

resource and pollution management

July 26, 1987

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

Dear Mr. Davidson:

Re: Minnova Inc., Rea Property, Samatosum Mountain, B.C.

Further to our telephone conversation of July 24, 1987 enclosed are a number of water licence application forms and general information on how and where to apply. I recommend that your application be filed after the "Prospectus" has been submitted so that the relevant government agencies have some prior knowledge as to the nature of your development.

As you are no doubt aware, low flows in the watershed generally conflict with irrigation, cattle watering and fish habitat requirements and will be the major concern to the Water Management Branch and other downstream users. Since other licence holders downstream of your point of withdrawal are allowed to object to your application, we expect that a water licence application on Johnson Creek would be denied. An application on Johnson Lake may be approved, provided you could demonstrate that the amount to be withdrawn had no impact on existing lake levels, fish populations and the normal outflow from the lake.

Should you require any additional information or wish to discuss any aspects of this matter please do not hesitate to give me a call.

Yours truly
HATFIELD CONSULTANTS LIMITED

A handwritten signature in cursive script that reads "Robert Hallam".

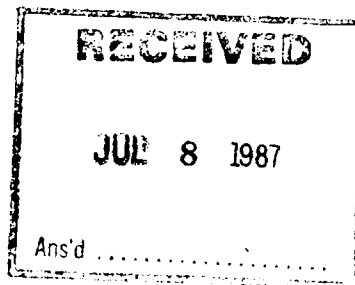
ROBERT L. HALLAM
Associate Biologist

RLH/ems

resource and pollution management

July 05, 1987

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



Dear Mr. Davidson:

Re: Minnova Inc., Rea Property, Samatosum Mountain, B.C.

Enclosed for your review is a summary report on the preliminary environmental work undertaken at the Samatosum Mountain property on May 23 and 24 of this year pursuant to our proposal of February 17, 1987. This data has proven to be extremely valuable and will be used in preparation of the Stage I Report to the B.C. Mine Development Steering Committee.

Should you have any questions regarding the contents of the report, please do not hesitate to give me a call.

Yours very truly,
HATFIELD CONSULTANTS LIMITED

A handwritten signature in cursive script that reads "Robert L. Hallam".

Robert L. Hallam
Associate Biologist

RLH/ems
Encl.

MINNOVA INC.
SAMATOSUM MOUNTAIN PROJECT, BARRIERE, B.C.

PRELIMINARY BASELINE WATER QUALITY ASSESSMENT

On May 23, 1987, Mr. Rob Northcote of Hatfield Consultants Limited met with Mr. Graeme Evans of Minnova Inc. to review the proposed baseline water quality, hydrology and wildlife program. A bound field manual containing sampling procedures and hydrology and wildlife logs was provided. The field program was started approximately 1:00 pm with the examination of the watershed for purposes of selecting appropriate sample sites. A total of seven stations were previously identified for the initial baseline water quality survey. They included three stations on Johnson Creek, two on Homestake Creek and two on Sinmax Creek. Staff gauges were installed on Johnson and Homestake Creeks and calibrated using 1 ml of 20% Rhodamine WT dye.

The annual snowmelt was essentially complete and runoff was in a post freshet stage with water levels on the decline. A summary of hydrology data are presented below in Table 1. Johnson Creek discharge was calculated to be 0.364 m³/s at the gauge reading of 1.00 ft. Homestake Creek discharge was calculated to be 0.14m³/s at a gauge reading of 0.65 ft. Mr. Evans is to continue staff gauge readings on the basis of at least once per week.

Table 1

A Summary of Staff Gauge Calibration Data, May 22, 1987

	Johnson Creek Station No. 5	Homestake Creek Station No. 6
Gauge Reading :	1.00 feet	0.65 feet
Amount of Dye :	1 ml	1 ml
Vial Numbers :	combined	combined
Frequency :	every 5 seconds	every 5 seconds
Total Samples :	11 samples (55 seconds)	16 samples (75 seconds)
Estimated Flow:	< 0.2 m ³ /s	< 0.2 m ³ /s
Actual Flow :	0.364 m ³ /s	0.140 m ³ /s

A complete set of water quality samples were obtained from the selected locations and returned to the exploration camp for filtering and preservation. Samples were returned to the laboratory within 48 hours of collection. Analysis of water samples were performed by Analytical Services Limited of

Vancouver in accordance with "Standard methods for the Examination of Water and Wastewater" published by the American Public Health Association, 1985. All data are presented in Table 2.

