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7.0 GLOSSARY

Contaminated - Material that has a surface radioactive contamination such that it does not meet the criteria for shipping off site without restrictions as defined in the radiation safety procedures.

Exposure Area – All fish habitat and water frequented by fish that are exposed to "effluent". May extend through several types of receiving environments (e.g., different stream orders, lakes or marshes, estuarine to marine, or inter-tidal to sub-tidal) and contain a variety of habitat types.

Field Sub-Sample – Consists of individual area or time-limited collections of benthic invertebrates (e.g., one grab, core, quardrat, cylinder, kick or U-net sample). The sub-sample is one of several samples collected within the replicate station.

Reference Area – Water frequented by fish that is not exposed to effluent and that has a fish habitat, as far as practicable, similar to that of the exposure area. Reference areas need not represent pristine conditions and may have anthropogenic impacts from other sources than the mine in question.

Replicate Station – A specific, fixed sampling location with an area than can be recognized, re-sampled, and defined quantitatively (e.g., latitude and longitude and a written description). Several stations are sampled within the exposure and reference area of an EEM study, and as such, are considered as 'replicates' for statistical purposes (number of stations sampled).

APPENDIX A

HISTORICAL DATA REPORT
LUPIN GOLD MINE TECHNICAL ADVISORY PANEL COMMENTS AND KINROSS/GOLDER RESPONSES

Prairie & Northern Region
Environmental Protection Branch
Twin Atria #2, Room 200
4999-98th Avenue
Edmonton, AB T6B 2X3

June 29, 2004

Greg Budge
Environmental Coordinator
Kinross Gold Corporation, Lupin Operations
9818 Edmonton International Airport
Edmonton, Alberta
T5J 2T2

Dear Mr. Budge:

Re: Historical Data Report Comments

The Technical Advisory Panel (TAP) has completed their review of "Lupin Gold Mine, Environmental Effects Monitoring Program, Historical Information Report", received December 9, 2003. The compiled review comments are appended. Please address the comments in the subsequent study design submission due no later than Dec 6, 2004.

If you have any questions or concerns, please do not hesitate to contact me [Email: Paula.Siwik@ec.gc.ca, Tel: (780) 951-8824, Fax: (780) 495-2758].

Sincerely,

Paula Siwik
Regional EEM Coordinator

Cc: Peter Blackall Environment Canada, Regional Authorization Officer
Chuck Brumwell Environment Canada, Northern Division Manager
Craig Broome Environment Canada, Enforcement

Lupin Gold Mine Technical Advisory Panel

Chris Baron	Fisheries and Oceans Canada
Dionne Filiatrault	Nunavut Water Board
Meighan Wilson	Indian and Northern Affairs Canada
Anne Wilson	Environment Canada
Steve Harbicht	Environment Canada

Environment Effects Monitoring

Technical Advisory Panel Comments on "Lupin Gold Mine, Environmental Effects Monitoring Program, Historical Information Report"

General Comments

1. Mines are encouraged to follow guidance in the *Metal Mining Guidance Document* (MMGD). Other new material available for use is posted on the EEM web-site at **http://www.ec.gc.ca/eem/English/Whatsnew.cfm.**

Site Characterization

2. p. 7: Please provide more detail on the actual final discharge point. Are siphons used to move water from Pond #2 directly to Seep Ck or is effluent discharged into Dam 1 Lake or Dam 2 Lake?

3. p. 12: what percentage of the flow in Seep Creek is effluent during discharge? Please discuss how the creek flow will be affected during years of no effluent discharge.

Historical Monitoring Study Designs

4. p. 17: The TAP recommends that the current plume be delineated before submission of the study design. Please note specific information concerning the effluent plume is required under Schedule 5, 11 a) of the MMER.

Historical Information

5. p. 20: Please note, there has been a general shift in the EEM program towards the use of small-bodied forage fish as sentinel species. In general, these fish move less than large bodied fish species, and are therefore more likely to be exposed to effluent in water bodies receiving effluent discharge. The TAP recommends the use of at least one, preferable two, small bodied fish species in the adult fish survey. If historical reference areas do not have sufficient numbers of a suitable small bodied fish, other reference sites should be investigated.

6. p. 20: The historical fish data should facilitate the design of an Initial Monitoring Program. However, the sampling gear used in many of the past studies biased results towards larger bodied fish. The TAP recommends a field reconnaissance to determine the presence and abundance of small bodied fish in the exposure area.

