



**Royal Oak
Mines Inc.**

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March 31, 1999

Mr. Gordon Wray
Chairman
Northwest Territories Water Board
P.O. Box 1500
Yellowknife, N.T.
X1A 2R3



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Dear Mr. Wray,

Please find enclosed the Annual Report for 1998, for the Giant Mine Water Licence (No. NIL2-0043).

Please contact the undersigned at (867) 669-3729 if you have any questions or require further information.

Yours sincerely,

Royal Oak Mines Inc.

Stephen Schultz
Superintendent, Environmental Services
NWT Division

cc: John Stard
Larry Connell



WATER LICENCE N1L2-0043
1998 ANNUAL REPORT
GIANT MINE

Submitted to: The Northwest Territories
Water Board

Submitted by: Royal Oak Mines Inc.
NWT Division

March 31, 1998

Royal Oak Mines Inc. - GIANT MINE

Water Licence N1L2-0043 ANNUAL REPORT 1998

INTRODUCTION

The Giant Mine operates under the conditions of Water Licence N1L2-0043, issued to Royal Oak Mines Inc. by the Northwest Territories Water Board. The current Water Licence was issued June 30, 1998 and will expire June 29, 2003. The previous licence was amended to extend the licence term by 61 days from the original expiry date of April 30, 1998.

A number of the terms and conditions of the previous Water Licence were amended in the licence issued June 30, 1998. Some terms of the Surveillance Network Program (SNP) were also changed. These changes, which came into effect during 1998, are reflected in this annual report.

Part B, Item 5 of this Water Licence requires that an annual report be filed by March 31st of the year following the calendar year reported and this document serves that purpose.

REQUIRED INFORMATION

This report is submitted in accordance with the requirements of Part B, Item 5 of Water Licence N1L2-0043, granted to the Giant Mine Operation of Royal Oak Mines Inc.

The information presented below addresses these requirements as listed in the Water Licence.

Part B, Item 5....

(a) Quantity of water obtained from Great Slave Lake

The monthly quantities of water drawn from Great Slave Lake for use in the mining and milling processes are shown in Table 1. The annual quantity was 787,929 cubic metres.

(b) Quantity of water obtained from the City of Yellowknife

The monthly quantities of water obtained from the City of Yellowknife for domestic purposes are given in Table 1. The annual quantity was 13,677 cubic metres.

(c) **Quantity of minewater pumped from the mine**

The monthly quantities of *groundwater* pumped from the mine are given in Table 1. It should be noted that these figures are calculated from the measured volumes of minewater pumped from the mine, based on the assumption that 698 cubic metres of water from the Northwest tailings pond seeps into the mine per calendar day and pumping of this water does not constitute additional water consumption. The metered volume of fresh water pumped into the mine for use in the mining process is also subtracted from the volume of water pumped from the mine, since this fresh water is included in the measured volume of water drawn from Great Slave Lake and does not constitute additional water consumption. The annual quantity of groundwater pumped from the mine was 573,395 cubic metres.

(d) **Quantity of waste discharged from the Effluent Treatment Facility**

The monthly quantities of treated effluent discharged to Baker Creek are summarized in Table 1. The annual quantity of treated effluent discharged was 1,447,842 cubic metres. Release of effluent commenced May 29 and ceased for the season on November 12. Effluent was released at a controlled, reduced rate for a period of approximately two weeks, under a temporary written agreement with Environment Canada (Environmental Protection Division) and the Department of Fisheries and Oceans.

(e) **Data generated under the Surveillance Network Program**

Water quality data, for SNP stations currently active, are presented in Tables 2 to 10. These tables have been generated with spreadsheet software (Lotus 123) and the data file is included with this report on a floppy diskette. This data is readily convertible into other software formats.

(f) **Maintenance work on water distribution and effluent treatment systems, and associated structures**

Maintenance work on these systems was limited to the following:

(1) ***Inspection and maintenance of water meters***

On March 20, a technical representative of Rosemount Instruments inspected and tested all of the major flowmeter installations. Almost all of the flowmeters were

found to be functioning adequately. The higher priority recommendations made by Rosemount were addressed over the following months, including factory calibration of a differential-pressure transmitter used to measure flow of fresh water from Great Slave Lake and purchase of a new electronic totalizer for the same installation. The Rosemount inspection and maintenance work required were described in detail in two reports to the Water Board: "A Review of Water Use at the Giant Mine" (March 1998) and "Report on Water Use and Water Flow Measurement" (October 1998).

