NORTHAIR MINES LTD. (N.P.L.)
METALLURGICAL REPORT
JUNE 18, 1974

BENEFICIATION OF NORTHAIR MINES LTD.

Cu-Pb-Zn-Au-Ag ORE

BACON, DONALDSON & ASSOCIATES LTD.

June 12, 1974

BACON, DONALDSON & ASSOCIATES LTD.
Consulting Engineers
117 East 4th Avenue · Vancouver, B.C. V5T 1G4 · Telephone 876-2023

June 12, 1974

File No. 350

Mr. D. McLeod,
Northair Mines Ltd.,
333-885 Dunsmuir Street,
Vancouver, B.C.
V6C 1N5

Dear Mr. McLead,

We are pleased to enclose a summary of our testwork on the Northair Mines Ltd. Brandywine Falls property.

The objectives of our work were to determine the feasibility of producing separate copper, lead, zinc and precious metal concentrates and to perform preliminary flowsheet design calculations.

We have tested material from the Warman Zone and a blend of material from the Warman and Main zones and have found similar results to be achievable on both materials. Results indicate that overall recovery of base metals should be 95 percent or better and of precious metals should be 90 to 95 percent. These recoveries were achieved at at grind of 60% minus 200 mesh. The products which we feel could be produced from this ore are presented in the summary of results. The complete test results are appended to this report as Appendix I.

The information for the pollution control board which was derived from laboratory tests is enclosed as Appendix II.

Enclosed as Appendix III is the design data for sizing the concentrator. Only major equipment is sized as incomplete data is available for sizing pumps and conveyors. Our report of May 27, 1974 is appended as Appendix III - A. This report indicates the additional equipment required. Several changes to this report should be noted since a pyrite concentrate is no longer to be produced:

1. 16 - #24 DR cells are required instead of 18.
2. DSM Rapifine screen is no longer required.
3. Instead of a 4 ft. ϕ - 4 disc American filter, a 3 ft. ϕ by 0.5 ft. long (or equivalent) belt filter is required.

These changes are included in the enclosed flowsheet which is based on the test results obtained to date.

We trust that this report fulfills your requirements and we will be pleased to assist you in future stages of this project.

Yours truly,

BACON, DONALDSON & ASSOCIATES LTD.,

M. Vreugde

M.J.A. Vreugde, M.A.Sc.

W.G. Bacon

W.G. Bacon, P.Eng.

/db
Encl.

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SUMMARY OF RESULTS

With regard to the copper-lead circuit, two alternatives present themselves:

1. produce a copper-lead concentrate
2. produce separate copper and lead concentrates

While test results gave only limited success in producing separate copper and lead concentrates, we feel that with further testwork the following results can be achieved:

a. Lead Concentrate

5-6 tpd (@ 340 TPD)
68-69% Pb
2-3% Zn
<0.5% Cu
2 oz/ton Au
25 oz/ton Ag
0.029% As
0.014% Sb
0.002% Bi

b. Copper Concentrate

1-2 tpd
10% Pb
2-3% Zn
15-20% Cu
14 oz/ton Au
68 oz/ton Ag

If production of a bulk copper-lead concentrate is acceptable the circuit will be less complicated to operate and the following product will result:

7-8 tpd (@ 340 TPD)
54-56% Pb
2-3% Zn
8-10% Cu
10% Fe
3-4 oz/ton Au
34 oz/ton Ag

Although test results for production of zinc concentrates have been variable, this has largely been due to excessive copper and lead reporting to the zinc concentrate. It is believed that this problem can be overcome by proper operation of the copper-lead circuit, and the following zinc concentrate is expected:

10-12 tpd
1% Pb
55-60% Zn
<1% Cu
3-4% Fe
1-2 oz/ton Au
70-75 oz/ton Ag

Test no. 7 was performed on a large sample (10 kilogram) in order to get accurate data on the distribution of values in the jig concentrate and flotation pyrite concentrate. It appears from this test that when the copper-lead and zinc flotation circuits and the jig circuit are properly controlled, very little gold or silver report to the pyrite concentrate. Production of a jig concentrate and no pyrite concentrate is therefore recommended as capital cost is reduced and circuit operation is simplified. The jig concentrate is expected to have the following analysis:

1 tpd
24.0 oz/ton Au
23.07 oz/ton Ag

DISCUSSION

Ore Samples

Tests no. 1 to 3 were performed on 2000 gram portions of a 200 pound sample of wet muck from the Warman Zone. As received, the sample consisted of material from extreme fines to fist sized. The total sample was crushed to minus 10 mesh prior to splitting into 2000 gram fractions. The assay of this sample was as follows:

0.43 % Cu
2.57 % Pb
4.80 % Zn
0.52 oz/ton Au
0.68 oz/ton Ag

Test no. 4 was performed on a 2000 gram portion of a 200 pound sample of Main Zone material. The sample consisted of fist-size pieces of vein and wall material taken along the drift. The total sample was crushed to minus 10 mesh prior to splitting into 2000 gram fractions. The assay of this sample was as follows:

0.10 % Cu
0.39 % Pb
0.78 % Zn
1.70 % Fe
0.25 oz/ton Au
13.71 oz/ton Ag

Test no. 5, 6 and 7 were performed on a blend of materials from the Main and Warman zones. The Main zone material was as for test no. 4 and the Warman Zone material was from a 200 pound sample of fist sized material taken along the drift. This sample had also been crushed to minus 10 mesh prior to blending. The Warman and blended material assayed as follows:

	Warman	Blend
% Cu	0.31	0.24
% Pb	2.00	1.4
% Zn	2.85	2.1
% Fe	3.60	3.4
oz/ton Au	0.65	0.32
oz/ton Ag	0.76	5.35

Flotation Tests

Tests 1, 2 and 3 were preliminary tests to establish acceptable procedures and reagent additions. Tests were carried out at a grind of 70% passing 200 mesh. It became apparent in these tests that while high rougher recoveries of base metals were attainable, excessive zinc was reporting to the copper-lead concentrate as middlings with lead. When the copper-lead concentrate was reground and the zinc depressed, improvement in concentrate grade and recovery in the respective concentrates was achieved.

It also became apparent that much of the gold and silver, particularly from the Warman Zone was not reporting to the sulphide concentrates but was ending up in the flotation tailings. Gravity separation was attempted on the tailings and was successful in recovering gold and silver to give a high overall recovery. On the basis of these results it is recommended that a mineral jig be installed to treat the flotation tailings.

Since a coarser grind reduces the cost of grinding and would also make the jig more effective, in tests subsequent to no. 3, a grind of 60% minus 200 mesh was used. Acceptable recoveries of all values were achieved at this coarser grind.

Test no. 1 employed cyanide additions to effect a copper-lead separation. Only limited success was attained and the large quantities of cyanide required for the separation were undesirable from a pollution aspect. Tests no. 2 and 3 employed additions of dextrin and sulphurous acid to depress the galena from the chalcopyrite. The tests were successful in that a low copper, lead concentrate was produced. The copper concentrate had a very high lead content however and this problem would be hard to overcome due to the very fine particle size of the galena. In the tests performed on the blend of ores, copper-lead separation could not be achieved as the low grade of this material resulted in amounts of products that were insufficient for testing.

In tests no. 5 and 6, the flotation tailings were treated by a mineral jig to recover coarse electrum and the jig tails were floated to recover a pyrite concentrate bearing some additional gold and silver. The results of these two tests indicated a high degree of success although considerable variation in grades and distributions was experienced due to the small quantities of material involved. Test no. 7 was therefore performed on a much larger sample to give accurrate results. The results of this test indicate that it is possible to recover more than 90 percent of the gold and silver in the lead, zinc and jig concentrates. This

is preferrable over the results of the previous tests which required that the jig concentrate be screened and the undersize combined with the pyrite concentrate which would then have to be marketed. As a result of test no. 7 a simplified scheme producing only a high value jig concentrate from the flotation tailings is required.

APPENDIX I

REPORTS ON TEST RESULTS

BACON, DONALDSON & ASSOCIATES LTD.
Consulting Engineers
717 East 4th Avenue · Vancouver 10, B.C. · Telephone 876-41

April 4, 1974

File No. 350

Northair Mines Ltd.,
333-885 Dunsmuir Street,
Vancouver, B.C.
V6C 1N5

Attention: W. Fothergill

Dear Sir:

Re: Northair Mines Metallurgy

Results to Date

We have completed the preliminary testwork on the Warman and Main zones. The results to date indicate that both ore zones can be processed in the same manner, as per Appendix II. While we have not treated the ores as a blend, we feel that there will be no problem in doing so.

On the basis of this preliminary work the following results should be attainable:

Overall Recoveries

Zinc	>95%
Lead	>95%
Copper	>95%
Silver	>90%
Gold	>95%

While these overall recoveries are high, the actual recovery of these metals in their respective concentrate will be somewhat lower. For example we expect a better than 60% Zn zinc concentrate containing better than 85% of the total zinc.

