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ENVIRONMENTAL CONSULTANTS

YOUR REFERENCE
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NUMBER H0/147

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January 28, 1991

Mr. Alex J. Davidson
Exploration Manager, Western Canada
MINNOVA INC.
Suite 400, 311 Water Street
Vancouver, B.C.
V6B 1B8

Dear Mr. Davidson:

Re: **Lara Project, Chemainus, B.C.**
Underground Exploration Program

Attached for your review is a copy of the 1990 year end water quality monitoring report for the underground exploration program covering the period January 01 to December 31, 1990. According to requirement 11 of your Mines Inspector Approval dated March 14, 1988 a copy of the attached report should be sent to the District Inspector of Mines in Nanaimo for his review:

Inspector of Mines and Resident Engineer,
Ministry of Energy Mines and Petroleum Resources,
2569 A, Kenworth Road,
NANAIMO, B.C.
V9T 4P7

Should you require any additional information on this matter please do not hesitate to give me a call.

Yours truly,
HATFIELD CONSULTANTS LIMITED

Jenifer Johnson

Jenifer Johnson
Project Biologist

Encl.
cc. Mr. Bert Reeve - Laramide Resources Ltd.
Mr. John Villamere - Hatfield Consultants Ltd.
Mr. Garry Wells - Minnova Inc.

(alex147)

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MINNOVA INC.
LARA PROJECT

UNDERGROUND EXPLORATION PROGRAM
WATER QUALITY MONITORING

Year End Report
For The Period
January, 1990 to December, 1990

Collection: **Minnova Inc.**
Analyses: **Analytical Services Laboratories**
Reporting: **Hatfield Consultants Limited**

January, 1991

MINNOVA INC.
LARA PROJECT

UNDERGROUND EXPLORATION PROGRAM
WATER QUALITY MONITORING

Year End Report For The Period
January, 1990 to December, 1990

1.0 INTRODUCTION

This report presents the results of water quality samples collected from the Minnova Inc. (formerly Abermin Corporation), Lara underground exploration project collected between January 01, 1990 and December 31, 1990 pursuant to requirements of the Mines Inspector Approval dated March 14, 1988 for a bulk ore sampling program.

Previous reports were as follows:

- First Quarterly Report issued August 1988
- Second Quarterly Report issued November 1988
- Third Quarterly Report issued January 1989
- Fourth Quarterly Report issued April 1989
- Fifth Quarterly Report issued August 1989 ("Reclamation Proposal for the Lara Waste/Ore Piles")
- Sixth Quarterly Report issued February 1990
- Seventh Quarterly Report issued June 1990
- Eighth Quarterly Report issued August 1990
- Ninth Quarterly Report issued November 1990

Samples for the 1990 Year End Report were obtained from the underground portal, ore pile runoff, water quality monitoring pond and from Solly Creek above and below the exploration site on four occasions as follows: April 9, July 16, October 15, and December 11, 1990.

Samples were collected by Minnova Inc. field staff in proper laboratory containers and returned to Vancouver for analyses. Analyses were performed by Analytical Service Laboratories Ltd. using procedures described in "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, 1985 and 1989 editions. Both editions contained identical procedures for the required tests. Procedures involved a variety of instrumental analyses involving inductively coupled plasma (ICP) and atomic absorption spectrophotometry (AAS) to obtain the required detection limit for each element. Complete results are presented in Table 1.

2.0 SUMMARY OF WATER QUALITY RESULTS

2.1 Mine Water from the Underground Portal

Water from the umderground portal remained relatively unchanged (Table 1) throughout 1990. Alkalinity and associated pH tended to rise slightly during the dry, summer months reflecting lower dilution. Sulphate content dropped (to 4.0 mg/L) during the last quarter of the year. Although there was a small increase in total aluminum, from 0.019 mg/L to 0.091 mg/L throughout the year, copper concentrations decreased during 1990 from 0.010 mg/L to 0.001 mg/L. Iron concentrations showed a peak during the third quarter both in total (0.36 mg/L) and dissolved (0.27 mg/L) forms. Slight variations were indicative of the remaining metals throughout 1990.

2.2 Waste Rock Pile Runoff

Runoff from the ore pile was only present during the rainy season (first and last quarters). As a result during the dry season samples could not be obtained. PH was neutral (7.40 to 7.43) and high in alkalinity (181 to 268 mg/L $CaCO_3$) and high in sulphate content (791 to 1180 mg/L).

Concentrations of metals found during the rainy season fluctuated slightly for all parameters. High concentrations of zinc (60.0 mg/L to 50.7 mg/L) occurred during the rainy season, although there was a lowered concentration from the 1989/90 winter season (TZn = 60.0 mg/L, DZn = 57.7 mg/L) to the 1990/91 winter season (TZn = 50.8 mg/L, DZn = 50.7 mg/L). Other metals such as aluminum, arsenic, copper, and lead were generally low and were approximately the same in both sample collections.

Water from the ore pile is diverted to the monitoring pond before entering Solly Creek.

2.3 Monitoring Pond Discharge

On the basis of samples taken from the monitoring pond inlet and outlet on July 21, 1988 it was found that the monitoring pond is between 96 and 99% effective in the removal of total metals and moderately effective in removal of sulphates.