(2) ***Minor repairs to the crest of Dam 11***

In preparation for the recommenced discharge of tailings to the South Pond, a section of the crest of Dam 11, some 200 feet long, was repaired in June. The dam crest had settled in this area, varying from one to 2.5 feet lower than the nominal dam elevation of 6088 feet. The crest was raised to a uniform height using locally excavated clay-silt at the dam core, and coarse waste rock on the upstream and downstream shell. The deposited material was compacted in layers with a bulldozer. The initial work was inspected and recommendations were made by a Senior Geotechnical Engineer with Golder Associates Ltd.

(3) ***Installation of decant pipeline from the South Pond to the North Pond***

Also in preparation for the recommenced discharge of tailings in the South Pond, and in response to recommendations made by the Golder Associates Geotechnical Engineer, a 12 inch fused HDPE pipeline was installed from the north-east corner of the South Pond to transfer supernatant water by gravity flow to the North Pond. The first 800 feet (approx.) of pipe was buried in a trench from Dyke 5 on the South Pond to the Central Pond 'canyon'. A further 1,200 feet of pipe, laid on a ramp constructed on the solid tailings, transported the water to the discharge point on the east side of Dyke 6. Tailings were discharged to the South Pond from July through September and the decant system performed as designed.

(4) ***Extension of tailings discharge pipeline - Northwest Pond***

The tailings pipeline to the Northwest Pond was extended in late summer to permit discharge of tailings along Dam 21D. Beaching of tailings at the bedrock outcrop on the west side of the pond commenced in late October 1998.

Other minor maintenance work conducted in the Tailings Containment Area in 1998 was described in a letter to the Water Board of October 1998, included in the appendix of this report.

(g) **Methods to recycle and reduce water consumption**

The large reduction in the operation's consumption of fresh water (which in 1998 was reduced by 38 % from 1997), and the associated reduction in the volume of effluent released, was achieved by using treated minewater in various parts of the milling process. The maximum reductions in total water use achievable through the recycling of minewater have been almost fully realized, with close to 100% of available minewater being recycled in periods when groundwater flows are low.

In 1998, the total water consumption (fresh lake water plus groundwater) was 1,361,324 cubic metres, which is 15 % lower than the maximum annual limit prescribed in the water licence, to take effect December 31, 1999. Some further reductions to fresh water requirements will be achieved by modified piping in the Mill, which will allow treated minewater to be used in more applications when excess minewater is available (i.e. when seasonal groundwater flows are high). The benefits of recycling treated minewater for mining applications underground are also under review.

Some reductions to total water consumption can also be made with improved maintenance of water distribution lines underground, and reduced wastage of water due to pipe leaks. The progress of this work, as well as modifications to pipework in the Mill, are dependant on the manpower resources available to the operation. At this time, these projects are on hold, as other critical maintenance work takes priority.

The methods being used or planned to reduce water consumption were fully described and discussed in a report submitted to the Water Board: "Report on Water Use and Water Flow Measurement" (October 1998).

(h) **Reclamation activities, studies and anticipated work**

Reclamation activities conducted in 1998 included the following work:

- Hydro-seeding of the slope to the west of the Baghouse and Cottrell buildings.
- Landscaping of mounded overburden and waste rock adjacent to Ingraham Trail south of main car park. Removal of redundant fencing in this area. Soil conditioned with manure in preparation for seeding
- Removal of redundant fencing north of Baghouse building.

- Landscaping and spreading of soil in open area north of access road to the Townsite.
- Removal of scrap metal from area adjacent to Baker Creek north of B-shaft and disposal in B1 open pit. Excavation and removal of old stockpile of roaster calcine. Landscaping of area.
- Removal of scrap steel (pipe) adjacent to Ingraham Trail in A-shaft area, disposed of in B1 open pit.
- Removal of hydrocarbon (oil) contaminated soil from TRP storage yard and establishment of land farm for hydrocarbon contaminated soils adjacent to B1 pit.
- Removal of redundant tailings pipeline adjacent to Ingraham Trail
- Establishment of revegetation test plots on exposed tailings in Central Pond area. Manure was spread over and mixed with tailings in preparation for seeding.

This work is described in the Abandonment & Restoration Plan submitted to the Water Board in December 1998. Information on the cost of this work is not available.

