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PART 2: CRITICAL REVIEW OF THE ECOLOGICAL RISK ASSESSMENT CONDUCTED AT THE NANISIVIK MINE

1.0 INTRODUCTION

Jacques Whitford Environment Limited conducted human health and ecological risk assessments at the Nanisivik Mine (Nunavut) to evaluate the potential for detrimental effects based on the existing contaminant concentrations and future use of the property after mine closure. This critical review is limited to the ecological risk assessment (ERA). A separate review will be conducted for the human health risk assessment. In addition, the results of the ERA were used to develop site-specific threshold limits (SSTLs) for contaminants in surface material in and around the mine. Subsequently, these SSTLs for ecological effects were compared with the SSTLs for human health and the lesser of the two values were identified as the "Soil Quality Remedial Objectives.

Overall, the ERA is well-organized and uses a format that is easily followed. This ERA is conservative in its conclusion, as risk assessments usually are, and this review can find no serious fault with the conclusions. There are a few minor errors or omissions that do not influence the conclusions. There are also several questions raised by some of the statements made in the ERA, but again these have no effect on the conclusions.

2.0 ORGANIZATION OF THE ERA

Section 7.0 (Ecological Risk Assessment) seems to jump immediately into the discussion of trace elements as the contaminants of potential concern. A sentence or two regarding the lack significant amounts or the absence of other categories of contaminants (e.g. hydrocarbons) would seem appropriate to get everything else "out of the way" so that the ERA could proceed.

3.0 TERMINOLOGY, CENTRAL TENDENCY AND THE CONCEPTUAL MODEL

Having examined the Phase II Environmental Site Assessment, the authors of the ERA should probably have given some thought to whether they should be referring to the surface material at Nanisivik as "soil" (see the review of the Nanisivik Phase II Environmental Site Assessment).

In section 7.1.5 (Surface Water) the statement is made (on page 53) the "EPCs for each metal were calculated as arithmetic mean total metal concentrations (mg/L), based on 2001 data as shown in Table 7.3." This seems to conflict with the statement made in the first paragraph of Section 3.6 that states: "All data were found to be log-normally distributed, hence the EPC and BSC were calculated as the 95% UCL on the geometric mean of the log-transformed data." If the trace element concentrations in water were log-normally distributed, the geometric mean should be a better measure of central tendency than the arithmetic mean.

The conceptual model (Figure 8) appears complete, but shouldn't there be a connection between "surface soil" and "surface water" to account for surface water runoff? Surface water runoff (from snowmelt water) would seem to be a mechanism whereby trace elements would have the potential to be transferred from the solid surface material to a solute in surface water. Should water associated with the tailings also be identified as a pathway from the solid material to aqueous dissolution in surface water?

4.0 RECEPTOR IDENTIFICATION, EXPOSURE & HAZARD ASSESSMENTS

The discussion of receptor identification, exposure assessment and hazard assessment seem appropriate to the conditions at Nanisivik and the availability of data. One question that might be asked with respect to the section on exposure assessment is the effect of snow cover that occurs approximately eight months of the year. Although, discussion is provided concerning the lemming and its winter habitat in spaces between the snow and surface material, would the fact that the surface material is frozen reduce the exposure of this animal to the trace elements? Would the snow cover reduce the exposure of the Arctic fox to trace elements? If snow cover does reduce, in some fashion, the exposure to trace elements in the surface material, it would seem to reduce the hazard posed by the specific elements identified as contaminants to an even greater degree than currently calculated.

5.0 THRESHOLD LIMITS, ASSUMPTIONS AND UNCERTAINTIES

The discussion and calculation of threshold limits are appropriate to the available data. The evaluation of assumptions and uncertainties is very well accomplished in the tabular format. This review is in agreement with all that is discussed in these sections.

Perhaps, an additional entry concerning the effect of snow cover for eight months would have been appropriate here. The issue of using the 95% upper confidence limit of the geometric mean certainly appears to be a "worse case scenario." One question that is raised regarding this issue is the pervasiveness of the contamination. Can the contamination be characterized as slightly elevated over the entire area or highly elevated at a few so-called "hot spots?"

The bioavailability of ingested trace elements was assumed to be 100% in this risk assessment. However, this has been known not to be the case for over 30 years. Reference to general texts related to trace element metabolism and toxicity such as Venugopal and Luckey (1978) would provide a more realistic, and yet still conservative (and still worse case) value for intestinal absorption. The differences between a non-essential trace element such as lead and an essential trace element (such as zinc) that is homeostatically controlled by mammalian physiology would also help to present a truer picture of the extremes caused by the assumed 100% bioavailability. In ecological risk assessments, there always exists a high probability that the "worse case" scenario becomes the "impossible case" scenario.