7. p. 25: Could not find RL&L 1990.

8. p. 31: A number of fish had tissue mercury concentrations that exceed the MMER threshold for fish tissue (0.45 µg/g). Further discussion, and possibly investigation, may be warranted.

Conclusions

9. p. 34: The historical work provides valuable background and will facilitate the development of an Initial Monitoring study design. The benthic invertebrate

recommendations presented in this section are valuable points. Based on the historical data, careful consideration must be given to exposure and reference area selection.

10. p. 35: If the adult fish survey moves into Seep Creek and includes Arctic Grayling, the TAP suggests a reconnaissance to determine the population structure and residence times of the individuals using the creek. It is possible that the majority of Arctic Grayling in Seep Creek are juveniles (p. 52 of RL&L and DFO 1991 report).

Appendix

11. Moore 1978: missing every second page

12. RL&L 1996: missing page 8 and every even numbered page from 30 onwards.

RESPONSE TO TAP COMMENTS

As requested by Environment Canada (above letter to Greg Budge of Kinross Gold Corporation), the TAP's review comments on the "Lupin Gold Mine, Environmental Effects Monitoring Program, Historical Information Report" (Golder 2003a) are addressed below.

1. The authors of the historical and present report followed, to the best of their ability, materials provided in Environment Canada's (2002) Metal Mining Guidance Document during the preparation of MMER/EEM documents, as well as other new materials on the website provided. These sources of information were cited, where deemed appropriate, throughout the historical and present study design reports.

2. The final discharge point is located at the west-centre of TCA Pond 2 (Figure 3-1). Siphons are used to discharge Pond 2 water into Dam 1a Lake. Dam 1a Lake is one of three headwater tributaries to Seep Creek. Detailed information on TCA operations and Seep Creek are found in Sections 3.5, 3.6, and 3.7 of the present report.

3. According to RL&L and DFO (1991, appended to Golder 2003a), approximately 90% of the flow of Seep Creek at its mouth with Unnamed Lake was effluent; it would vary depending on rate of discharge and natural creek flow. This estimate was made during initial discharges from the TCA in 1990. During periods of low flow, it would be reasonable to assume that effluent comprises up to 100% of the discharge at the mouth of Seep Creek. More information on effluent discharge characteristics and delineation of its plume is provided in Sections 3.5, 3.6, and 3.7 of the present report.

4. Delineation of Lupin Mine's effluent plume was modelled using the CORMIX™ software (Section 3.6.3 of the present report) and includes the required MMER/EEM estimation of 1% dilution.

5. Section 4.0 of the present report suggests that ninespine stickleback and slimy sculpin be used as the two sentinel species for the required EEM fish population survey. Arctic grayling was a third contingency choice. These species represent two small-bodied fish species (ninespine stickleback and slimy sculpin) and one large-bodied fish species (Arctic grayling). Additional historical data (reference and exposure areas) were reviewed and presented to assist with rationalizing the choice of these species.

Historical data were further reviewed with regard to presence and abundance of small-bodies fish in the exposure area (Sections 3.7, 3.8, and 4.0). Data included sampling methods that targeted small-bodied fish species; these included backpack electrofishing and seine hauls (RCPL and RL&L 1985), hoop nets with 0.64 mm meshing (RL&L and DFO 1991), and drift nets with 0.243 mm meshing (RL&L 1993a). Drift nets, fitted with 0.243 mm meshing, were used to collect fish in Norma Creek (proposed reference area) and were extremely successful in collecting ninespine stickleback (Table 4-1).

7. On page 25 of the historical information report, and various pages thereafter, RL&L and DFO (1991) was erroneously cited as RL&L (1990).

8. Baseline (i.e., pre-development) mercury content in tissues of fish have been measured in several subArctic waterbodies (Appendix Tables A-1 through A-6). All data discussed are expressed on a 'dry weight' basis. MMER's (2002) guideline level of 0.45 mg/kg 'wet weight' as the threshold limit for mercury, this converts to 2.25 mg/kg on a 'dry weight' basis (assuming 80% moisture content).