Water quality in the Samatosum Mountain watershed (Johnson, Homestake and Sinmax Creeks) was found to be moderately alkaline in pH (7.55 to 8.20), relatively clear (Turbidity <1.0 NTU's; Suspended solids <1.0 to 4.6 mg/L), moderately hard (96 to 183 mg/L CaCO₃ equivalents) but high in dissolved solids (151 to 274 mg/L) and moderately high in conductivity (154 to 302 umhos/cm)

Sample station No. 7, Sinmax Creek downstream of Homestake Creek contained the highest levels of suspended solids (16 mg/L) and dissolved solids (274 mg/L) resulting in an opaque appearance (Turbidity 7.4 NTU's) and high conductivity (302 umhos/cm). The cause of these high levels was possibly the result of irrigation or cattle watering upstream of the sample location.

Approximately 30% of the hardness at all sites could be accounted for by dissolved calcium and magnesium which averaged 40 mg/L and 10 mg/L, respectively. The entire watershed could be characterized as a hard, calcium-sulphate-bicarbonate rich water with alkaline pH. Dissolved bicarbonate (109 to 194 mg/L HCO₃), sulphate (5.1 to 20.4 mg/L SO₄) are considered moderately high.

Except for sample stations No.'s 1, 6 and 7, dissolved nitrates, nitrites and ammonia nitrogen were generally below the level of analytical detection. Elevated levels of nitrate nitrogen were found at station No. 1 (0.021 mg/L) and No. 7 (0.056 mg/L). Ammonia nitrogen was slightly elevated at sample station No. 6 (0.007 mg/L) but generally well below the level of concern. Dissolved phosphorous levels at all sites (0.033 to 0.053 mg/L) are regarded as high and with increases in nitrogen availability could result in increased algae growth.

Chloride and cyanide were not detected at the 0.50 and 0.005 mg/L level of detection, respectively.

For the most part total metal levels were low or below the level of detection. These included cadmium, lead, mercury, molybdenum, selenium, and silver. The major exceptions were, aluminum which ranged between <0.005 and 0.012 mg/L, barium which ranged between 0.012 and 0.058 mg/L, and iron which ranged between <0.03 to 0.32 and 0.33 mg/L at sample stations No. 6 and 7, respectively. High levels of total zinc were also recorded at station No.'s 6 and 7. Total arsenic and copper were found to range from just above detection limits to 0.0005 and 0.010 mg/L at sample stations No. 3 and 6, respectively.

Dissolved metal analyses revealed that all of the aluminum occurred as particulate matter but arsenic, barium, copper and zinc occurred primarily in the dissolved form. However, for the most part dissolved metals were low and generally below the level of analytical detection.

Table 2

Baseline Water Quality Data, Minnova Inc., Samatosum Mountain Project, Barriere, B.C., May 23, 1987.