6.0 CHEMICAL INTERACTIONS

Section 7.9 (Chemical Interactions) is a good introduction to uncertainties that revolve around the metabolism of trace elements. In hindsight, of course, more is always possible. The presence of metallothioeins in mammals should have been at least mentioned, if only in one sentence.

7.0 SOIL QUALITY REMEDIAL OBJECTIVES

If there is one sentence in this ERA that should be copied and placed much further forward in the text in bold font (e.g. in the introduction), it is the first sentence of the last paragraph in Section 8.0. It gives a perspective that should be realized from the outset.

Note that Table 8.2 contains an error concerning the final SQRO for lead. It would appear to be 4,600 mg/kg rather than 4,500 mg/kg. The 4,500 mg/kg value is repeated again in Table 8.4.

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7.0 SUMMARY

The ecological risk assessment conducted for the Nanisivik Mine is a well-written and organized discussion of the potential for adverse ecological effects due to the presence of various trace elements in the Nanisivik area. This review is in complete agreement with the conclusions.

8.0 REFERENCE

Venugopal, B. and T.D. Luckey. 1978. Metal Toxicity in Mammals. Volumes 1 & 2. Plenum Press, New York.

PART 3: Review of Quantitative Risk Assessment – Nanisivik Mine, CanZinco Ltd.

1.0 Introduction

A Human Health and Ecology Risk Assessment (HHERA) was prepared by Jacques Whitford Environmental Limited (JWEL) to address contamination found at the Nanisivik Mine situated on northern Baffin Island, Nunavut (Site)[1]. AMEC Earth and Environmental Limited (AMEC) was retained by Nunavut Tunngavik Inc., Department of Lands and Resources to review the risk assessment.

2.0 Objective

The objective of the review was to determine if the HHERA was conducted in a manner that adequately evaluates the human health risks.

3.0 Scope of Work

The scope of work included:

- Review of the conceptual exposure model and the assumptions used in the HHERA;
- Review exposure models to determine if they are applicable (a detailed checking of the calculations is considered outside the scope of work); and
- Review each phase of the HHERA to ensure that the process was followed correctly and that the conclusions of the HHERA are supported by the data.

To facilitate the review process, AMEC based the review on the Checklist for Reviewers found in the Ontario Ministry of Environment (MOE) "*Guidance on Site-Specific Risk Assessment for Use at Contaminated Sites in Ontario"* (http://www.ene.gov.on.ca/envision/gp/326701e.pdf) which is also a modification of the checklist described by the U.S. EPA in their "*Risk Assessment Guidance for Superfund, Volume 1: Human Health Evaluation Manual (Part A)*."

4.0 Comments and Issues

4.1 General

The site-specific objectives of the risk assessment were described in Section 1.1 of the HHERA. The objective was to "determine concentrations of potential contaminants of concern (COCs) in surface soil below which no adverse health effects would be expected." The scope of work identified three specific tasks including:

- Review, compile and summarize existing data;
- Qualitative screening of risks to identify scenarios of greatest risk; and
- Quantitative risk analysis to develop Soil Quality Remedial Objectives (SQRO) specific to the scenarios of greatest risk.

The project was designed to evaluate the risks associated with current and future exposures, not historical exposures. The risks were primarily evaluated by comparison of the surface soil concentrations of the COCs with the calculated SQROs.

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[1] Jacques Whitford Environmental Limited. 2003. Report to CanZinco Ltd. on Human Health and Ecological Risk Assessment, Nanisivik Mine, Nunavut.

4.2 Hazard Identification/Problem Formulation

4.2.1 Site Characteristics

Section 2.0 of the HHERA details the characteristics of the Site and divides it into three study areas based on future uses of the land *i.e.,* town area, dock area, and general mine area. Historical activities and facilities on the Site are also described.

Generally, the Site has been heavy industrial, principally as an underground mine, extracting lead and zinc ore. Specifically, however, there should be greater detail provided as to the specific activities within each of the individual areas. Some areas are described in later sections, but others are lacking in their description so that the reader is unclear whether the types and extent of contamination observed are consistent with the site activities.

General maps of the Site location, mine site and study areas are provided in the HHERA.

The HHERA indicates that the future land use may involve the ongoing use of the dock area as a storage facility for marine environmental response equipment and refuelling, use of area as a regional training centre for equipment operation, trades, and jobs and use of area as a military training base. As for the town facilities, there are two possibilities: demolition of all facilities within the town or transfer ownership of the town facilities to other organizations for ongoing use.

A qualitative and quantitative description of the nature of the contaminants is provided in Section 3 of the HHERA. A screening of the data was based on selection of samples within 0.3 m of the surface. Although it is typical site assessments use either 1.0 m or 1.5 m as the depth for surface soils, JWEL demonstrated adequately that the use of 0.3 m would lead to a more conservative assessment.

