APPENDIX II - 7

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M. J. Brodie P. Eng. 572 St. Andrews Place, Vancouver, B.C. V7S 1V8

Attention: Mr. John Brodie, P.Eng.

B.Y.G. NATURAL RESOURCES -MT. NANSEN PROJECT GEOCHEMICAL REVIEW

Dear John;

As requested in your letter dated November 8, 1995. I have reviewed the information to assess the oxidation potential of the tailings and the potential for significant leaching of arsenic from the tailings as a result of oxidation. The documents provided were:

- M.J. Brodie, P.Eng. report of November 8, 1995 Revised Reclamation Unit Cost Review;
- Appendix IV, Tailings Treatment Test Report from Volume 2 Mount Nansen Initial Environmental Evaluation, dated November 1994, as submitted by B.Y.G. Natural Resources Inc;
- Mount Nansen Initial Environmental Evaluation Addendum, dated April 6, 1995, as submitted by B.Y.G. Natural Resources Inc.;
- A seepage analysis for the tailings pond showing unsaturated tailings, taken from Tailings Impoundment Final Design Report, B.Y.G. Natural Resources Inc., Mt. Nansen Gold Project, by Klohn-Crippen Consultants Ltd. August 1995;
- Letter from B.Y.G. Natural Resources Inc., to DIAND Kevin McDonell, RE: Comments on Site Visit, September 12, 1995;
- Letter from T.W. Higgs Associates Ltd. to DIAND, Mt. Nansen Project Response to Reclamation Cost Estimate Review, Comments, August 9, 1995;

In addition to the printed documents, a section of the Appendix V of the IEE describing distilled water leach tests on tailings was subsequently provided by fax.

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OXIDATION POTENTIAL OF THE TAILINGS

SUMMARY OF TESTWORK

One tailings sample was submitted for acid-base accounting (ABA). The sample was produced from metallurgical testwork on a composite of 178 diamond drill core samples of ore. The sample was apparently composed of both strongly oxidized material from near surface and deeper less oxidized rock. The test material had been subjected to CIP cyanide leach and subsequent INCO-SO₂ treatment to oxidize cyanide.

The ABA test indicated 1.7% total sulphur of which 0.59% sulphur was present in the form of sulphide, which was converted to an acid potential (AP) of 18 kg $CaCO_3/t$. The neutralization potential was 13 kg $CaCO_3/t$. It was concluded by the laboratory that the material had a very low potential for acid generation due to the low sulphide content, despite the negative net neutralizing potential of - 5 kg $CaCO_3/t$.

Head analyses on the test material indicated arsenic, copper, lead and zinc concentrations of 0.6%, 496 ppm, 0.4% and 0.1%, respectively.

DISCUSSION

Since the tailings will contain elevated concentrations of metals and arsenic, the conclusion that the tailings will be non-acid generating needs to be evaluated. The NP of the tailings is low and appears likely due primarily to residual lime and alumino-silicates. No carbonate analysis was performed on the tailings to determine whether carbonate minerals are present. Although the lime will provide buffering during operation, it is generally accepted that it is rapidly leached by percolating water and does not-provide long term buffering capacity. The NP can probably be discounted from the equation. In which case, the reactivity of the tailings should be considered with respect to the sulphide content.

There are no reliable criteria for determining at what level sulphide concentrations become insignificant in terms of acid generation potential. The British Columbia guideline is 0.3% sulphide; although others have proposed values as low as 0.1%. My opinion is that the value is site specific and should be referenced largely to the presence of buffering capacity from minerals other than carbonates, and the potential for liberation of metals and metalloids due to marginal pH depression. I have observed a humidity cell with 0.4% total sulphur and negligible neutralizing potential in any form oxidize sufficiently rapidly to liberate acidity (pH<5), zinc and arsenic. The arsenic concentration in the sample was 0.2%. A second cell in the same project with 0.6% total sulphur showed similar results.

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It has been suggested for this project that the sulphide minerals present are residual products of weathering and are therefore not likely to oxidize rapidly. While this argument would be relevant to rock, the tailings have been ground and the residual sulphide minerals liberated from the silicate matrix and exposed to oxidation.

An additional concern for the Mt. Nansen project is that the sample tested represented a composite of the whole orebody, but the mining sequence will proceed from oxidized (low sulphide concentration) rock to less oxidized (higher sulphide concentration) rock. The tailings mass will therefore be segregated with the sulphide-rich material at the top of the deposit. The upper part of the deposit may therefore be more susceptible to oxidation than implied by the test result.

I would therefore conclude that the acid generation potential of the tailings is unknown though pH depression (probably to pH less than 5 but greater than 4) in exposed tailings after closure is likely rather than improbable as was concluded in the IEE.

POTENTIAL FOR ARSENIC LEACHING

SUMMARY OF TESTWORK

As noted above, the test material feed contained 0.6% arsenic. Deionized water leach tests on the tailings indicated a leachable arsenic component which remained steady at a relatively constant arsenic concentration, implying equilibration of the test solution with a weakly soluble arsenic containing substance. Addition of ferric sulphate to the test solution lowered arsenic concentrations, presumably due to precipitation of basic ferric arsenates with high Fc/As ratios.

DISCUSSION

The potential for arsenic leaching depends on the occurrence of arsenic in the tailings. Several major forms are likely:

- Arsenopyrite residual primary mineralization. Since the orc feed contained 0.6% arsenic and 0.6% sulphide it is likely that a significant proportion, if not the majority of arsenic occurs in this form.
- Scorodite a natural weathering product of arsenopyrite, increasing in concentration in the more
 oxidized zones of the deposit. The leachable arsenic component in the tailings is reported to be
 2 ppm.
- Calcium Arsenate resulting from lime addition during cyanidation.

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The arsenic in arsenopyrite could be liberated by oxidation, generally occurring as a long term process, accelerating as pH depression occurs.

The solubility of scorodite (iron arsenate) decreases as pH decreases. In comparison, calcium arsenate becomes more soluble as pH decreases.

As noted above, moderate pH depression in the long term seems likely due to the oxidation of sulphide minerals, including arsenopyrite. Under these conditions, arsenic release due to dissolution of calcium arsenates could be expected. Leaching of scorodite could also be expected. Much of the discussion in the IEE has focused on stabilizing this leachable arsenic component in the tailings. However, the potential for long term release of arsenic due to arsenopyrite oxidation is probably the more significant issue from a closure perspective.

CONCLUSIONS

Based on review of the materials provided and previous experience, the following is concluded:

- the potential for moderate pH depression in the tailings is significant, especially given the likelihood of increasing sulphide concentration in the upper portions of the final tailings deposit; and
- unquantified long term arsenic leaching due to oxidation of arsenopyrite under depressed pH conditions may occur in exposed tailings after milling operations cease.

Operational and closure measures such as long term flooding or placement of engineered low permeability covers of clearly demonstrated effectiveness should be considered.

The above conclusions are based on the existing testwork and information available. The need for engineering measures to address acid generation and arsenic leaching could be addressed through welldesigned kinetic tests. Due to the low buffering capacity of the tailings, the tests would probably provide sufficient information for decision-making after a few months of leaching. NDM RICHMOND

NORECOL, DAMES & MOORE, INC.

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Please call the undersigned if you have any questions.

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Very truly yours, NORECOE, DAMES & MOORE, INC. per: Scientific Scientific Stephen J. Day, P.Geo. Senior Geochemist

SJD:ijk