissolved copper after filtering
 - add 50 mg/l ferric chloride, rapid mix for 1 minute, slow mix for 10 minutes, settle for 2 hours; filter and run for dissolved copper
 - as above only add 50 mg/l ferric chloride and 3 mg/l TMT

Please review and call me if you have any questions. If this doesn't work, we can be reasonably sure it is not a cyanide complex and we will then try some hypochlorite which will destroy any thiocyanate or ammonia complex.

As a separate trial, take a 1 litre sample of X4, adjust pH to 9.5, bubble air through the sample for 6 hours, allow overnight settling then run the supernatant for total and dissolved copper. This will provide us with an indication if simple aeration between or in the ponds will accomplish any metals removal.



**CURRAGH
RESOURCES INC.**

117 Industrial Road
Whitehorse, Yukon
Y1A 2T8
Tel: (403) 668-8021
Fax: (403) 668-6518

TELEFAX TRANSMISSION

TO: Eric Sepovich

FROM: St. Acutt

WHITEHORSE OFFICE

DATE: 4/3/92 **TIME:** _____

ORIGINAL TO FOLLOW: YES ☐ NO ☒

SUBJECT: REVISED bench test memo

cc John Hoagy / Bill Dunn - Faro

W. Brandt 6044 36-0563

T Mudder 206-881-1581

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TOTAL 0:00'54" 3

NOTE:

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PD : POLLED BY REMOTE SF : STORE & FORWARD RI : RELAY INITIATE RS : RELAY STATION
MB : SEND TO MAILBOX PG : POLLING A REMOTE MP : MULTI-POLLING RM : RECEIVE TO MEMORY



Curragh
Resources Inc.

117 Industrial Rd.
Whitehorse, Yukon Y1A 2T8
Tel.: (403) 668-8021
Fax: (403) 668-6518

March 6, 1992

PRIVILEGED & CONFIDENTIAL

Anton, Campion, Macdonald & Phillips
200 - 204 Lambert Street
Whitehorse, Yukon
Y1A 3T2

Attention: C. Brian Campion

Dear Sir:

Re: Environmental Protection Warning Letters dated February 27, 1992

Enclosed please find our draft response to the above noted warning letter concerning the X5 and V25 sites.

Please attend to have the attached letter distributed to:

Colin Benner, President, Operations, Toronto Office
(on vacation March 7/8/9, in Whitehorse March 10/11)
Godfrey McDonald, Vice-President, Metallurgy, Toronto Office
(in Sā Dena Hes until March 7, Faro March 8/9, Whitehorse March 10/11)
John Hogg, General Manager, Faro Office
(on vacation March 7/8, in Faro March 9 →)
Bill Dunn, Chief Engineer, Faro Office
Eric Soprovich, Environmental Engineer, Faro Office

Also note that this office must have comments from all parties, including yourself, by March 12, 1992 as the EPS deadline for reply is March 13, 1992.

Thank you for your attention in this matter.

Yours truly,

CURRAGH RESOURCES INC.

G. B. Acott, P. Biol.
Manager, Environmental Affairs

March 6, 1992

D R A F T

PRIVILEGED & CONFIDENTIAL

Environment Canada
Environmental Protection Service
100 Hamilton Blvd.
Box 6010
Whitehorse, Yukon
Y1A 5L7

Attn: Mr. Vic Enns, P.Eng.
Manager, Pollution Abatement

Dear Sir:

**Re: Ammonia and Zinc Monitoring Results at the Vangorda Water Treatment Plant
Clarification Pond Outflow - Site V25**

With reference to your letter of February 27 regarding the above subject, the following will constitute the report documenting Curragh's efforts and timeframes for water quality improvement at Site V25.

Increased zinc levels at the water treatment pond discharge began on about December 5/91. Unfortunately, the water quality analyses were slow to arrive at Curragh due to a backlog of samples at our contracted laboratory as well as our shipment of samples by truck rather than air freight. We became aware of the problem early in January and took immediate action to have all future samples shipped by air, request faster turnarounds from the lab and implement an internal weekly sampling of V25 outflows.

Problems with zinc originated as a result of a series of equipment failures and power interruptions within the water treatment plant. In an attempt to discern the problem, the Pump Crew Foreman was asked to prepare a detailed review of the equipment malfunctions, implement any immediate repairs which were required and complete an analysis of operating procedures making any changes necessary to ensure correct operation in the future. This has been completed and the Foreman has since prepared a revised and simplified operating manual. Training sessions, including hands on operating and trouble shooting exercises have been scheduled for all individuals with operational responsibilities followed by a written and oral test. Additionally, the Engineering Department will conduct a monthly review of the log book and the water quality results to ensure that these problems do not reoccur.

.../2

With regard to ammonia, problems began in early December but, again, were not recognized until January for the reasons described earlier. The source of the ammonia is the leaching of uncombusted blasting products utilized in the Vangorda Pit. We immediately initiated an internal evaluation of our blasting products and procedures and found that, despite our use of emulsion which are designed to be non-soluble in water, the large volume of groundwater which was accumulating in the drillholes was apparently diluting the slurry to the point there was incomplete combustion of the product. On January 27 through 31, we employed the services of Mr. Ian Ross of ICI Explosives Ltd. to investigate the problem and make some recommendations to improve ignition and reduce the loss of nitrogen based product. On February 10, we received a report from Mr. Ross recommending that all production holes in the Vangorda Pit be double primed; this would maximize the detonation within each hole and reduce the loss of product. Additionally, we are minimizing the time between loading of the holes and initiation of the blast as much as possible.

Other options currently under consideration include:

- probing production drillholes prior to loading and utilizing solid or encapsulated explosive products in the wettest holes; using a portable ammonia meter in the pit to try and trace the areas where the highest ammonia releases are occurring
- install a pump in the Vangorda Pit dewatering well in an attempt to reduce groundwater levels in the pit and reduce the volume of water to Little Creek Sump (assuming discharge to Vangorda Creek); if water quality unsuitable for direct discharge, it should dilute the high ammonia water in the Little Creek Sump
- try natural aeration on the pump discharge to Little Creek Sump; allow discharge to drop five to ten feet into an open ditch prior to flowing into the pond; construct additional cascades along the length of the ditch
- mechanical aeration; increase pH levels in the treatment plant to 10.5 to 11.0 and utilize a large compressor to bubble air through the reactor
- addition of chlorine; use chlorine gas or hypochlorite prior to pH elevation to remove ammonia as nitrogen gas

The option of aeration will be attempted next week using both the natural and mechanical means described above. Additionally, bench testing on bleach addition will be undertaken in the event that alternative methods are unsuccessful.