The following reports on *reclamation studies* were submitted to the NWT Water Board in 1998:

- "Tailings Covering Study - Final Report" (April 1998). Conclusion of three year study of the effects of waste rock covers on thermal conditions in the tailings deposits.
- "Evaluation of Surface Contamination Data, Giant Mine Site, Yellowknife, NWT", prepared by EBA Engineering Consultants Ltd. (March 1998). Review of data collected from 1994 through 1997 on soil contamination at the mine site, with recommendations for further work.
- "Arsenic Trioxide Management, Giant Mine, Yellowknife, NT", (March 1998). Summary of data collected during water licence term on conditions of arsenic trioxide in the underground storage chambers, storage chamber integrity and processing technology for upgrading arsenic concentrate.
- "Surface Contamination Study, Giant Mine", prepared by EBA Engineering

Consultants (December 1998). Report on additional soil sampling and analysis conducted at the site in the summer of 1998.

- "Baker Creek Fish Habitat and Rehabilitation Study for Abandonment & Restoration Planning", prepared by Dillon Consulting Ltd. (October 1998). Report on study conducted by Dillon personnel at the site.
- "First Quarterly Report - Arsenic Trioxide Management Project" (October 1998) First report on progress made in this project during the first quarter of the renewed licence term. The report discussed the results of laboratory testwork conducted by Royal Oak Mines on application of the Hot Water Leach process to upgrade the arsenic trioxide concentrate to a marketable quality and initiation of pilot-plant scale testwork at the CANMET research laboratories in Ottawa.

Other studies conducted but not yet reported include an evaluation of the Hazardous Waste Storage Area and potential soil control site sampling north of Yellowknife. Both studies were conducted jointly by EBA Engineering Consultants and Royal Oak Mines in September 1998. Royal Oak also commissioned recommendations from EBA for design of erosion protection for the tailings deposit on Yellowknife Bay and these were reported in the revised A & R Plan.

Anticipated site reclamation work to be conducted in 1999 include:

- Re-seeding of the Trapper Creek diversion channel area and the slope west of the Baghouse building. New seeding in a number of areas adjacent to the Ingraham Trail and near the Townsite. New seeding of revegetation test plots on the Central Pond.
- Further removal of scrap steel from various locations on the mine site and disposal in the B1 open pit.
- Removal of scrap metal and other garbage from some locations in the Baker Creek channel
- Consolidation of waste batteries from several old storage areas on the mine site to one central location. Removal of batteries from the site for lead recycling.
- Classification and improved storage of hazardous materials at the Northwest Pond storage site.

- Provision of erosion protection for the deposit of tailings on the shore of Yellowknife Bay

(i) **List of unauthorized discharges**

There were three (3) incidents of unauthorized discharges during 1998. This one third of the number of such incidents in 1997 and is the lowest number of incidents in eight years of operations at the site (there were two spill incidents in 1990). The three incidents in 1998 were all relatively minor and are listed in the following table:

1998 Unauthorized Discharges

<i>Date</i>	<i>Material Spilled</i>	<i>Location</i>	<i>Description</i>	<i>Response</i>
June 19, 1998	Treated effluent above max. average limit for arsenic	SNP Station 43-1	Caused by underdosing of ferric sulphate in ETP. Effluent discharge had ceased before max. average limit was exceeded	Discharge of effluent ceased before limit was exceeded. Effluent in Polishing Pond above limits was pumped to North Pond.
October 27, 1998	Tailings slurry, approx. 10 m ³	East side of Mill building	Fused joint on pipeline failed due to high pressure surge	Majority of material was excavated and disposed of in TCA. Some work outstanding
December 4, 1998	Baghouse dust (As ₂ O ₃ concentrate) approx. 2 kg	Just north of Baghouse building	Leak developed in newly installed joint on dust pipeline	Material was recovered to drum. Leaking joint repaired

(j) **Quantity of minewater recycled**

At this time, the quantity of minewater used in the milling process is not measured. Measurement would require the purchase of a new flowmeter specifically for this purpose. Close to 100 % of the minewater has been recycled during periods of lower groundwater flow.

(k) **Revisions to Contingency Plan and Abandonment & Restoration Plan**

The Contingency Plan was thoroughly revised and submitted to the Water Board in August 1998. The plan was approved by the Water Board in October, with a request for

the inclusion of some additional specific information. Due to limited resources, this additional information has not yet been appended to the plan.

The Abandonment & Restoration Plan for the site was thoroughly revised by EBA Engineering Consultants Ltd. and Royal Oak Mines, and submitted to the Water Board on December 2, 1998. A one month extension to the original submission date was granted by the Water Board. The document included a revision to the estimated reclamation liability, calculated using the Reclaim Version 3.1 software. The specific financial liability of the arsenic trioxide concentrate stored underground was excluded from this cost estimate, since the research being conducted on removal, processing and chemical stabilization methods for the material has not yet yielded firm conclusions on the technical viability of the methods being considered.

