

Arctic Gold and Silver Tailings Site

Monitoring Report 2005



Prepared by:
**Indian and Northern Affairs
Waste Management Program
Yukon Region**

Location

The Arctic Gold and Silver mill and tailings impoundment is located approximately 4 km south of the Village of Carcross on the road to both the Arctic Caribou and Big Thing mines on Montana Mountain (60° 08' 00" N, 134° 43' 20" W).



Figure 1: Location of Arctic Gold and Silver Tailings

Background

The Arctic Gold and Silver mill was in operation during the late 1960's. It is estimated that about 50,000 tonnes of ore were processed, using a basic flotation method (without cyanide) and leaving nearly 27,000 m³ of tailings.

A phase III environmental assessment was commissioned By DIAND, Waste Management in August, 1997. It was found that the tailings were acid generating and that seepage into a small lake adjacent to the tailings impoundment contained significant concentrations of metals. Several health and safety concerns and environmental risks were identified and it was recommended to clean up the site and assess remedial measures for the tailings (Public Works and Government Services Canada, 1998).

Geotechnical and geochemical testing and delineation of the tailings were initiated in 1998 and options for remediation were presented in a report prepared by Steffen Robertson and Kirsten Inc. (1999).

Clean up of the site and preparations to secure and cap the tailings were carried out in 1999 according to specifications prepared by Public Works and Government Services Canada (1999). The contract for the excavation of previously submerged tailings from the unnamed lake, adjacent to the tailings impoundment, took place during winter 1999/2000. The recovered tailings were expected to dry during the summer 2000 to be placed in the impoundment and covered with clay capping material. Due to a wet and cool summer, the tailings had not dried enough to the satisfaction of the engineer. The final work, including the seeding and fertilizing of the entire capped tailings pond, had therefore be postponed to the summer of 2001. Completion of all components of the remediation effort was achieved in September, 2001 (EBA Engineering Consultants Ltd., 2001).

Monitoring Program

DIAND Waste Management personnel carried out the annual site monitoring for 2005. This included:

- Visual inspection of capped tailings impoundment.
- State of vegetation and signs of erosion on all re-seeded areas.
- Inspection of tailings dam, drainage channels and diversion ditch.
- Inspection of the newly constructed spillway and dam of the unnamed lake.
- Sampling of ground water at selected monitoring wells and analysis for dissolved metals.
- Sampling of surface water at Tank Creek and analysis for dissolved metals.

Observations

The site was visited by Waste Management personnel on June 16, 2005. Weather conditions were partly cloudy and 15°C. The overall state of the impoundment, tailings dam, drainage channel, diversion ditch, spillway and dam of the unnamed lake were satisfactory.

The beaver dam near the spillway (**Photo 1**) is for the most part still intact.

The vegetation on the tailings cover is dry, brown and not doing very well compared to the vegetation around it.



Photo 1: Beaver Dam near the Spillway

Sampling of Monitoring Wells

Groundwater samples were taken from two selected monitoring wells (MW-2 and MW-1D) within the tailings impoundment area (see **Figure 2**). The well volume was established and each well was purged (3 x well volume) prior to sampling. Water quality data as recorded on site is shown in **Table 1** and sampling locations on **Figure 2**. The samples were filtered (0.45 μm) and sent to an accredited laboratory for dissolved metals analysis.

Surface Water Sampling

Surface water samples were taken from Tank Creek at the inflow (AGS-1) and outflow (AGS-2) of the unnamed lake as well as at the point of seepage from the tailings pile (AGS-0). Water quality data as recorded on site is shown in **Table 1** and sampling locations on **Figure 2**. The samples were filtered (0.45 µm) and sent to an accredited laboratory for dissolved metals analysis.