Weekly sampling at the lower Vangorda Creek site (V8) has been ongoing since mid February to monitor any effects of these problems which may persist at this location. January 17 sampling shows ammonia below detection limit (less than 0.05 mg/l) and total zinc at 0.027 mg/l.

Fish bioassay sample was taken at V25 on February 4 and has been completed at BC Research. Official results have not yet been received; additional bioassay sample was taken on February 28 and have not yet been completed. We will provide the results as they become available.

We would appreciate your further review of our progress to date and proposed plans. Should you have any additional suggestions toward the resolution of these problems, we would appreciate your input.

Yours truly,

CURRAGH RESOURCES INC.

G. B. Acott, P. Biol.
Manager, Environmental Affairs

GBA*blb



Curragh
Resources Inc.

117 Industrial Rd.
Whitehorse, Yukon Y1A 2T8
Tel.: (403) 668-8021
Fax: (403) 668-6518

March 13, 1992

Environment Canada
Environmental Protection Service
100 Hamilton Blvd.
Box 6010
Whitehorse, Yukon
Y1A 5L7

Attn: Mr. Vic Enns, P.Eng.
Manager, Pollution Abatement

Dear Sir:

Re: Bioassay and Zinc Monitoring Results at the Cross Valley Dam Decant - Site X5

With reference to your letter of February 27, 1992 regarding the above subject, the following will constitute the report documenting Curragh's efforts and timeframes for water quality improvement at Site X5.

Water quality results from December of 1991 showed an unexpected increase in zinc levels. Due to delays occasioned by the contracted laboratory's backlog of work and the carrier's delivery of the samples to the independent laboratory, we were not made aware of these increased levels until January of 1992. Upon becoming aware of these delay factors, we immediately took action to eliminate shipping delays, to insist upon air shipment of all samples and to demand more expeditious turn around by the laboratory. Jar tests were run on-site to confirm that simple pH increase would be successful in lowering the zinc levels. The tests provided positive results and a procedure was immediately implemented to increase pH of the tailings discharge from the mill to a minimum level of 9.5. The pH was additionally checked on regular intervals at X9 by the minesite Environmental Department. This action produced results almost immediately as zinc levels dropped by the January 14 sample date and have continued to decrease to the present date. January monthly average zinc concentrations at X5 will be below the required MMLER limit. The pH control policy will be constantly monitored by mill and environmental personnel.

The bioassay results experienced at X5 are more perplexing. The search for a solution has been complicated by a continuous change of possible causes: in mid 1991, ammonia appeared to be the only possible cause of the problem; in November zinc levels rose; while in December and

January copper began to appear. We have diligently undertaken numerous initiatives to identify the cause of the problem and identify possible field solutions. A chronological documentation of those initiatives is as follows:

October 25/91	- completion of the raise of the Intermediate Dam; the additional retention time provided by this structure improves water quality through more efficient settling and ageing
November 15/91	- employed B.C. Research to conduct a toxicity audit to determine the cause of bioassay problems
December 19/91	- bioassay samples taken at downstream Rose Creek locations pass with LC50 results exceeding 100% survival
December 13/91	- B.C. Research report that the only constituent which follows the trend of bioassay results appears to be ammonia; study expands using 1990 data to verify trends
January 7/92	- noticed that fluctuations in the tailings pH were occurring; talked to plant personnel and emphasized the need to keep tails pH high to remove zinc content from pit pumping; plant implements daily checks of pH in the tailings trench; checked regularly by environmental personnel at X9; these actions were successful in bringing zinc under control
January 8/92	- BC Research conducts bioassay tests on xanthates to determine possible toxicity; neither reagent appears to be toxic at the utilized concentrations
January 14/92	- recognized slow turnaround of lab results from Quanta Trace and sample shipping delays and took action to rectify these delays; began running weekly samples internally
January 30/92	- conduct depth sampling within the Cross Valley Pond to determine if metal values were consistent with depth; analysis done internally
February 7/92	- flow increased in the Rose Creek Diversion through additional release of fresh water through the pumphouse pond to dilute tailings decant
February 10/92	- run a series of jar tests on X4 and X5 effluent with varying pH levels; removes zinc but not copper
February 12/92	- organize a meeting with representatives of all federal regulatory agencies to present the most up-to-date information, detail our proposed action plan and request their assistance; submit our finalized action plan to the regulatory authorities in written form
February 13/92	- implement a series of jar testing through Quanta Trace Laboratory to determine the impacts of pH adjustment,

	ferric chloride addition and application of DeGussa Canada sulphide agent, TMT; none of these measures were successful in removing substantial amounts of the complexed copper
February 21/92	- implement further jar tests on ferric chloride with pH adjustment after addition; not successful
February 24/92	- implement further jar tests involving filtration of TMT samples to see if copper tied up with colloidal solids; not successful
February 28/92	- implement further jar tests using hydrogen peroxide destruction of cyanide followed by addition of ferric chloride and TMT; results indicate the use of peroxide warrants further investigation
March 2/92	- implement jar testing involving extended physical aeration; not successful
March 5/92	- implement jar testing utilizing various rates of hydrogen peroxide at varying pH; results pending

Experts Consulted:

1. Terry Mudder, Senior Water Treatment Specialist, Steffen, Robertson and Kirsten, Seattle Office
2. Walter Kuit, Water Treatment Specialist, Cominco Engineering, Trail BC
3. Tom Higgs, Water Treatment Specialist and consultant to the Yukon Territory Water Board
4. Walter Brandl and Darrel Dixon, Quanta Trace Lab, Burnaby BC
5. Dan Davies and Jim Sharpe, DeGussa Canada, Vancouver BC
6. Benoit Godin, EPS, Vancouver
7. Jack Nickel and Jerry Whitley, DIAND, Whitehorse
8. Vic Enns and Joan Eamer, EPS, Whitehorse
9. Godfrey MacDonald, VP Metallurgy, Curragh Resources, Toronto, Ont
10. Ray Gagnon, Plant Manager, Ketz River, Canamax

It is our opinion that the problematic parameter is a complexed form of copper. The ongoing tests will ultimately determine whether the complexing agent is cyanide, thiocyanate or ammonia and in so doing, will indicate the methodology to be implemented.

The results of the hydrogen peroxide and aeration testing, received March 6, indicate that aeration was not effective but that peroxide additions in combination with pH adjustment demonstrate some success in removing total and dissolved copper from solution. A third phase of the bench testing program has been implemented to confirm the apparent effectiveness of peroxide, determine the optimal rates of addition for de-complexing and the optimal pH for precipitation of the metals. Pending the results of this final laboratory testing, expected no later than March 13, a combination of peroxide addition and pH adjustment will be implemented in

Environmental Protection Service
March 13, 1992
Page 4

the X4 siphon by March 20. This will be a temporary system utilizing gravitational feed from barrels of hydrogen peroxide currently in inventory; should this treatment methodology prove successful on the Cross Valley Pond discharge, a more permanent system will be installed. However, should the current testing not provide definitive evidence that peroxide is the solution to the problem, the next phase of the testwork will immediately commence and will involve the use of hypochlorite aimed at the destruction of thiocyanate and ammonia.