With respect to the other concentrates, it is at this time not possible to estimate the grades which will be achieved with any degree of accuracy. Regardless of the grades however, recoveries will be high.

Although some gold and silver report with the flotation concentrates in both ore zones, due to the fact that there is free electrum (particularly in the Warman Zone) it is necessary to subject the flotation tailings to a gravity separation as has been done in the present testwork. It should be noted here that the electrum has been analyzed using the electron microprobe and found to be 80% Au and 20% Ag and carries no platinum. The malleable nature of this electrum results in relatively large flat platelets reporting to the tailing and makes it amenable to jig concentration.

Problems Encountered

1. Excessive zinc reporting to the lead-copper circuit.
2. Achieving an acceptable copper-lead separation.

Further Work Necessary

All further work will be performed on a blend of material from the two zones in the ratio in which they are to be mined (2 parts Warman - 1 part Main).

A minimum of two additional tests are necessary to solve the above two problems. A third and possibly a fourth test will be required to ascertain the desired design criteria for the concentrator.

Yours respectfully,

BACON, DONALDSON & ASSOCIATES LTD.

Marius Vreugde

M.J.A. Vreugde, M.A.Sc.

W.G. Bacon

W.G. Bacon, P.Eng.

/db

APPENDICES

APPENDIX I

Test No. 350-1

PURPOSE: This will serve as a preliminary test to establish reagent additions and suitability of grind.

PROCEDURE:

Stage	Time (minutes)	Additions
Grinding	9	0.5 lb./ton Na_2CO_3 0.6 lb./ton $ZnSO_4$ 0.2 lb./ton KCN 65% solids
Lead-Copper Rougher	5½	pH = 9.2 0.02 lb./ton AF 208 0.02 lb./ton Ethyl Xanthate 0.1 lb./ton Dowfroth 250
1st Bulk Cleaner	4	--
2nd Bulk Cleaner	4	--
Conditioning	3	Na_2CO_3 to pH = 10 1.0 lb./ton KCN
Cu-Pb separation	3	--
Lead cleaner	3	Na_2CO_3 to pH = 10 1.0 lb./ton KCN
Conditioning	4	0.6 lb./ton $CuSO_4$ lime to pH = 10 0.04 lb./ton Z-200 0.08 lb./ton Dowfroth 250
Zinc Rougher	5	--
1st Zn cleaner	3	lime to pH = 10.5
2nd Zn cleaner	2½	lime to pH = 11.5
Pyrite Rougher	3	H_2SO_4 to pH = 6 0.1 lb./ton Amly Xanthate

SIZE ANALYSIS:

Flotation Feed = 70% minus 200 mesh

DISCUSSION:

1. Excessive copper has reported to the zinc circuit and collector addition to the Copper-Lead rougher should be increased.
2. Zinc concentrate grade is low due to the presence of pyrite. Rougher and first cleaner pH should be increased to depress the pyrite.
3. Cyanide addition to the copper-lead separation was not satisfactory for obtaining a separation. Other separation schemes should be attempted.
4. The overall recovery of Pb, Zn and Cu is very satisfactory. Gold and silver recovery are very low and suggest free gold or electrum in the ore.

TEST NO. 350-1

PRODUCT	ASSAY WT.%	% Pb	% Zn	% Cu	oz/ton Au	oz/ton Ag	DISTRIBUTION Pb	Zn	Cu	Au	Ag
Lead conc.	4.7	47.33	15.08	4.40	2.94	6.58	86.2	14.7	49.5	26.8	52.0
Lead CL.T.	0.3	29.02	14.05	7.80	*	*	3.4	0.9	5.6	--	--
Cu conc.	0.3	13.58	22.15	7.20	*	*	1.6	1.4	5.2	--	--
2nd BULK CL.T.	0.3	6.50	4.50	0.84	*	*	0.7	0.3	0.6	--	--
1st BULK CL.T.	2.0	3.00	3.10	0.41	.70	1.41	2.3	1.3	2.0	2.7	4.7
Zinc conc.	6.8	0.65	55.20	1.70	.14	.74	1.7	77.6	27.7	1.8	8.5
2nd Zn CL.T.	2.0	0.61	3.00	0.35	.64	.69	0.5	1.2	1.7	2.5	2.3
1st Zn CL.T.	4.2	0.63	1.80	0.28	trace	1.36	1.0	1.6	2.8	--	9.6
Pyrite conc.	2.1	0.53	0.52	0.26	1.53	1.34	0.4	0.2	1.3	6.2	4.7
Final Tails	77.3	0.07	0.06	0.02	.40	.14	2.1	1.0	3.7	60.0	18.2
Head calc.	100	2.58	4.84	.42	0.52	0.60	100	100	100	100	100
Head assay		2.80	5.00	.43	0.52	0.68					

*Insufficient sample for assay

Test No. 350-2

PURPOSE: This test will incorporate the suggested changes of Test No. 1 to achieve improved results.

PROCEDURE:

Stage	Time (minutes)	Additions
Grinding	9	0.5 lb./ton Na_2CO_3 0.6 lb./ton $ZnSO_4$ 0.2 lb./ton KCN 65% solids
Lead-Copper Rougher	5½	pH = 9.2 0.02 lb./ton AF 208 0.03 lb./ton Ethyl Xanthate 0.1 lb./ton Dowfroth 250
1st Bulk Cleaner	4	--
2nd Bulk Cleaner	4	--
Conditioning	5	H_2SO_3 to pH = 6 0.1 lb./ton Dextrin
Cu-Pb separation	2	--
Copper cleaner	2	0.2 lb./ton H_2SO_3 0.02 lb./ton Dextrin
Conditioning	4	0.6 lb./ton $CuSO_4$ lime to pH = 10.5 0.04 lb./ton Z-200 0.08 lb./ton Dowfroth
Zinc Rougher	5½	--
1st Zn cleaner	3	lime to pH = 11
2nd Zn cleaner	3½	lime to pH = 11.5

SIZE ANALYSIS:

Flotation Feed = 70% minus 200 mesh

DISCUSSION:

1. Copper recovery in the bulk Cu-Pb concentrate has been improved by increased collector addition. A slight further increase in collector addition appears to be warranted.
2. Zinc concentrate grade has been improved and is acceptable.
3. The copper-lead separation by the scheme followed in this test is not acceptable. Excessive galena has reported to the copper concentrate indicating that the galena was not adequately depressed.
4. Excessive zinc is reporting to the copper-lead concentrate. A microscopic examination of the lead concentrate indicated that zinc is occurring as middlings with lead. The bulk concentrate should be reground prior to cleaning, and the zinc should then be depressed.
5. The flotation tailings from this test assayed 0.24 oz/ton Au and 0.39 oz/ton Ag. The tailings from this test were combined with those of test no. 1 and then subjected to shaking table concentration. A concentrate assaying 8.56 oz/ton Au and 4.28 oz/ton Ag and a final tailing assaying 0.029 oz/ton Au and 0.129 oz/ton Ag were produced. This represents an overall recovery of 95.1% for gold and 92.1% for silver. On this basis, a mineral jig on the flotation tailings is required.

TEST NO. 350-2

PRODUCT	WT.%	ASSAY % Pb	ASSAY % Zn	ASSAY % Cu	DISTRIBUTION Pb	DISTRIBUTION Zn	DISTRIBUTION Cu
Copper conc.	2.4	37.44	8.90	12.00	35.1	4.5	65.5
Lead conc.	3.7	40.17	19.00	1.50	58.1	14.7	12.7
2nd BULK CL.T.	0.5	4.30	3.30	0.69	0.8	0.3	0.7
1st BULK CL.T.	2.1	1.70	2.20	0.27	1.4	1.0	1.4
Zinc conc.	5.9	0.52	61.91	0.74	1.2	76.4	10.0
2nd Zn CL.T.	0.4	1.80	12.00	0.88	0.3	1.0	0.9
1st Zn CL.T.	2.7	0.53	1.30	0.24	0.5	0.7	1.4
TAILS	82.2	0.08	0.08	0.04	2.6	1.4	7.5
Head calc.	100	2.56	4.78	0.44	100	100	100

Test No. 350-3

PURPOSE:

1. To omit KCN from the copper-lead circuit in order to determine if zinc sulphate alone is adequate for zinc depression.
2. To omit Aerofloat 208, which was added as a gold promoter.
3. To introduce a regrind stage for the bulk copper-lead concentrate.