To this date, Royal Oak Mines has not received a response from the Water Board on the revised A & R Plan.

(l) Acid-Base Accounting Testwork

The acid rock drainage monitoring program specified in the renewed water licence has not yet been implemented. The first semi-annual samples of tailings and waste rock will be collected in April 1999 and will be submitted to a commercial laboratory for acid-base accounting testwork. Test results should be available in May.

(m) Erosion Control on Trapper Creek

Trapper Creek was observed to be low in suspended solids throughout the year, indicating successfully limited erosion. No additional maintenance work was carried out in the area in 1998. Further seeding of exposed till in the area is required and this work is planned for the summer of 1999. A stock of grass seed and fertilizer is in storage at the mine.

(n) Updates to the Tailings Management Plan

The first formal Tailings Management Plan was prepared by Golder Associates Ltd. and submitted to the Water Board February 1, 1999. There have been no revisions to the data or plans discussed in this report. To this date, Royal Oak Mines has not received a response from the Water Board on this submission.

(o) **Measures to control wind blown tailings**

A detailed description of measures taken to control wind blown tailings in 1998 and measures proposed for 1999 was provided to the Inspector for the site, in a letter dated October 9, 1998. A copy of this letter is provided in the Appendix to this document.

(p) **Current mine reclamation liability**

The current mine reclamation liability was estimated for the submission of a revised Abandonment & Restoration Plan made December 2, 1998. Please refer to this plan and also see item (k) of this annual report.

(q) **Other details requested by the Water Board**

Special requests for information made by the NWT Water Board in 1998 have been addressed elsewhere in this document.

TABLES

Table 1. 1998 Water Volumes and Quantity of Ore Milled

(all volumes in cubic metres)

Month	Water Pumped from Great Slave Lake	Domestic water from City of YK	Groundwater Pumped from Mine	Treated Effluent To Baker Creek	Ore Milled (tonnes)
January	67,806	995	3,761	0	28,716
February	86,918	980	19,948	0	26,988
March	78,007	1,078	27,102	0	29,611
April	51,166	975	61,463	0	25,980
May	44,217	821	72,813	13,266	26,416
June	33,163	934	60,800	202,175	24,198
July	60,834	1,229	62,126	385,936	27,291
August	47,464	971	55,873	281,394	24,759
September	67,356	949	53,412	307,172	24,778
October	71,091	1,284	64,362	189,127	25,003
November	82,354	1,052	54,709	68,772	25,467
December	97,553	2,409	37,026	0	26,756
TOTAL	787,929	13,677	573,395	1,447,842	315,963

Table 2. Station 43-1, 1998 Surveillance Network Program Results
(Decant from Effluent Treatment System to Baker Creek)

