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CS 02 005 NU

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**Re: Addendum 1 to Health Canada's Comments on the Doris North Gold Mine Project Final Environmental Impact Statement**

Dear Ms. Traynor and Ms. Briscoe:

In response to the March 11 email from Hugh Wilson of Miramar, providing written responses to the February 2 conformity review of the Final EIS, for the above noted project, Health Canada would like to provide the following additional comments, with respect to human health concerns.

## Air Quality

Health Canada acknowledges the response from Miramar, but has the following additional comments. Health Canada will review further Miramar's attempt to correlate effects on workers to mortality coefficients prepared by Health Canada. Health Canada will also review further Miramar's explanation regarding Health Canada's comments on *study area*.

Our scientists in the Fuel and Air Quality Assessment Section have provided the following preliminary comments on the air quality assessment (supporting document B3) completed for the Doris North gold mine.

***Is the assessment adequate?***

*Section 2.3.2.2, p.5*

The Ozone Limiting Method (OLM), found in equation [1], to estimate the total amount of $NO_x$ emissions converted to $NO_2$ is based on the assumption that approximately 10% of the $NO_x$ emissions will be released in the form of $NO_2$ and that the remaining NO will react with available rate-limiting ozone [2], forming additional $NO_2$.

$$[NO_2] = [O_3] + 0.1[NO_x] \quad [1]$$

$$[NO_2] + [O_2] = [NO] + [O_3] \quad [2]$$

…/2

The WHO (1997) also states that approximately 90-95% of $NO_x$ emitted from combustion processes are in the form of NO, while 5-10% are emitted as $NO_2$, however this assumption needs to be further substantiated. Because the 1-hour maximum predicted $NO_2$ concentration of 334.7 µg/m$^3$ is largely based on the assumption that 10% of the $NO_x$ emitted from mine fleet exhaust and power generators is released as $NO_2$, Health Canada would like to see additional peer reviewed scientific documentation supporting this assumption.

Furthermore, while equation [2] typically predominates as the main chemical transformation of NO to $NO_2$, equation [3], which was not addressed by the consultants, becomes important when the concentration of NO is greater than 1886 µg/m$^3$ (1 ppm) (WHO, 1997).

$$[2NO_2] = [NO] + [NO] + [O_2] \qquad [3]$$

NO concentrations exceeding 1886 µg/m$^3$ are not typically found in ambient air, but they may occur near industrial sources. Using the CALPUFF model, the maximum $NO_x$ concentration from the Doris North project was predicted to be 2407 µg/m$^3$ (Section 4.3.2, Table 4-4, p.35). Assuming that 90% of the $NO_x$ combustion emissions are in the NO form, then the maximum concentration of NO is 2166 µg/m$^3$ (1.77 ppm). Since the maximum concentration of NO exceeds 1886 µg/m$^3$ (1 ppm) by a factor of 1.15, then equation [3] should also be considered as a pathway to form $NO_2$. This would serve to increase the maximum expected concentration of $NO_2$, and the resulting value could potentially exceed the acceptable national ambient air quality objectives (NAAQOs) of 400 µg/m$^3$.

The WHO has recommended a 1-hour average daily maximum $NO_2$ guidance concentration not exceeding 200 µg/m$^3$. Health Canada is currently in the process of examining the latest scientific evidence regarding health risks associated with exposure to $NO_2$, and may recommend a decrease in the acceptable1-hr NAAQO to 200 µg/m$^3$ as well. Timing of these recommendations are not yet clear.

***Are the appropriate air quality criteria being used (Table 2-1)?***

*Section 2.4, p.8*

For the most part, appropriate air quality criteria were used while conducting this air quality assessment. When available, Canadian NAAQOs, CCME Canada-wide standards (CWS), and NWT guidelines, which were established under the Canadian Environmental Protection Act (CEPA) were employed. In order to make Table 2-1 more complete, existing air quality criteria from the WHO and the US EPA should be added as separate columns for comparison. This addition would then eliminate the confusion regarding annual guidelines being presented as higher than their 24-hour counterpart (eg. $PM_{10}$).

An error was made with respect to the annual US EPA standard for $PM_{10}$, which is 50 µg/m$^3$. On several occasions within the air quality assessment (Table 2-1 & footnote, p.8; Table 4-6, p.44), the US EPA standard is incorrectly listed as 60 µg/m$^3$. This error is believed to be of a typographical nature because the consultant specifically states in Section 4.3.4 (p.44) that "none of the annual $PM_{10}$ predictions exceed the US EPA primary standard of 50 µg/m$^3$." The errors on the previously mentioned pages should be corrected.