Within the monitoring pond, variations are seen for all parameters. Alkalinity and sulphate concentrations fluctuated throughout the year ranging from 18.9 mg/L to 65.5 mg/L for calcium carbonate and from 13.4 mg/L to 182 mg/L for sulphate. Increases were observed for the last quarter of the year for total aluminum (from 0.028 to 0.640 mg/L) and total iron (from <0.03 to 0.270 mg/L). Increased total zinc (2.99 mg/L) and dissolved zinc (2.80 mg/L) were a result of increased zinc in runoff from the ore pile. However, these increases do not show any notable effect on Solly Creek Below in comparison with Solly Creek Above. Continued testing is recommended to ensure effectiveness of the monitoring pond.

2.4 Solly Creek

Water taken from Solly Creek above the exploration site can be characterized as slightly alkaline in pH (variations from 7.21 to 7.84), low in alkalinity (variations from 4.1 mg/L to 11.4 mg/L $CaCO_3$), sulphate (from 2.3 mg/L to <1.0 mg/L SO4) and selected total and dissolved metals. Except for aluminum which is always found to be moderately high in Solly Creek (from 0.066

mg/L to 0.112 mg/L), most total and dissolved metals were low or below the level of detection for the entire year. Solly Creek below the operations area was also near neutral in pH (from 6.72 to 7.42), low in alkalinity (from 4.9 mg/L to 12.4 mg/L $CaCO_3$), sulphate (from 10.6 mg/L to < 1.0 mg/L SO_4) and selected total and dissolved metals. Total and dissolved aluminum was found to be lower in Solly Creek below the operations than above, which is frequently the case.

3.0 CONCLUSIONS

Overall, the waste rock runoff and monitoring pond water has had little or no impact on Solly Creek water quality. Continued monitoring of the operation is advised to maintain low impact on Solly Creek.

TABLE 1

MINNOVA INC., LARA PROJECT
UNDERGROUND EXPLORATION PROGRAM WATER QUALITY ANALYSES

1990 YEAR END REPORT

PARAMETERS (mg/L)	PORTAL SITE				ORE PILE				MONITORING POND				SOLLY CREEK ABOVE				SOLLY CREEK BELOW			
	A9	J16	O15	D11	A9	J16	O15	D11	A9	J16	O15	D11	A9	J16	O15	D11	A9	J16	O15	D11
pH	7.43	7.70	8.05	7.69	7.40	-	-	7.43	7.37	8.30	7.88	7.82	7.21	7.35	7.25	7.84	7.11	6.72	7.16	7.42
Alkalinity CaCO3	40.6	72	79	29.8	181	-	-	268	65.5	35.2	44.4	18.9	6.3	11.4	7.6	4.1	6.4	12.4	9.8	4.9
Sulphate SO4	11.1	12.8	11.5	4.0	1180	-	-	791	182	13.4	66.3	43.0	<1.0	2.3	<1.0	<1.0	<1.0	10.6	1.2	<1.0
TOTAL METALS																				
Aluminum	0.019	0.071	0.060	0.091	0.007	-	-	0.007	0.028	0.110	0.150	0.640	0.085	0.066	0.112	0.082	0.078	0.080	0.040	0.060
Arsenic	0.001	0.001	0.0006	0.0008	0.0015	-	-	0.002	0.0012	0.0019	0.0005	0.0006	0.0006	0.0001	<0.0001	0.0003	0.0004	0.0001	<0.0001	0.0001
Copper	0.010	0.004	0.001	0.001	0.031	-	-	0.025	0.005	0.005	0.001	0.004	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Iron	0.070	0.030	0.360	0.090	0.040	-	-	0.070	0.040	<0.030	<0.030	0.270	<0.030	<0.030	<0.03	<0.030	<0.030	<0.030	<0.030	<0.030
Lead	0.004	0.002	0.003	<0.001	0.037	-	-	0.017	0.004	0.006	0.008	0.005	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	0.120	0.100	0.120	0.091	60.0	-	-	50.8	7.84	0.012	0.110	2.99	<0.005	<0.005	0.005	<0.005	<0.005	<0.005	<0.005	<0.005
DISSOLVED METALS																				
Aluminum	0.010	0.065	0.020	0.016	0.007	-	-	0.006	<0.005	0.110	0.021	0.038	0.070	0.066	0.096	0.082	0.074	0.056	0.039	0.050
Arsenic	0.001	0.0005	0.0002	0.0004	0.0001	-	-	0.002	0.0003	0.001	0.0003	0.0004	0.0006	0.0001	<0.0001	0.0002	0.0001	0.0001	<0.0001	0.0001
Copper	0.009	<0.001	<0.001	0.001	0.008	-	-	0.011	0.003	<0.001	<0.001	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Iron	<0.030	<0.030	0.270	<0.030	<0.030	-	-	0.040	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030
Lead	<0.001	<0.001	0.002	<0.001	0.011	-	-	0.016	<0.001	0.002	0.003	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc	0.120	0.084	0.061	0.082	57.7	-	-	50.7	7.54	0.012	0.066	2.80	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005

< indicates less than
Results expressed in mg/L except for pH