Our program of bench scale testing was based on a pragmatic approach to systematically investigate potential solutions beginning with those most feasible to implement in the Rose Creek Valley Tailings Area. Initial tests focused on single addition techniques which have, thus far, shown no potential as a solution to the problem. The multiple reagent additions we are currently testing will be more difficult to effectively implement in the field as a series of mixing and settling sequences will be required to allow the reagents to adequately perform. Our abilities to implement such systems are limited by the mixing available in the siphon decant from the Intermediate Pond and the settling time available in the Cross Valley Pond. Subsequently, methods which are effective in the laboratory may require some refinement to be effective in the field.

We are concerned about the potential for adverse effects to the downstream aquatic environment as a result of the use of chemical additives to treat the water, particularly if a chlorine based treatment is required. We are optimistic that hydrogen peroxide/pH adjustment will be effective in the field and chlorine additions will be contemplated only as a last resort.

We would appreciate your further review of our progress to date and current plans. Should you have any additional suggestions, we would welcome your input.

Yours truly,

CURRAGH RESOURCES INC.



G. B. Acott, P. Biol.
Manager, Environmental Affairs
GBA*blb

cc. Colin Benner, President, Base Metals
Godfrey MacDonald, VP, Metallurgy
Brian Campion, Anton, Campion, Macdonald & Phillips
John Hogg, General Manager, Faro
Bill Dunn, Chief Engineer, Faro
Al Von Finster, DFO
Jack Nickel, DIAND, Water Resources

CURRAGH RESOURCES INC.

Inter-Office Memorandum

TO: John Hogg
General Manager
Faro Office

FROM: Gerry Acott
Manager, Environmental Affairs
Whitehorse Office 

cc: Bill Dunn, Chief Engineer
Ken Ball, Manager of Processing
David Godfrey, Director of Materials
Colin Benner, President, Operations
Godfrey McDonald, VP, Metallurgy
Brian Campion, Anton, Campion, Macdonald & Phillips

RE: **Final Results and Recommendations as a Result of
Down Valley Tailings Water Quality Testing**

DATE: 03 19 1992

The results of the third and final phase of laboratory jar testing have now been received and have confirmed that a combination of hydrogen peroxide addition and pH adjustment is effective in substantially reducing total copper in our effluent. The testing indicates that adding the equivalent of 1.0 mg/l of pure hydrogen peroxide following by thorough mixing and pH adjustment to 9.5 reduced total copper by about 70% of pre-application levels.

Hydrogen Peroxide Requirement

In order to reduce shipping costs, I would recommend we purchase 70% strength peroxide in bulk containers. We should investigate if suppliers will rent non-corrosive metering equipment that can be easily coupled to the bulk containers such that we can carefully regulate the volume added. This is a very strong oxidizing agent and all personnel which handle this material must be well trained and wear appropriate protective equipment.

- at 70% strength, $1.0 \text{ mg/l} \times 100/70 = 1.428 \text{ mg/l}$ say 1.5 mg/l
 - assuming an average flow through the X4 siphon of 660 l/sec
$$\begin{aligned} 660 \text{ l/sec} \times 1.5 \text{ mg/l} &= 990 \text{ mg/sec} \\ &= 0.001 \text{ kg/sec} \\ &= \underline{85.5 \text{ kg/day or } 14.6 \text{ Imp. Gallons/ day}} \end{aligned}$$
- at 50% strength, $1.0 \text{ mg/l} \times 100/50 = 2.0 \text{ mg/l}$
$$\begin{aligned} 660 \text{ l/sec} \times 2.0 \text{ mg/l} &= 1320 \text{ mg/sec} \\ &= 0.0013 \text{ kg/sec} \\ &= \underline{114.0 \text{ kg/day or } 21.0 \text{ Imp. Gallons/ day}} \end{aligned}$$

pH Adjustment

It is very important to maintain pH at 9.5 in order that the copper will precipitate out of solution. The laboratory indicated that soda ash was more effective than lime, presumably because it adds carbonate and increases alkalinity and hardness. Increase in hardness is also important to reduce the toxicity on downstream aquatic life.

The volume of soda ash required is difficult to predict as it depends on the initial pH in the Intermediate Pond. This can fluctuate depending on consistency of pH in the tailings and amount of water incoming from other sources (pit pumping, runoff, dump seepage). Soda ash addition will have to be regulated daily based on field monitoring of the siphon inflow.

Recommended Procedure

I would suggest that we look at addition of hydrogen peroxide into the siphon at the crest of the Intermediate Dam. This may be done by drilling a small entry hole into the siphon. The suction or venturi effect of the water moving inside the pipe may be sufficient to draw the peroxide into the flow and a simple valve may be sufficient to regulate the amount of peroxide added. The hydrogen peroxide does not freeze until about -40°C so the product container can be simply placed beside the siphon.

pH adjustment could be implemented by adding the soda ash in dry or slurried form. If slurried, freezing could be a problem and may require a small heated building. It may also be possible to set up a dry feed; apparently there is equipment available which consists of a hopper and a screw conveyor to meter the feed. The soda ash addition could also be conducted at the crest of the dam

such that it is thoroughly mixed into the flow when it enters the Cross Valley Pond.

Timing

The source of copper is most likely the Vangorda ore and we should plan on treating the water until tailings deposition is moved to the Faro Pit.

We have indicated to the Government that some form of treatment will be in place this week (response to EPS Warning dated March 13). I understand that we have limited quantities of hydrogen peroxide on site and that soda ash is available.

I would suggest that we try to implement a temporary addition immediately, even if it is as simple as gravity feed from barrels of peroxide and soda ash solution regulated by hand valve.s This will offer some immediate results while awaiting a more permanent distribution system.

Monitoring

Daily monitoring of total copper and pH both upstream and downstream of the addition points will be required initially to determine addition rates and evaluate effectiveness. Downstream copper analysis should be done only after the sample has had a minimum of 6 hours of quiet settling time.

Frequency may reduce over time as we establish patterns/trends in the monitored levels and the addition rates become standardized.

Bioassay

We feel that copper, possibly in combination with zinc, is the cause of the bioassay problems we have ben encountering but we require further testing to confirm this.

