GARROW LAKE - STATION 262 - 3A (NEAR OUTLET) - TOTAL METALS ANALYSIS
MID WINTER SAMPLING EVENT - JANUARY 26, 2004
DUPLICATE RESULTS

Project	Polaris SNP Saline Water Analysis (Garrow Lake)
Report to	Gartner Lee Ltd
ALS File No.	T9118
Date Received	30/01/2004
Date:	20/02/2004

Sample ID	**GL South- 7m**	**GL South- 7m**	**RPD %**	**GL South- 16m**	**GL South- 16m**	**RPD %**
Date Sampled	27/01/2004	QC# 373745		27/01/2004	QC# 373746	
Time Sampled						
ALS Sample ID	5			14		
Nature	Water			Water		
Total Metals						
Arsenic T-As	<0.00020	<0.00020	0	0.00079	0.00073	7.89
Cadmium T-Cd	0.000522	0.000562	7.38	0.000092	0.000088	4.44
Cobalt T-Co	0.000067	0.000076	12.6	0.000412	0.000396	3.96
Copper T-Cu	0.000916	0.000896	2.21	0.00167	0.00161	3.66
Iron T-Fe	<0.010	<0.010	0	0.232	0.229	1.3
Lead T-Pb	0.000325	0.000173	61	0.00265	0.00263	0.758
Manganese T-Mn	0.00906	0.0093	2.61	0.0948	0.094	0.847
Molybdenum T-Mo	<0.0050	<0.0050	0	0.0059	0.0072	19.8
Nickel T-Ni	0.00361	0.00372	3	0.00912	0.00907	0.55
Uranium T-U	<0.010	<0.010	0	<0.010	<0.010	0
Zinc T-Zn	0.208	0.231	10.5	0.27	0.265	1.87
Inorganic Parameters						
Sulphide S	-	-	-	<0.020	<0.020	0

GARROW LAKE - STATION 262 - 3A (NEAR OUTLET) - TOTAL METALS ANALYSIS
MAXIMUM ICE THICKNESS SAMPLING EVENT - MAY 3, 2004
DUPLICATE RESULTS

Project	40137 Saline Water Analysis Garrow SNP (Polaris)
Report to	Gartner Lee Ltd.
ALS File No.	U3253
Date Received	07/05/2004
Date:	21/05/2004

Sample ID	**GL South- 4m**	**GL South- 4m**	**RPD %**	**GL South- 15m**	**GL South- 15m**	**RPD %**
Date Sampled	03/05/2004	QC# 385637		03/05/2004	QC# 385638	
Time Sampled						
ALS Sample ID	2			13		
Nature	Water			Water		
Physical Tests						
Salinity o/oo				64.4	64.3	0.155
Total Metals						
Antimony T-Sb	<0.00020	<0.00020	0	0.00067	0.00077	13.9
Arsenic T-As	<0.00020	<0.00020	0	0.00052	0.00065	22.2
Cadmium T-Cd	0.000615	0.00061	0.816	0.000083	0.000082	1.21
Cobalt T-Co	0.000112	0.000075	39.6	0.000402	0.000451	11.5
Copper T-Cu	0.000963	0.00106	9.59	0.00127	0.0012	5.67
Iron T-Fe	<0.010	<0.010	0	0.245	0.235	4.17
Lead T-Pb	0.000322	0.000329	2.15	0.0021	0.00214	1.89
Manganese T-Mn	0.00994	0.01	0.602	0.0832	0.0804	3.42
Molybdenum T-Mo	<0.0050	<0.0050	0	0.0056	0.0056	0
Nickel T-Ni	0.00375	0.004	6.45	0.00886	0.00847	4.5
Uranium T-U	<0.010	<0.010	0	<0.010	<0.010	0
Zinc T-Zn	0.23	0.247	7.13	0.211	0.201	4.85

GARROW LAKE - STATION 262 - 3A (NEAR OUTLET) - TOTAL METALS ANALYSIS
MINIMUM ICE THICKNESS SAMPLING EVENT - NOT SAMPLED
DUPLICATE RESULTS

Project	
Report to	
ALS File No.	
Date Received	
Date:	

Sample ID	**RPD %**	**RPD %**
Date Sampled		
Time Sampled		
ALS Sample ID		
Nature		
Total Metals		
Antimony T-Sb		
Arsenic T-As		
Cadmium T-Cd		
Cobalt T-Co		
Copper T-Cu		
Iron T-Fe		
Lead T-Pb		
Manganese T-Mn		
Molybdenum T-Mo		
Nickel T-Ni		
Uranium T-U		
Zinc T-Zn		

APPENDIX 17

CORRESPONDENCE BETWEEN

TECK COMINCO AND ENVIRONMENT CANADA

REGARDING THE APPLICATION OF THE

METAL MINING EFFLUENT REGULATIONS

AZIMUTH

Azimuth Consulting Group Inc.
218-2902 West Broadway
Vancouver, BC V6K 2G8

Phone: 604-730-1220
Fax: 604-739-8511

Our File #: TC-03-03

March 29, 2004

Sidney F. Bruinsma
Enforcement/Emergencies Officer, Nunavut
Northern Division, Environmental Protection Branch
Environment Canada
Box 1870, Iqaluit
Nunavut X0A 0H0

Dear Mr. Bruinsma:

Re: Polaris Mine EEM – Missed Sublethal Toxicity Test Sampling Event

Further to our recent discussion, we are pleased to document the issues and circumstances surrounding the missed 2003 sampling event for sublethal toxicity testing (SLTT) of effluent at Teck Cominco's Polaris Mine.