Sample ID	Time	Temperature (°C)	pH	Conductivity (µS)
MW-2	14:33	8.8	2.99	>3999
MW-1D	15:01	6.0	6.64	309
AGS-1	15:35	9.4	6.95	47
AGS-2	16:09	14.2	6.96	63
AGS-0	15:51	21.6	3.01	3300

Table 1: Water Quality Field Measurements

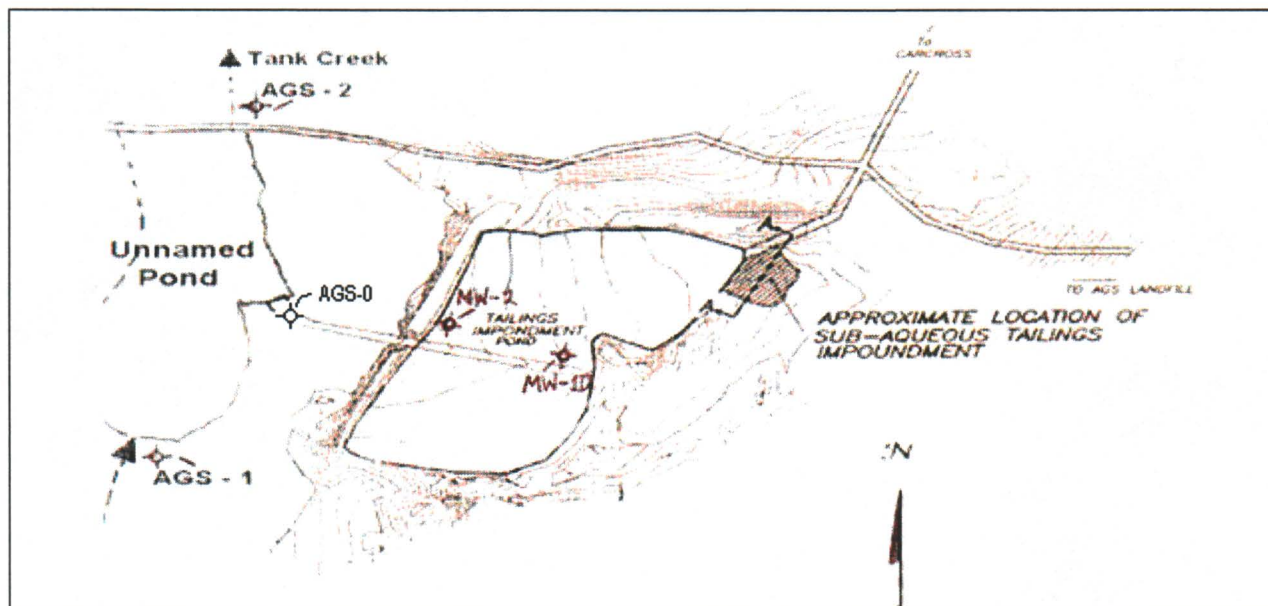


Figure 2: Water Sampling Locations

Analytical Results

The analysis of the groundwater samples for dissolved metals showed elevated levels of several metals in monitoring well MW-2 which is located near the lowest area in the tailings

impoundment, next to the drainage channel. The results are generally higher than the concentrations found in this well in 2004 (see **Table 2**). The water quality for this well (low pH and high conductivity – see **Table 1**) suggests that metals would be present in a dissolved state. Since the tailings are covered with a low permeable layer of clay capping material, acid generation should be strongly reduced or not happening at all. Outflow of water containing high levels of metals from the containment cell into the surface water of Tank Creek via the spillway or by seepage is evident in the lower portion of the spillway (see **Table 1**, sample AGS-0).

Parameter	MW-2 2005 mg/L	MW-2 2004 mg/L	CCME ^a Guidelines mg/L Total Metals	YCSR ^b Guidelines mg/L Total Metals
Arsenic	2.41	1.04	0.005	0.050
Aluminum	62.4	24.4	5 - 100	n/a
Zinc	152	83.5	30	0.075 – 2.4*
Copper	0.33	0.33	0.002 – 0.004	0.02 – 0.09*
Lead	< 0.05	0.067	0.3	0.04 – 0.16*
Iron	3140	2340	0.3	n/a

Table 2: Comparison of Metal Levels (dissolved) in Groundwater at MW-2

^a CCME: Canadian Council of Ministers of the Environment 1999- “Canadian Water Quality Guidelines for the Protection of Aquatic Life

^b YCSR: Yukon Contaminated Sites Regulations for the Protection of Aquatic Life (*depending on water hardness)



Photo 2: Seep from tailings into unnamed pond.