On our next scheduled bioassay at X5, we will collect two twenty litre samples for shipment to the lab. We will run a bioassay on one and if it fails, apply the treatment procedure above and re-test. Hopefully, the second will receive a passing grade. I will ensure that B.C. Research is provided with a comprehensive set of instructions for treatment of the second sample.



CURRAGH
RESOURCES INC.

117 Industrial Road
Whitehorse, Yukon
Y1A 2T8
Tel: (403) 668-8021
Fax: (403) 668-6518

TELEFAX TRANSMISSION

TO:

Tamara

FROM:

Gerry Acott, Manager, Environmental Affairs

WHITEHORSE OFFICE

DATE:

19/3/92

TIME:

ORIGINAL TO FOLLOW:

YES ☐

NO ☒

SUBJECT:

Attached is a replacement for my original memo dated March 16 of the same title. Would you please issue this one to John, Bill, Ken and David and ask them to destroy the previous one.

There was a typographical error on the original which increased hydrogen peroxide requirement by a factor of 10. 70% strength will be fed at a rate of 85.5 Kg/day (not 855 kg/day); as 50% strength may be easier to handle, I have calculated a feed rate for it at 114.0 kg/day.

I apologize for any inconvenience caused by this oversight.

If all pages are not received, please contact Bette at 668-8034

THIS TRANSMISSION CONSISTS OF 4 PAGE(S)
(including cover page)

Gerry



Curragh
Inc.

117 Industrial Rd.
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Tel.: (403) 668-8021
Fax: (403) 668-6518

August 7, 1992

Department of Indian Affairs
& Northern Development
200 Range Road
Whitehorse, Yukon
Y1A 3V1

Attention: Bud McAlpine
Water Resources

Dear Sir:

As a follow up to our telephone conversation of August 6, 1992 regarding the Faro Intermediate Dam Spillway, I have discussed the matter with Mr. Bill Dunn. We agree that the spillway, as constructed is inadequate in the long term and additional material will be required to buttress the south side. However, we disagree with your assessment that immediate action is required. In our estimation the current channel is capable of withstanding a short term flood event without risk of failure. Additionally, the combination of tailings discharge to the Faro pit (commenced August 3) and normal seepage from the dam will provide some drawdown of the pond water elevation offering a buffering capacity to reduce the impact of any severe runoff condition which may develop in the short term. We have asked a representative of Golder Associates to give us their assessment of the problem; should it be similar to our viewpoint, remedial action is not anticipated until next summer. However, if Golder indicates that immediate action is required, we will comply with their suggestions.

With regard to your enquiry regarding the upgrading of the chute on the Camp Creek Diversion at Sā Dena Hes, plans are currently being prepared for that task. At such time as the plans are completed and reviewed by site personnel, we will forward the information to the Yukon Territory Water Board with a copy directly to yourself. Other information/plans which are currently prepared and near

.../2

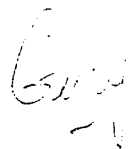
Mr. Bud McAlpine
August 7, 1992
Page 2

readiness for submission are the plans for south dam raising (scheduled to begin in late August) and an inspection report on the earthen structures at Să Dena Hes. As you are aware, the latter report is required by the Licence and is to be provided by September.

Should you have any questions or comments, please feel free to contact me.

Yours truly,

CURRAGH INC.



G. B. Acott, P. Biol.
Manager, Environmental Affairs

GBA*blb

cc: Bill Dunn, Chief Engineer, Faro
Vic Rozon, Director of Processing
& Maintenance, Să Dena Hes



**Curragh
Inc.**

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September 9, 1992

Steffen, Robertson & Kirsten (Canada) Inc.
Suite 800 - 580 Hornby Street
Vancouver, B.C.
V6C 3B6

Attention: Mr. Peter Healey, P. Eng.
Project Manager

Dear Sir:

RE: PROPOSED KINETIC TESTING - FARO WASTE ROCK

Thank you for your recent proposal on the above subject. I appreciate the work which went into it and the speed with which it was prepared.

I agree, in principle, with the need for additional leach tests for the Faro Waste Rock Dumps toward defining, to the best reasonable and affordable level, the long term drainage water quality and contaminant loading. I further agree that the SRK Modified Humidity Cell design would be much more applicable to the actual field situation than the previous kinetic testing which has been conducted.

However, I feel that the proposed program could be altered to be more cost effective and still yield the required information. Specifically, I have the following problems with the proposal:

1. Rock Composition of the Dumps

An investigation by Curragh Geologists of the surface of the Faro Dumps has made it quite clear that dump composition is highly variable. The degree of oxidation at each location is also highly variable and is a function of the length of time that the material has been exposed to the elements and the relative degree of exposure (depth within the dump).

Based on this information, I have concluded that the rock composition within the dumps will be impossible to accurately predict either by trenching or drilling and that each location will vary significantly.

.../2

2. Drill Program

For the reasons mentioned above, the drill program would render limited useful information and impose large costs on the company. Furthermore, I can imagine appearing in front of the Water Board and trying to convince the intervenors that three drill holes represented the composition of the Faro Waste Dumps; the regulatory agencies would demand many more holes.

The approach I would take is to make the assumption that all dump areas at Faro will be net acid generators. The Sulphate Reduction Study has made this same assumption and proposes to collect drainage from all areas and mix them within Zone II prior to pumping them underground for treatment. We know the approximate percentage of rock composition as it was extracted from the pit (see first table on page 9 of the Schedule D Progress Report, October, 1991, attached). It follows, then, that a mixture or blend of rock types in the composition percentages shown in the table would produce an estimate of the average dump seepage quality when evaluated in a humidity cell or field barrel test. As our treatment procedure will involve mixing all seepage from all dump areas, this testing assumption should be representative of site drainage which will occur from the Faro Dumps over time.

My specific recommendation would be to:

- collect samples of the following rock types (4 inch minus) under supervision of Curragh Geologists and stockpile in separate piles.

SOURCE		SOURCE	
10E	pit wall or core	1CD	pit wall
1DO	pit wall	1D2	pit wall or core
1D4	pit wall or core	2A	core
2CE	core	2CO	core
2EO	core	3D	pit wall

- set up three field barrels of the blended material (to provide statistically representative results); prepare material for two sets of SRK Modified Humidity Cells one set with blended material, the other set also of blended material to be operated in series with acid consuming material.
- using a field weigh scale, Curragh personnel will weigh out the representative amount of each rock type for each barrel and humidity cell and mix the sample volumes; fine materials remaining after hand placement of the rock in each sample will be dumped into the barrels/cells in volumes equivalent to the sample weight.