Since the data was derived from a number of reports, data validation is a necessary step of the risk assessment process to ensure that errors in transcription are minimized. JWEL conducted a Level 2 validation check for quality control purposes where 20% of the data was checked between the original and transcribed data. While such a process may be adequate, for this assessment where public scrutiny and confidence in the data are of paramount importance, it is suggested that the data validation should cover 100% of the data. Therefore, there can be no future criticism that the assessment might have missed something or faulty data was used.

4.2.2 Data Evaluation

The HHERA used the 95% confidence interval for the assessment. However, on page 13, it indicates that the 95% upper confidence limit (UCL) of the geometric mean of the log-transformed data was calculated for the exposure point concentration (EPC). This is different than the 95% UCL of the log-transformed distribution suggested for the EPC on page 15. Clarification should be provided on which is the value used. Typically, the geometric mean is determined by calculating the mean of log-transformed data.

Furthermore, there is no indication of how the confidence interval is derived. There are many ways that the confidence interval can be estimated based on a number of assumptions (*e.g.,* the data is normally distributed). Deviations from the assumptions may require a different approach to calculate the confidence interval. The HHERA does not provide any evidence that the data is either normally or log-normally distributed and that the method used to calculate the 95% confidence interval is applicable.

In addition, there is no indication of what proxy concentration was used for samples that had concentrations below the limit of quantification (LOQ). Typically, previous practices have used proxy concentrations of zero, ½ the LOQ, or the LOQ itself. The selection of a proxy concentration may have significant bearing on the calculation of the 95% confidence interval and the underlying assumptions regarding the data.

4.2.3 Contaminants Selected for Detailed Analysis

Screening of chemicals was conducted by comparison of the maximum concentrations with the generic guidelines. Chemicals were further screened by comparison of the EPC with the background soil concentrations (BSC). This approach is commonly accepted for determining the chemicals to be assessed in a HHERA. However, the use of Ontario Typical Range (OTR_{98}) as the representative BSC may be criticized since it can be argued that the soil conditions of the high arctic may be different than those found in Ontario. This is important in one respect because arsenic was observed to exceed the guideline in 15.6% of the Town Area data and yet was screened out because it did not exceed the OTR_{98}. Cadmium and zinc were included in the assessment with 9.48% and 4.31%, respectively of the Town Area data exceeding criteria. Because arsenic can be considered to have carcinogenic endpoints, it might be worthwhile to also evaluate the chemical, just like lead was screened out but also included in the assessment.

The HHERA compared the soil concentrations to the residential criteria for screening for the Town Area and the General Mine area and to industrial criteria for the dock area.

4.3 Exposure Assessment

The exposure assessment component of the HHERA considered most of the relevant exposure pathways for a receptor in the Town Area, Dock Area or General Mine Area.

Cadmium inhalation exposures were considered for an adult receptor. However, there is no discussion regarding inhalation exposures for lead and zinc for either the adult or toddler receptor. These exposures to lead and zinc should also be evaluated for the inhalation pathways, especially for the toddler who is a very sensitive receptor to lead exposures.

Table 6.4 describes the parameters used to calculate the appropriate SRQOs. However, the exposure duration and averaging time for non-cancer effects for a 6-month to 4-year toddler is 4.5 years. However, this might be argued that the value should be only 3.5 years.

Similarly, the soil ingestion of a toddler is 41 mg/d. Typically, CCME recommends the use of 80 mg/d for a toddler. The difference is the soil ingestion rates was based on the assumption of the period of snow cover associated with the winter months would prevent direct contact with the soil. While this is an important distinction in cancer assessments where exposures would be averaged over a lifetime, non-carcinogenic threshold exposures do not have the luxury of averaging over a lifetime. Therefore, it would be more prudent to suggest that the soil ingestion rate for a toddler should remain as 80 mg/d.

In the estimation of total daily intakes, the determination of background drinking water concentrations is based on the selection of drinking water concentrations from national surveys. The selection of median concentrations from such surveys may not be appropriate given that the area may naturally have elevated concentrations of metals due to the source geochemistry. The background drinking water concentrations should take advantage of any surface water data available from East Twin Lake where the Town sources its drinking water supply.

The exposure assessment indicated that the consumption of wild game would be considered in the HHERA. However, there is no indication in Table 6.8 that the exposure pathway was considered. Furthermore, there was no discussion on how the wildlife consumption pathway would be integrated into the process.