First, Azimuth Consulting Group (Azimuth) takes full responsibility for the missed sampling event, which resulted from an oversight on our part. Our staff have considerable experience conducting environmental effects monitoring (EEM) programs under the Pulp and Paper Effluent Regulations (PPER), which have been in place for some years. We understand the importance of the SLTT as an EEM investigative tool and would not knowingly miss a sampling event. The oversight comes from our interpretation of the new Metal Mining Effluent Regulations (MMER) and how they apply to the Polaris Mine, which has a unique discharge situation (i.e., limited to approximately 60 days per calendar year). Under both the PPER and MMER, two sampling events are required for the SLTT. However, if the discharge period is less than 120 days, the PPER require only one sampling event. We mistakenly assumed that these terms would also apply to the MMER, which provide less detail pertaining to the requirements of this test than the PPER. This issue was compounded by the unique discharge characteristics and receiving environment of the Polaris Mine, which make the MMER more difficult to interpret and apply compared to mines discharging under more usual conditions.

We became aware of the missed SLTT event during a December 2003 workshop intended to present results of 2003 reconnaissance studies carried out at the mine and to seek feedback from the Technical Advisory Committee (TAP) on our proposed study design for the Polaris Mine. Following our presentation, Ms. Sandra Blenkinsopp pointed out that two sampling events were indeed required under MMER. She then indicated that Environment Canada would contact us to further discuss the implications of this matter.

We agree that the missed SLTT event is unfortunate and will ensure that this test is carried out twice during the 2004 and 2005 discharge periods.

Please do not hesitate to contact us if you have any questions or require further clarification.

Sincerely,
Azimuth Consulting Group Inc.

PAllard

Patrick Allard, M.Sc., R.P.Bio.

cc: Randy Baker (Azimuth)
Bruce Donald (Teck Cominco)

Environment Canada
Environmental Protection Branch
Prairie and Northern Region
Northern Division
P.O. Box 1870 Iqaluit, Nunavut
X0A 0H0

PROTECTED

Occurrence File: 4408-2004-03-11-003

27 April 2004

WITHOUT PREJUDICE

Mr. David Thompson
Deputy Chairman and CEO
Teck Cominco Metals Ltd.
Suite 600 – 200 Burrard Street
Vancouver, British Columbia
V6C 3L9

and

Mr. John Knapp
Manager of Operations
Teck Cominco Metals Ltd.
Polaris Mine Operation
Polaris, Little Cornwallis Island, Nunavut
X0A 0Y0

RE: ***FISHERIES ACT;***
Metal Mining Effluent Regulations, Environmental Effects Monitoring
Part 1, Section 6(1)

The purpose of this correspondence is to remind Teck Cominco Metals Ltd. and John Knapp, in his capacity as Manager of Operations, Polaris Mine, in the Territory of Nunavut, of their obligations under the Environmental Effects Monitoring provisions of the Metal Mining Effluent Regulations of the *Fisheries Act*. It relates to a report of February 24, 2004 by Azimuth Consulting Group Ltd., acting as an agent for Teck Cominco Metals Ltd. and its officers. This correspondence sets out in writing the circumstances surrounding a failure to collect the appropriate samples as outlined within the regulations to wit: Part 1, Section 6, Environmental Effects Monitoring Studies of the Metal Mining Effluent Regulations.

../1

On 24 February 2004, Azimuth Consulting Group Ltd. had discussions with Environment Canada's Prairie and Northern Region, Senior Environmental Effects Monitoring Coordinator, Sandra Blenkinsopp. It was at this time that the deficiency in sampling was noted by Environment Canada. Azimuth Consulting Group acting as a contractor for Teck Cominco Metals Ltd. stated it had only collected a single sample for Sub-lethal Toxicity Testing (SLTT) contrary to the regulation requirements which required two samples to be collected.

Subsequently this matter was reported to the enforcement section of the Environmental Protection Branch of Environment Canada on the same day. Once I was notified I contacted Mr. Patrick Allard of Azimuth Consulting Group Ltd. requesting information on the circumstances surrounding this failure to meet the requirements of the Fisheries Act. Mr. Allard provided a letter to Environment Canada outlining the issues pertaining to the oversight by Azimuth Consulting Group Ltd. This letter was later also forwarded with the revised Polaris Mine - 2003 ANNUAL Metal Mining Effluent Regulations Summary Report dated March 31, 2004 and sent to Mr. Peter Blackall, Regional Director of Environmental Protection.

Environment Canada recognizes through these correspondences that Teck Cominco Metals Ltd. has taken measures to correct the aforementioned situation. Accordingly, a formal Warning Letter will not be issued in these circumstances.

This correspondence is intended to bring this matter to your attention in order for you to take necessary action to prevent a repeat of the circumstances described herein. In conclusion no further enforcement action is being considered or deemed warranted at this time. Environment Canada will be closing our file on this incident.

If you have any questions or require clarification, please contact the undersigned at (867) 975-4644.