Steffen Robertson & Kirsten
September 9, 1992
Page 3

- operate the field barrels for a five year period as part of Schedule D analyzing collected water once per year; one year of information will not be sufficient for the oxidation process to be initiated and will flush only the products of previous oxidation.
- run humidity cells to end point, analyze and interpret the data per SRK proposal; conduct ABA testing before and after.
- conduct mineralogy on the waste rock composite before and after humidity cells; details of this portion of the program should be reviewed with Gregg Jilson.

This procedure will allow us through kinetic testing to determine the peak loadings from the dump and provide an indication of relative time period of release. The field barrels will then allow us to put a "real life" time perspective on the problem.

I would ask that you review and comment on this research plan. When we reach agreement on exactly what should be done and how it will be accomplished, I will ask you to prepare a final budget for the work.

Yours truly,

CURRAGH INC.



G.B. Acott, P. Biol.
Manager, Environmental Affairs

Enclosure

ROCK TYPE	DESCRIPTION	APPROXIMATE % IN DUMPS (ULTIMATE)
Intrusive Rocks		
10E	Diorite	6
10F	Monzonite	<1
Mt. Mye Formation		
3B	Chloritic phyllite/schist	3
1CD	Biotite-muscovite schist	13
1D0	Biotite-muscovite-andalusite schist	23
1D2	Carbonaceous biotite-muscovite	6
1D4	Altered schist-muscovite quartz schist	8
1H0	Chlorite schist	<1
1H4	Altered chloritic schist	< <1

Results of these tests are presented in Table 3.

The following rock types, comprising the remaining waste dump volume, were examined in 1990.

ROCK TYPE	DESCRIPTION	APPROXIMATE % IN ULTIMATE DUMPS
2A	Ribbon banded pyritic carbonaceous quartzite (10-30 % pyrite)	3 %
2B	Quartzite, non-pyritic, non-carbonaceous (trace pyrite)	< <1 %
2CE	Semi massive sulphides (50-70% pyrite)	3 %
2C0	Pyritic quartzite, non-carbonaceous (10-50 % pyrite)	2 %
2E0	Massive sulphide (70-100 % pyrite)	3 %
3D	Calc-silicate schist	30 %

Results are depicted in Table 4A (B.C. Research Method) and 4B (Sobek Method)



Curragh
Inc.

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November 19, 1992

Environment Canada
Environmental Protection Service
P.O. Box 6010
Whitehorse, Yukon
Y1A 5L7

Attn: Mr. R. Allan
Fisheries Act Inspector

Dear Sir:

This will acknowledge receipt of your hand delivered letter of November 5, 1992.

As documented in our monthly water quality report for September of 1992, average monthly concentrations of total zinc appear to have exceeded the MMLER Standard of 0.5 mg/l. Notice to Curragh of the situation was delayed as a result of a problem which developed at our contracted analytical laboratory. Inconsistent results in analysis at the lab alerted the contract personnel to a potential problem in the calibration of the ICP units. To resolve this problem, the laboratory immediately discontinued the normal processing of all regular samples until the problem could be rectified. Unfortunately, Curragh was not informed of the situation and did not become aware until the laboratory was questioned about the lack of results for the previous 2 - 3 week period. When the lab problem was rectified, Curragh received a three week block of X5 readings which indicated high zinc levels were being discharged. Due to this failure by the contractual third party, Curragh was denied the opportunity to immediately respond and rectify.

Upon receiving notification, Curragh immediately responded by shutting off the siphon from the Intermediate Pond and physically blocking the outflow from the Cross Valley Pond to prevent further outflow. No X5 outflow has occurred since October 13 and X13 seepage from the base of the Cross Valley Dam continues to be in compliance.

Curragh is, of course, concerned about the indicated elevated dissolved zinc levels which are currently being retained in the Cross Valley and Intermediate Ponds and is taking the following actions to reduce those levels. Soda ash is being utilized to increase the pH of waters in the Cross Valley Pond, initially along the upstream face of the dam. The material will be difficult to add as a result of the complete ice cover; a number of holes will have to be augured to allow the entry of the ameliorant. Depending on the degree of success with this method, a similar approach will be utilized to advance the pH adjustment proceeding in the direction of the

Intermediate Dam. Timing of this work will be dependent on the depth of ice in order to allow the safe access of equipment and personnel onto the pond surface; currently the ice is 10 to 15 cm deep, which appears adequate for personnel but not for equipment. The objective will be to decrease the dissolved zinc levels in the event that some future release may be required or the quality of X13 seepage should change for the worse. Internal monitoring of water quality in the Cross Valley Pond and at the X13 location has been initiated to ensure that we are immediately knowledgeable of seepage quality changes, should they occur, and the effectiveness of the treatment program.

Concurrently, we are taking measures to reduce zinc levels within the Intermediate Dam. This will be done by dedicating a consistent flow of lime enriched water from the mill to the tailings pond area. The elevation of pH in the Intermediate Pond will ensure that any sources of upstream acid generation products will be neutralized and that contaminated effluent is controlled at this location and does not reach the Cross Valley Pond. During the remediation process, constant water quality monitoring will be conducted to evaluate the success of these treatment methods. Regular monitoring will continue thereafter.

The failure of the contractor to provide timely results has been frustrating and embarrassing to Curragh. A major reason for our decision to move our business to this new laboratory in July of 1992, was the fact that they were a larger company with expanded manpower and equipment availabilities. We were guaranteed that, in the event of a problem, backup equipment was available and the Burlington subsidiary laboratory could be called upon to ensure the continuity of our results. There was also a 30% cost penalty for late reporting, which we felt was adequate to ensure that there would be no interruption in service. It is most unfortunate they encountered a system failure exactly at the time that a problem was apparently developing with the water quality at the site, thus resulting in a delayed response on our part. To remedy this situation in the future, our laboratory has been instructed to **immediately advise us** of any delay in analytical processing beyond the 6 working day agreement within our contract. Additionally, the lab has agreed to supply results for the duration of the period that they are experiencing problems, by an alternate methodology or from a Curragh approved subcontracted lab, for certain critical parameters at certain critical monitoring locations at each minesite. This agreement is formalized in an October 8, 1992 letter from Curragh to Zenon Environmental Laboratories, a copy of which is attached for your reference.

Environmental Protection Service

November 19, 1992

Page 3

In conclusion, Curragh continues with its objective and commitment to live within water licence and MMLER standards and we trust that our mitigative actions as outlined in this letter demonstrates a responsible action plan toward remediation. I would welcome any advice or suggestion that EPS may offer toward the improvement of our response plan.

Yours truly,

CURRAGH INC.

A handwritten signature in cursive script, appearing to read "G.B. Acott".