4.4 Toxicity Assessment

In the selection of toxicity values, a noncarcinogenic exposure limit for cadmium via inhalation exposure routes was not available. With zinc, however, the exposure limits for both ingestion and inhalation routes are identical. A review of the reference for the zinc exposure limits indicates that there is no inhalation exposure limit. It is assumed therefore, that the zinc inhalation exposure limit is based on a route extrapolation of the ingestion exposure limit. Given this, there is no indication why a similar route extrapolation was not assumed for cadmium exposures.

The HHERA used a target cancer risk of one in a million for the assessment of cancer effects. This is an extremely conservative target risk and can be considered overly protective given the isolated location of the Site and the population of residents in the area. Typically, acceptable risks in risk assessments may range from one in ten thousand to one in a million.

4.5 Risk Characterization

The risk characterization component of the HHERA focused primarily on the derivation of the safe concentration in the soil (SSTL) for noncarcinogenic chemicals and incremental risks due to carcinogen exposures. Comparisons were then conducted to evaluate the relative contribution of each of the exposure pathways on the total dose of the receptor and the tolerable daily intake of the chemical. For all of the noncarcinogens, the tolerable daily intakes were not exceeded for cadmium, lead or zinc.

However, it was not possible to evaluate these calculated SSTL since there was no worked calculation demonstrating how the SSTL was derived. The generic equation and parameters were provided in Appendix C, but not the worked example. Typically worked examples are given to indicate that the calculations in the HHERA were correctly calculated.

Similarly, it was shown in the risk characterization that wild game consumption was a viable exposure pathway. However, there is no discussion or calculations showing how the predicted intake by this pathway was calculated. It is unclear how the soil concentration was used to determine a tissue concentration in the wild game and eventually a dose into the human receptor. There was insufficient information on this to adequately validate the mathematical models used to evaluate this exposure pathway.

Carcinogenic risks were evaluated using a composite receptor rather than just evaluate the risks for an adult receptor. The CCME approach typically assesses the carcinogenic risks for an adult receptor. There was no discussion regarding the deviation from the CCME protocol, especially since the rest of the HHERA had adopted the CCME approach.

In the Uncertainty Analysis, there was discussion of summing hazard indices between compounds. However, the HHERA did not calculate any hazard indices and therefore, these comments are unnecessary.

5.0 Conclusions

Based on the review of the HHERA, AMEC is of the opinion that the assessment adequately addresses the potential risks to human receptors at the Nanisivik Mine. The issues identified above, once addressed, are not significant enough to invalidate the HHERA.

AMEC Earth & Environmental Limited

6.0 ENVIRONMENTAL

On October 25th and 26th, FSC Architects and Engineers, conducted an environmental sampling process on a selected group of houses identified by the environmental soils report. Based on this report, four (4) houses(approximately 10% of the total number of units) were used for the environmental sampling process. The previous report indicated high concentrations of zinc, lead and cadmium throughout the Nanisivik town site.

Using sampling procedures determined by the FSC Environmental Department, eleven (11) samples were obtained from each of the four houses, each consisting of a sample size of approx 10cm x 10cm and are as follows

- 6 dust samples taken from various parts of the house (return and supply duct work, window sills in the living room and a bedroom, closet located next to the bathroom and a sample obtained from the kitchen – either on top of the refrigerator or upper millwork). These samples were taken to determine the levels of zinc, lead and cadmium
- 2 paint chip samples taken from the front vestibule of each of the houses and from the lower millwork of the kitchen or wall of one of the bedrooms. These samples were taken to determine the levels for lead and PCB's in the paint.
- A ceiling tile sample was taken from one of the bedrooms to be analyzed for asbestos.
- A floor tile sample was taken from the mechanical room to be analyzed for asbestos.
- A piece of insulation from the hot water tank was taken as a sample to be tested for asbestos.
- Mercury tipping switches (as found in a thermostat) were noted as being present in each of the homes. This information was passed onto the FSC Environmental Dept.
- A search in each of the homes was conducted for fluorescent lighting, which may or may not contain PCB's in the transformers for each of the lights. None were found. This information was passed onto the FSC Environmental Dept.

6.1 Results

Three possible sources of contamination from 4 different houses were sampled for the Nanisivik Feasibility Study. Once the materials were sampled they were sent to Enviro-Test Laboratories in Edmonton for analyses. Enviro-Test Laboratories are accredited by the Standard Council of Canada / Canadian Association for Environmental Analytical Laboratories (SCC/CAEAL), American Industrial Hygiene Association (AIHA), and SCC/Health Canada, and certified by the National Environmental Laboratory Accreditation Program (NELAP).

The sources of contamination under consideration were:

- Asbestos
- Lead/PCB Paint
- Cadmium/Lead/Zinc Dust

Asbestos

In Canada, regulations state that the maximum acceptable concentration of asbestos is 1%. As shown in Table 1, none of the samples that had been taken contained detectable levels of asbestos and thus there is no asbestos contamination.