Sidney Frank Bruinsma
Fisheries Act Inspector

cc: Craig Broome – Head of Enforcement Environmental Protection
Prairie and Northern Region, Environment Canada

teckcominco

Bruce J. Donald
Reclamation Manager

April 27, 2004

Prairie & Northern Region
Environment Canada
Room 200, 4999 98th Ave.
Edmonton, AB T6B 2X3

Attention: Peter Blackall, Regional Director of Environmental Protection

Dear Sir;

Re: Polaris Mine – Alteration of System at Final Discharge Point at Garrow Dam

As required under Section 10(2) of the Metal Mining Effluent Regulations, please be advised that the siphons at Garrow Lake dam will not be used for discharging effluent this summer. As part of our decommissioning and closure activities, the dam is being partially decommissioned with a channel constructed through the decommissioned portion of the dam. Flow through the dam will be via the original creek channel starting with this year's effluent discharge season. Sampling of the effluent will be continued from the same location as in previous years so that a change in the location of the Final Discharge Point is not being contemplated.

Yours truly,

Original signed by B. Donald

Bruce Donald

cc:

Walter Kuit (Teck Cominco Limited)
Bob Hutchinson (Teck Cominco Limited)
Trevor Feduniak (Teck Cominco Limited)
Joe Dahoy (Cascade Mgmt)
Randy Baker (Azimuth Consulting Group)

Polaris Mine EEM - Outline of Study Design for Biological Monitoring Studies

Highlights:

- Program builds on 1) results of historical studies covering pre-mining and operational periods; 2) findings of 2003 reconnaissance studies (i.e., field effluent plume delineation, underwater video survey, fish survey, and sediment survey); 3) theoretical effluent plume modeling; and 4) considerable feedback obtained during consultations with the Technical Advisory Panel (TAP) as part of two workshops (April and December 2003) and follow-up discussions.

- Approach consists of a Control/Impact design focusing on one high exposure area (i.e., aquatic receiving environment that is nearest to the mouth of Garrow Creek and that contains an appropriate habitat type with sufficient geographic area to accommodate the necessary number of replicate stations; Environment Canada, 2002) and one reference area. Both areas are located in Garrow Bay, approximately 1 km apart (see attached figure).

- Our rationale for targeting one high exposure area, rather than multiple near-field and far-field exposure areas, follows guidance from Environment Canada (2002) and reflects findings of the 2003 reconnaissance studies which clearly indicated the lack of an exposure gradient between the mouth of Garrow Creek and the reference area.

- The field program is planned from August 11th - 25th 2004, when the likelihood of safe access to Garrow Bay for sampling is optimal.

- Standard and accepted QAQC procedures will be used throughout the program.

- The proposed study design is optimistic. While every attempt will be made to achieve the goals of the program, field conditions and safety issues may require us to focus on a few priority study components. As discussed with members of the TAP, all clam, benthos, and sediment collections will be diver-assisted, so local weather and ice conditions will dictate level of effort. We propose the following priorities and would appreciate feeback from the TAP: 1) fish survey and tissue analyses; 2) supporting environmental variables (water and sediment quality surveys); 3) SIMS survey (faster to accomplish and provides semi-quantitative basis for evaluating any gross impacts to marine communities); and 4) benthic invertebrate community survey (time intensive given replication required to achieve statistically sound assessment).