***Should the 4.6 ha encompassing the campsite and processing facilities have been included within the air quality assessment?***

*Section 4.3, p.30*

The air quality modelling results presented in the report is noted as excluding the 4.6 ha area enclosing the campsite and ore processing facilities and does not provide a rational for doing so. This exclusion presents an issue from a human exposure standpoint.

The campsite, where off-duty workers reside, is located within close proximity to the ore processing facility, the Rock quarry #2 , and the diesel power generators. While occupational exposure to contaminants is governed by the National Institute for Occupational Safety & Health (NIOSH) or the Canadian Centre for Occupation Health & Safety (CCOHS), when the workers have completed their shift, the site then also becomes residential in nature. Within the campsite, the workers/residents will continuously be exposed to $NO_2$ over a period of 24 hours, which at the levels predicted, could result in deleterious health effects. According to the WHO (1997), concentrations of $NO_2$ at which effects on health start to be observed is 365 - 565 $\mu g/m^3$. Short term $NO_2$ exposure causes decreases in lung function and increase in airway responsiveness, while long term exposures produce pulmonary irritation and respiratory illness.

Due to the potential of high concentrations of $NO_2$ produced by the power generators and the mine fleet exhaust, an $NO_2$ monitoring program should be established.

In summary, the Air Health Effects Division recommends that:

- Additional scientific documentation be obtained to support the assumption that 10% of the NOx emissions from diesel power generators and mine fleet exhaust will be released in the form of NO2;

- Due to predicted concentrations of NOx, exceeding 1886 µg/m3 (1ppm), then equation [3] should also be considered as a pathway to form NO2;

- The air quality modelling be recalculated to include the 4.6 ha area enclosing the campsite and ore processing facilities;

- Measures be put in place to mitigate NO2 emissions;

- An NO2 monitoring regime be established.

***References***

World Health Organization. (WHO). 1997. International Programme on Chemical Safety, Environmental Health Criteria 188: Nitrogen Oxides 2nd ed. Wissenschaftliche Verlagsgesellschaft mbH, Stuttgart, Germany. pp. 550.

**Noise**

Health Canada would like to thank Miramar for their response; however, Miramar has failed to recognize the workers camp as their primary residence. The workers camp should be subject to more stringent standards than those prescribed in occupational health and safety standards and guidelines.

**Human Health Risk Assessment**
**Foods**

Health Canada staff will review further the comments provided by Miramar, but in the meantime, offer the following preliminary comments:

- Background data for the levels of metals which were determined to be contaminants of potential concern (COPCs) found in the liver and meat of fish are provided in Appendix I, Table 1-2, of supporting document report F2 of the Final EIS (Tail, Doris and Little Robert Lakes). Data presented in Table 1-2 for those fish actually collected from the Doris and Little Roberts Lake outflows can be used for comparison purposes to determine the impact of this project in regard to the contamination of foods after the project commences. This information can be used to determine the need for further monitoring of the levels of COPCs in country foods under study and, also, to determine if additional risk assessments in regard to human health issues are required. According to information provided in the report, Tail Lake is not presently used for fishing and, since tailings will be discharged into this lake, fishing in this lake will be prohibited.

- Levels of COPCs are required using available analytical methodology capable of achieving limits of detection of at least the parts per billion (ppb) range for the assessment of human health issues in regard to potential contamination of foods. In regard to the baseline data presented in Table 1-2 for metal levels found in fish, the results provided are at sufficiently low levels for assessment purposes. However, no detection limits are provided. It would appear that most values are presented at the detection limits since so many values are similar. The detection limits should be provided and values at the detection limit must be identified.
- Background data was collected for the levels of COPCs in the liver and meat of fish and in wholefish for Lake trout (Tail, Doris and Little Roberts Lakes) and for Lake Whitefish (Doris Lake and Little Roberts Lake). It must be determined if wholefish or these individual fish tissues of each fish species are consumed by the local population.
- Follow-up monitoring (after commencement of the project) is mentioned in the report. A further explanation of these monitoring details is required. It is suggested that follow-up monitoring studies include the measurement of the levels of COPCs in individual country foods that are gathered from the project area and consumed by the "local" residents.
- Subsistence harvesting (hunting, fishing, trapping and gathering) by residents of the Kitikmeot Region is mentioned in the report. Information on the foods which are actually gathered and consumed would be preferable for the human health risk assessment of contaminants in foods. This information can be collected from residents of the nearest communities (Umingmaktok for instance). Table 3.2, page 23 of the report mentions caribou and arctic hare which were determined to be exposure pathways evaluated for human receptors.
- Information, if available, on the amounts of each food (including specific tissues of fish and game) consumed would be useful for human health risk assessment purposes. This could be determined based on the approximate amounts of fish and game caught in the project area. Some foods may be preserved (frozen etc.) for future consumption .
- Toxicity Reference Values (TRVs) employed by Health Canada (e.g. by the Health Products and Foods Branch (HPFB), Health Canada) must be used to determine the potential human health impact of the intake of COPCs from the consumption of country foods harvested from the Doris North Project area. These TRVs were not used for this study.
- TRVs for the COPCs in this study currently employed by HPFB are presented below. These TRVs are subject to ongoing review and may change in the event that new toxicological information becomes available:

| COPC | TRV | Value |
|---|---|---|
| | | |
| Arsenic | PTWI | 15 mg/kg bw/week (as inorganic arsenic) |
| Cobalt | - | NE |
| Molybdenum | UL | 30 mg/kg bw/day |
| Nickel | TDI | 50 mg/kg bw/day |
| Strontium | RfD | 0.6 mg/kg/day |

Where:

COPC- contaminant of potential concern
TRV – toxicity reference value
PTWI – provisional tolerable weekly intake
bw – body weight
UL – upper limit
TDI - tolerable daily intake
RfD – reference dose

## TABLE 1

## Metals in Lake Trout - Baseline Results for Doris Lake Outflow

| Metal | Fish Tissue | Level Found mg/kg | Fish Tissue Intake g/day | Metal Intake ug/kgbw/day | TRV | TRV Units | % TRV | RMWI g/week |
|---|---|---|---|---|---|---|---|---|
| Antimony | Muscle | 0.07 | 40 | 0.05 | 3 | ug/kgbw/day | 1.6% | 18000 |
| | Liver | 0.07 | 20 | 0.02 | 3 | ug/kgbw/day | 0.8% | 18000 |
| | Whole Fish | 0.07 | 40 | 0.05 | 3 | ug/kgbw/day | 1.6% | 18000 |
| Arsenic | Muscle | 0.06 | 40 | 0.04 | 15 | ug/kgbw/week | 1.9% | 15000 |
| | Liver | 0.03 | 20 | 0.01 | 15 | ug/kgbw/week | 0.5% | 30000 |
| | Whole Fish | 0.06 | 40 | 0.04 | 15 | ug/kgbw/week | 1.9% | 15000 |
| Barium | Muscle | 0.3 | 40 | 0.20 | 200 | ug/kgbw/day | 0.1% | 280000 |
| | Liver | 0.3 | 20 | 0.10 | 200 | ug/kgbw/day | 0.1% | 280000 |
| | Whole Fish | 0.3 | 40 | 0.20 | 200 | ug/kgbw/day | 0.1% | 280000 |
| Boron | Muscle | 0.02 | 40 | 0.01 | 400 | ug/kgbw/day | 0.003% | 8400000 |
| | Liver | 1 | 20 | 0.33 | 400 | ug/kgbw/day | 0.1% | 168000 |
| | Whole Fish | 1 | 40 | 0.67 | 400 | ug/kgbw/day | 0.2% | 168000 |
| Chromium (Assumed Cr III)* | Muscle | 0.3 | 40 | 0.20 | 1500 | ug/kgbw/day | 0.01% | 2100000 |
| | Liver | 0.3 | 20 | 0.10 | 1500 | ug/kgbw/day | 0.01% | 2100000 |
| | Whole Fish | 0.3 | 40 | 0.20 | 1500 | ug/kgbw/day | 0.01% | 2100000 |
| Cobalt | Muscle | 0.3 | 40 | 0.20 | No TRV established | | | |
| | Liver | 0.3 | 20 | 0.10 | | | | |
| | Whole Fish | 0.3 | 40 | 0.20 | | | | |
| Copper | Muscle | 0.3 | 40 | 0.20 | 250 | ug/kgbw/day | 0.1% | 350000 |
| | Liver | 12.9 | 20 | 4.30 | 250 | ug/kgbw/day | 1.7% | 8140 |
| | Whole Fish | 1.6 | 40 | 1.07 | 250 | ug/kgbw/day | 0.4% | 65625 |
| Manganese | Muscle | 0.2 | 40 | 0.13 | 140 | ug/kgbw/day | 0.1% | 294000 |
| | Liver | 1.4 | 20 | 0.47 | 140 | ug/kgbw/day | 0.3% | 42000 |
| | Whole Fish | 0.3 | 40 | 0.20 | 140 | ug/kgbw/day | 0.1% | 196000 |
| Strontium | Muscle | 0.6 | 40 | 0.40 | 600 | ug/kgbw/day | 0.1% | 420000 |
| | Liver | 0.5 | 20 | 0.17 | 600 | ug/kgbw/day | 0.03% | 504000 |
| | Whole Fish | 0.6 | 40 | 0.40 | 600 | ug/kgbw/day | 0.1% | 420000 |
| Zinc | Muscle | 3 | 40 | 2.00 | 700 | ug/kgbw/day | 0.3% | 98000 |
| | Liver | 38.5 | 20 | 12.83 | 700 | ug/kgbw/day | 1.8% | 7636 |
| | Whole Fish | 6.5 | 40 | 4.33 | 700 | ug/kgbw/day | 0.6% | 45231 |