Table 1 Asbestos Results

Sample ID	Sample Date	Location	Asbestos Type	% Asbestos
H604-7.	26-Oct-02	Hot water tank insulation - Mechanical room	N.D	<1
H604-7	26-Oct-02	Hot water tank insulation - Mechanical room	N.D.	<1
H604-8	26-Oct-02	Ceiling Tile - Bedroom #2	N.D.	<1
H604-9	26-Oct-02	Floor tile - Mechanical room	N.D.	<1
H700-7	26-Oct-02	Floor tile - Mechanical room	N.D.	<1
H700-8	26-Oct-02	Ceiling Tile - Bedroom #1	N.D.	<1
H700-11	26-Oct-02	Hot water tank insulation - Mechanical room	N.D.	<1
H801-7	25-Oct-02	Ceiling Tile - Bedroom #1	N.D.	<1
H801-8	25-Oct-02	Floor tile - Mechanical room	N.D.	<1
H801-11	25-Oct-02	Hot water tank insulation - Mechanical room	N.D.	<1
H905-7	25-Oct-02	Ceiling Tile - Bedroom #1	N.D.	<1
H905-8	25-Oct-02	Floor tile - Mechanical room	N.D.	<1
H905-11	25-Oct-02	Hot water tank insulation - Mechanical room	N.D.	<1

N.D. None detected, Detection Limit: 1%

Paint

The next set of analyses performed was for lead and/or PCBs in paint. PCBs were undetectable in the paint, but there was some lead. Canadian Guidelines consider lead paint to be a toxin, but do not have a concentration values on the amount of lead that may be considered a hazard. We have used the U.S. Poison Protection Act (42 U.S.C. 4822 (c)) as our guidelines when dealing with lead concentrations. The following table shows the results.

Table 2 Paint Results

				Lead Poison Prevention Act (42 U.S.C. 4822(C))
				50,000 mg/kg
Sample ID	Sample Date	Location	PCBs	Lead (mg/kg)
			All Aroclors (mg/kg)	
H604-10	26-Oct-02	Vestibule #2	<0.3	190
H604-11	26-Oct-02	Bedroom #1	<0.3	10
H700-9	26-Oct-02	Bedroom #3	<0.3	520
H700-10	26-Oct-02	Vestibule #2	<0.3	30
H801-9	25-Oct-02	Vestibule #2	<0.6	30
H801-10	25-Oct-02	Lower Millwork - Kitchen	<0.3	40
H905-9	25-Oct-02	Vestibule #2	<0.3	210
H905-10	25-Oct-02	Bedroom #3	<0.3	<10

As shown in the above table the concentration of lead did not surpass the guideline limit, neither does the paint contain PCB's.

Dust

The dust in the house was tested for cadmium, lead and zinc. Table 3 shows the laboratory results of the samples. A control sample of the cloth used to collect the samples was analysed for background levels of the above noted parameters. The results listed as "actual" on this table are the result of subtracting the control values from the laboratory results.

There are no Canadian Guideline concentrations for any of these parameters. In the U.S., there are only concentration guidelines for lead dust. These have been used and are displayed in the following table.

Table 4 Lead Dust Contaminants

U.S. Protection Agency Lead Standards (40 CFR Part 745) January 5, 2001			**Floors - 40ug/ft2 Window Sills - 250ug/ft2**
Sample ID	**Location**	**Lead (ug/100cm2)**	**Conversion - ug/ft2**
H604-1	Window sill - Living room	76.8	713.5
H604-2	Window sill - Bedroom #4	20.1	186.7
H604-3	Supply Duct - Bedroom #3	34.6	321.4
H604-4	Closet next to bathroom	14.3	132.9
H604-5	Top of fridge - Kitchen	9.4	87.3
H604-6	Return air duct - Dining room	24.5	227.6
H700-1	Window sill - Living room	2.2	20.4
H700-2	Window sill - Bedroom #3	1443.7	13412.4
H700-3	Return air duct - Dining room	42.6	395.8
H700-4	Supply Air Duct - Bedroom #1	10.2	94.8
H700-5	Closet next to bathroom	<0.2	N/A
H700-6	Upper Millwork - Kitchen	<0.2	N/A
H801-1	Window sill - Living room	349.7	3248.8
H801-2	Window sill - Bedroom #4	819.7	7615.3
H801-3	Return air duct - Dining room	138.7	1288.6
H801-4	Supply Duct - Bedroom #3	33.5	311.2
H801-5	Upper Millwork - Kitchen	2.6	24.2
H801-6	Closet next to bathroom	<0.2	N/A
H905-1	Window sill - Living room	618.7	5747.9
H905-2	Window sill - Bedroom #3	22.1	205.3
H905-3	Supply Air Duct - Bedroom #1	5.1	47.4
H905-4	Closet next to bathroom	<0.2	N/A
H905-5	Top of fridge - Kitchen	<0.2	N/A
H905-6	Return air duct - Dining room	37.6	349.3

We have considered every item that is not a floor to fall under the windowsill parameter. As seen in this table, there is extensive lead dust contamination in these houses. Because we do not have results for flooring, and because of these elevated levels, we must assume that there has been dust ground into the floors that would most likely be well above the guideline limits.