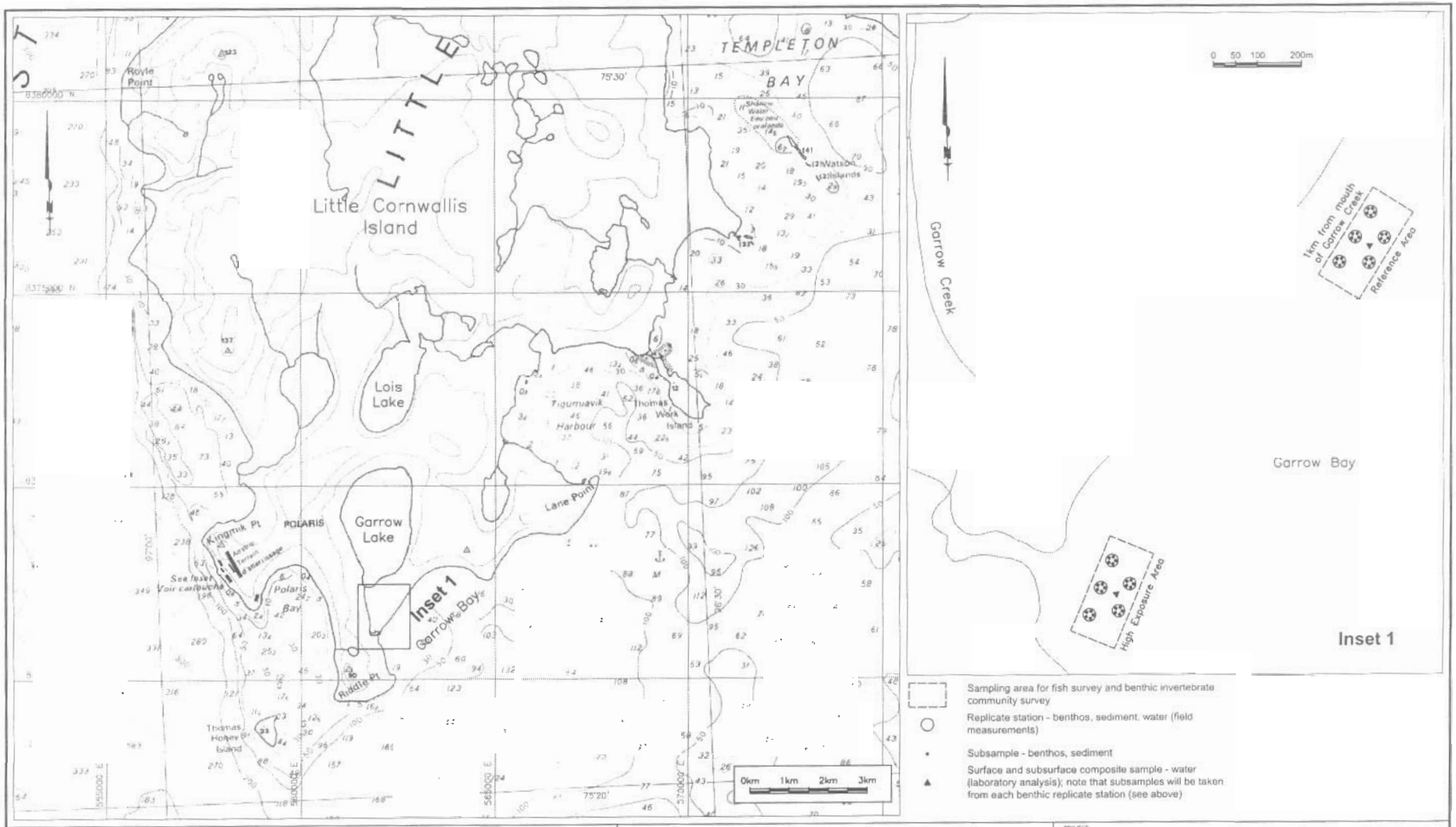
Study Component	Sampling Areas	Sample Size and Replication		Mesurement Endpoints	Sampling Method
Fish Survey and Tissue Analyses - Species selected: softshell clam (*Mya truncata*)	**Garrow Bay high exposure area**: located in the area closest to the mouth of Garrow Creek where sufficient clams can be collected (approx. 6 - 8 m depth)	- Target of 40 clams[1]	- Individual clams	- Length - Width - Whole animal wet weight - Shell weight - Soft tissue fresh weight - Gonad fresh weight Sex Condition index Gonadosomatic index[2]	- Diver-assisted sampling; collection of individuals by hand, only intact clams will be retained
			- 4 soft tissue composites of 10 undepurated clams	- Tissue chemistry: moisture and lipid content, suite of metals	
	Garrow Bay reference area: located approximately 1 km to the northeast, upstream of the predominant current direction (approx. 6 - 8 m depth)	- Target of 40 clams[1]	- Individual clams	Same as high exposure area	Same as high exposure area
			- 4 soft tissue composites of 10 undepurated clams	Same as high exposure area	
Benthic Invertebrate Community Survey	**Garrow Bay high exposure area**: located in the area closest to the mouth of Garrow Creek where benthic communities can be sampled (approx. 6 - 8 m depth)	- 5 replicate stations (approx. 10 m x 10 m each and separated by approx. 50 m)	- 5 x 1L subsamples per station	- Total invertebrate density - Taxon richness - Simpson's diversity index - Bray-Curtis index - Evenness - Taxon density Taxon proportions - Taxon presence/absence	- Diver-assisted sampling; upper 10 cm of sediment will be collected for each subsample using a 1L plastic container - All 5 x 1L subsamples for a given station will be physically pooled prior to processing - Processing will be performed using a 1 mm mesh size - Identifications will be performed to the lowest practicable taxonomic level
	Garrow Bay reference area: located approximately 1 km to the northeast, upstream of the predominant current direction (approx. 6 - 8 m depth)	- 5 replicate stations (approx. 10 m x 10 m each and separated by approx. 50 m)	- 5 x 1L subsamples per station	Same as high exposure area	Same as high exposure area

Polaris Mine EEM - Outline of Study Design for Biological Monitoring Studies

Study Component	Sampling Areas	Sample Size and Replication		Mesurement Endpoints	Sampling Method
Supporting Environmental Variables					
- Water quality monitoring	**Garrow Bay high exposure area**: location matching fish and benthic survey sampling area	- 5 replicate stations for field measurements (matching benthic replicate stations)	- Measurements made at 1 m depth intervals	- Field measurements: DO, pH, temperature, salinity, transparency and water depth	- Calibrated YSI meter, pH probe, and depthmeter will be used for all field measurements - Surface water samples will be collected directly into sample containers; all 5 subsamples for a given sampling area will be composited prior to analysis - Subsurface sampling will be conducted using divers; care will be taken not to disturb sediments during sampling; all 5 subsamples for a given sampling area will be composited prior to analysis - Timing of sampling will match routine MMER effluent characterization as well as EEM effluent and water quality monitoring
		- 1 composite surface sample for laboratory analysis	- 5 subsamples matching benthic replicate stations	- Laboratory analyses: pH, temperature, DO, hardness, alkalinity, Al, As, Cd, Cu, cyanide, Fe, Hg, Pb, Mo, Ni, Zn, TSS, ammonia, nitrate, radium 226	
		- 1 composite subsurface sample for laboratory analysis (0.25 m from bottom)	- 5 subsamples matching benthic replicate stations		
	Garrow Bay reference area: location matching fish and benthic survey sampling area	- 5 replicate stations for field measurements (matching benthic replicate stations)	- Measurements made at 1 m depth intervals	Same as high exposure area	Same as high exposure area
		- 1 composite surface sample for laboratory analysis	- 5 subsamples matching benthic replicate stations		
		- 1 composite subsurface sample for laboratory analysis (0.25 m from bottom)	- 5 subsamples matching benthic replicate stations		
- Sediment quality monitoring	**Garrow Bay high exposure area**: location matching fish and benthic survey sampling area	- 5 replicate stations (matching benthic replicate stations)	- 5 subsamples (matching benthic subsamples) per station	- Sediment chemistry: TOC, grain size, suite of metals	- Diver-assisted sampling; upper 10 cm of sediment will be collected for each subsample using a 1L plastic container - All 5 subsamples for a given station will be composited prior to analysis
	Garrow Bay reference area: location matching fish and benthic survey sampling area	- 5 replicate stations (matching benthic replicate stations)	- 5 subsamples (matching benthic subsamples) per station	Same as high exposure area	Same as high exposure area
Additional Studies - Seabed Imaging and Mapping System (SIMS)	**Garrow Bay high exposure area and Garrow Bay reference area**	- Numerous georeferenced tracklines within each area	- Continuous imagery	- Seabed classification maps including: substrate type, vegetation type and cover, distribution and relative abundance of macrofauna	- Towed underwater camera (SIMS) providing semi-quantitative survey of physical and biological features of the seabed