Notes:

- The total arsenic reported was assumed to be in the inorganic form
- * Chromium III is the form of Cr typically found in foods.
- TRV - toxicity reference value
- RMWI - recommended maximum weekly intake bw - body weight = 60 kg for an adult
- Fish Tissue Consumption Figures (HPFB) - best available estimates for the eaters only figures for the consumption of the filet and liver of fish and for whole fish.
- Based on the baseline data presented in Table 1-2 of the report.

- While we note your comment that mercury would not be used in the milling process, it is suggested that consideration be given to measuring the levels of mercury found in fish harvested from lakes in the project area. Mercury in fish is of interest from the perspective of human health, particularly where water flow issues exist. In those areas where sufficient levels of mercury are naturally occurring in soil, bioaccumulation of methylmercury (MeHg) typically occurs in the filet of fish, in particular predatory fish.
- Arsenic is commonly a concern in the area of gold mines. As mentioned in this report, however, arsenic is typically found in animal and fish tissues in the less toxic organic form.
- Appendix II Table II-1 – The operation or post-operation levels of metals are estimated based on modeling. These estimated metal levels were used, along with other criteria, to determine COPCs. In this regard, laboratory analysis is typically conducted on suites of metals and the results for several metals can be provided. Therefore, it is suggested that operation and post-operation monitoring include the analysis for the levels of the following metals in foods: antimony, arsenic, barium, boron, cadmium, chromium, copper, lead, mercury (see comment below), molybdenum, nickel, selenium, silver, strontium, thallium, uranium and zinc.
- In the report, the estimated total intake of COPCs from the consumption of all country foods gathered from the project area were used to calculate exposure ratios based on the potential intakes of COPCs from all media.
- We note that you have referenced the "Compendium of Canadian Human Exposure Factors of Risk Assessment" (Richardson, 1997), adopted by Health Canada (2003). However, in regard to the above comment, estimated intake of each COPC from the consumption of each individual country food (or individual tissue of fish and/or wild game) should be determined. These estimates can then be employed for the assessment of the potential impact on human health due of the intake of these COPCs from the consumption of country foods gathered from area of the Doris North Project. Exposure ratios, used in this study to estimate human health impacts, do not address human health issues from the perspective of potential levels of contaminants in individual foods (or individual tissues of fish and/or wild game). Consumption advisories or other remediation procedures must be determined for individual foods.
- Estimated metal intakes were calculated and are presented in Tables 1 to 4 (prepared by EHAS) based on the levels of metals provided in Table 1-2 of the report. The levels of metals found in the fish caught in Doris Lake and Little Roberts Lake outflows are, in general, low and would not present a health risk to consumers. It was noted that Tail Lake was not considered since fishing does not presently occur in this lake and since fishing will be prohibited in Tail Lake after the project commences due to the discharge of tailings.

**Socio-Economic**

We note that Miramar did not specifically respond to Health Canada's comments, but trust that they will do so in due course. Health issues precipitated by socio-economic factors are as important as the bio-physical factors that have been discussed such as water, air, food, and noise.

In relation to the comments provided, by email on March 11, to the Department of Indian Affairs regarding the socio-economic assessment, Health Canada would like to encourage Miramar to note that some of the assumptions/socio-cultural mitigation measures for the Diavik project have since been found to be inappropriate or not as effective as predicted[1]. A full review of the success of that EA should be conducted before referencing/using that project as an example or model.

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[1] Based on a presentation made by Dene Chief Catholique, March 25, 2004, Timmins, Ontario.

Finally, we note that Miramar has failed to respond to Health Canada's comments regarding cumulative effects assessment, valued components, and data and monitoring requirements. Although some responses to issues in these areas have been submitted in the letter to the Department of Indian Affairs, by email on March 11.

We would like to remind NIRB that the responsibility for health lies primarily with the Nunavut Ministry of Health, and therefore, we trust that the appropriate territorial authorities are involved in review of the EIS. Health Canada has expertise that is of value to the federal environmental assessment process, and is primarily responsible for the health of First Nation and has an interest in the health and well-being of all Canadians, and it is in this spirit in which we may be of assistance.

Should you have any further questions, please feel free to contact me (tel: 416.954.0821 or email: anjala_puvananathan@hc-sc.gc.ca).

Yours sincerely,

Signed Original to Follow

Anjala Puvananathan

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