6.2 Recommendations

In order to deal with the problem of dust contamination, the houses must be thoroughly cleaned.

1. All items in the house must be washed down from floor to ceiling, into all crevices.

2. Ductwork should be vacuumed using HEPA-filter type equipment.

3. If there are wood floors in the house, they should be sanded down in high traffic areas to remove the top layer of ground-in dust, then resealed.

4. During the cleaning of the houses, personal protective equipment (PPE) should be worn. PPE required would be a dust mask, gloves, and coveralls. Ensure that proper personal washing takes place after PPE is removed.

5. All surfaces in houses should be re-sampled following cleaning. We believe that to wash an entire house down to these specifications would take a four-person crew a full day to complete.

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April 24, 2003

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Our file: 4705 037 NANI

Via Email

Dear Patrick:

RE: NWB1NAN0208 – Phase II Environmental Site Assessment
Human Health and Ecological Risk Assessment
Emergency Response Plan

On behalf of Environment Canada (EC), I have reviewed the information submitted with the above-mentioned documents. The following specialist advice has been provided pursuant to Environment Canada's mandated responsibilities for the enforcement of the *Canadian Environmental Protection Act*, Section 36(3) of the *Fisheries Act*, the *Migratory Birds Convention Act*, and the *Species at Risk Act*.

Breakwater Resources Ltd. has submitted the Phase II Environmental Site Assessment (ESA II), the Human Health and Ecological Risk Assessment (HHERA), and the Emergency Response Plan (ERP) as required under the water license issued by the Nunavut Water Board (NWB) for their closure and reclamation plan. While commenting on the HHERA is outside of the mandated responsibilities of EC, we offer the following comments and recommendations in regards to the ESA II and ERP. These comments are based on the information provided in the above mentioned documents, as well as the Nanisivik Closure and Reclamation Plan (2002) Proposed 2002 Site Assessment Program, and the discussions held at the Technical Session held in Iqaluit, NU on March 29, 2003.

Phase II Environmental Site Assessment:
The overall objective of the Phase II ESA as outlined by Breakwater Resources Ltd. was to assess current environmental conditions to provide direction for future remedial planning. In this regard, EC feels that the ESA II meets its objective. However, EC offers the following comments to be considered during the final Closure and Reclamation Plan:

- A more detailed discussion of the methodology used for the sediment sampling program is required. The ESA II outlines the methodology used for test pit excavations, surficial soil sampling, and the installation of seepage sampling wells and water sampling, but does not detail the methodology used for sediment sampling. This information is required in order to assess the validity of the results presented in the ESA II.

- Environment Canada requests that a summary of the spills that have occurred to date be included in the report. This information is necessary in order to determine which areas of the Nanisivik mine site need to be sampled. For example, the ESA II identifies that hydrocarbon testing was completed at the location of one spill along the fuel pipeline; however, no indication is given as to whether other spills have occurred, and if testing is required at these locations as well.

- Section 5.2.2 of the ESA II outlines the areas in the Industrial Complex and Related Facilities that were sampled. However, this section does not make mention of the diesel fuel storage area or the refueling area. Environment Canada requests clarification as to whether test pitting was completed in these areas. If no test pitting was completed, EC recommends that the diesel fuel storage area and the refueling area be sampled for hydrocarbon contamination.

- The ESA II does not indicate that water samples were taken in the dock area. Environment Canada recommends that water samples be taken in the dock area in order to determine if any contamination of the surrounding environment (including the marine environment) has occurred and if remediation is necessary. Samples should be analyzed for the "Contaminates of Environmental Concern" identified in the report, including metals and hydrocarbons.

- Environment Canada recommends that PCB testing be conducted at the Industrial Complex, as this was the location of both the power plant and a former PCB storage site. If testing reveals that PCB's are present, they should be added to the list of "Contaminants of Concern".

- Breakwater Resources Ltd. needs to provide more justification regarding their comment in Section 5.3.3 that hydrocarbon impacts at the chemical and fuel storage areas will be confined to within 50 m of the highwater mark. Further sampling of the area is required in order to substantiate this comment.