PARAMETER	Minnova 1	Minnova 2	Minnova 3	Minnova 4
Physical Tests				
pH	7.55	7.77	7.88	7.83
Conductivity (μ mhos/cm)	154.	223.	283.	204.
Turbidity (NTU)	<1.0	1.6	<1.0	<1.0
Suspended Solids (mg/L)	<1.0	1.3	<1.0	<1.0
Dissolved Solids (mg/L)	151.	218.	230.	187.
Hardness (mg/L) CaCO ₃	96.1	141.	148.	105.
Dissolved Anions (mg/L)				
Bicarbonate HCO ₃	109.	159.	166.	136.
Chloride Cl	<0.50	<0.50	<0.50	<0.50
Sulfate SO ₄	5.1	5.4	12.8	8.4
Nitrate N	0.021	<0.005	<0.005	<0.005
Nitrite N	<0.001	<0.001	<0.001	<0.001
Phosphorus P	0.033	0.040	0.047	0.053
Other Tests (mg/L)				
Ammonia N	<0.005	<0.005	<0.005	<0.005
Total Cyanide CN	<0.005	<0.005	<0.005	<0.005
Total Metals (mg/L)				
Aluminum Al	0.008	0.010	0.008	<0.005
Arsenic As	0.0001	0.0001	0.0005	0.0001
Barium Ba	0.035	0.012	0.044	0.012
Cadmium Cd	<0.0005	<0.0005	<0.0005	<0.0005
Copper Cu	0.001	0.001	0.001	<0.001
Iron Fe	<0.03	0.06	0.06	<0.03
Lead Pb	<0.001	<0.001	<0.001	<0.001
Mercury Hg	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum Mo	<0.005	<0.005	<0.005	<0.005
Nickel Ni	<0.001	<0.001	<0.001	<0.001
Selenium Se	<0.0005	<0.0005	<0.0005	<0.0005
Silver Ag	<0.0005	<0.0005	<0.0005	<0.0005
Zinc Zn	<0.005	<0.005	<0.005	<0.005
Dissolved Metals (mg/L)				
Calcium Ca	34.6	42.1	41.7	38.9
Magnesium Mg	2.33	8.86	10.7	8.03
Sodium Na	0.43	0.77	0.83	5.1
Potassium K	0.27	0.42	0.37	0.47
Aluminum Al	<0.005	<0.005	<0.005	<0.005
Arsenic As	0.0001	0.0001	0.0004	0.0001
Barium Ba	0.035	0.012	0.041	0.010
Cadmium Cd	<0.0005	<0.0005	<0.0005	<0.0005
Copper Cu	0.001	<0.001	0.001	<0.001
Iron Fe	<0.03	<0.03	<0.03	<0.03
Lead Pb	<0.001	<0.001	<0.001	<0.001
Molybdenum Mo	<0.005	<0.005	<0.005	<0.005
Nickel Ni	<0.001	<0.001	<0.001	<0.001
Selenium Se	<0.0005	<0.0005	<0.0005	<0.0005
Silver Ag	<0.0005	<0.0005	<0.0005	<0.0005
Zinc Zn	<0.005	<0.005	<0.005	<0.005

< = Less than

Results expressed as milligrams of element per liter of sample

Table 2 (Cont')

Baseline Water Quality Data, Minnova Inc., Samatosum Mountain Project, Barriere, B.C., May 23, 1987.

PARAMETER	Minnova 5	Minnova 6	Minnova 7
Physical Tests			
pH	8.01	8.20	8.07
Conductivity (μ mhos/cm)	254.	244.	302.
Turbidity (NTU)	1.0	1.3	7.4
Suspended Solids (mg/L)	4.6	<1.0	16.0
Dissolved Solids (mg/L)	243.	221.	274.
Hardness (mg/L) CaCO ₃	153.	140.	183.
Dissolved Anions (mg/L)			
Bicarbonate HCO ₃	178.	147.	194.
Chloride Cl	<0.50	<0.50	<0.50
Sulfate SO ₄	6.6	20.4	14.1
Nitrate N	<0.005	<0.005	0.056
Nitrite N	<0.001	<0.001	<0.001
Phosphorus P	0.053	0.053	0.053
Other Tests (mg/L)			
Ammonia N	<0.005	0.007	<0.005
Total Cyanide CN	<0.005	<0.005	<0.005
Total Metals (mg/L)			
Aluminum Al	0.006	<0.005	0.012
Arsenic As	0.0001	0.0001	0.0001
Barium Ba	0.017	0.058	0.034
Cadmium Cd	<0.0005	<0.0005	<0.0005
Copper Cu	0.003	0.010	0.003
Iron Fe	0.06	0.32	0.33
Lead Pb	<0.001	0.001	<0.001
Mercury Hg	<0.00005	<0.00005	<0.00005
Molybdenum Mo	<0.005	<0.005	<0.0005
Nickel Ni	0.001	<0.001	<0.001
Selenium Se	<0.0005	<0.0005	<0.0005
Silver Ag	<0.0005	<0.0005	<0.0005
Zinc Zn	<0.005	0.088	0.012
Dissolved Metals (mg/L)			
Calcium Ca	44.7	43.3	49.9
Magnesium Mg	10.1	7.68	14.2
Sodium Na	1.01	0.68	1.81
Potassium K	0.46	0.32	0.68
Aluminum Al	<0.005	<0.005	<0.005
Arsenic As	0.0001	0.0001	0.0001
Barium Ba	0.016	0.041	0.023
Cadmium Cd	<0.0005	<0.0005	<0.0005
Copper Cu	0.001	0.008	0.002
Iron Fe	<0.03	0.17	0.06
Lead Pb	<0.001	<0.001	<0.001
Molybdenum Mo	<0.005	<0.005	<0.005
Nickel Ni	0.001	<0.001	<0.001
Selenium Se	<0.0005	<0.0005	<0.0005
Silver Ag	<0.0005	<0.0005	<0.0005
Zinc Zn	<0.005	0.066	<0.005