Date	Total Arsenic	Total Cyanide	Total Copper	Total Lead	Total Nickel	Total Zinc	pH	Total Susp. Solids	Total Ammonia	Temperature (°C)
30-May-98	0.25	0.06	0.12	0.05	0.12	0.04	7.3	0.009	8.2	15
01-Jun-98	0.23	0.10	0.08				7.3	0.013	7.8	15
02-Jun-98	0.12	0.14	0.08		0.16		7.2	0.008	7.2	13
03-Jun-98	0.18	0.02	0.02		0.28		7.4	0.090	6.7	12
08-Jun-98	0.31	0.68	0.12		0.30		7.4	0.009	6.0	18
09-Jun-98	0.13	0.01	0.02		0.35		7.4	0.006	9.4	19
10-Jun-98	0.22	0.03	0.04	0.04	0.30	0.10	7.4	0.001	7.0	19
11-Jun-98	0.42	0.12	0.10		0.33		7.5	0.028	8.4	19
12-Jun-98	0.18									
15-Jun-98	0.68	0.18	0.02		0.37		7.5	0.017	9.4	15
16-Jun-98	0.98	0.18	0.04		0.41		7.5	0.011	9.2	18
07-Jul-98	0.38	0.22	0.04		0.31		7.7	0.012	9.2	22
08-Jul-98	0.47	0.09	0.04	0.08	0.30	0.03	7.6	0.012	9.2	24
09-Jul-98	0.44	0.17	0.06		0.30		7.6	0.013	9.6	23
10-Jul-98	0.64	0.22	0.04		0.27		7.5	0.011	9.6	22
11-Jul-98	0.37									
13-Jul-98	0.76	0.18	0.06		0.30		7.5	0.010	11.6	23
14-Jul-98	0.22	0.09	0.04		0.25		7.5	0.013	12.2	18
15-Jul-98	0.30	0.04	0.06	0.08	0.31	0.04	7.5	0.033	12.8	18
16-Jul-98	0.34	0.19					7.5	0.010	13.6	16
17-Jul-98	0.26	0.18	0.02		0.26		7.5	0.012	12.8	20
20-Jul-98	0.27	0.30	0.09		0.34		7.5	0.009	13.6	19
21-Jul-98	0.61	0.15	0.08		0.22		7.5	0.009	13.8	20
22-Jul-98	0.21	0.16	0.08	0.08	0.23	0.05	8.0	0.008	15.6	20
23-Jul-98	0.14	0.18	0.10		0.29		7.5	0.011		20
24-Jul-98	0.28	0.16	0.06		0.29		7.5	0.013		22
27-Jul-98	0.26	0.18	0.08		0.30		7.5	0.016		19
28-Jul-98	0.21	0.20	0.09		0.30					
29-Jul-98	0.35	0.16	0.04		0.31		7.5	0.017	13.4	19
30-Jul-98	0.32	0.21	0.04		0.29		7.6	0.011		19
31-Jul-98	0.18	0.16	<0.02		0.29		7.4	0.012		22
04-Aug-98	0.37	0.14	<0.02		0.22		7.7	0.008		23
05-Aug-98	0.46	0.18	0.05		0.24		7.7	0.012	13.0	22
06-Aug-98	0.29	0.22	<0.02		0.25		7.6	0.012		21
07-Aug-98	0.37	0.14	0.02		0.25		7.6	0.013		19
10-Aug-98	0.26	0.19	0.05		0.23		7.6	0.008		20
11-Aug-98	0.26	0.21	<0.02		0.25		7.6	0.013		18
12-Aug-98	0.36	0.10	<0.02		0.24		7.5	0.010		17
13-Aug-98	0.21	0.17	<0.02	0.03	0.25	0.03	7.5	0.011	13.6	17
14-Aug-98	0.32	0.18	<0.02		0.22		7.5	0.008		17
17-Aug-98	0.22		<0.02		0.25		7.5			18
18-Aug-98	0.37	0.22	0.02		0.25		7.5	0.010		20
19-Aug-98	0.42	0.18	<0.02		0.29		7.6	0.007	15.2	18

NOTE: All concentrations in mg/l

Table 2. Station 43-1, 1998 Surveillance Network Program Results
(Decant from Effluent Treatment System to Baker Creek)

Date	Total Arsenic	Total Cyanide	Total Copper	Total Lead	Total Nickel	Total Zinc	pH	Total Susp. Solids	Total Ammonia	Temperature (°C)
20-Aug-98	0.28	0.12	<0.02		0.24		7.7	0.013		14
21-Aug-98	0.27		<0.02		0.25		7.7	0.008		16
24-Aug-98	0.37	0.18	<0.02		0.23		7.6	0.012		19
09-Sep-98	0.19	0.05	0.06	0.06	0.24	0.04	7.7	0.011	11.2	14
10-Sep-98	0.40	0.14	0.02		0.27		7.6	0.012		16
11-Sep-98	0.38	0.20	0.07		0.28		7.7	0.010		
12-Sep-98	0.37									
14-Sep-98	0.29	0.08	0.05		0.26		7.6	0.018		14
15-Sep-98	0.33	0.12	0.03		0.21		7.7	0.008		12
16-Sep-98	0.29	0.16	0.06		0.27		7.7	0.012	13.6	14
17-Sep-98	0.31	0.16	0.05		0.24		7.7	0.010		13
18-Sep-98	0.38	0.17	0.04		0.24		7.7	0.009		13
21-Sep-98	0.35	0.28	0.08		0.27		7.7	0.011		14
22-Sep-98	0.39	0.16	0.03		0.27		7.7	0.008		15
23-Sep-98	0.28	0.17	<0.02	<0.02	0.27	0.03	7.7	0.010	12.0	13
24-Sep-98	0.43	0.12	0.07		0.22		7.7	0.007		13
25-Sep-98	0.22	0.22	0.06		0.29		7.7	0.012		12
28-Sep-98	0.41	0.16	0.04		0.24		7.7	0.011		11
29-Sep-98	0.28	0.19	<0.02		0.29		7.7	0.010		10
30-Sep-98	0.32	0.15	0.04		0.32		7.8	0.012	12.0	8
01-Oct-98	0.36	0.33	0.08	0.14	0.29	0.03	7.8	0.011		10
02-Oct-98	0.40	0.27	0.06		0.24		7.8	0.010		11
05-Oct-98	0.36	0.21	0.04		0.27		7.4	0.011		11
07-Oct-98	0.26	0.06	0.06		0.31		7.5	0.012	13.6	9
08-Oct-98	0.24	0.41	0.08		0.08		7.8	0.012		10
15-Oct-98	0.29	0.25	0.04		0.36		7.5	0.010		8
16-Oct-98	0.40	0.15	0.07		0.35		7.4	0.015		8
19-Oct-98	0.43	0.13	0.09		0.35		7.4	0.014		7
20-Oct-98	0.39	0.15	0.08		0.35		7.5	0.014		6
21-Oct-98	0.36	0.14	0.08		0.40		7.5	0.016	12.8	9
22-Oct-98	0.30	0.31	0.07		0.37		7.2	0.011		9
23-Oct-98	0.22	0.37	0.08		0.37		7.5	0.012		6
26-Oct-98	0.31	0.36	0.08		0.36		7.4	0.012		11
27-Oct-98	0.36	0.19	0.06		0.35		7.2	0.018		6
28-Oct-98	0.36	0.30	0.06	0.08	0.34	0.02	7.4	0.033	12.4	8
29-Oct-98	0.37	0.26	0.08		0.31		7.6	0.015		8
30-Oct-98	0.38	0.48	0.09		0.33		7.6	0.010		11
02-Nov-98	0.32	0.22	0.10		0.34		7.7	0.011		15
03-Nov-98	0.19	0.24	0.12		0.34		7.7	0.009		7
04-Nov-98	0.35	0.23	0.11		0.34		7.4	0.013		6
05-Nov-98	0.36	0.27	0.12		0.38		7.6	0.018		6
06-Nov-98	0.26	0.24	0.15	0.12	0.39	0.05	7.4	0.016		17
09-Nov-98	0.10	0.18	0.16		0.43		7.6	0.017		13
10-Nov-98	0.33	0.31	0.33		0.41		7.4	0.012		11
12-Nov-98	0.14	0.35	0.34	0.19	0.45	0.02	7.6	0.012	12.6	7
Effluent discharge ceased										