- Environment Canada recommends that the proponent use an approved incinerator for the disposal of combustible wastes, rather than the current practice of simply "burning" the wastes.

- Environment Canada recommends that further sampling for metals and hydrocarbons be undertaken at the solid waste facility. For example, Section 5.2.5 of the ESA II indicates that a white crystalline substance was observed on surface at test pits TP02-94 and TP02-97. However, since the vegetation in and surrounding the precipitate did not appear to be impacted, the precipitate was therefore not considered to be an environmental concern. Additional sampling at this site should be conducted in order to verify this assumption.

- Environment Canada notes that no acid base accounting or acid rock drainage analysis was completed as part of the ESA II. The Nanisivik Closure and Reclamation Plan (2002), Proposed 2002 Site Assessment Program identified verification sampling of roadways as part of the ESA II. This information will be required for the final Closure and Reclamation Plan.

- The ESA II lacked a formal quality assurance and control program for the analytical program for the 2002 sampling program, which was identified in the Proposed 2002 Site Assessment Program as a component of the ESA II. The quality assurance program should include a discussion on why the in-house laboratory was used for certain sample tests and an independent laboratory in Ottawa used for others, as well as an outline of both the in-house and external laboratory procedures and protocols. This discussion is necessary in order to allow for a direct comparison between the two sets of results.

Emergency Response Plan

The Emergency Response Plan submitted by Breakwater Resources Inc. is a fairly straightforward document designed to be used as a module based plan, with each section intended to be usable as a stand alone document. Given this, EC recommends that the requirement that all spills are to be documented and reported to the NWT Spill Response Line at (867) 920-8130 be included in each module of the plan, rather than only in the Reporting Procedure Section. Furthermore, EC recommends that Breakwater Resources Ltd. ensure that any personnel listed in the document are still employed at the mine site and available for response if required.

If there are any changes to the ESA II or the ERP, EC should be notified, as further review may be necessary. Please do not hesitate to contact me with any questions or comments with regards to the foregoing at (867) 975-4639 or by email at colette.meloche@ec.gc.ca.

Yours truly,

Original signed by:

Colette Meloche
Environmental Assessment Specialist

cc: (Mike Fournier, Northern Environmental Assessment Coordinator, Environment Canada, Yellowknife)
(Stephen Harbicht, Head, Assessment and Monitoring, Environment Canada, Yellowknife)

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DEPARTMENT OF JUSTICE
MINISTÈRE DE LA JUSTICE

April 25, 2003

Mr. Philippe Di Pizzo
Executive Director
P.O. Box 119
Gjoa Haven, NU
X0B 1J0

BY FAX 1 867 360 6369

Dear Mr. Di Pizzo:

Re: Licence NWB1NAN0208 – HHERA, Phase 2 ESA, and Emergency Response Reports - GN Comments

These comments are provided on behalf of the Government of Nunavut, with respect to the following reports submitted by Canzinco/ Breakwater Resources Ltd. as required by their License NWB1NAN0208.

In addition to this response, the GN has also requested by e-mail, April 24th, 2003 (attached) a second opportunity to submit comments and expert review regarding the HHERA and Phase 2 ESA reports.

1. HHERA and Phase 2 ESA - SQRO's and related concerns

The Government of Nunavut recommends that the NWB not accept the HHERA or Phase 2 ESA until further study can be carried out by qualified reviewers addressing the following points:

- **Whether assumptions included in these two reports are appropriate.** GN Regulators are concerned about a number of assumptions underlying these two studies, particularly (but not limited to) the use of 1985 soil geochemistry measures, to establish background or "naturally occurring" metal level estimates for the town site, dock, and general mine area. There are several reasons why a layperson would ask whether the background metal levels assumed in these reports are acceptable. For example, how can the use of 1985 data reflect naturally background levels of metal concentration, given that human activities such as exploring, developing, and mining had been in progress in this area for over a decade before these measures were taken? These concerns have potentially serious implications, and require expert review and commentary in order to be validated or satisfied. An inappropriately high background level could lead to SQRO's that allow inappropriate ongoing residual metal contamination near Nanisivik, even after remediation is complete. GN and DIAND jointly have engaged EBA Associates, to prepare a peer review addressing this issue.

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- **Why are the recommendations for Nanisivik Mine, and the recommendations Polaris Mine different?** Polaris is more remote from human communities than Nanisivik, however, the Cantox reports prepared for Polaris recommends SQRO's which are significantly more restrictive that the reports presently under review. Our questions are: i) why the difference? and ii) does this reflect a problem with the assumptions used in either set of reports? GN and DIAND jointly have engaged EBA Associates, to prepare a peer review addressing this issue.