   Between 1982 and 1984 (prior to onset of effluent discharge at the Lupin Mine), concentrations of mercury in lake trout muscle have ranged between 0.16 and 4.11 mg/kg (mean of 0.896 mg/kg), whereas concentrations in liver have ranged between 0.34 and 11.4 mg/kg (mean of 2.28 mg/kg). Following the initial effluent discharge (commenced on 5 September 1985) at the Lupin Mine, mercury concentrations in lake trout muscle from the exposure area (Inner and Outer Sun bays) have ranged between 0.09 and 5.98 mg/kg (mean of 0.992 mg/kg) and liver tissue mercury concentrations ranged between 0.28 and 19.2 mg/kg (mean of 1.31 mg/kg). Mercury concentrations in muscle and liver tissues from lake trout inhabiting reference areas (greater Contwoyto Lake, Concession Lake and Burnside River) were generally similar to, and in some cases higher than, those of Inner and Outer Sun bays. For example, the mean mercury concentration of muscle tissues collected from Concession Lake in 1993 was 2.85 mg/kg. This concentration not only exceeded the MMER (2002) usability threshold, but was higher than lake trout collected from Inner Sun Bay (1.16 mg/kg) and Contwoyto Lake (1.12 mg/kg) (Appendix Tables A-1 and A-2).

   Concentrations of mercury in tissues of fish collected from subArctic waterbodies commonly exceed MMER's (2002) threshold limit of 0.45 mg/kg wet weight (2.25 mg/kg dry weight), particularly in lake trout. Exceedances were observed in baseline data from the Izok Project situated approximately 50 km to the west of the Lupin Mine (Appendix Table A-3), the Jericho Project located about 30 km northwest of the Lupin Mine (Appendix Table A-4), the Doris Hinge Project near Bathurst Inlet (Appendix Table A-5), and the Meliadine Project near Rankin Inlet

(Table A-6). Mercury concentrations exceeding the 0.45 mg/kg (wet weight) guideline occur in fish from many lakes without an obvious point source of pollution (Bodaly et al. 1984; Wren et al. 1991). Furthermore, mercury bioaccumulates and increases in species with higher trophic position, such as lake trout (Cabana et al. 1994)

9. Sections 3.7, 3.8 and 4.0 of the present report summarize historical assessments that include various reference areas. The results of these assessments as well as characteristics of candidate areas were reviewed when selecting a reference area for the proposed MMER/EEM biological study design. Suggestions from the TAP would be welcome and taken into consideration prior to implementing field studies.

10. Section 3.7.4 of the present report summarizes historical fish catch data for Seep Creek. It appears that the majority of Arctic grayling captured in Seep Creek are juveniles. Should adult Arctic grayling be the final selection as a sentinel species for proposed MMER/EEM biological studies, additional sampling (e.g., gill nets, angling) could be carried out within Inner Sun Bay (part of the exposure area; Sections 3.6.3 and 3.7). Should adult Arctic grayling prove to be difficult to sample during the initial MMER/EEM biological field sampling session, juvenile Arctic grayling can be considered as a contingency sentinel fish (see study options outlined in Section 4.1).

11. A copy of Moore (1978) is provided in Appendix D of the present report.

12. A copy of RL&L (1996) is provided in Appendix D of the present report.

Table A-1 Mercury concentrations (mg/kg, dry weight) of fish tissues in the vinciny of the Lupin Mine (RL&L and DFO 1991).

Location	Species	Year	Muscle Tissue					Liver Tissue				
			n	Mean	Range		SD	n	Mean	Range		SD
					Min	Max				Min	Max	
Inner Sun Bay	*Lake Trout*	1982-1984	43	0.891	0.28	3.2	0.624	25	2.467	0.77	11.4	2.415
		1985	10	0.896	0.67	1.3	0.219	10	1.015	0.52	1.46	0.267
		1988	9	0.963	0.3	1.81	0.473	9	1.371	0.39	3.69	1.043
		1990	30	0.901	0.09	3.54	0.61	30	1.494	0.31	6.83	1.217
Outer Sun Bay	*Lake Trout*	1982-1984	--	--	--	--	--	--	--	--	--	--
		1985	--	--	--	--	--	--	--	--	--	--
		1988	11	0.947	0.59	1.27	0.217	10	0.975	0.48	1.51	0.35
		1990	4	1.085	0.59	1.39	0.381	4	0.895	0.28	1.45	0.522
Contwoyto Lake	*Lake Trout*	1982-1984	29	0.735	0.16	4.01	0.749	7	1.781	0.53	6.28	2.046
		1985	5	0.728	0.44	1.16	0.282	5	0.879	0.34	2.01	0.653
		1988	13	1.121	0.38	2.51	0.718	13	1.501	0.51	4.31	1.259
		1990	22	1.101	0.34	2.65	0.613	22	1.908	0.67	8.21	1.84
Concession Lake	*Lake Trout*	1982-1984	42	1.063	0.27	4.11	0.912	14	2.599	0.34	10.8	2.7
		1985	--	--	--	--	--	--	--	--	--	--
		1988	--	--	--	--	--	--	--	--	--	--
		1990	15	1.25	0.59	2.46	0.507	15	2.346	0.12	6.88	1.79
Burnside River	*Lake Trout*	1982-1984	--	--	--	--	--	--	--	--	--	--
		1985	--	--	--	--	--	--	--	--	--	--
		1988	--	--	--	--	--	--	--	--	--	--
		1990	9	0.614	0.29	1.08	0.267	9	0.952	0.52	1.64	0.385