G. B. Acott, P. Biol.
Manager, Environmental Affairs

GBA*blb

cc. A. Von Finster, DFO
G. Whitley, DIAND, Water Resources



**Curragh
Inc.**

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Fax: (403) 668-6518

October 8, 1992

Zenon Environmental Laboratories
8577 Commerce Court
Burnaby, B.C.
V5A 4N5

Attn: Ms. Tracy Sutela
Project Administrator

Dear Tracy:

Re: Results on Curragh Water Quality Sampling

The problems experienced by Zenon with analytical equipment in mid September and the resulting late arrival of water quality monitoring results for our Faro operation has caused some severe difficulties for us. It occurred at a time when we were experiencing some elevated zinc levels in our effluent and the delay in reporting has adversely affected our ability to provide a timely remedial response to the problem.

We would like Zenons' cooperation to ensure that procedures are developed to prevent this situation from recurring. I would ask that, in the event of a future delay in receipt on analytical results beyond the 6 working days agreed to within the contract, the following actions be implemented:

- i) Curragh be **immediately** informed of the problem such that the appropriate internal action can be taken, and;
- ii) Zenon continue to provide results for the following critical locations and parameters;
 - at Faro/Vangorda, critical locations are X5, X4, X13, V25, V24 and V2
 - at Sa Dena Hes, critical locations are MH02, MH04, MH06 and MH07
 - critical parameters for all sites are total copper, lead, zinc and ammonia

These results can be provided by variation of technique at Zenon (ie by Atomic Absorption) or by subcontract to another lab to be approved by Curragh.

Zenon Environmental Laboratories
October 8, 1992
Page 2

I trust that you will contact me should you have any problems with implementing this procedure.

Yours truly,

CURRAGH INC.

A handwritten signature in cursive script, appearing to read "G. B. Acott".

G. B. Acott, P. Biol.
Manager, Environmental Affairs

GBA*blb

cc. Eric Soprovich, Faro
Ewald Pengel, Sa Dena Hes

Zenon 8577 Commerce Court Tel 604 444 4808
Environmental Burnaby B C Fax 604 444 4511
Laboratories Canada V5A 4N5



Mr. Gerry Accott
Curragh Resources Inc.
117 Industrial Road
Whitehorse, Yukon
V1A 2T8

October 13, 1992

Dear Gerry:

Re: Turnaround for Curragh Water Quality Samples, your letter Oct. 8, 1992

Regional
Laboratories:
British Columbia
Ontario
Quebec

Zenon is committed to a regular turnaround time of 6 days for all Curragh mine samples. In the event that Zenon experiences any analytical problems, an alternative method will be used for the critical locations mentioned in your letter (Faro: X5, X4, X13, V25, V24, V2 and SDH: MH02, MH04, MH06 and MH07). Zenon has on site back up atomic absorption systems that could be used for metals analysis in the event of ICP failure. We also have a back up TRAACS machine for the ammonia. In the unlikely event that our internal backup systems are down, the services of both our Quebec and Burlington laboratories are available to handle your critical parameters: zinc, copper, lead and ammonia. Both labs use proven methods, based on "STANDARD METHODS for the Examination of Water and Wastewater". Zenon has a monthly sample exchange program which ensures comparable data from all three of our network labs.

If any problems do occur that may delay your results, I will immediately inform you and the appropriate contact at both mines. With these procedures in place, we do not anticipate exceeding the 6 day turnaround for any critical sites for critical parameters.

Please do not hesitate to contact me if you have any further concerns or questions.

Sincerely,

Tracy M. Sutela
Project Manager

CC Eric Soprovich, Curragh Faro
Ewald Pengel, Curragh Sa Dena Hes
David Hope, Zenon Lab Manager
Dorrie Olejniczak, Zenon Metals Manager
Robert Gilbert, Zenon Auto-analysis Manager



Curragh
Inc.

117 Industrial Rd.
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Fax: (403) 668-6518

December 15, 1992

Environment Canada
Pacific and Yukon Region
Box 6010
Whitehorse, Yukon
Y1A 5L7

Attn: Vic Enns, P.Eng.
Head, Pollution Abatement

Dear Sir:

Your correspondence of October 27, 1992 raised several questions as a result of your October 4 - 6 tour of the site. My response has been organized in the same sequence for ease of reference.

1.1 The vibratory core drilling program which was carried out in late October on the Original and Second Tailings Impoundments drilled 20 holes of 10 to 25 m depth and collected samples for metallurgical evaluation. Measurements of pH, metal analysis, particle size distribution and free water analysis were conducted on one metre intervals through the 259 metres of samples extracted. Additionally, two three metre cores were taken specifically for shake flask testing, one in coarse tailings and one where there was an obvious slimes cover. These samples will be subjected to shake flask testing on ten centimetre intervals with complete ICP metal scan done on the filtrate of each along with pH and sulphate. Particle size analysis will be conducted at 1 metre intervals.

1.2 The water level in the tanks which we observed is much higher than normal. The tanks were pumped out just after our tour of October 4 in conjunction with final solids sampling; arrangements will be made to keep the test plots pumped out on a more regular basis in the future. We will also attempt to log the volumes of water removed from each tank during the pump out periods.

2.1 Analysis on the outflow from the tailings line showed high pH and no dissolved zinc. It was determined to be wash water from the mill. The majority of this water has now been added to the tailings line to the Faro pit, however, a portion continues to be routed to the Intermediate Impoundment to provide some pH adjustment.

2.2 Curragh has sampled this pond on two occasions and the results are enclosed. You will note that the zinc levels are high and this appears to be the source of zinc elevation in the Intermediate and recently, the Cross Valley Pond. Also enclosed are the old S6 samples which show that this has always been a source although an increase is apparent since 1981/1982. This

is not a large increase, however, considering the second tailings have been exposed for ten years since the S6 readings and illustrates the slow nature of AMD development in the Faro situation. It is obvious, however, that a constant source of increasing pH adjustment is required from the mill to prevent the Intermediate and Cross Valley Ponds from becoming zinc enriched.

2.3 As noted in my earlier telephone conversation with you, the siphon at X4 was shut off on October 13 after drawing down the pond level approximately 3 metres from overflow elevation to provide for a spring retention capacity. The siphon at X5 has not been operating for quite some time; the flows you observed are gravity feed as a result of the Cross Valley Pond being at spillway elevation. Sampling of the combined flow of the spillway, North Interceptor and siphon occurred only once in September of 1992 in response to a matching sample taken by DIAND. We have instructed our technician to sample only X5 outflow in the future as has been past practice.

2.4 The continuous flow monitoring system at X14 has performed reasonably well to date and we have no reason to believe that it will not operate effectively through the winter of 1992/1993. We are cognizant of our commitment to maintain a minimum of 1000 IGPM from the pumphouse pond; it is now included in our amended Faro Water Licence assuming signature of the Minister of Indian Affairs and Northern Development is forthcoming.