PROCEDURE:

Stage	Time (minutes)	Additions
Grinding	9	0.5 lb./ton Na_2CO_3 0.6 lb./ton $ZnSO_4$ 65% solids
Lead-Copper Rougher	5½	pH = 9.2 0.01 lb./ton Aero 130 0.05 lb./ton Ethyl Xanthate 0.1 lb./ton Dowfroth 250
Regrind	10	Ball mill 0.2 lb./ton $ZnSO_4$
1st Bulk cleaner	5	pH = 8.2 0.005 lb./ton Z-200 0.005 lb./ton Ethyl Xanthate Dowfroth as needed
2nd Bulk cleaner	4	pH = 9.0 0.1 lb./ton $ZnSO_4$ 0.005 lb./ton Z-200
Conditioning	5	H_2SO_3 to pH = 6 0.1 lb./ton Dextrin 0.015 lb./ton Z-200
Pb-Cu separation	5	---
Cu cleaner	4	H_2SO_3 to pH = 6 0.05 lb./ton Dextrin

	(minutes)	
Conditioning	4	0.5 lb./ton $CuSO_4$ 0.04 lb./ton Z-200 lime to pH = 10.5 0.1 lb./ton Dowfroth 250
Zinc rougher	5	--
1st Zn cleaner	3	lime to pH = 11.0
2nd Zn cleaner	2½	lime to pH = 11.5
Pyrite flotation	4	H_2SO_4 to pH = 7 0.1 lb./ton Amyl Xanthate

SIZE ANALYSIS:

Flotation Feed = 73% minus 200 mesh.

DISCUSSION:

1. Removing cyanide from the copper-lead circuit is not acceptable as excessive zinc has reported to this circuit.
2. Excessive pyrite is reporting to the lead and copper concentrates. Adjustment of the first bulk cleaner pH to 10.0 with lime should be attempted to overcome this problem.
3. Microscopic examination of the lead concentrate indicated that regrinding was reducing the number of lead-zinc middlings. The presence of pyrite and zinc due to the omission of cyanide resulted in low concentrate grade however.
4. An acceptable copper-lead separation has not been achieved and increased destrin additions should be attempted.

5. The pyrite concentrate assayed 0.34 0z/ton Au and 14.08 oz/ton Ag. It is probable that this material will report to a jig on the flotation tailings, making the flotation of a pyrite concentrate unnecessary.

6. The flotation tailings were tabled and the concentrate screened to give the following results:

Fraction	WT.% Flotation Feed	Au Assay	Au Recovery	Ag Assay	Ag Recovery
+65	0.008	16.18%	72.6%	6.44%	22.1
-65 +100	2.9	0.270 oz.	1.5%	0.134 oz	0.57
-100	9.3	0.03 oz.	0.5%	0.09 oz	1.23

The results indicate that the gold is quite coarse and should be amenable to concentration by jigging.

TEST NO. 350-3

PRODUCT	WT.%	ASSAY % Pb	ASSAY % Zn	ASSAY % Cu	DISTRIBUTION Pb	DISTRIBUTION Zn	DISTRIBUTION Cu
Copper conc.	1.6	12.50	16.02	14.5	7.8	5.1	54.0
Cu CL. TAIL	2.6	17.02	13.50	4.70	17.1	7.0	28.4
Lead conc.	5.0	32.50	13.02	0.42	63.0	13.0	4.9
2nd BULK CL.T.	0.8	5.05	12.00	0.87	1.6	1.9	1.6
1st BULK CL.T.	3.9	1.60	9.50	0.38	2.4	7.4	3.5
Zinc conc.	4.7	0.25	63.00	0.20	0.5	59.2	2.1
2nd Zn CL.T.	0.4	1.50	12.50	0.43	0.2	1.0	0.5
1st Zn CL.T.	2.9	0.40	1.02	0.14	0.5	0.6	0.9
Pyrite conc.	2.0	1.20	2.05	0.51	0.9	0.8	2.3
Tails (calc.)	76.0	0.21	0.25	0.01	6.1	3.9	1.8
Head (assay)		2.58	5.00	0.43	100	100	100

Test No. 350-4

PURPOSE: While tests no. 1, 2 and 3 were performed on ore from the Warman Zone, this test will be performed on ore from the Main Zone. This test will serve as a preliminary test on the Main Zone to determine whether its milling properties are similar to those of the Warman Zone.

PROCEDURE:

Stage	Time (minutes)	Additions
Grinding	9	0.5 lb./ton Na_2CO_3 0.6 lb./ton $ZnSO_4$ 65% solids
Lead-Copper Rougher	3½	pH = 9.5 0.01 lb./ton Aero 130 0.05 lb./ton Ethyl Xanthate 0.1 lb./ton Dowfroth 250
Regrind	10	--
1st Bulk cleaner	3½	0.2 lb./ton $ZnSO_4$ 0.005 lb./ton Z-200 0.005 lb./ton Ethyl Xanthate
2nd Bulk cleaner	3	0.1 lb./ton $ZnSO_4$ 0.005 lb./ton Z-200
Conditioning	5	H_2SO_3 to pH = 6 0.1 lb./ton Dextrin
Cu-Pb separation	4	--
Conditioning	4	0.5 lb./ton $CuSO_4$ lime to pH = 10.5 0.04 lb./ton Z-200 0.1 lb./ton Dowfroth 250

Stage	Time (minutes)	Additions
Zinc rougher	3	--
Zinc cleaner	3	lime to pH = 11.0
Pyrite Flotation	4	H_2SO_4 to pH = 7 0.1 lb./ton Amyl Xanthate

SIZE ANALYSIS:

Flotation Feed = 85% minus 200 mesh

DISCUSSION:

1. Recovery of Pb, Zn and Cu is high, comparable to results achieved with Warman Zone material.

2. Concentrate grades in this test are much lower than for the Warman Zone but this is readily explained by the low feed grades.

3.

Product	wt.%	Au oz/ton	Au recovery	Ag oz/ton	Ag recovery
Feed	100	0.25	100	13.71	100
pyrite conc.	0.8	7.80	24.97	5.77	0.31
table conc.	15.0	trace	---	1.67	1.83

Although only a small amount of gold and silver have failed to be recovered by flotation, it is probable that this material would be recovered by a jig.

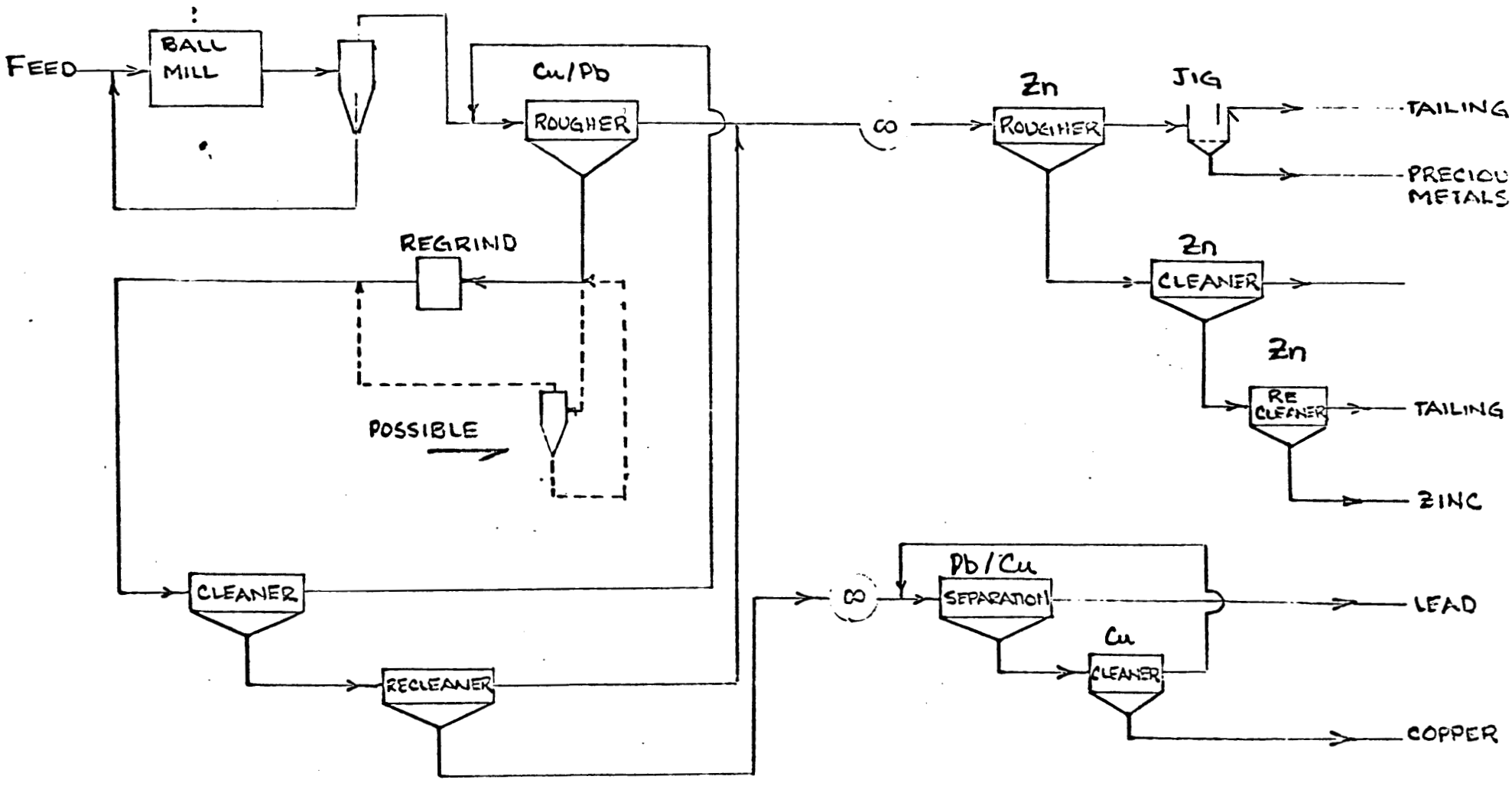
4. On the basis of this test it appears that blending of the ore from the Warman and Main zones is acceptable.