NOTE: All concentrations in mg/l

Table 3. Station 43-5, 1998 Surveillance Network Program Results
(Mouth of Baker Creek, prior to discharge into Yellowknife Bay)

Date	Total Arsenic	Total Cyanide	Total Copper	Total Lead	Total Nickel	Total Zinc	pH	Total Susp. Solids	Total Ammonia	Temperature (°C)
12-May-98							6.9		0.03	11.5
10-Jun-98	0.26	0.05	0.01	0.02	0.11	0.06	8.3	0.011	1.55	19
24-Jun-98	0.03	0.02	0.02	0.06	0.01	0.04	7.0	0.002	0.50	18
08-Jul-98							7.4		0.10	22
15-Jul-98	0.24	0.03	0.10	0.08	0.21	0.05	7.4	0.019	7.4	20
22-Jul-98	0.22	0.10	0.08	0.08	0.08	0.07	7.8	0.012	9.8	18
29-Jul-98							7.5		11.2	16
05-Aug-98							7.5		13.4	21
13-Aug-98	0.11	0.15	<0.02	0.04	0.24	0.02	7.5	0.010	11.2	14
19-Aug-98							7.6		11.4	15
26-Aug-98	0.32	0.11	<0.02	0.11	0.22	0.05	7.3	0.012	13.0	16
02-Sep-98							7.1		2.2	11
09-Sep-98	0.32	0.12	0.04	0.05	0.18	0.07	7.5	0.021	9.6	13
16-Sep-98							7.5		11.4	11
23-Sep-98	0.31	0.17	<0.02	<0.02	0.26	0.05	7.5	0.012	14.0	9
30-Sep-98							7.5		11.4	5
07-Oct-98							7.4		9.8	5
14-Oct-98	0.28	0.18	0.02	0.05	0.24	0.02	7.3	0.014	6.2	4
21-Oct-98							7.2		10.4	3
28-Oct-98	0.33	0.17	0.02	0.10	0.22	0.03	7.3	0.007	8.4	3
04-Nov-98							7.4		7.6	1
12-Nov-98	0.36	0.17	0.08	0.16	0.26	0.02	7.2	0.007	8.2	0
Effluent discharge ceased										

NOTE: All concentrations in mg/l

Table 4. Station 43-11, 1998 Surveillance Network Program Results
(Baker Creek upstream of Station 43-1)

Date	Total Arsenic	pH	Total Susp. Solids	Total Ammonia	Temperature (°C)
18-Jun-98		7.2		<0.1	19
15-Jul-98		7.5		<0.1	20
26-Aug-98	0.12	7.3		<0.1	14
24-Sep-98	0.13	7.4	0.004	<0.1	4
29-Oct-98	0.27	7.2	0.008	<0.1	1
Station frozen over					