2.5 We agree that application of a lime slurry on the Original and Second Tailings Impoundments appear to be impractical as a result of the extreme hardpan observed in many locations on the surface. The immediate solution, as discussed earlier, will be to maintain a stream of high pH inflow from the tailings line to neutralize and remove the dissolved metal load contributed from these sources. We will continue to assess the feasibility of other options to control AMD release from the old tailings.

2.6 The hardpan may well impede the progress of AMD down through the tailings profile. The shake flask testing of the core samples discussed in 1.1 above should provide some insight on that question.

3.1 The sulphate reduction field test evaluation is currently planned for sometime in mid to late 1993. Construction of the sugar addition facilities and inoculation of the bacterium must first be undertaken. Following those steps, Zone II water will be piped into the underground and monitoring of the water discharged from the dewatering hole will provide a measure of the effectiveness of the system. Dump drainage will continue to be routed through the tailings pond where it will be pH adjusted to reduce dissolved metal contents.

3.2 Bioassays will be conducted on Faro pit water on a monthly basis beginning in December. The frequency will revert to quarterly at such time as the survival reaches 100%.

3.3 The amended Faro Water Licence (in draft form) recently forwarded by the YTWB, requires Curragh to divert all flows of Faro Creek into the pit. Although we have not physically opened the diversion, winter flows in Faro Creek are minimal and the vast majority of the flow in the diversion is seeping into the pit. As we continue to be operational in the Faro pit (AY Zone), it is most important to limit the amount of water flowing over the pit wall in that vicinity. It is our plan to breach the diversion sometime prior to April of 1993 when mining operations in the AY and Down Dip Zones of the Faro pit have been completed; this will divert all spring flows into the pit. Water level in the pit will be carefully monitored to ensure that the filling rate allows the required time to construct the plug dam which is scheduled for late summer/early fall of 1993.

4.1 Plans are currently being made to bring a drilling contractor on site early in January to install the monitoring infrastructure as described in our submission to the YTWB during the last public hearing. The drilling will also evaluate foundation conditions for the plug dam and will facilitate the engineering design of that structure.

4.2 The Zone II dewatering well has been operational between the dates of November 10 to December 1 at an approximate rate of 21 l/sec. Attempts to re-open the monitoring well have been unsuccessful to date and should future attempts meet with failure, the drilling contractor referred to in #4.1 will be utilized to re-establish the monitoring well. The discharge pipeline from the Zone II dewatering well has been re-routed to flow down the southeast ramp into the Faro pit.

4.3 The drilling contractor will also re-drill BH-3 while he is in the area; an attempt will be made to establish a permanent staff gauge in the North Fork immediately adjacent to the BH series.

5.1 The amended Faro Water Licence requires that Curragh submit an Integrated Decommissioning Plan no later than December 31, 1994. One of the critical elements of the plan will be a better understanding/determination of the volumes and qualities of water which will emanate from the waste dumps over time. A program focused toward attempting a better prediction of those values is currently being developed but has not been finalized. As the program becomes more definitive, we will request input from yourself and other interested parties through a meeting of the Technical Advisory Committee.

6.1 Between the dates of October 20 and November 12, Curragh undertook a program to upgrade the Vangorda Dump Finger Drains #1, 2 and 3 by constructing impermeable clay berms around the pervious drains and channelling the flow into 4 inch high density polyethylene pipe. A subsequent program is planned prior to spring, to install a collection pipeline from the finger drains to a point downstream where it will free drain to the Little Creek Sump. This will prevent the metal enriched seepage to stand in the ditch where the potential exists for loss to groundwater.

Environment Canada
December 15, 1992
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6.2 SRK has been contracted to review the status of the Vangorda Dump and document the proposed modification to the original design. This report is currently being finalized and will be submitted to the YTWB upon completion.

6.3 We would appreciate being apprised of any concerns which you may have regarding mine fuel storage facilities or those of our contractors. It is difficult to react to any real or perceived problems if they are not brought to our attention.

Thank you for your extensive documentation of your October 4 - 6 site visit. I trust that my comments will satisfactorily address your questions and concerns.

Yours truly,

CURRAGH INC.



G. B. Acott, P. Biol.
Manager, Environmental Affairs

GBA*blb
encl.

cc: Eric Soprovich
Bill Dunn
Jack Nickel
Kirstie Simpson
Al Von Finster
YTWB

ENVIRONMENTAL SUMMARY

		S6 (Tailing Dikes Seepage)						S7						S7A					
		pH	Cu	Pb	Zn	Fe	CN	pH	Cu	Pb	Zn	Fe	CN	pH	Cu	Pb	Zn	Fe	CN
1982	DEC 22	6.9	0.01	0.07	1.63	3.61	-0.02	7.5	ND	0.03	0.04	0.09	-0.02	9.6	ND	0.02	0.02	0.15	-0.0
	23																		
	29	7.0	ND	0.03	1.22	0.25	0.022	7.6	ND	0.03	0.05	0.03	0.027	9.7	ND	0.02	0.09	0.11	-0.0
	31	7.1	ND	ND	1.14	1.74	0.02												
	JAN 6	7.8	0.01	0.06	0.52	0.03	-0.02	8.1	0.01	0.05	0.01	0.04	-0.02	9.0	0.01	0.03	0.01	0.12	-0.0
	12	7.2	0.02	0.13	1.27	1.48	-0.02	7.7	0.03	0.10	0.37	0.15	-0.02	9.7	0.03	0.11	0.58	0.20	-0.0
	19	6.9	0.01	0.12	1.23	0.83	-0.02	7.6	ND	0.06	0.08	0.04	-0.02	9.2	ND	0.02	0.04	0.11	-0.0
	26	7.0	0.01	0.01	1.18	1.14	-0.02	7.6	0.01	0.06	0.03	0.01	-0.02	9.4	0.01	0.04	0.02	0.15	0.0
	FEB 2	7.8	0.01	0.07	0.94	0.04	0.02	8.1	0.01	0.06	0.79	0.02	-0.02	8.1	0.01	0.05	0.02	0.05	-0.0
	9	6.8	0.01	0.03	0.99	2.17	-0.02	7.7	0.01	0.02	0.06	0.03	0.026	7.7	0.01	0.02	0.06	0.03	0.0
	16	6.8	0.01	0.08	1.07	7.08	0.04												
	23	7.1	0.02	0.03	1.41	2.55	0.03												
	Mar 2	7.1	0.02	0.03	1.17	1.78	0.05												
	9	7.0	0.01	0.06	1.25	3.87	-0.02												
	16	6.9	ND	0.07	0.85	6.67	~~0.05~~												
	23	7.0	ND	0.01	0.59	0.09	NA												
	30	6.8	0.01	0.07	0.63	0.14	-0.02												

c.c. G.W. Chapman, J.K. Carrington, L.P. Taggart,
R. McCallum, N.G. Cornish, S. Chmryk, W.N. Wallinger