[1] During the 2003 reconnaissance studies, a total of 29 clams were collected by divers; access to Garrow Bay for diving was limited to 3 out of 14 field days due to harsh weather conditions (e.g., presence of ice flows, strong winds, blizzard). Every effort will be made during the 2004 field program to meet the mininum EEM requirement of 40 individuals per sampling area; however, the total sample size may be limited by field conditions. In addition, the inherent difficulty in identifying clam sexes in the field may result in a departure from the requirement for 20 males and 20 females.

[2] The gonadosomatic index will be determined under the supervision of Sylvie St-Jean, National Water Research Institute. The sample size will be assessed once field work is completed.



Inset data and surrounding creeks digitized from Map 1: Sampling Sites 1980 prepared by B.C. Research January 1978

Other data from Crozier Strait And/Et Pullen Strait 7935 corrected 2003-03-28 published by the Canadian Hydrographic Service

AZIMUTH
Azimuth Consulting Group Inc.
218-2902 West Broadway
Vancouver BC, V6K 2G8

DRAWN BY	CHK. BY	PROJECT No.
BT	PA	TC-03-03
	DATE: 3/6/2004 1:04 PM	

PROJECT: Polaris

TITLE: **Polairs Mine EEM**
Study Design for Biological Studies

CLIENT: Teck Cominco

Figure 1

Review of Polaris Mine EEM
Study Design Outline for Biological Monitoring Studies

Highlights Section
The benthic survey component should be given the 3rd priority rather than the 4th priority. The benthic survey is a main EEM component. If time becomes an issue, the TAP recommends that sediment and water quality sample collection be reduced as indicated in the comments below.

Fish Survey and Tissue Analysis
Gonad dry weight and animal height should be added to the list of measured endpoints.

Benthic Invertebrate Community Survey
The MMER TGD recommends that in marine systems, a stacked set of 1.0 and 0.5 mm screens be used in the field with the 0.5 mm samples being archived and processed only if appropriate.

Benthic Supporting Environmental Variables (Chapter 5 of TGD)
Please see Table 5-7 of the MM TGD for the recommended supporting explanatory variables to be measured at each station in marine/estuarine benthic invertebrate habitats. In addition to the parameters listed in your outline, this table also recommends that dissolved oxygen near the bottom, sediment Eh (redox) and sediment total sulfides, as well as substratum characteristics be measured at each benthic station.

If time is limiting, the TAP recommends that **one sediment sample be collected per station** at the same time as the benthic invertebrate sampling.

Water Quality Monitoring during biological field work (Chapter 6 of MM TGD)
If time is limiting, the TAP recommends that the water quality sample collection work be done within each fish and benthic invertebrate sampling **area at one representative station** (pg 6-5, MM TGD).

Field Measurement of Water Quality Parameters - Please note that when water depth is greater than 4m, the standard water quality parameters measurable in the field should be taken throughout the water column at one to five metre intervals depending on total depth (pg. 6-9 MM TGD). The TAP recommends that the interval at which measurements are taken be less than every meter in the upper portion of the water column, in order to pick up where the freshwater lens is, etc. It is also recommended that conductivity be added to the list of standard field measurements.

Collection of Water Samples for Laboratory Analyses - The water collected for laboratory analyses of water quality should be collected at 2 depth intervals: the subsurface and near bottom (pg. 6-10 MM TGD), as described in your outline.

FINAL MEETING MINUTES

ENVIRONMENTAL EFFECTS MONITORING
STUDY DESIGN MEETING
POLARIS MINE (TECK COMINCO) & TECHNICAL ADVISORY PANEL
Tuesday, December 16, 2003
1:00 p.m to 5:00 pm.

Bev Burns Boardroom, Environment Canada, Edmonton

Attendees:

Bruce Donald	Teck Cominco, Cranbrook
John Knapp	Teck Cominco
Randy Baker	Azimuth Consulting Group Inc., Vancouver
Patrick Allard	Azimuth Consulting Group, Inc., Vancouver
Dionne Filiatrault	Nunavut Water Board, Gjoa Haven
Chris Baron	F&O Canada, Winnipeg
Meighan Wilson	Indian and Northern Affairs, Yellowknife
Stephen Harbicht	Environment Canada, Yellowknife
Sandra Blenkinsopp	Environment Canada, Edmonton
Jenny Ferone	Environment Canada, Edmonton
Paula Siwik	Environment Canada, Edmonton

1. Attendees introduced themselves.

2. No additional items were added to the agenda.

3. Review of the objective: To discuss the findings of the August 2003 reconnaissance studies, and to incorporate these findings into a revised EEM study, scheduled for August 2004.