The analysis of the surface water samples for dissolved metals indicated a slight but insignificant increase in metal content in the outflow sample compared to the inflow (see **Appendix** for analytical report). The concentrations are well below the Yukon Contaminated Sites Regulations and CCME guidelines for the protection of aquatic life (YCSR 2002, CCME 2002). An extra surface water sample was taken from the seep at the spillway (AGS-0). This sample showed relatively high levels of metal content; exceeding both CCME and YCSR for some metals (see **Appendix** for analytical report).

The annual monitoring will be continued.

References

- CCME. 2002. *Canadian Environmental Quality Guidelines*. Canadian Council of Ministers of the Environment, Winnipeg, Manitoba.
- EBA Engineering Consultants Ltd. 2001. *Arctic Gold & Silver Tailings Site Remediation Near Carcross, Yukon*. Prepared for Public Works and Government Services Canada, Environmental Services, Western & Northern Region and DIAND Waste Management, Yukon Region. EBA Whitehorse, Yukon.
- EBA Engineering Consultants Ltd. 2001. *Monitoring of Low Permeability Cover Performance: Arctic Gold and Silver Mine Site, Carcross Yukon*. Prepared for the Mining Environment Research Group (MERG). EBA Whitehorse, Yukon.
- Indian and Northern Affairs. 2002. *Arctic Gold and Silver Tailings Site: Monitoring Report 2002*. Waste Management Program, Yukon Region, Whitehorse, Yukon.
- Indian and Northern Affairs. 2003. *Arctic Gold and Silver Tailings Site: Monitoring Report 2003*. Waste Management Program, Yukon Region, Whitehorse, Yukon.
- Indian and Northern Affairs. 2004. *Arctic Gold and Silver Tailings Site: Monitoring Report 2004*. Waste Management Program, Yukon Region, Whitehorse, Yukon.
- Public Works and Government Services Canada. 1998. *Phase III Environmental Assessment of the Arctic Gold and Silver Mill and Tailings Impoundment*. Environmental Services, Western & Northern Region, Edmonton, Alberta.
- Public Works and Government Services Canada. 1999. *Specifications: Arctic Gold and Silver, Environmental Clean Up of Mine Tailings Site*. Environmental Services, Western & Northern Region, Edmonton, Alberta.
- Steffen Robertson & Kirsten. 1999. *Final Report: Assessment of Remedial Measures for Arctic Gold & Silver Tailings Site*. SRK Consulting, Vancouver, B.C.
- YCSR. 2002. *Contaminated Sites Regulations: Generic Numerical Water Standards*. Environment Act. Yukon Territorial Government, Whitehorse, Yukon.

Appendix

(Analytical Report)

Lot 390005

CHAIN OF CUSTODY / ANALYTICAL REQUEST FORM

Indian and Northern Affairs Canada
 Werner Liebau
 Waste Management & Northern Contaminants Programs
 415C-300 Main Street
 Whitehorse, Yukon
 Y1A 2B5
 Telephone: (867) 667-3272
 Facsimile: (867) 667-3861
 E-mail: liebau@inac.gc.ca

Project Name/No: Arctic Gold & Silver Monitoring 2005

Laboratory: NorWest Labs
 Lab Contact: _____

Phone/Fax #: _____

Payment by credit card
 please contact the above.