TEST NO. 350-4

PRODUCT	WT.%	ASSAY % Pb	ASSAY % Zn	ASSAY % Cu	DISTRIBUTION Pb	DISTRIBUTION Zn	DISTRIBUTION Cu
Lead conc.	1.2	17.50	8.80	5.12	53.8	13.5	52.6
Copper conc.	0.8	10.10	1.00	3.65	20.8	1.0	25.0
2nd BULK CL.T.	0.2	4.80	5.02	1.35	2.6	1.3	2.6
1st BULK CL.T.	2.3	1.42	3.20	0.50	8.5	9.5	9.5
Zinc conc.	1.0	0.75	48.05	0.35	2.0	61.5	2.6
Zn CL.T.	3.6	0.52	0.96	0.20	4.9	4.5	6.0
Pyrite conc.	0.8	0.27	0.71	0.28	0.5	0.8	1.7
Tails (calc)	90.1	0.03	0.07	--	7.2	8.0	--
Head (assay)	100	0.39	0.78	0.11	100	100	100

APPENDIX II

PRELIMINARY FLOWSHEET



PRELIMINARY NORTHAIR FLOWSHEET

4/4/74 MV/wgb

BACON, DONALDSON & ASSOCIATES LTD.
Consulting Engineers
117 East 4th Avenue · Vancouver, B.C. V5T 1G4 · Telephone 876-2023

May 21, 1974

File No. 350

Northair Mines Ltd.,
333-885 Dunsmuir Street,
Vancouver, B.C.
V6C 1N5

Attention: W. Fothergill

Dear Sir:

Re: Northair Mines Metallurgy
Progress Report No. 2

We have completed two additional tests on a blend of ores from the Main and Warman zones. The ore was blended in the ratio of 2 parts Warman to 1 part Main and assayed:

0.24 % Cu
1.4 % Pb
2.1 % Zn
3.4 % Fe
0.32 oz/ton Au
5.35 oz/ton Ag

No significant problems were encountered in treating the blend apart from the low copper assay making a copper lead separation impractical to test. We feel that a small copper-lead separation circuit should be installed in the plant however and operated whenever copper assays warrant.

Based on the test results to date, the following products appear to be indicated:

1. Lead Concentrate

(a) With no Cu-Pb separation

7-8 tpd (@ 340 TPD)
54-56 % Pb
2-3 % Zn
8-10 % Cu
10 % Fe
3-4 oz/ton Au
34 oz/ton Ag

(b) With Cu-Pb separation

(i) Lead concentrate

5-6 tpd (@ 340 TPD)
68-69 % Pb
2-3 % Zn
< 0.5 % Cu
2 oz/ton Au
25 oz/ton Ag

(ii) Copper concentrate

1-2 tpd
10 % Pb
2-3 % Zn
15-20 % Cu
14 oz/ton Au
68 oz/ton Ag

2. Zinc Concentrate

10-12 tpd
2-5 % Pb
55-60 % Zn
< 1 % Cu
3-4 % Fe
1-2 oz/ton Au
70-75 oz/ton Ag

3. Jig Concentrate

(a) plus 65 mesh
150-1500 lbs./day
70-150 oz/ton Au
100-250 oz/ton Ag

The remainder of this product would be pyrite and some coarse gangue.

(b) minus 65 mesh
2 tpd
4-6 oz/ton Au
40-50 oz/ton Ag

The remainder of this product would be pyrite.

4. Flotation pyrite concentrate

10 tpd
40 % Fe
.85 oz/ton Au
18 oz/ton Ag

This product accounts for approximately 5% of gold recovery and 8% silver recovery.

5. The flotation pyrite concentrate and minus 65 mesh jig concentrate could be combined to produce a pyrite concentrate:

12 tpd
1.5-2 oz/ton Au
>20 oz/ton Ag

This combined product would account for better than 10% of the gold recovery and better than 12% of the silver recovery.

The overall recoveries to be expected are:

Lead 90%
Zinc 95%
Copper 85-90%
Gold >90%
Silver 85%

Due to the variation in head grade of the ore, the weights and assays of concentrates produced will be somewhat variable. The figures presented in this report are the best estimates possible, based on the testwork to date.

The copper-lead separation which can be achieved has not been thoroughly tested and this work should be completed if a separation is to be attempted in the plant.

Further work will be undertaken immediately to complete test-work on the jig circuit in order to more accurrately predict the products to be expected and allow proper design for this portion of the circuit.

Yours respectfully,

BACON, DONALDSON & ASSOCIATES LTD.,

Morris Vreugde

Morris Vreugde, M.A.Sc.

W.G. Bacon

W.G. Bacon, P.Eng.

/db

APPENDIX

TEST NO. 350-5

PURPOSE:

1. To test a blend of ores from the Main and Warman Zones according to procedure established by previous testwork. Ore was blended in the ratio 2 parts Warman to 1 part Main by weight. Ore samples selected for this work are samples no. 2 and 3 as described by P. Dickson in a memo to W. Fothergill dated 11/4/74.
2. Flotation tailings from this test will be jigged to produce an electrum bearing pyrite concentrate.

PROCEDURE:

Stage	Time (minutes)	Additions
Grinding	8	1.0 lb./ton Na_2CO_3 0.2 lb./ton KCN 0.6 lb./ton $ZnSO_4$ 65% solids
Lead-Copper Rougher	5	pH = 9.1 0.05 lb./ton Ethyl Xanthate 0.01 lb./ton Z-200 0.005 lb./ton Dowfroth 250
Regrind	15	thicken prior to regrind 0.2 lb./ton $ZnSO_4$ 0.05 lb./ton KCN
1st Bulk Cleaner	5	lime to pH = 10.0 0.01 lb./ton Ethyl Xanthate 0.005 lb./ton Z-200
2nd Bulk Cleaner	3½	pH = 10.0

Stage	Time (minutes)	Additions
Conditioning	6	0.15 lb./ton Dextrin H_2SO_3 to pH = 6 0.01 lb./ton Z-200
Pb-Cu separation	4	--
Conditioning	4	0.5 lb./ton $CuSO_4$ lime to pH = 10.5 0.03 lb./ton Z-200 0.08 lb./ton Dowfroth
Zinc Rougher	5	--
1st Zn Cleaner	3½	lime to pH = 11
2nd Zn Cleaner	2½	lime to pH = 11.5
Jigging	---	1st and 2nd zinc cleaner tailings were combined with the rougher tailings for jigging. Jig concentrate was cleaned twice.