Table A-2 Mercury concentrations (mg/kg, dry weight) of fish tissues in the vinciny of the Lupin Mine (RL&L 1995).

Location	Species	Year	Muscle Tissue				Liver Tissue			
			n	Mean	Range		n	Mean	Range	
					Min	Max			Min	Max
Inner Sun Bay	*Lake Trout*	1993	30	1.16	0.27	5.98	30	2.08	0.55	19.20
Contwoyto Lake			20	1.12	0.38	6.00	20	2.10	< 0.005	17.70
Concession Lake			30	2.85	0.87	8.89	30	5.92	< 0.005	21.30

Table A-3 Mercury concentrations (mg/kg, dry weight) in fish tissues from the Izok Project area, 1992 and 1993 (RL&L 1993).

Location	Species	Muscle Tissue					Liver Tissue				
		n	Mean	Range		SD	n	Mean	Range		SD
				Min	Max				Min	Max	
Iznogoudh Lake	*Lake Trout*	46	1.27	0.30	6.08	0.99	42	2.30	0.10	15.46	2.40
	Round Whitefish	15	0.33	0.19	0.70	0.15	13	0.52	0.34	0.82	0.13
Izok Lake	*Lake Trout*	37	0.66	0.17	2.06	0.52	31	1.29	0.10	4.52	1.13
	Round Whitefish	13	0.26	0.14	0.52	0.10	13	0.49	0.20	0.92	0.16
Itchen Lake	*Lake Trout*	56	0.99	0.05	3.36	0.69	50	2.02	0.32	8.87	1.79
	Round Whitefish	5	0.34	0.26	0.51	0.10	5	0.62	0.48	0.81	0.13
Control Lake	*Lake Trout*	20	1.34	0.27	4.39	1.20	20	3.22	0.32	14.40	3.90

Table A-4 Mercury concentrations (mg/kg, dry weight) in fish tissues from the Jericho Study Area, 1996 and 1999 (RL&L 2001).

Location	Species	Muscle Tissue					Liver Tissue				
		n	Mean	Range		SD	n	Mean	Range		SD
				Min	Max				Min	Max	
Carat Lake	*Lake Trout*	21	1.074	0.400	2.100	0.486	21	2.803	0.240	4.760	1.154
	Round Whitefish	16	0.501	DL	0.891	0.241	20	0.843	0.005	1.72	0.426
Control Lake	*Lake Trout*	21	0.925	0.528	2.140	0.341	21	0.501	0.070	2.120	0.572
	Round Whitefish	20	0.278	DL	0.462	0.124	20	0.248	DL	0.8	0.241
Lake C3	*Lake Trout*	10	0.408	0.190	0.740	0.164	10	0.795	0.210	2.080	0.583

Note: DL = detection limit.

Table A-5 Mercury concentrations (mg/kg, dry weight) in fish tissues from the Doris Hinge Project Area (RL&L/Golder 2002).