CYPRUS ANVIL MINING CORPORATION

1981 WATER QUALITY SUMMARY

SAMPLE STATION S6

<u>Date</u>	<u>pH</u>	<u>S.S.</u>	<u>Temp.</u> (° C)	<u>Flow</u> (c.f.s.)	<u>NH₃</u>	<u>Pb</u>	<u>Zn</u>	<u>CN</u>	<u>Cu</u>	<u>Mn</u>
Jan. 6	6.9	0	2.0	1.6	0.90	0.10	0.07	0.01	0.01	19.45
Jan. 13	6.9	0	2.5	1.6	0.51	0.04	0.06	-0.02	0.01	24.6
Jan. 20	7.0	0	2.5	1.6	1.05	0.03	0.06	-0.02	0.03	18.3
Jan. 27	7.0	4	2.5	1.6	1.40	0.08	0.07	-0.02	0.03	12.20
Feb. 3	6.7	1	2.0	1.6	1.25	0.05	0.02	-0.02	TR	23.9
Feb. 10	6.9	10	2.0	1.6	0.86	0.07	0.02	-0.02	0.01	15.70
Feb. 17	7.0	2	2.0	1.6	1.00	0.15	0.12	-0.02	0.01	18.8
Feb. 24	6.8	8	2.0	1.6	0.47	0.08	0.08	-0.02	0.02	21.45
Mar. 4	7.0	2	2.5	1.6	1.20	0.10	0.10	-0.02	0.02	20.60
Mar. 11	6.9	98	2.0	1.6	1.20	0.12	0.14	-0.02	0.01	21.2
Mar. 18	7.2	19	2.0	1.6	1.10	0.04	0.09	-0.02	TR	20.4
Mar. 25	7.1	0	2.5	1.6	1.40	0.12	0.10	-0.02	0.01	22.1
Apr. 1	7.3	17	2.5	1.7	1.15	0.11	0.18	-0.02	TR	25.9
Apr. 8	7.2	6	2.5	1.7	0.81	0.20	0.12	-0.02	TR	34.6
Apr. 15	7.3	15	2.5	1.7	1.60	0.01	0.01	-0.02	0.02	27
Apr. 22	7.3	41	2.5	1.7	1.80	0.14	0.04	-0.02	0.01	21.1
Apr. 29	7.1	3	2.5	1.7	1.20	0.09	0.06	-0.02	0.01	25.2
May 6	7.1	10	3.0	1.8	-	0.04	0.03	-0.02	0.01	30.8
May 13	6.9	11	2.5	3.0	-	0.06	0.87	-0.02	TR	13.31
May 20	6.9	3	4.0	3.0	-	0.07	0.76	-0.02	TR	12.4
May 27	7.1	4	4.5	2.9	-	0.02	0.90	-0.02	TR	13.20
June 3	7.8	6	-	1.8	-	0.06	0.61	-0.02	TR	45.4
June 10	7.5	-	4.0	3.0	-	0.09	0.58	-0.02	0.01	16.6
June 17	7.3	-	4.0	3.0	-	0.09	0.66	-0.02	0.08	11.6
June 24	7.2	4	4.0	2.9	-	0.06	0.49	-0.02	TR	14.4
June 30	7.2	0	4.0	3.0	-	0.10	0.54	-0.02	0.01	11.74
July 8	7.0	6	4.0	1.8	-	0.04	0.49	0.02	0.03	10.4
July 15	7.0	2	5.0	3.0	-	0.01	0.61	-0.02	0.01	8.65
July 22	7.0	2	5.0	3.0	-	0.09	0.53	-0.02	0.01	9.53
July 29	7.3	0	5.0	2.9	-	0.02	0.58	-0.02	TR	8.90
Aug. 5	7.3	0	4.0	3.0	-	0.08	0.55	-0.02	0.01	8.74
Aug. 12	7.3	0	4.0	3.0	-	0.12	0.78	-0.02	0.02	9.98
Aug. 19	7.3	0	-	3.0	-	0.07	0.61	-0.02	0.01	9.24
Aug. 26	7.2	3	5.0	3.0	-	0.05	0.64	-0.02	TR	9.47
Sept. 2	7.1	0	3.0	3.0	-	0.02	0.68	-0.02	0.01	9.82
Sept. 9	7.2	1	4.0	3.0	-	0.04	0.65	-0.02	N.D.	10.4
Sept. 16	7.1	0	4.5	3.0	-	0.08	0.58	-0.02	0.01	10.60
Sept. 23	7.1	0	4.5	3.0	-	0.06	0.67	-0.02	0.02	10.42
Sept. 30	7.2	0	4.0	3.0	-	0.04	0.60	-0.02	0.01	9.78

CYPRUS ANVIL MINING CORPORATION

1981 WATER QUALITY SUMMARY

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SAMPLE STATION S6

<u>Date</u>	<u>pH</u>	<u>S.S.</u>	<u>Temp.</u> (° C)	<u>Flow</u> (c.f.s.)	<u>NH₃</u>	<u>Pb</u>	<u>Zn</u>	<u>CN</u>	<u>Cu</u>	<u>Mn</u>
Oct. 7	7.1	1	4	3.0	-	0.06	0.70	-0.02	0.01	10.4
Oct. 14	7.1	0	5	3.0	-	0.04	0.57	-0.02	0.01	10.0
Oct. 20	7.2	8	3	3.0	-	0.20	0.61	-0.02	0.02	10.5
Oct. 27	7.1	8	4	3.0	-	0.11	0.80	-0.02	N.D.	9.95
Nov. 3	7.2	7	3	3.0	-	0.05	1.03	0.03	0.01	11.3
Nov. 10	7.1	12	3	3.0	-	0.06	0.88	-0.02	N.D.	11.5
Nov. 17	7.0	3	1	3.0	-	0.11	1.07	-0.02	N.D.	11.80
Nov. 24	7.0	14	0	3.0	-	0.06	0.92	-0.02	0.01	12.2
Dec. 1	7.2	12	1	3.0	-	0.11	1.28	-0.02	0.03	12.9
Dec. 8	7.1	4	1	3.0	-	0.04	1.17	-0.02	0.01	12.13
Dec. 15	6.9	4	0	3.0	-	0.07	1.34	-0.02	N.D.	12.30
Dec. 22	6.9	22	0	3.0	-	0.07	1.63	-0.02	0.01	13.0
Dec. 29	7.0	13	0	3.0	-	0.03	1.22	-0.02	N.D.	11.47