NOTE: All concentrations in mg/l

Table 5. Station 43-14, 1998 Surveillance Network Program Results
(30 metres from breakwater out into Yellowknife Bay)

Date	pH	Total Ammonia	Temperature (°C)
12-May-98	7.3	0.01	7
10-Jun-98	8.2	<0.1	16
18-Jun-98	7.2	<0.1	16
24-Jun-98	6.8	<0.1	17
08-Jul-98	7.6	<0.1	21
Sampling ceased due to change in SNP			

NOTE: All concentrations in mg/l

Table 6. Station 43-12, 1998 Surveillance Network Program Results
(End of breakwater at outlet of Baker Creek)

Date	pH	Total Ammonia	Temperature (°C)
12-May-98	7.2	0.04	12
10-Jun-98	8.2	0.10	16
18-Jun-98	7.4	0.10	17
24-Jun-98	6.8	0.13	18
08-Jul-98	7.3	<0.1	22
17-Jul-98	7.2	<0.1	19
22-Jul-98	7.4	<0.1	18
29-Jul-98	7.8	<0.1	17
05-Aug-98	7.2	0.1	19
13-Aug-98	7.6	0.2	15
19-Aug-98	7.5	0.1	16
26-Aug-98	7.2	<0.1	16
02-Sep-98	7.2	<0.1	14
09-Sep-98	7.6	<0.1	12
16-Sep-98	7.4	<0.1	12
23-Sep-98	7.4	0.1	10
30-Sep-98	7.5	<0.1	7
07-Oct-98	7.4	<0.1	7
14-Oct-98	7.1	<0.1	5
21-Oct-98	7.0	<0.1	4
28-Oct-98	7.1	0.5	3
04-Nov-98	7.2	<0.1	2
Station frozen over			

NOTE: All concentrations in mg/l

Table 7. Station 43-15, 1998 Surveillance Network Program Results
(Outflow from Trapper Lake)

Date	Total Arsenic	pH	Total Susp. Solids	Total Ammonia	Temperature (°C)
26-Aug-98	0.16	7.1	0.129	<0.1	13
24-Sep-98	0.27	7.2	0.015	<0.1	7
29-Oct-98	0.33	7.3	0.010	0.2	1
Station frozen over					

NOTE: All concentrations in mg/l

Table 8. Station 43-16, 1998 Surveillance Network Program Results
(Trapper Creek, upstream of confluence with Baker Creek)

Date	Total Arsenic	pH	Total Susp. Solids	Total Ammonia	Temperature (°C)
26-Aug-98	0.18	7.0	0.018	<0.1	16
24-Sep-98	0.22	7.2	0.017	<0.1	3
29-Oct-98	0.24	7.4	0.018	0.1	1
Station frozen over					

NOTE: All concentrations in mg/l

Table 9. Station 43-17, 1998 Surveillance Network Program Results
(Final tailings discharge from Mill)

Date	Total Arsenic	Total Cyanide	Total Copper	Total Lead	Total Nickel	Total Zinc	pH	Total Solids (% by weight)	Total Ammonia	Temperature (°C)
02-Sep-98	83	75	4.04	0.12		0.14	7.8	16.0	9.0	14
Oct-98	Sample unrecoverable									
16-Nov-98	86	25	4.27	0.09	0.68	0.79	8.4	8.0	7.8	9
18-Dec-98	144	120	8.40	0.12	<0.02	3.10	8.0	22.0	13.0	9

NOTE: All concentrations in mg/l

Table 10. Station 43-18, 1998 Surveillance Network Program Results
(Minewater discharge at Mill)

Date	Total Arsenic	Total Cyanide	Total Copper	Total Lead	Total Nickel	Total Zinc	pH	Total Susp. Solids	Total Ammonia	Temperature (°C)
26-Aug-98	3.9	0.07	0.13	0.16	0.15	0.16	7.5	0.211	7.6	12
01-Oct-98	16.0	0.06	0.08	0.24	0.12	0.14	7.3	0.151	7.6	9
06-Nov-98	4.6	0.06	0.06	0.12	0.14	0.14	6.9	0.148	7.8	11
14-Dec-98	13.5	0.06	<0.02	0.09	0.10	0.17	7.4	0.222	10.0	8

NOTE: All concentrations in mg/l

APPENDIX



**Royal Oak
Mines Inc.**

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Fax: (867) 873-2980 - Manager
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October 8, 1998

Mr. Gordon Wray
Chairman
Northwest Territories Water Board
P.O. Box 1500
Yellowknife, N.T.
X1A 2R3

Dear Mr. Wray,

Re: Giant Mine - 1998 Geotechnical Inspection of the Tailings Containment Areas

Please find enclosed, three (3) copies of a report by Golder Associates Ltd. on a geotechnical inspection of the Giant Mine tailings dams, conducted in June of this year. An additional, unbound copy is provided for reproduction and further distribution.