Location	Species	Year	Muscle Tissue					Liver Tissue				
			n	Mean	Range		SD	n	Mean	Range		SD
					Min	Max				Min	Max	
Doris Lake	*Lake Trout*	1995	1	1.16	--	--	--	1	1.58	--	--	--
		1996	1	0.20	--	--	--	--	--	--	--	--
		1997	22	1.45	0.36	3.37	0.77	22	2.44	0.43	6.23	1.49
	Lake Whitefish	1995	3	0.30	0.07	0.59	0.27	3	0.64	0.26	1.11	0.43
		1996	1	0.21	--	--	--	1	0.62	--	--	--
		1997	29	0.36	0.07	0.85	0.19	29	0.86	0.19	1.87	0.21
Tail Lake	*Lake Trout*	1995	5	0.69	0.36	0.94	0.23	5	0.68	0.35	1.02	0.32
		1996	1	0.46	--	--	--	1	0.83	--	--	--
Ogama Lake	*Lake Trout*	1996	1	0.63	--	--	--	1	0.38	--	--	--
Patch Lake	*Lake Trout*	1995	1	1.48	--	--	--	1	2.88	--	--	--
		1996	1	0.79	--	--	--	1	1.29	--	--	--
		1997	25	1.91	0.51	4.19	0.90	25	3.31	0.99	6.59	1.77
	Lake Whitefish	1996	1	0.87	--	--	--	1	2.33	--	--	--
		1997	26	0.59	0.20	1.13	0.30	26	1.82	0.66	3.80	0.92
Pelvic Lake	*Lake Trout*	1998	21	1.48	0.73	1.96	0.35	21	1.64	0.58	2.29	0.49
	Lake Whitefish	1998	22	0.42	0.15	1.10	0.28	22	1.19	0.27	2.66	0.60
Windy Lake	*Lake Trout*	1996	--	--	--	--	--	1	0.11	--	--	--
		1997	25	0.18	0.08	0.36	0.08	25	0.27	0.11	0.73	0.15
	Lake Whitefish	1997	1	0.07	--	--	--	1	0.31	--	--	--
Spyder Lake	*Lake Trout*	1996	3	2.56	1.81	3.89	1.16	3	7.54	5.55	11.06	3.06
		1997	25	1.76	0.65	4.00	0.87	25	3.24	1.23	8.28	1.75
	Lake Whitefish	1997	24	1.07	0.33	2.10	0.51	24	4.68	0.86	27.37	5.48
Trout Lake	*Lake Trout*	1996	3	0.12	0.03	0.17	0.08	3	0.94	0.09	2.40	1.27

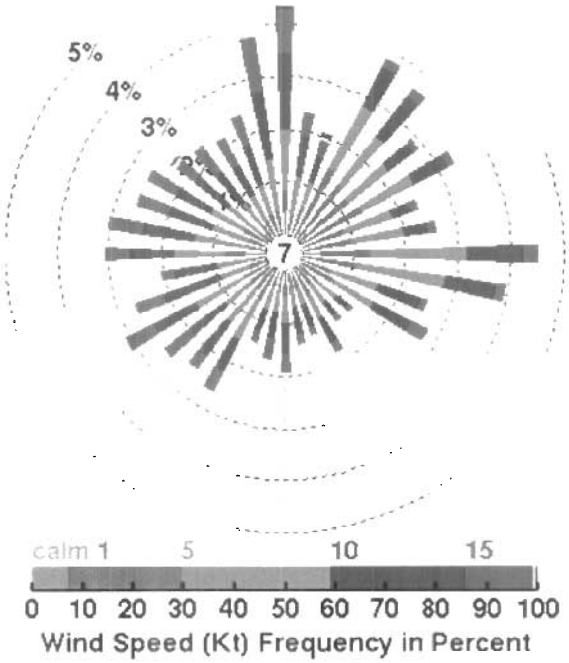
Table A-6 Mercury concentrations (mg/kg, dry weight) in fish tissues from the Meliadine West Project study area, 1998 (RL&L 1999).

Location	Species	Muscle Tissue					Liver Tissue					Kidney Tissue				
		n	Mean	Range		SD	n	Mean	Range		SD	n	Mean	Range		SD
				Min	Max				Min	Max				Min	Max	
Meliadine Lake	*Lake Trout*	30	1.42	0.22	4.64	0.97	30	1.77	0.20	8.13	1.72	30	3.04	0.82	9.30	1.56
	Round Whitefish	7	0.14	0.12	0.17	0.02	7	0.20	0.15	0.25	0.03	7	0.69	0.37	1.41	0.35
	Lake Cisco	16	0.58	0.25	2.21	0.46	16	1.37	0.20	6.65	1.74	16	1.28	0.44	4.93	1.14
Parallel Lake	*Lake Trout*	21	0.65	0.13	2.44	0.61	21	1.21	0.24	4.84	1.34	21	1.91	0.41	6.63	1.91
	Round Whitefish	10	0.21	0.08	0.43	0.11	10	0.27	0.11	0.48	0.13	10	1.14	0.46	2.63	0.66
Lake B5	*Artic Grayling*	3	0.20	0.19	0.22	0.01	3	0.17	0.14	0.21	0.03	3	0.38	0.30	0.48	0.09