Sample ID	Date	Time	Sample Type	Preserved (P) Filtered (F)	Analysis Requested						Remarks/Notes	
					Dissolved	Metals						
MW-2	June 16/05		W	f								Samples filtered
MW-1D	"		W	f								0.45 µm
AGS-1	"		W	f								Not Preserved!
AGS-2	"		W	f								
AGS-0	"		W	f								
AGS-D	"		W	f								

Relinquished By: <u>W.L.</u>	Date: <u>June 17/05</u>	Received By:	Date:	Special Instructions:
<u>W. Liebau</u>	Time: <u>16:00</u>		Time:	
Relinquished By:	Date:	Received By:	Date:	
	Time:		Time:	

06-20-05P03:57 RCVD

JS



Report Transmission Cover Page

Norwest Labs
#104, 19575-55 A Ave.
Surrey, BC. V3S 8P8
Phone: (604) 514-3322
Fax: (604) 514-3323

Bill to: Indian & Northern Affairs Canada
Report to: Indian & Northern Affairs Canada
415C, 300 Main Street
Whitehorse, YT, Canada
Y1A 2B5
Attn: Werner Liebau
Sampled By:
Company:

Project ID:
Name: Artic Gold & Silver Monitoring 2005
Location:
LSD:
P.O.:
Acct. Code:

NWL Lot ID: 390005
Control Number:
Date Received: Jun 20, 2005
Date Reported: Jun 24, 2005
Report Number: 713114

Contact	Company	Address												
Werner Liebau Web Email Notification	Indian & Northern Affairs Canada	415C, 300 Main Street Whitehorse, YT Y1A 2B5 Phone: (867) 667-3272 Email: liebauw@inac.gc.ca												
<table border="1"> <thead> <tr> <th>Copies</th> <th>Delivery Strategy</th> <th>Format</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Post</td> <td></td> </tr> <tr> <td>1</td> <td>Fax</td> <td></td> </tr> <tr> <td>A 1</td> <td>Email - Single Report</td> <td>PDF</td> </tr> </tbody> </table>		Copies	Delivery Strategy	Format	1	Post		1	Fax		A 1	Email - Single Report	PDF	Fax: (867) 667-3861
Copies	Delivery Strategy	Format												
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NOTE: P indicates a preliminary report is required
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Report Transmission Notes

Agreement Notes

Lot Notes

Sample Notes:

Notes to Clients <u>Lot Notes:</u> <u>Sample Notes:</u> <u>Batch Notes:</u> <u>Method Notes:</u> <u>Method Result Notes:</u>
--

Reports associated with this Lot

Id/Format/Reported Date
713114 Env2 3 Smp & DL

Id/Format/Reported Date

Id/Format/Reported Date

Comment:

See Methodology and Notes page of Analytical Report for all comments pertaining to this report.

If this report transmission is not satisfactory, please send report requirements to the address at the top of this page.

6/24/05 713114 24-Jun-2005



Sample Custody

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Fax: (604) 514-3323

Bill to: Indian & Northern Affairs Canada
Report to: Indian & Northern Affairs Canada
415C, 300 Main Street
Whitehorse, YT, Canada
Y1A 2B5
Attn: Werner Liebau
Sampled By:
Company:

Project
ID:
Name: Artic Gold & Silver Monitoring 2005
Location:
LSD:
P.O.:
Acct. Code:

NWL Lot ID: **390005**
Control Number:
Date Received: Jun 20, 2005
Date Reported: Jun 24, 2005
Report Number: 713114

Sample Disposal Date: Jul 24, 2005

All samples will be stored until this date unless other instructions are received. Please indicate other requirements below and return this form to the address or fax number on the upper right of this page.

_____ **Extend Sample Storage Until** _____ (MM/DD/YY)

The following charges apply to extended sample storage:

Storage for 1 to 5 samples per month	\$ 10.00
Storage for 6 to 20 samples per month	\$ 15.00
Storage for 21 to 50 samples per month	\$ 30.00
Storage for 51 to 200 samples per month	\$ 60.00
Storage for more than 200 samples per month	\$ 110.00

_____ **Return Sample, collect, to the address below via:**

- _____ Greyhound
- _____ Loomis
- _____ Purolator
- _____ Other (Specify) _____

Name: _____
Company: _____
Address: _____

Phone: _____
Fax: _____
Signature: _____

If no other arrangements have been made, samples will be disposed of on Jul 24, 2005.