SIZE ANALYSIS:

Flotation Feed = 61% minus 200 mesh
Reground Bulk concentrate = 81% minus 325 mesh

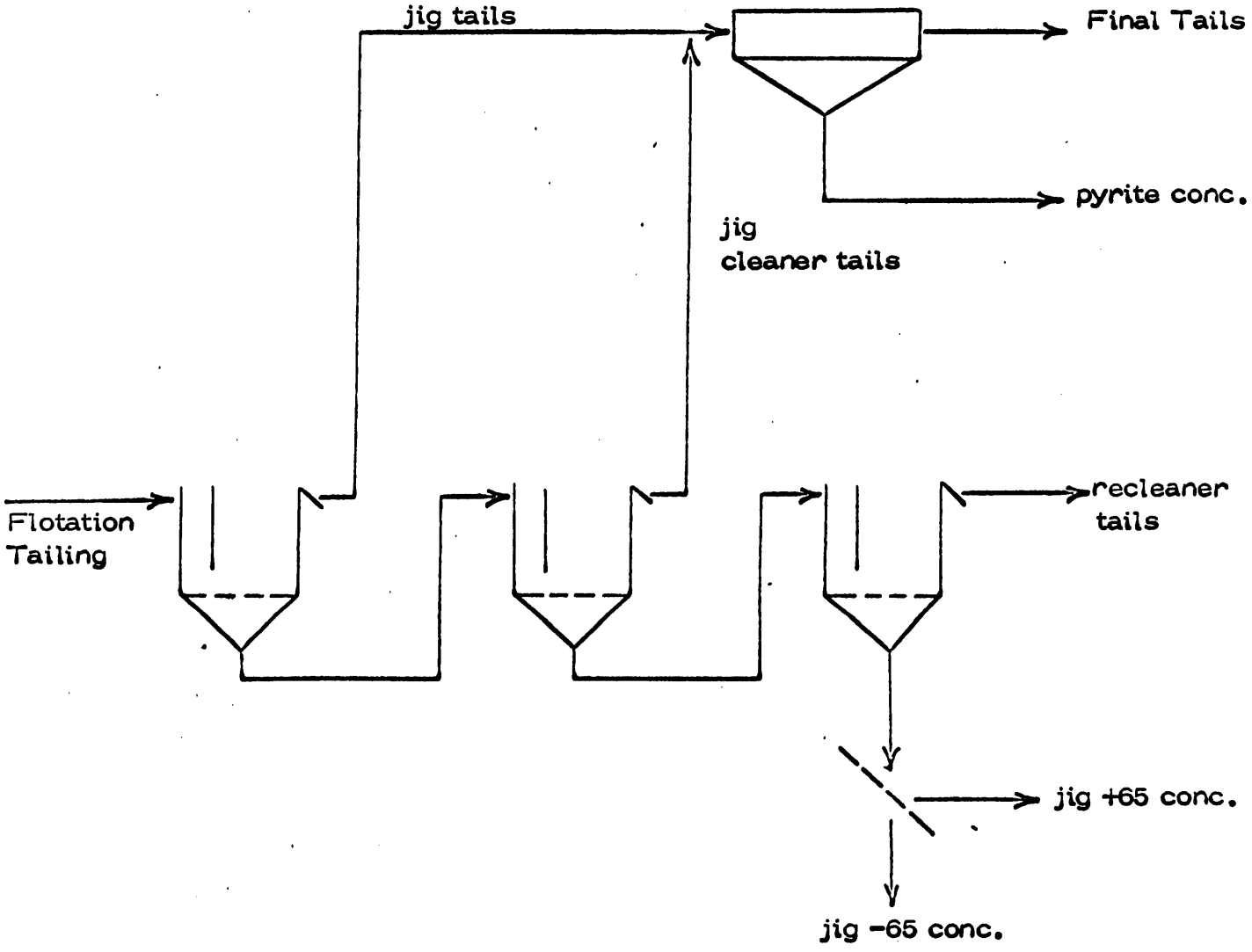
SAMPLE ASSAYS:

	%Cu	%Pb	%Zn	%Fe	oz/ton Au	oz/ton Ag
Main Zone	0.10	0.39	0.78	1.70	0.25	13.71
Warman Zone	0.31	2.00	2.85	3.60	0.65	0.76
Blend	0.24	1.4	2.1	3.4	0.32	5.35

TEST NO. 350-5

PRODUCT	WT.%	%Pb	%Zn	%Cu	%Fe	oz/ton Au	oz/ton Ag	PERCENT Pb	PERCENT Zn	PERCENT Cu	DISTRIBUTION Fe	DISTRIBUTION Au	DISTRIBUTION Ag
Cu conc.	0.4	69.1	2.5	3.9	5.0	14.88	68.36	16.4	0.5	6.3	0.6	18.8	5.1
Pb conc.	1.2	68.5	4.6	2.3	4.4	2.28	25.12	48.6	2.7	11.2	1.5	8.7	5.6
2nd Bulk CL.T.	0.1	16.0	8.6	2.2	12.2	2.29	19.85	1.0	0.4	0.9	0.4	0.7	0.4
1st Bulk CL.T.	2.6	8.9	11.1	1.9	14.2	1.14	17.54	13.7	14.0	20.1	10.5	9.4	8.5
Zinc conc.	3.0	9.0	53.1	3.8	6.2	1.32	75.24	16.0	77.1	46.4	5.3	12.5	42.2
Tailing	92.7	0.08	0.12	.04	3.1	0.17	2.20	4.4	5.4	15.1	81.8	49.9	38.1
Head (calc.)	100	1.7	2.1	.25	3.5	.32	5.35						

Flowsheet - Jig Circuit



TEST 350-5

Jig Circuit Balance

PRODUCT	WT.%	oz/ton Au	oz/ton Ag	DISTRIBUTION Au	DISTRIBUTION Ag
Flotation tailing	92.7	.17	2.20	49.9	38.1
jig concentrate +65 mesh	.03	150.10	243.81	14.2	1.4
-65 mesh	.82	6.61	45.76	17.1	7.0
jig recleaner tails	.46	.19	4.66	0.3	.4
jig cleaner tails	16.39	.087	2.13	4.5	6.5
jig tails	66.32	.041	1.19	8.6	14.8
flotation pyrite conc.	3.18	.68	24.05	6.8	14.3

DISCUSSION:

1. The lead concentrate grade (68%Pb) is acceptable. Since no copper-lead separation was achieved these two concentrates can be combined to give a lead recovery of 65 percent. This low recovery results from excessive lead reporting to the lead cleaner tails and zinc concentrate. Increased collector addition to the lead rougher should be attempted to overcome this problem.
2. Zinc concentrate grade is lower in this test than what was indicated to be achievable in tests no.2 and 3. This is due to excessive copper and lead in the concentrate. Improved recovery in the lead circuit will improve the zinc concentrate grade.
3. Regrinding of the lead concentrate has been effective in liberating the zinc from the lead so that the zinc was depressed in the lead cleaners. Recycling of these products in a continuous circuit will enable the zinc to report to the zinc concentrate and thereby improve zinc recovery.
4. The plus 65 mesh jig concentrate represents a high grade gold-silver concentrate, recovering a significant proportion of gold and silver. The minus 65 mesh jig concentrate when combined with the flotation pyrite concentrate results in a pyrite concentrate of 12 tpd when processing 300 tpd. This concentrate would assay 1.9 oz/ton Au and 13.09 oz/ton Ag and represents 23.9% gold recovery and 21.3% silver recovery. Although these figures give an indication of what could be expected, the exact grades and recoveries achieved in practice could vary greatly due to the changeable nature of the ore.

TEST NO. 350-6

PURPOSE:

1. To increase collector addition to the lead circuit in order to improve lead and copper recovery.
2. To perform a test with addition of cleaner tails to succeeding stages in order to approximate continuous operation.

PROCEDURE:

Stage	Time (minutes)	Additions
Grinding	8	1.0 lb./ton Na_2CO_3 0.2 lb./ton KCN 0.6 lb./ton $ZnSO_4$ 65% solids
Lead Rougher	3	0.1 lb./ton Ethyl Xanthate 0.005 lb./ton Aero 130 0.02 lb./ton Z-200 Dowfroth 250
Regrind	15	thicken prior to regrind 0.1 lb./ton $ZnSO_4$ 0.025 lb./ton KCN
Lead Cleaner	4	lime to pH=10 0.005 lb./ton Ethyl Xanthate 0.002 lb./ton Z-200
Lead Recleaner	4	---
Conditioning	4	Lead rougher, cleaner and recleaner tails combined for zinc feed. 0.5 lb./ton $CuSO_4$ lime to pH=10.5 0.03 lb./ton Z-200 Dowfroth 250

Stage	Time (minutes)	Additions
Zinc Rougher	3	---
Zinc Cleaner	3	lime to pH=11.0
Zinc Recleaner	3	lime to pH=11.5
jig-rougher	--	zinc rougher, cleaner and recleaner tails combined for jig feed
jig-cleaner	--	cleaner concentrate screened to plus and minus 65 mesh fractions
pyrite flotation	2	jig rougher and cleaner tails combined for pyrite feed 0.15 lb./ton Isopropyl Xanthate
pyrite cleaner	2	---

SIZE ANALYSIS:

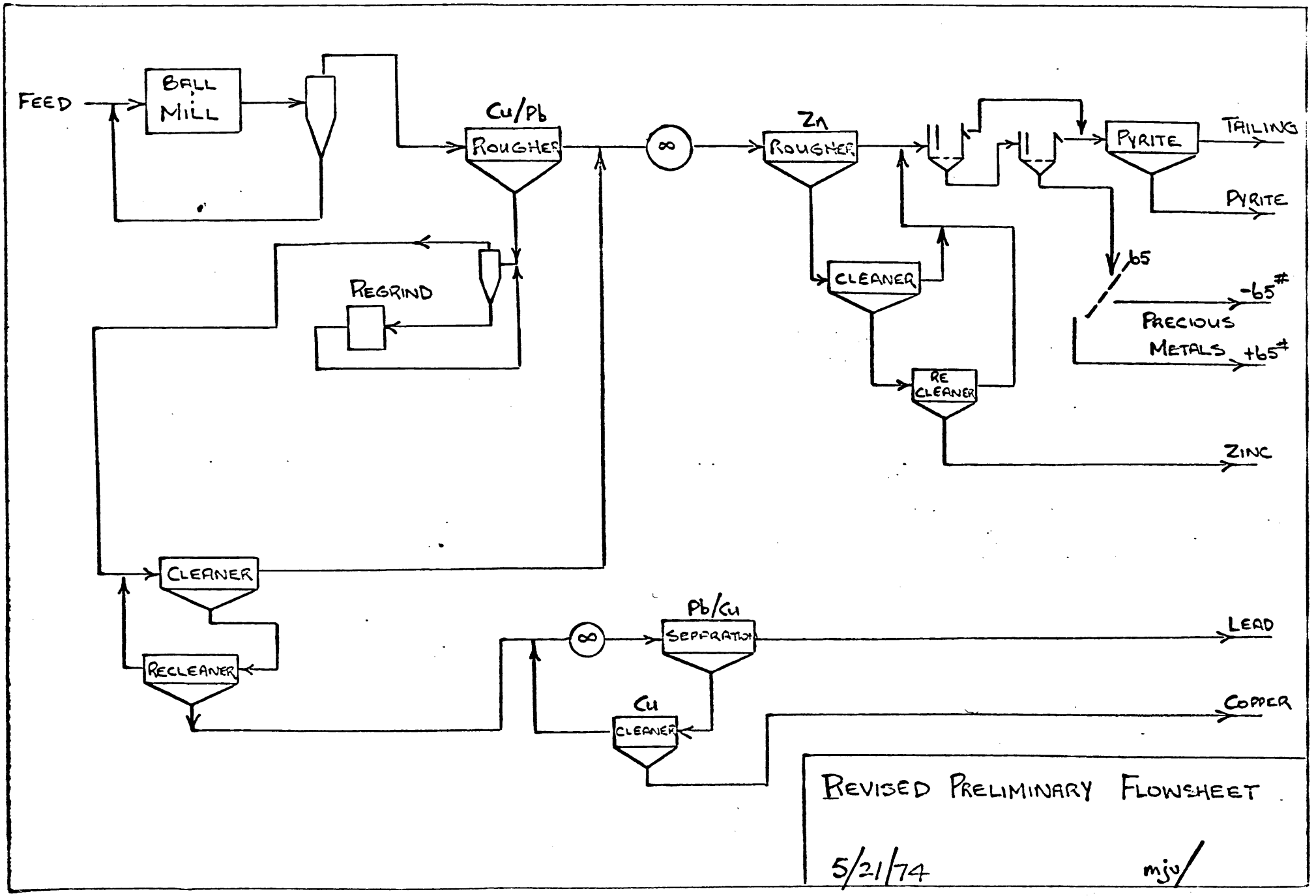
Flotation Feed = 56% minus 200 mesh.

TEST NO. 350-6

PRODUCT	WT.%	%Pb	%Zn	%Cu	%Fe	oz/ton Au	oz/ton Ag	PERCENT DISTRIBUTION Pb	Zn	Cu	Fe	Au	Ag
Lead conc.	1.4	67.39	3.33	2.10	4.09	3.50	34.04	66.9	2.2	12.7	2.0	13.1	9.2
Zinc conc.	4.2	6.44	46.61	3.79	7.77	2.10	72.54	19.2	92.1	68.6	11.2	23.5	58.6
jig conc. +65	0.2	---	---	---	---	69.99	96.04	---	---	---	---	37.3	3.7
-65	0.6	---	---	---	---	3.79	38.90	---	---	---	---	6.0	4.5
Pyrite conc.	2.3	2.41	1.82	.57	40.01	.850	17.85	3.9	2.0	5.6	31.5	5.2	7.9
Pyrite CL.T.	0.6	2.49	1.16	.53	10.50	4.12	5.33	1.1	0.3	1.4	2.2	6.6	0.6
Tailing	90.8	.14	.08	.03	1.71	.034	.89	9.0	3.4	11.7	53.2	8.2	15.5
Head (calc.)	100	1.41	2.13	.23	2.92	.375	5.20						

DISCUSSION:

1. Excessive copper and lead have reported to the zinc concentrate resulting in low concentrate grade. Several circuit changes to overcome this problem are proposed:
    a. Add Z-200 to grinding stage instead of lead rougher.
    b. Increase collector addition to the lead cleaner circuit.
    c. Return lead recleaner tailings to lead rougher circuit instead of to zinc rougher circuit.
2. Addition of lead cleaner tailing to the zinc roughers has resulted in improved zinc recovery (92.1%).
3. Jigging produced a high grade gold-silver concentrate. Cleaning of the jig concentrate by a second jig is necessary to upgrade the concentrate.
4. Flotation of a pyrite concentrate after jigging recovered further gold and silver. Combining the minus 65 mesh jig concentrate with the pyrite flotation concentrate results in a pyrite concentrate of 8.7 tpd when processing 300 tpd. This concentrate assays 1.46 oz/ton Au and 22.21 oz/ton Ag and represents 11.2% Au recovery and 12.4% Ag recovery.


FEED
BALL MILL
Cu/Pb
ROUGHER
Zn
ROUGHER
PYRITE
TAILING
PYRITE
REGRIND
CLEANER
-65#
PRECIOUS METALS
+65#
RE CLEANER
ZINC
CLEANER
RECLEANER
Pb/Cu
SEPARATION
LEAD
Cu
CLEANER
COPPER
REVISED PRELIMINARY FLOWSHEET
5/21/74
mjv

BACON, DONALDSON & ASSOCIATES LTD.
Consulting Engineers
117 East 4th Avenue · Vancouver, B.C. V5T 1G4 · Telephone 876-2023

May 31, 1974

File No. 350

Mr. D. McLeod,
Northair Mines Ltd.,
333-885 Dunsmuir Street,
Vancouver, B.C.
V6C 1N5

Dear Don,

Re: Northair Mines Ltd.
Jig Circuit Performance

We have completed a test on the Northair ore, aimed at obtaining more precise data for the products to be expected from the jig circuit. The test was performed on a 10 kilogram sample of a blend of ores as in test no. 5 and 6.

The results, appended to this report, indicate two alternatives:

A. Produce plus and minus 65 mesh concentrates and a flotation pyrite concentrate and combine the minus 65 mesh fraction with the pyrite to give:

1. plus 65 mesh jig concentrate

340 lbs per day
129.4 oz/ton Au
104.9 oz/ton Ag
18.0 % Au Recovery
1.0 % Ag Recovery

2. Pyrite concentrate (including minus 65 mesh jig concentrate).

7.4 tons per day
0.45 oz/ton Au
5.45 oz/ton Ag
2.8 % Au Recovery
2.3 % Ag Recovery

B. To not produce a pyrite concentrate since it accounts for only 1.4 % Au recovery and 2.0 % Ag recovery and, produce an unscreened jig concentrate:

1.0 ton per day
24.0 oz/ton Au
23.07 oz/ton Ag
19.4 % Au recovery
1.3 % Ag recovery

This second alternative would result in some modifications to the previously established flowsheet. The pyrite roughers and cleaners and the wet screen would be omitted and a belt filter should be considered instead of an American disc filter for pyrite.

The results of this test also indicate improved recovery of copper and lead. On the basis of all tests to date it appears that 90 to 95 percent recovery of all metals (Cu, Pb, Zn, Au, Ag) will be attained in practice.

We strongly recommend alternative B because of the reduced capital cost, equipment to operate and difficulty in marketing a pyrite concentrate.

Yours truly,

BACON, DONALDSON & ASSOCIATES LTD.,

Mario Vreugde

M.J.A. Vreugde, M.A.Sc.

W.G. Bacon

W.G. Bacon, P.Eng.

/db..

TEST NO. 350-7

PURPOSE: The primary purpose of this test was to obtain more accurate and precise data for the jig and pyrite flotation circuits both for design purposes and marketing considerations. At the same time, minor changes in the copper, lead and zinc flotation stages will be tested to improve the performance in these circuits.