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Results expressed as milligrams of element per liter of sample

Table 3

Schedule of Baseline Water Quality and Hydrology Sample Locations
Minnova Inc., Samatosum Mountain Project, Barriere, B.C., May 23,
1987.

Sample Station No.1	Homestake Creek at elevation 5200 feet at logging road crossing.
Sample Station No.2	Johnson Creek below Johnson Lake at logging road crossing.
Sample Station No.3	Tributary to Johnson Creek below proposed dedevelopment.
Sample Station No.4	Sinmax Creek above Johnson creek on Skwaam Bay Road.
Sample Station No.5	Johnson Creek near mouth at Skwaam Bay Road (hydrology staff gauge location).
Sample Station No.6	Homestake Creek near mouth at Skwaam Bay Road (hydrology staff gauge location).
Sample Station No.7	Sinmax Creek below Homestake Creek on Skwaam Bay Road.

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July 05, 1987

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Exploration Manager
Western Canada
MINNOVA INC.
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Phosphorus P	0.033	0.040	0.047	0.053
Other Tests (mg/L)				
Ammonia N	<0.005	<0.005	<0.005	<0.005
Total Cyanide CN	<0.005	<0.005	<0.005	<0.005
Total Metals (mg/L)				
Aluminum Al	0.008	0.010	0.008	<0.005
Arsenic As	0.0001	0.0001	0.0005	0.0001
Barium Ba	0.035	0.012	0.044	0.012
Cadmium Cd	<0.0005	<0.0005	<0.0005	<0.0005
Copper Cu	0.001	0.001	0.001	<0.001
Iron Fe	<0.03	0.06	0.06	<0.03
Lead Pb	<0.001	<0.001	<0.001	<0.001
Mercury Hg	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum Mo	<0.005	<0.005	<0.005	<0.005
Nickel Ni	<0.001	<0.001	<0.001	<0.001
Selenium Se	<0.0005	<0.0005	<0.0005	<0.0005
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Iron Fe	<0.03	<0.03	<0.03	<0.03
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Nickel Ni	<0.001	<0.001	<0.001	<0.001
Selenium Se	<0.0005	<0.0005	<0.0005	<0.0005
Silver Ag	<0.0005	<0.0005	<0.0005	<0.0005
Zinc Zn	<0.005	<0.005	<0.005	<0.005

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Molybdenum Mo	<0.005	<0.005	<0.0005
Nickel Ni	0.001	<0.001	<0.001
Selenium Se	<0.0005	<0.0005	<0.0005
Silver Ag	<0.0005	<0.0005	<0.0005
Zinc Zn	<0.005	0.088	0.012
Dissolved Metals (mg/L)			
Calcium Ca	44.7	43.3	49.9
Magnesium Mg	10.1	7.68	14.2
Sodium Na	1.01	0.68	1.81
Potassium K	0.46	0.32	0.68
Aluminum Al	<0.005	<0.005	<0.005
Arsenic As	0.0001	0.0001	0.0001
Barium Ba	0.016	0.041	0.023
Cadmium Cd	<0.0005	<0.0005	<0.0005
Copper Cu	0.001	0.008	0.002
Iron Fe	<0.03	0.17	0.06
Lead Pb	<0.001	<0.001	<0.001
Molybdenum Mo	<0.005	<0.005	<0.005
Nickel Ni	0.001	<0.001	<0.001
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