GN Regulators recommend that the HHERA and Phase 2 ESA should include sampling south of Twin Lake, both to increase slightly the geographic scope of the study, and more importantly to provide more appropriate data in support of the background metal levels ultimately adopted in the approved versions of these reports. The sampling area recommended by the GN would run from a point southeast of West Twin Lake, north-easterly to the north-west of Kuhulu Lake.

2. HHERA and Phase 2 ESA – Human Health and related concerns

- **Carcinogenic risk from lead exposure:** The EBA review report submitted in March 2003, documented a scientifically recognized[1] potential for cancer as the result of lead exposures. This should be incorporated in the HHERA.

- **Lead impacts on Pregnant Women and or Foetal health:** The Government of Nunavut recommends that the NWB not accept the HHERA or Phase 2 ESA until further study can be carried out by qualified reviewers addressing the impacts of lead exposure on reproductive health, including the health of Pregnant Women and foetal life. The American Conference of Governmental Industrial Hygienists, have classified inorganic lead as a reproductive hazard. The National Institute for Occupational Safety and Health, NIOSH, has determined that lead can damage a developing foetus and that lead stored in bone can be released to the blood system during pregnancy.

- **General risks from lead dust, and related assumptions:** GN Regulators are concerned by environmental findings from our recent Housing Study (Attachment #2), which appear to indicate a serious risk of unacceptable exposure, and resulting harm to human health, based on the levels of indoor contamination in residences. Given this contradictory result, GN Public Health Officials are especially concerned about potential omissions, or wrong assumptions in the HHERA and Phase 2 ESA regarding the pathways or likelihood of human exposure based on existing lead contamination levels generally, and at the town site in particular.

To resolve all of these concerns relating to human health, GN has engaged Dr. Tenenbein, M.D., FRCPC, FAAP, FAACT, FACMT, to provide an expert assessment of these two reports from a qualified human health perspective. Dr. Tenenbein is the only expert we could locate in Canada who has the full expertise required for this evaluation. His CV is the third attachment to these GN comments.

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[1] *International Agency for Research on Cancer; Canadian Environmental Protection Agency; B.C. Workers' Compensation Board; State of California.*

3. Emergency Response Plan

GN Regulators were generally pleased with the Emergency Response Plan submitted by CanZinco Ltd, however it is important to emphasize the need for ongoing dialogue and cooperation in this area. In particular:

- As presently drafted the plan falls short of GN Regulatory requirements, and cannot be approved by GN Environmental Protection. By way of an overview, the GN Environmental Protection standards for Contingency Planning and Spill Reporting require that the spill response section of this Plan state the following information more clearly, even where this may involve a restatement or summary of existing information filed with NWB[2].

    - Name, Job Title and 24-hour contact information for the CanZinco Official in charge of Spill Response;

    - Confirmation of the name, title and contact information for the Company CEO generally responsible for activities Nanisivik;

    - The Plan must be revised to clearly address the following:
        - Location, size and capacity of the facility
        - Type and quantity of contaminants
        - Site map
        - Description of training for Spills, including the contents of the training, and an ongoing list of individuals on-site who are qualified to respond to spills
        - Inventory and location of spill response equipment.

- Emergency response equipment for fire or medical responses at the mine site should be inspected and recertified, particularly the fire truck and breathing apparatus. This will be incorporated in upcoming related inspections;

- Proposed airport emergency response should be reviewed and updated on an ongoing basis with Airport authorities, particularly in light of the variable numbers of qualified CanZinco and/or reclamation staff on site over the next 3-5 years;

- Proposed fire and medical emergency response should also be reviewed and updated on an ongoing basis with the relevant GN and municipal authorities. Once again, the variable numbers of qualified CanZinco and/or reclamation staff on site over the next 3-5 years is causing a concern for Regulators: if the Plan does not reflect actual on-site response capacity, then in event of an emergency the Plan could actually induce errors when GN and municipal authorities attempt to mount a complementary response;

- The plan should also take into consideration that fire-fighting equipment and personnel from Arctic Bay may not be available to respond to an emergency, due to weather or other obstacles. In this case, depending on the availability and the

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[2] *Additional information about GN Environmental Protection standards for Contingency Planning and Spill Reporting is available on request – GN Contact: Robert Eno*

availability of persons on-site with appropriate emergency response training, the best response may be to cordon off the affected site and undertake reasonable action to prevent the spread of fire to neighboring structures.

Thank you for the opportunity to provide these comments. Should you have any questions about this GN submission or any wider issues relating to GN's role and concerns about the closure of Nanisivik, I can be reached by e-mail or c/o Crowne Plaza Hotel Phone (613) 237 3600, pending my return to Iqaluit May 2nd 2003.

Sincerely,

Susan Hardy,
Legal Counsel

Encl.