PROCEDURE:

Stage	Time (minutes)	Additions
Grinding	8	0.5 lb./ton Na_2CO_3 0.2 lb./ton NaCN 0.6 lb./ton $ZnSO_4$ 0.02 lb./ton Z-200 65 % solids
Lead Rougher	3	0.1 lb./ton Ethyl Xanthate 0.005 lb./ton Aero 130 0.04 lb./ton SA 1012
Zinc Rougher	3	0.5 lb./ton $CuSO_4$ lime to pH = 11.5 0.03 lb./ton Z-200 0.04 lb./ton SA 1012
Jig Rougher	--	Zinc rougher tailings fed to jig
Jig Cleaner	--	
Screening	--	Jig concentrate screened plus and minus 65 mesh
Pyrite Rougher	2	0.15 lb./ton Z-11
Pyrite Cleaner	3	0.01 lb./ton Z-11

TEST NO. 350-7

PRODUCT	WT.%	% Cu	% Pb	oz/ton Au	oz/ton Ag	RECOVERY Cu	Pb	Au	Ag
Lead Rougher conc.	4.62	2.24	31.34	4.196	24.71	42.3	94.7	53.9	22.3
Zinc Rougher conc.	3.52	2.42	0.77	1.501	75.82	34.8	1.8	14.7	52.2
Copper conc.	0.77	5.69	1.17	2.088	102.9	17.9	0.6	4.5	15.5
Pyrite conc.	1.93	0.12	0.37	0.254	5.38	0.9	0.5	1.4	2.0
Pyrite CL. Tail	0.94	0.05	0.14	0.049	1.22	0.2	0.1	0.1	0.2
Jig conc. +65	0.05	--	--	129.4	104.9	--	--	18.0	1.0
-65	0.24	--	--	2.059	5.98	--	--	1.4	0.3
Jig Cl. Tail	4.59	0.02	0.08	0.072	1.22	0.4	0.2	0.9	1.1
Tailing	83.37	0.01	0.04	0.022	0.33	3.4	2.2	5.1	5.4
Head (calc)	100	0.24	1.53	0.36	5.12				

DISCUSSION:

1. Improved copper and lead recovery was achieved in this test over tests no. 5 and 6. It should be noted however that this is a rougher concentrate and minor losses would occur in the cleaning stages. The copper concentrate in this test was actually a zinc pre-float aimed at finding an explanation for the poor recovery of copper with lead. The copper and zinc concentrates were examined microscopically and the chalcopyrite was determined to be liberated. It appears that increased collector additions to the grinding stage should improve copper recovery in the lead rougher circuit.

2. The pyrite concentrate in this test carries only 1.4 % of the gold and 2.0 % of the silver. This strengthens the belief that most of the gold and silver are free and that close control of the jigs should ensure high gold and silver recovery.

3. The overall recovery of copper, lead, gold and silver was greater than 90 percent in this test. Zinc was not assayed for in this test as previous results indicated that acceptable grade and recovery was being achieved.

APPENDIX II

POLLUTION CONTROL BOARD DATA

INFORMATION FOR POLLUTION CONTROL BOARD

NORTHAIR MINES

MINERALOGY (percent composition)

Ore Minerals:

	Warman Zone	Main Zone
1. Galena	3	0.5
2. Sphalerite	7.5	1.0
3. Chalcopyrite	1.5	0.5
4. Argentite	<.01	<0.1
5. Electrum	trace	trace
6. Pyrite	4.5	4.5

Gangue Minerals:

1. Feldspar	50
2. Silica	25
3. Carbonates	15

Marcasite - None

Pyrrhotite - None

Arsenopyrite - None

REAGENTS

Name	Function	Quantity
Zinc Sulphate	Depressant	0.8 lb./ton
Sodium Carbonate	pH control	0.5 lb./ton
Copper Sulphate	Promoter	0.6 lb./ton
Lime	pH control	2.0 lb./ton
Potassium Cyanide	Depressant	0.3 lb./ton
Polyglycol Frother	Frother	0.2 lb./ton
Z-200 (Xanthate)	Collector	0.04 lb./ton
Ethyl Xanthate	Collector	0.05 lb./ton

SIZE ANALYSIS OF TAILINGS

Mesh	Weight%
+ 65	0.1
- 65+100	1.2
-100+150	7.5
-150+200	14.2

Mesh	Weight %
-200+270	16.7
-270+325	16.5
-325	43.8

METHOD AND DEGREE OF CONTROL OF MILLING REAGENTS

- Sodium Carbonate (Na_2CO_3) and Lime ($Ca(OH)_2$) to give required pH pH by means of pH meter.

- All other reagents added by CLARKSON feeders on a feed tonnage basis.

WATER DISCHARGE FROM MILL

= 150,000 Imp. gals/day

QUANTITY OF TAILS DISCHARGED FROM MILL

= 240 tons/day

EFFLUENT:

specific gravity = 1.50 (1.23) ≈ 1.35
percent solids = 30

CHARACTERISTS OF EFFLUENT

	Before Treatment	After Treatment
Total suspended solids (mg./l)	370	0.2
Total solids (mg./l)	370	1.5
BOD	--	--
pH	9.5	8.0
Temperature (°F)	5° Above Intake	
Coliform bacteria	N.A.	
Toxic constituents:		
Mercury Hg	< 1 ppb	--
Cyanide CN^-	7.5 ppm	< 1 ppm
Other constituents:		
Iron Fe (ppm)	.035	
Copper Cu (ppm)	0.07	
Zinc Zn (ppm)	0.04	
Lead Pb (ppm)	0.08	
Sulphate SO_4 (ppm)	712	

Bacon, Donaldson & Associates

117 East 4th Avenue

Vancouver, B.C.

COAST ELDRIDGE
PROFESSIONAL SERVICES DIVISION
WARNOCK HERSEY INTERNATIONAL LIMITED
125 EAST 4TH AVE. VANCOUVER 10, B.C., CANADA

PHONE: [illegible] 76-4111
TELEX: 04- [illegible] 53
CABLE ADDRESS: ELDRICO

FILE NO. 468 - 19172

DATE May 7, 1974

SEMI QUANTITATIVE SPECTROGRAPHIC ANALYSES

We Hereby Certify that the following are the results of semi quantitative spectrographic analyses made on PULP samples submitted.

SAMPLE IDENTIFICATION	Al	Sb	As	Ba	Be	Bi	B	Cd	Ca	Cr	Co	Cu	Ga	Au	Fe
D-[illegible] NORTHAIR TAILINGS	6.0	ND	ND	0.01	ND	ND	ND	ND	3.0	ND	ND	0.01	ND	Trace	3.0

SAMPLE IDENTIFICATION	Pb	Mg	Mn	Mo	Nb	Ni	Si	Ag	Sr	Ta	Sn	Ti	W	V	Zn
	0.01	2.0	0.3	ND	ND	0.001	Matrix	Trace	0.007	ND	ND	0.2	ND	0.003	ND

All results expressed as PERCENT BY WEIGHT

Note: Rejects retained one week.
Pulps retained one month.

COAST ELDRIDGE PROFESSIONAL SERVICES DIVISIC

Ted M. Williams
Supervisor, Chemical Division

Ted M. Williams
CHEMIST

TAILINGS DISPOSAL

A settling test was performed on the tailings of test no. 350-5. An initial settling rate of 1.27 ft./hr. was observed. The initial pulp density was 27.6% solids by weight resulting in a settling flux of 29.1 lb./ft.^{2}/hr. The supernatant from this test was essentially clear and would be suitable for reuse.

APPENDIX III

EQUIPMENT SIZE DATA

EQUIPMENT SIZE DATA

The purpose of this preliminary flowsheet design is to evaluate the suitability of equipment in the Copeland Mill and to determine the additional equipment required. Only major equipment is to be considered at this time.

Design milling rate = 342 TPD

1. Jaw Crusher

342 T/8 hrs. = 40.5 TPH
@ 90% availability = 45 DTPH
@ 6% moisture = 47.9 TPH
assume 50 TPH required for jaw to crush to - 2 inch
: 20"x36" with a 2½ in. discharge will handle 60-75 TPH
with a 60 HP motor

∴ Jaw Crusher O.K.

2. Cone Crusher

have a 36" must be coarse cavity
short head or standard
open = 3"
closed = 2"
discharge = 3/8" to 1/2"
75 HP
580 RPM

∴ Cone Crusher O.K.

3. Screening

48"x8' Dillon Model 70
7.5 HP
Handle: 125-150 TPH

∴ Dillon screen O.K.

4. Ball Mill

required grind = 63% - 200 mesh
≃ 80% - 125 u
Assume Wi = 9 (Britton's report No.1)
feed = 14.25 TPH
80%-3/8" to -1/2"

feed = 80%-3/8"
W=7.129 KWH/ton
=136.2 HP

∴ Ball mill no good
But 8'x10' with 300 HP is fine

5. Cyclone

overflow = 60%-200 mesh
separation size = 65 mesh = 208 μ
flow = 201.05 USGPM
feed density = 54.3 % solids by weight
= 28.4 % solids by weight
solids s.g. = 2.99

10" no good because coarse grind results in Δp = 1 psi = too low
15" Δp = 3.5 psi
flow = 240 USGPM

∴ require 15 inch KREBS cyclone
7 sq. in. inlet nozzle
4 in. I.D. Vortex finder
2 in. I.D. Apex

6. Lead Roughers

flow = 124.92 USGPM
= 16.70 cfm
residence time = 15 minutes
volume required = 15x16.70 = 250 cu.ft.
Denver DR No. 24 = 50 cu. ft./cell nominal
Actual Volume = 2/3 nominal
∴ require $\frac{250 \times 3}{50 \times 2}$ = 7.5 cells

∴ use eight cells
∴ require 8 new #24 DR's

7. Thickener

26 ft. ø Type A - 24A drive head
drive = 1735 rpm
4 rake arms
manual lifting

$$\frac{.741 \text{ TPH } x2000}{530.95 \text{ ft}^2} = 2.79 \text{ lb./ft}^2\text{/hr}$$

(rising velocity = 0.71 fph.)