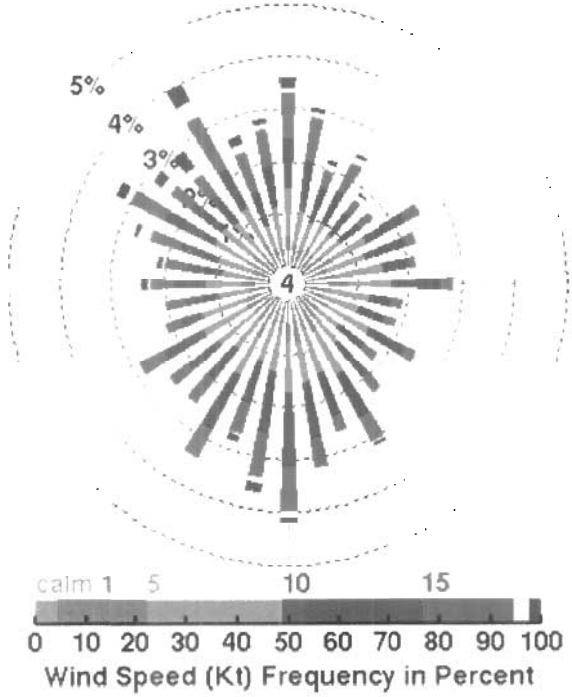
APPENDIX B

LUPIN AIRPORT WIND ROSES

Lupin Airport
July (1982–2000)
Wind Speed Frequency by Direction



Lupin Airport
September (1982–2000)
Wind Speed Frequency by Direction



APPENDIX C

BASELINE WATER QUALITY DATA

Table C1 Baseline water quality in the vicinity of the Lupin Mine (RCPL and RL&L 1985b)

11 August 1981

Constituent	Units	Dam 1a Lake	Mouth of Seep Creek	Centre of Inner Sun Bay	Mouth of Concession Creek	Norma Creek	Contwoyto Lake Outer Sun Bay 1 m	Contwoyto Lake Outer Sun Bay 1 m replicate
Conventional								
pH	units	7.80	8.00	8.00	7.80	7.90	7.90	7.90
Total Suspended Solids	mg/L	5	5	< 1.0	1	8	1	5
Total Disolved Solids								
at 105°C	mg/L	530	252	590	340	326	354	420
at 550°C	mg/L	124	64	94	52	100	74	86
Total Alkalinity	mg/L	3.79	8.42	7.94	6.47	8.06	6.59	7.57
True Colour APHA	units	10	5	5	10	10	5	< 5.0
Nutrients/Others								
Total Cyanide	mg/L	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Total Kjeldahl Nitrogen	mg/L	0.50	2.00	1.00	1.00	0.50	0.50	0.10
Total Nitrate Nitrogen	mg/L	0.50	0.20	0.20	1.50	0.50	0.20	0.20
Total Nitrite Nitrogen	mg/L	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Total Phosphouous	mg/L	0.24	0.12	0.04	0.03	0.02	< 0.02	0.09
Total Organic Carbon	mg/L	5.10	6.90	2.50	1.00	< 0.01	2.90	6.40
Oil and Grease	mg/L	0.36	1.97	1.35	1.14	2.90	2.60	0.63
Trace Elements (Acid Extractable)								
Cadium	ppm	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Chromium	ppm	< 0.01	< 0.01	< 0.01	< 0.01	0.48	< 0.01	< 0.01
Cobalt	ppm	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Copper	ppm	< 0.005	< 0.005	< 0.005	< 0.005	0.007	< 0.005	< 0.005
Iron	ppm	0.20	0.33	0.22	0.38	0.23	0.05	0.02
Lead	ppm	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Manganese	ppm	0.05	0.01	0.01	< 0.005	< 0.005	< 0.005	< 0.005
Mercury	ug/L	0.06	< 0.02	0.05	0.07	0.06	0.16	0.07
Molybdenum	ppm	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Nickel	ppm	0.03	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Zinc	ppm	0.03	0.03	< 0.02	0.07	0.02	0.10	< 0.02

Table C1 Continued. Baseline water quality in the vicinity of the Lupin Mine (RCPL and RL&L 1985b).