4. Results of the August 2003 field reconnaissance studies on water chemistry, toxicity testing, plume delineation & modeling, sediment chemistry, benthos, and fish were presented by Randy Baker and Patrick Allard. Their presentation is appended (a hard copy will be sent with the final version of the minutes). An underwater video clip was also viewed. Information from the video presentation and slide presentation is appended at the end of the minutes.

5. General Discussion on Study Design Key Components

Adult Fish Survey

- Given that fin fish were found to be very rare in Garrow Bay, clams will be used in lieu of fin fish.
- The sampling design for collecting clams was discussed, given the limitations on the divers (2 dives per day, approximately 30 -35 minutes per dive). If discrete sampling stations are used similar to a benthic invertebrate sampling design with 5 stations, the divers will only be able to collect about 5 clams per station. Further discussion is needed to confirm if 20 - 25 clams, for example, are sufficient given the variability in a natural population. Another option is to collect clams on a per area basis.
- The range of EEM endpoints found in the MMER EEM Technical Guidance for caged bivalves should be measured on the wild clams, e.g. length, width, etc. (Note: The information is found in the Alternative Monitoring Chapter - Chapter 12).
- The exposure area clams should be collected along the first depth contour where clams are exposed to the effluent from Garrow Creek. This would probably be at the 5 to 6 m depth. Note: Steve Harbicht wants to see solid baseline data from this area in the event that Garrow Lake has a release in the future.
- The reference area will be in the subtidal area to the north of the mouth of Garrow Creek. The reference area clams will be collected along the same depth contour as the exposure area clams to remove the effect of depth. Note that results from the reconnaissance work indicated that metal levels in clams and sediment in this area as well as in the exposure area were similar to background concentrations measured in Tigumiavik Harbour.
- Exposure will be assessed by conducting soft tissue analyses for a suite of metals.

Action Item: Sandra Blenkinsopp to collect information on wild clam sample size. Done - Sandra spoke with Dr. Sylvie St.-Jean en route to the EEM Science Symposium. Dr. St.-Jean suggested a minimum of 40 clams of each sex per area, which usually requires a field collection of about 120 clams.

Action Item: Sandra Blenkinsopp will send Sylvie St.-Jean's contact information to Patrick so that he can get the current information on reproductive endpoints, which are under development. Done. Patrick and Sylvie have discussed the study. Patrick indicated that it was agreed that while 40 clams of each sex per study area would be ideal, it is unlikely that such a large sample size can be achieved due to sampling limitations in Garrow Bay (e.g., diver-assisted, ice flows, weather conditions, etc). Rather, it was agreed that 40 clams total per study area will be targeted. While 20 males and 20 females are recommended for the fish survey, it was acknowledged that difficulties in sexing clams in the field may result in departures from this target ratio.

Benthic Invertebrate Community Survey

- Grabs from the surface will not work because the sediments are too hard.
- Could use diver-assisted cores or quadrats
  - Cores – subsurface too hard
  - Quadrats – difficult because of kelp beds
- Could do a combination – SIMS and diver assisted cores or through-ice cores.
- Benthic stations (5 per area) will be located along a depth contour (approx. 6 m) to remove effect of depth, using same areas as clam survey.
- Patrick suggested divers could use a 1L wide-mouth jar, and drag it at a consistent depth and in a consistent manner until full. Used this method at Burrard Inlet.
- TAP suggested increasing subsamples per station and using a smaller volume. Could possibly do 2 to 3 subsamples per 500 mL jar.
- Use of amphipods briefly discussed (& subsequently discarded).
- Unlikely to have enough time to collect samples from a far-field site. (Note to TAP: a far-field benthic site is not required for an initial MMER EEM survey.)
- SIMS will be back-up, used in same area.

Sediment Collection

- Grabs will not work because the sediments are too hard (see benthic above).
- Steve Harbicht asked about the sediment chemistry with respect to the digest, etc.

Action Item: Sandra Blenkinsopp to confirm if sediment is to be collected per station. Done - Sediment sampling is to be done at each benthic station.

Action Item: Sandra Blenkinsopp to check sediment chemistry guidance for marine environments to determine recommended digestion process for EEM. Status: In Progress.

Effluent and Water Quality Monitoring

- The effluent and water quality monitoring, which includes effluent sublethal toxicity testing, must continue for the full 3 year period until the mine receives recognized closed mine status
- Two effluent samples must be collected for sublethal toxicity testing per year. The mine indicated that it had only collected one in 2003 in 9 weeks of discharge.

Action Item: Sandra Blenkinsopp to follow up with Patrick Allard. Done. The 2004 and 2005 monitoring events will include two samples for sublethal toxicity testing.

Timing of Survey

- Survey will be conducted approximately Aug 10 – 25th, 2004.