∴ thickener O.K.

8. Regrind Ball Mill and Cyclone

- make work

9. Lead Cleaner

10.609 USGPM = 1.418 cfm
15 min. retention = 21.27 cu.ft.

∴ require $\frac{21.27x3}{12x2}$ = 2.66 cells
use 3 of existing #15 DR's

10. Lead Recleaners

5.728 USGPM = 0.766 cfm.
10 min. retention = 7.66 cu.ft.

∴ require $\frac{7.66x3}{12x2}$ = 0.958 cells

use 1 of existing #15 DR's

11. Copper-Lead Conditioner

4.646 USGPM = .6210 cfm.
10 min. retention = 6.2 cu.ft.

require 2½ Ø x 4 ft. high
plus mixer

12. Copper-Lead Separation

require 4 #12 Sub A's
2 for roughing
2 for cleaning

13. Zinc Conditioner

82.730 USGPM = 11.06 cfm.
10 min. retention time
110.6 cu.ft. volume (830 US gal.)

∴ 5' ∅ x 7' conditioner

14. Zinc Roughers

122.390 USGPM = 16.36 cfm.
15 minutes retention = 245.40 cu.ft.

∴ need 8 #24 DR's

15. Zinc Cleaners

11.052 USGPM = 1.477 cfm.
15 min. retention = 22.16 cu.ft.

∴ require $\frac{22.16}{12} \times \frac{3}{2}$ = 2.77 cells

∴ use 3 of existing #15 DR's

16. Zinc Recleaners

9.184 USGPM = 1.228 cfm.
12 min. retention = 14.73 cu.ft.

∴ require $\frac{14.73}{12} \times \frac{3}{2}$ = 1.84 cells

∴ use 2 of existing #15 DR's

17. Zinc Re-Recleaners

use 1 existing #15 DR

18. Jigs

rougher - 16"x24" Duplex "Selective" Jig
cleaner - 8"x12" Simplex or Duplex Jig

19. Filters

(a) copper-lead and zinc
use existing 4' ∅ x 4 disc filter

(b) jig concentrate
need drum filter having small area i.e. 3' ∅ x 0.5' long

APPENDIX III - A

BACON, DONALDSON & ASSOCIATES LTD.
Consulting Engineers

117 East 4th Avenue · Vancouver, B.C. V5T 1G4 · Telephone 876-2023

May 27, 1974

File No. 350

Mr. D. McLeod,
Northair Mines Ltd.,
333-885 Dunsmuir Street,
Vancouver, B.C.
V6C 1N5

Dear Don,

Enclosed please find a list of major equipment to be aquired in addition to the equipment in the Copeland mill. Also enclosed is a list of major mill equipment as we have sized it to date. This list does not include items such as pumps and conveyors as insufficient information is available at present to properly size such equipment. Please note that the jaw crusher has been sized on the basis of crushing 342 tons per 8 hours and not on the basis of the maximum feed size likely to be encountered.

On the equipment aquisition list the new cost of items is indicated where available. This may be of some assistance to you in evaluating the price of used equipment where available.

The DSM Rapfine screen is for handling the jig concentrate to screen out the coarse gold bearing fraction. These screens are available from Dorr-Oliver-Long. A slot opening of 0.008 ins. should be specified. In operation, this screen will likely have a surge tank in front of it and be operated on an intermittent basis.

Yours truly,

BACON, DONALDSON & ASSOCIATES LTD.,

Morris Vreugde

Morris J.A. Vreugde, M.A.Sc.

MJAV/db
Encl.

NORTHAIR MINES LIMITED

EQUIPMENT AQUISITIONS REQUIRED:

1. BALL MILL

The proposed aquisition of a 8' x 10' mill with 300 Hp motor would be suitable.

Cost New $95,000

2. CYCLONE

15 inch diameter
7 sq. in. inlet
4 in. I.D. vortex finder
2 in. I.D. Apex (variable if possible)

3. FLOTATION CELLS

18 Denver #24 DR's — Cost New $21,000

4. CONDITIONER

2½' Ø x 4' Deep
Open type mechanism
1 HP motor

5. JIGS

16" x 24" Duplex "Selective" Jig	Cost New	$ 5,000
8" x 12" Simplex or Duplex Jig	Cost New	$ 2,100

6. WET SCREEN

DSM Rapifine - 1 ft. width — Cost New $ 4,150

7. FILTER

4 ft. Ø - 4 disc American filter

NORTHAIR MINES LIMITED

MAJOR MILL EQUIPMENT

	HP
1. Jaw Crusher 10" x 36"	50
2. Cone Crusher 36"	75
3. Screen 48" x 8'	7½
4. Ball Mill	200
5. Cyclone 15"	
6. 8 Cell Bank Lead Rougher Flotation Cells 8-Denver #24 DR	4 x 15
7. 26' Diameter Thickener	1.5
8. Regrind Ball Mill 3' x 4'	15
9. Cyclone 3"	
10. 4 Cell Bank Lead Cleaner and Recleaner Flotation Cells 4-Denver #15 DR	2 x 4
11. Conditioner 2½' Ø x 4'	1
12. 4 Cell Bank Copper-Lead Separation Cells 4-Denver #12 Sub A	2 x 3
13. Conditioner 5' Ø x 7'	5
14. 8 Cell Bank Zinc Rougher Flotation Cells 8-Denver #24 DR	4 x 15
15. 6 Cell Bank Zinc Cleaner, Recleaner and Re-recleaner Flotation Cells 6-Denver #15 DR	3 x 4
16. 2 Cell Bank Pyrite Roughers 2-Denver #24 DR	15

17. 4 Cell Bank Pyrite Cleaners
    4-Denver #12 Sub A's — 2 x 3

18. Rougher Jig
    16" x 24" Duplex "Selective" Jig — 1½

19. Cleaner Jig
    8" x 12" Simplex or Duplex Jig — 3/4

20. Wet Screen - DSM Rapifine — ---

21. Filter
    a) Pyrite 4 ft. Ø - 4 disc. — 3/4
    b) Copper, Lead, Zinc 4 ft. Ø - 4 disc. — 3/4

BACON, DONALDSON & ASSOCIATES LTD.
Consulting Engineers

117 East 4th Avenue · Vancouver, B.C. V5T 1G4 · Telephone 876-2023

June 21, 1974

File No. 350

Mr. D. McLeod,
Northair Mines Ltd.,
333-885 Dunsmuir Street,
Vancouver, B.C.
V6C 1N5

Dear Mr. McLeod,

At the request of Mr. L. Manning we have prepared the enclosed table of simulated products for the purpose of calculating the smelter return for the Brandywine deposit. This report should be appended to our report of June 12, 1974 and is based on information derived from that report.

It should be noted that these specific results apply to the grade of material tested by us. When changes in head grade are encountered, the grades and recoveries will be expected to deviate from the results presented here. These results are useful however for calculating the smelter returns of various grade materials as the recoveries and grades can be applied to give estimated results.

The assay of the precious metal concentrate covers a wide range and the mill product will in fact likely also vary to such an extent depending on the nature of the material being treated.

Yours truly,

BACON, DONALDSON & ASSOCIATES LTD.,

M.J.A. Vreugde, M.A.Sc.

W.G. Bacon, P.Eng.

/db

SIMULATED MILL PRODUCTS

PRODUCT	WT.%	ASSAYS Cu	Pb	Zn	Au oz/ton	Ag oz/ton	RECOVERIES Cu	Pb	Zn	Au	Ag
Lead conc.	2.21	9.0	56	2.5	3.5	34	82.9	88.4	2.6	24.2	14.0
Zinc conc.	3.24	0.8	1	57	1.5	72	10.8	2.3	87.9	15.2	43.6
Precious conc.	0.29	--	--	--	56*	596*	--	--	--	51.6	32.4
Tailing	94.3						6.3	9.3	9.5	9.0	10.0
Head	100	.24	1.4	2.1	.32	5.35	100	100	100	100	100

* These are calculated values to provide the requested balance but in reality these assays will be:

20-150 oz/ton gold
20-250 oz/ton silver