1982

Constituent	Units	18-Sep Norma Creek		15-Sep Lake 1a Outlet		13-Sep Mouth of Seep Cr.		21-Sep Inner Sun Bay	
		A	B	A	B	A	B	A	B
Conventional									
pH	units	6.10	6.15	6.35	6.35	6.00	6.05	6.35	6.35
Conductivity	µS/cm	20.0	19.9	89.6	89.6	75.6	75.6	15.3	15.6
Total Suspended Solids	mg/L	0.8	2.0	6.0	4.0	25.5	29.0	2.5	1.5
Total Disolved Solids	mg/L	14	17	49	50	48	52	13	13
Nutrients/Others									
Bicarbonate	mg/L	3.77	3.77	7.54	8.80	5.03	3.77	5.03	5.03
Carbonate	mg/L	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Hydroxide	mg/L	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Chloride	mg/L	< 0.5	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Sulphate	mg/L	5.6	5.3	27.4	27.4	26.3	28.3	3.8	3.8
Nitrate	mg/L	< 0.1	< 0.01	< 0.01	< 0.01	0.01	< 0.01	< 0.01	< 0.01
Ammonia	mg/L	< 0.05	< 0.05	0.07	0.07	< 0.05	< 0.05	< 0.05	< 0.05
Cyanide	mg/L	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.01
Metals (Total)									
Aluminum	mg/L	0.83	0.47	< 0.15	0.16	0.48	1.26	0.79	0.73
Antimony	mg/L	< 0.15	< 0.15	< 0.15	< 0.15	< 0.15	< 0.15	< 0.15	< 0.15
Arsenic	mg/L	< 0.001	< 0.001	0.002	0.001	< 0.001	< 0.001	< 0.001	< 0.001
Barium	mg/L	0.005	0.003	0.008	0.006	0.016	0.018	0.005	0.004
Beryllium	mg/L	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003
Bismuth	mg/L	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Boron	mg/L	< 0.01	< 0.01	0.014	0.013	< 0.01	< 0.01	< 0.01	< 0.01
Cadium	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Calcium	mg/L	1.67	1.54	5.77	5.57	5.58	5.72	1.30	1.28
Chromium	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Cobalt	mg/L	< 0.02	< 0.02	< 0.01	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Copper	mg/L	< 0.001	0.001	< 0.001	< 0.001	0.001	0.004	< 0.001	< 0.001
Iron	mg/L	0.065	0.061	0.250	0.210	0.380	0.460	0.110	0.110
Lead	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Magnesium	mg/L	0.73	0.74	2.96	2.83	3.62	3.69	0.62	0.61
Manganese	mg/L	0.010	0.007	0.130	0.010	0.035	0.039	0.007	0.007
Mercury	mg/L	0.00007	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	0.00005	< 0.00005
Molybdenum	mg/L	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
Nickel	mg/L	< 0.005	< 0.005	0.028	0.009	0.049	0.038	< 0.005	< 0.005
Phosphorus	mg/L	< 0.04	< 0.04	< 0.04	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
Silicon	mg/L	0.28	0.18	0.89	1.11	5.03	7.28	0.23	0.19
Silver	mg/L	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	0.05
Sodium	mg/L	0.87	0.77	3.80	3.71	1.33	1.50	0.77	0.79
Strontium	mg/L	0.008	0.007	0.022	0.022	0.028	0.029	0.007	0.007
Tin	mg/L	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Titanium	mg/L	0.013	0.012	0.017	0.017	0.019	0.027	0.016	0.017
Vanadium	mg/L	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Zinc	mg/L	< 0.01	< 0.01	0.019	0.010	0.022	0.023	< 0.01	< 0.01

Note: A and B refer to replicate samples.

Table C1 Continued. Baseline water quality in the vicinity of the Lupin Mine (RCPL and RL&L 1985b).