Mr. Jim Cassie, P.Eng., inspected the dams on June 17, 19 and 20. The submission of this report is overdue, due to delays on the part of both Golder Associates and Royal Oak Mines. On June 24th, at Royal Oak's request, Mr. Cassie provided a summary of the maintenance required on the dams. Action on these maintenance issues was commenced on June 25th.

This letter will describe the actions taken, and planned, to address the maintenance recommendations in the final report. Please refer to Section 5.0 of the report, for a summary of these recommendations.

With regard to the dams in the ***Original Tailings Area***, the following actions and plans should be noted:

- Plans for the resumed discharge of tailings in the South Pond, and management of the supernatant water, were described in a letter to the NWT Water Board dated June 30, 1998. These plans were implemented as described and mill tailings have been discharged to this pond continuously since early July. Repairs to the crest of Dam 11 were completed successfully and substantial beaching has been achieved on both the north 'dogleg' extension to Dam 11, and in the erosional gully formed by seepage discharge at the centre of the dam, as recommended by Mr. Cassie.



- Supernatant water from the South Pond has been conveyed directly to the North Pond through a graded pipeline and, as recommended by Mr. Cassie, Dyke 6 has not been used to retain water. Water elevations in the North Pond were above the recommended limit early in the summer, but have been maintained within the limit since mid-July.
- The small sinkholes observed in the crests of Dam 3 and Dyke 5 will be backfilled this month. The recommended repairs to structures that do not retain water and are not involved in the long-term tailings management plan have been delayed this summer, due to other commitments to site surface work, and will be addressed next year.
- Data from the thermistors installed in Dam 11 is collected on a bi-weekly basis and is reviewed internally, however, data from the piezometer installations is not currently collected. The piezometer read-out instrument has recently been sent out for re-calibration and arrangements are being made for training mine site personnel in its use. This data will be collected during summer months, according to the requirements of the mine's geotechnical consultant.

With regard to Mr. Cassie's conclusions on the structures of the *Northwest Tailings Area*, the following actions and plans should be noted:

- Significant beaching has been achieved over the last year in the area of Dams 21B and 21C. Advancement of this beaching will continue this winter along Dam 21D to the western bedrock outcrop. Additional beaching is also warranted in the area of Dam 21A and will be conducted this winter.
- Data from thermistor installations at Dam 21D is recorded on a bi-weekly basis and is reviewed internally. This data is provided to Golder Associates on an annual basis. The piezometer installations and surface movement monuments have not been monitored for many years. This data will be collected during summer months, according to the requirements of the geotechnical consultant.
- Three sinkholes identified in the crest of Dam 21D were repaired, commencing June 25th. A trench was excavated to intersect all three sinkholes and find the bottom of the holes. At a depth of five feet, no further damage was found. The trench was backfilled with a layer of dry bentonite and capped with damp clay.
- The tailings discharge point at Dam 21C, noted by Mr. Cassie to be too close to the rockfill shell of the dam, was relocated immediately after the inspection. This issue has been reviewed with the Mill Shift Supervisors, who are responsible for daily management of the tailings facilities. The seepage return line at Dam 22B was extended, following the dam inspection, in an attempt to prevent ponding of this water against the dam face. A further extension to this line is required to direct the water towards the centre of the pond.



- Recording of the operating hours of the seepage return pump at Dam 22B will continue, on a bi-weekly basis. This data has been provided to Golder Associates as a graph of pumping hours per day. In future, this data will be reported as seepage volume, based on the discharge rate of the pump. This method of determining flow rates should be quite adequate for the characterization of seepage rate changes, however, further consideration will be given to the benefits of a V-notch weir to measure a portion of the seepage flow.

We trust that these actions will address Mr. Cassie's recommendation to your satisfaction. Please contact me at (867) 669-3729, if you have any questions or concerns.

Yours sincerely,

Royal Oak Mines Inc.

Stephen Schultz
Superintendent, Environmental Services
NWT Division

cc: Ron Breadmore (DIAND - South Mackenzie District)
John Stard (ROM)
Kent Morton (ROM)
Al Goetz (ROM)
Denis Gratton (ROM)