Analytical Report

Norwest Labs
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 Phone: (604) 514-3322
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Analyte	Units	390005-1		390005-2		390005-3	
		Results	Detection Limit	Results	Detection Limit	Results	Detection Limit
		NWL Number	390005-1	390005-2	390005-3		
		Sample Date	Jun 16, 2005	Jun 16, 2005	Jun 16, 2005		
		Sample Description	MW-2	MW-1D	AGS-1		
		Matrix	Water - General	Water - General	Water - General		
Analyte	Units	Results	Detection Limit	Results	Detection Limit	Results	Detection Limit
Metals Dissolved							
Silicon	Dissolved	mg/L	42.0	0.05	8.74	0.05	3.58
Sulfur	Dissolved	mg/L	2710	0.3	8.0	0.3	0.7
Aluminum	Dissolved	mg/L	62.4	0.005	0.031	0.005	0.045
Antimony	Dissolved	mg/L	0.002	0.0002	<0.0002	0.0002	<0.0002
Arsenic	Dissolved	mg/L	2.41	0.0002	0.0016	0.0002	0.0005
Barium	Dissolved	mg/L	<0.01	0.001	0.029	0.001	0.004
Beryllium	Dissolved	mg/L	0.007	0.0001	<0.0001	0.0001	<0.0001
Bismuth	Dissolved	mg/L	<0.005	0.0005	<0.0005	0.0005	<0.0005
Boron	Dissolved	mg/L	<0.02	0.002	0.004	0.002	<0.002
Cadmium	Dissolved	mg/L	0.0226	0.00001	0.00008	0.00001	<0.00001
Chromium	Dissolved	mg/L	0.067	0.0005	0.0009	0.0005	0.0011
Cobalt	Dissolved	mg/L	3.97	0.0001	<0.0001	0.0001	<0.0001
Copper	Dissolved	mg/L	0.33	0.001	<0.001	0.001	<0.001
Lead	Dissolved	mg/L	0.014	0.0001	0.0001	0.0001	0.0001
Lithium	Dissolved	mg/L	0.09	0.001	0.003	0.001	<0.001
Molybdenum	Dissolved	mg/L	<0.01	0.001	0.001	0.001	<0.001
Nickel	Dissolved	mg/L	1.46	0.0005	0.0026	0.0005	0.0035
Selenium	Dissolved	mg/L	<0.002	0.0002	<0.0002	0.0002	<0.0002
Silver	Dissolved	mg/L	<0.001	0.0001	<0.0001	0.0001	<0.0001
Strontium	Dissolved	mg/L	1.03	0.001	0.172	0.001	0.023
Thallium	Dissolved	mg/L	<0.0005	0.00005	<0.00005	0.00005	<0.00005
Tin	Dissolved	mg/L	<0.01	0.001	<0.001	0.001	<0.001
Titanium	Dissolved	mg/L	0.143	0.0005	0.0014	0.0005	0.0007
Uranium	Dissolved	mg/L	0.013	0.0005	0.0011	0.0005	<0.0005
Vanadium	Dissolved	mg/L	0.050	0.0001	0.0009	0.0001	0.0002
Zinc	Dissolved	mg/L	152	0.001	0.012	0.001	0.014
Subsample	Field Filtered		Yes	Yes		Yes	
Routine Water							
Calcium	Dissolved	mg/L	513	0.2	39.5	0.2	5.3
Magnesium	Dissolved	mg/L	216	0.1	9.0	0.1	1.4
Sodium	Dissolved	mg/L	32	0.4	3.4	0.4	1.2
Potassium	Dissolved	mg/L	7	0.4	2.1	0.4	<0.4
Iron	Dissolved	mg/L	3140	0.01	0.03	0.01	0.03
Manganese	Dissolved	mg/L	108	0.005	0.163	0.005	<0.005



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Project ID:
Name: Artic Gold & Silver Monitoring 2005
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Acct. Code:

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		NWL Number	390005-4	390005-5	390005-6		
		Sample Date	Jun 16, 2005	Jun 16, 2005	Jun 16, 2005		
		Sample Description	AGS-2	AGS-O	AGS-D		
		Matrix	Water - General	Water - General	Water - General		
Analyte		Units	Results	Results	Results	Detection Limit	
Metals Dissolved							
Silicon	Dissolved	mg/L	3.67	37.4	3.58	0.05	
Sulfur	Dissolved	mg/L	1.2	627	1.5	0.3	
Aluminum	Dissolved	mg/L	0.036	22.4	0.022	0.005	
Antimony	Dissolved	mg/L	<0.0002	<0.002	0.0004	0.0002	
Arsenic	Dissolved	mg/L	0.0009	0.014	0.0009	0.0002	
Barium	Dissolved	mg/L	0.006	0.02	0.006	0.001	
Beryllium	Dissolved	mg/L	<0.0001	0.003	<0.0001	0.0001	
Bismuth	Dissolved	mg/L	<0.0005	<0.005	<0.0005	0.0005	
Boron	Dissolved	mg/L	<0.002	<0.02	<0.002	0.002	
Cadmium	Dissolved	mg/L	0.00006	0.0180	0.00006	0.00001	
Chromium	Dissolved	mg/L	0.0012	<0.005	0.0046	0.0005	
Cobalt	Dissolved	mg/L	<0.0001	0.428	0.0002	0.0001	
Copper	Dissolved	mg/L	<0.001	0.10	<0.001	0.001	
Lead	Dissolved	mg/L	0.0002	0.011	0.0003	0.0001	
Lithium	Dissolved	mg/L	<0.001	0.05	<0.001	0.001	
Molybdenum	Dissolved	mg/L	0.001	<0.01	0.003	0.001	
Nickel	Dissolved	mg/L	0.0044	0.277	0.0064	0.0005	
Selenium	Dissolved	mg/L	<0.0002	<0.002	<0.0002	0.0002	
Silver	Dissolved	mg/L	<0.0001	<0.001	0.0039	0.0001	
Strontium	Dissolved	mg/L	0.035	1.56	0.035	0.001	
Thallium	Dissolved	mg/L	<0.00005	<0.0005	<0.00005	0.00005	
Tin	Dissolved	mg/L	<0.001	<0.01	<0.001	0.001	
Titanium	Dissolved	mg/L	<0.0005	0.036	<0.0005	0.0005	
Uranium	Dissolved	mg/L	<0.0005	0.014	<0.0005	0.0005	
Vanadium	Dissolved	mg/L	0.0002	<0.001	0.0001	0.0001	
Zinc	Dissolved	mg/L	0.018	6.13	0.008	0.001	
Subsample	Field Filtered		Yes	Yes	Yes		
Routine Water							
Calcium	Dissolved	mg/L	7.7	460	7.7	0.2	
Magnesium	Dissolved	mg/L	1.8	91	1.8	0.1	
Sodium	Dissolved	mg/L	1.5	8	1.4	0.4	
Potassium	Dissolved	mg/L	<0.4	<4	<0.4	0.4	
Iron	Dissolved	mg/L	0.08	105	0.10	0.01	
Manganese	Dissolved	mg/L	0.008	39.0	0.008	0.005	



Analytical Report

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Approved by:

Bill Warning, B.Sc.
Lab Operations Manager



Methodology and Notes

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Method of Analysis:

MethodName	Reference	Method	Date Analysis Started	Location
Metals ICP-MS (Dissolved) in water	US EPA	* Determination of Trace Elements in Waters and Wastes by ICP-MS, 200.8	24-Jun-05	Norwest Labs Edmonton
Metals Trace (Dissolved) in water	APHA	* Inductively Coupled Plasma (ICP) Method, 3120 B	23-Jun-05	Norwest Labs Edmonton

* Norwest method(s) is based on reference method

References:

APHA
US EPA

Standard Methods for the Examination of Water and Wastewater
US Environmental Protection Agency Test Methods

Comments:

Please direct any inquiries regarding this report to our Client Services group.
Results relate only to samples as submitted

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