1983

Constituent	Units	11-Jun Norma Creek		19-Jun Dam 1a Lake		19-Jun Mouth of Seep Cr.		10-Jun Inner Sun Bay		26-Jun Concession Cr.	
		A	B	A	B	A	B	A	B	A	B
Conventional											
pH	units	6.05	6.05	6.45	6.30	5.55	5.80	6.50	6.55	5.95	5.95
Conductivity	µS/cm	26.9	36.7	19.9	20.1	18.6	18.6	13.0	13.2	10.6	10.7
Total Suspended Solids	mg/L	1.0	1.5	3.0	3.0	1.0	0.5	< 0.5	< 0.5	< 0.5	0.5
Total Disolved Solids	mg/L	19	22	20	21	12	14	10	11	13	12
Nutrients											
Bicarbonate	mg/L	6.52	7.17	3.88	3.88	2.68	3.36	5.21	5.21	3.76	4.03
Carbonate	mg/L	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Hydroxide	mg/L	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Chloride	mg/L	< 0.50	< 0.50	< 0.50	< 0.50	1.37	1.37	< 0.5	< 0.5	< 0.5	< 0.5
Sulphate	mg/L	7.40	9.20	12.20	12.70	5.00	6.00	2.50	2.50	7.90	6.50
Nitrate	mg/L	0.036	0.025	< 0.01	< 0.01	< 0.01	< 0.01	0.021	0.043	< 0.01	< 0.01
Nitrites	mg/L	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
Ammonia	mg/L	< 0.01	< 0.01	0.043	0.069	< 0.01	< 0.01	< 0.01	< 0.01	0.010	< 0.01
Cyanide	mg/L	--	--	--	--	--	--	--	--	--	--
Phosphate	mg/L	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
Silicon	mg/L	0.87	0.84	1.48	1.48	0.59	0.70	0.66	0.56	< 0.08	< 0.08
Metals (Total)											
Aluminum	mg/L	< 0.15	< 0.15	0.16	0.19	0.17	0.17	< 0.15	< 0.15	< 0.15	< 0.15
Antimony	mg/L	< 0.15	< 0.15	< 0.15	< 0.15	< 0.15	< 0.15	< 0.15	< 0.15	< 0.15	< 0.15
Arsenic	mg/L	0.03	0.03	0.00	0.00	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Barium	mg/L	0.008	0.008	0.005	0.005	0.005	0.006	0.003	0.003	0.003	0.003
Beryllium	mg/L	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	0.00	< 0.003	< 0.003	< 0.003
Bismuth	mg/L	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Boron	mg/L	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.02	< 0.01	< 0.01	< 0.01
Cadium	mg/L	< 0.0001	0.0001	< 0.0001	< 0.0001	0.0002	< 0.0001	< 0.0001	< 0.0001	0.0003	0.0002
Calcium	mg/L	4.38	4.31	1.61	1.63	1.32	1.27	1.17	0.99	0.83	0.83
Chromium	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	0.00	< 0.001
Cobalt	mg/L	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Copper	mg/L	0.002	0.005	0.003	0.003	0.005	0.006	0.002	0.002	0.001	0.003
Iron	mg/L	0.160	0.170	0.210	0.480	0.210	0.160	< 0.03	< 0.03	0.087	0.096
Lead	mg/L	0.001	< 0.001	0.002	< 0.01	0.002	0.005	< 0.001	0.002	< 0.001	0.002
Magnesium	mg/L	2.06	2.07	0.75	0.74	0.65	0.65	0.49	0.48	0.35	0.35
Manganese	mg/L	0.028	0.028	0.100	0.100	0.260	0.022	0.004	< 0.003	0.006	0.007
Mercury	mg/L	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005	< 0.00005
Molybdenum	mg/L	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
Nickel	mg/L	0.010	0.014	0.014	0.014	0.005	0.005	< 0.005	< 0.005	< 0.005	< 0.005
Silver	mg/L	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Sodium	mg/L	1.41	1.45	0.66	0.66	0.68	0.65	0.51	0.42	0.46	0.57
Strontium	mg/L	0.023	0.022	0.008	0.007	0.008	0.008	0.007	0.006	0.006	0.006
Tin	mg/L	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Titanium	mg/L	< 0.006	< 0.006	0.007	0.006	0.009	0.012	< 0.006	< 0.006	0.015	< 0.006
Vanadium	mg/L	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Zinc	mg/L	< 0.01	< 0.01	< 0.01	< 0.01	0.014	0.019	< 0.01	< 0.01	< 0.01	0.031

Note: A and B refer to replicate samples.