- Based on experience during the field reconnaissance survey last year, ½ of days up there might be working days.
- Field support for divers was discussed. A lot of the infrastructure will be gone and the medical facility will be decommissioned by August. Sandra Blenkinsopp suggested that it may be better to sample in May through an ice platform when more infrastructure was present at the site. Bruce Donald indicated that effluent wouldn't be flowing in May. Sandra Blenkinsopp has discussed this site with the National EEM Office, and the National EEM Office indicated that the effluent would not have to be flowing during sampling at this site. The consultants decided to work in August. They want to concentrate on open water sampling.
- If due to inclement weather or other difficulties the survey can't be completed, Patrick asked what happens, and the following summarizes the discussion:
  - Sandra Blenkinsopp indicated that the consultants should keep in touch with her or the Authorization Officer (AO) during the field work so that the TAP can be informed if weather is causing a problem, etc., Weather problems, communications with EC, etc., should be documented by the consultants for use in writing up the interpretive report. **Human safety is of primary importance.**
  - Sandra indicated that two weeks is an acceptable level of effort to attempt to achieve the objectives of the field survey.
  - Fall-back position – Combine 2 years of data.
  - Jenny Ferone suggested prioritizing elements of study, e.g. collect clam biological endpoints first.
  - Seabed Imaging and Mapping System (SIMS – see below) will be a backup, since it will be done in the same area. There is value in having both – cores and visual.
- First weekend of September in 2004 – sea-lift. Everybody and everything goes.

Seabed Imaging and Mapping System (SIMS) – The consultants indicated that there is a F&O requirement for SIMS to be done at the dock site now that the dock structure has been removed. Ten to 15 m intervals parallel to shore will be done, followed by tows perpendicular to shore, and then oblique tows. Abundance, and presence / absence will be noted, as well as depth. Drop camera, magnify and do quadrat survey. This is a semi-quantitative method.

6. Steps Forward
   - Sandra Blenkinsopp to distribute minutes
   - Azimuth to finalize study design. Anticipate a 2 to 3 month turn-around time.
   - Randy will make a copy of the video for EC (Received by Edm Office January 7, 2004).

Video and Slide Presentation

Notes from video presentation:

- Video taken first weeks of August 2003
- Thin layer of sand/silt over cobble and gravel
- One fish; Clouds of amphipods (mysids)
- Starting at mouth of creek and moving out
- Ice scour area – rocky, no kelp
- Lot of cobble and gravel and attached kelp typical of 5 to 8 metres depth, 150 – 200 m offshore
- Stark difference in kelp/benthic community abundance between scoured intertidal and subtidal area
- Maximum depth sampled approximately 8 m. Floats were set for the collection of clams at approximately 8 m.
- Clams in softer sediments as well as between larger substrates
- Looking for clams as near to shore as possible, looking for siphons that stick out of the sand. Suspended material hung in water column
- Collected paired sediment and clam tissue samples
- Sediments collected by hand into jar prior to clam collection
- Clams (*Mya truncata*), 17 - 50 g wet body weight, approx. 4 size classes (17-19, 32, 40, & 50 g)
- Dragged a zooplankton net in shallows and collected specimens. Made a representative zooplankton collection.
- Water temperature was -0.5 to -1 ^{o}C water temp, 0 ^{o}C at surface
- 30 to 35 minutes per dive

Slide 4 - Garrow Lake Effluent Characterization

- Collected water samples weekly
- Early in the year the freshwater ice melt causes a drop in salinity
- Garrow Lake is siphoned over the dam then flows by gravity.
- Garrow Creek typical discharge was 0.1 to 0.2 m^3/s. Spring flow generally 1.5 to 2 m^3/s.
- Flow rates are higher this year because more siphons were on line.
- Approximately 20 cm remains to get lake down to level. The dam will be opened for this.
- Garrow Lake sampling performed for Fisheries & Oceans Canada in August 2003: Captured 19 sculpins, sacrificed 11; Zooplankton
- Garrow Lake top 9 or 10 m was brackish water; 2 ppt down to 7 or 8 ppt. Transition zone at 10 or 11m when salinity went from 10 to 60 ppt. Pretty well uniform at 60 ppt to bottom. Temperature inversion – about 8^{o}C at bottom.

Slide 6 – 2003 Effluent Chemistry Data

- BC Aquatic Water Quality Guidelines are marine limits based on toxicity to algae with a 2 fold safety factor

Slide 7 – Contaminants of Potential Concern

- Concentration of Zinc – low initially at ice melt and then increases
- Bruce Donald indicated that in the future Zinc concentrations should be lower, since only meltwater should be drawing down.
- High Pb, reason not known. Could have been due to new siphons.

Slide 8 – Effluent Characterization - Sublethal Toxicity Testing

- Didn't miss any holding times for getting samples to the toxicity lab in Vancouver.
- Acute Lethality Tests – included salinity controls
- SLTT – 72% v/v highest effluent concentration tested; used sea salts
- Randy Baker asked if other mines are doing the salinity adjustment. Sandra B indicated that for marine tests the standard protocol is to adjust salinity.
- Note: Only one effluent collection for SLTT was done. The mine discharged for approximately 9 weeks.

Slides 10 & 11 – Effluent Characterization - Sublethal Toxicity Testing

- Think Zinc was the cause of the toxicity. Paired samples - one for toxicity and one for chemistry.
- Arctic amphipods used by Peter Chapman were collected from discharge environment. Temperature known to affect toxicity. The higher the temperature, the higher the toxicity.

Slide 12 to 13 - Reconnaissance Studies in Garrow Bay

- 16' boat, rifle, communications – radio to mine
- Plume Delineation was done using a boat and chest-waders

Slide 14 to 20 – Plume Delineation

- Chest waders and boat survey, working from outside in
- Field measurements taken of temperature, salinity and zinc concentration
- Samples collected at surface (top 30 cm) and subsurface (10 cm off bottom)
- Effluent was 40 cm 'thick' at mouth of Garrow Creek and decreased to 10 to 20 cm 'thick' 200 m offshore
- At about 25 to 26 ppt salinity, Zinc was down to 0.05 mg/L (detection limit)
- Negative regression between zinc concentration and salinity
- Ice present in bay really accelerates mixing process as plume moves around and under ice blocks.

Slide 21 Modeling - Frick *et al.* 2003 EPA visual plumes software

- Wind and current influences mixing.
- No ice involved in model
- In the future, discharge will be approximately 1/5 to 1/10 of what it was in 2003

Slide 27 – 2003 Reconnaissance Design

- Had planned to use Tigumiavik Harbour as a reference area, but access was too difficult.
- Reference was moved to approximately 500 m north of Garrow Creek mouth, based on results of plume delineation.
- Water Quality Monitoring as well as sediment and clam tissue data indicate background conditions.

Slide 28
- Previous surveys, clams collected under ice but tried to get clams from closer to the creek mouth this time using divers. Intertidal area devoid of life except for amphipods.
- 2 reference areas, one for intertidal and one for sub-tidal, access limited.
- Plume moved both ways, went far enough away north/south to be out of the plume. Also suspected a back eddy but wind a bigger issue.
- Three exposure stations sampled & 1 reference– were limited by divers and clams.

Slide 30
- Prawn trap was baited with cat food. Worked very well in Garrow Lake when baited with cat food. Tried in marine environment – amphipods ate cat food. Was crushed by ice on second night.
- Clams – composited 3 to 4 clams per size category and analyzed composite.

Slide 31
- N=3 means 3 composite samples each comprised of 3 to 4 clams
- Metal suite on body tissue
  - Intended to depurate but not enough clams
  - Pulled them out, put them in bags, scrubbed them in lab, pulled siphon and cleaned as best as could
  - Results include everything: siphon, sediment, gut contents, etc.
- No relationship between size and metal concentration

Slide 32 – Historical Metals Concentrations in Clam Tissue
- Fallis' historical clam data was on depurated clams. Sample size is number of composites in all cases except for BC research who analyzed individual clams.

Slide 34 – Sediment Survey
- Unable to collect sediment with standard Ponar grab
- Recovered kelp on gravel most times in spaces allowed for water movement
- Rate of failure consistent between near-field, far-field and ref area

Slide 35 – Metal Concentrations in Sediment 2003
- Intertidal concentrations higher than sub-tidal concentrations.

- Did analysis on 2mm (sand) fraction and down. In both subtidal and tidal targeted fine sediments.
- Note: likely the first metals data for intertidal sediment collected at this site.

Four options raised for discussion:

- conduct an EEM compliant study design
  - consultants don't think this can be done
- conduct a limited field study using alternative tools
  - diver assisted clams and sediment
    - underwater imagery (SIMS)
    - F&O Canada requires SIMS for intertidal areas by barge
- No further biological monitoring
  - Continue effluent and water quality monitoring
- Other?

Donald Bruce KIMB

From: Donald Bruce KIMB
Sent: August 18, 2004 3:59 PM
To: 'Blenkinsopp,Sandra [Edm]'
Cc: 'Beth Power'
Subject: Polaris EEM Program Update

I just got a call from Randy Baker via the satellite phone from site. The phone system at site is not demolished (and thus no email either) along with the Accommodation Building (so the crews are now living in Sea Containers and Trailers in the temporary camp). The satellite phones do not have good connections and the signal is often distorted. The connection breaks off frequently so they need to call back two or more times to accomplish a 5 minute call.

The 3 Azimuth scientists and the two divers they contracted are on site now. They arrived August 14th as planned. They have all their gear mobilized including the sampling equipment and bottles. We have left a rental compressor on site for the divers (they have to fill their bottles on site as can't ship them full on the airlines). They have set up a tent for shelter by the bay (for the divers) and we have assigned them access to quads for transportation as well as two boats. We purchased one of the boats specifically the EEM program and flew it in during the winter so that they would have a second boat as a safety back up. The winds in Garrow Bay can get fairly strong so we need to be able reach them incase they run into trouble in the first boat. Last year we used an older boat as the backup but it is not adequate for safety and we should have had something more reliable last year. They have the SIMS gear on site with them as well, so are ready to do the video survey.

Randy asked that I pass on to you that they are currently waiting for the ice to free up in Garrow Bay. Last year the ice was off the bay at this time. Randy is concerned that the ice may not leave the bay this year. As we committed, we are having them remain on site for two weeks incase the ice is just a bit later leaving this year. We mutually agreed with Environment Canada that a two week period was as an acceptable level of effort. Hopefully we get a strong wind that frees the ice so we can complete the planned work program.

For your information, we collected our monthly water samples from Garrow Creek yesterday as well as the sub-acute samples. However, it was foggy today so the plane from Resolute was unable to come into site but it didn't really matter as it doesn't look like the commercial flights could make it into Resolute today either. There is a slim chance the weather may change and the plane will try later today but it is a slim chance. Will try to sample again if it looks like the flight can get in tomorrow. If there isn't a flight tomorrow, then we'll try again next Tuesday.

Randy will try to give you a call in a few days to update you directly.
I am in contact with the site on a regular basis incase you want to pass any messages onto them.

Regards,
Bruce Donald