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Pour
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Analyse de l'étude d'impact sur l'environnement et le milieu social du projet Matawinie de Nouveau Monde Graphite

RISQUES DE CONTAMINATION DE L'EAU ASSOCIÉS À L'ENFOUISSEMENT DES DÉCHETS MINIERS À COURT ET À LONG TERME (100+ ANS)

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RÉSUMÉ EN FRANÇAIS

À la demande de MiningWatch Canada, *Kuipers & Associates* a analysé les risques de contamination de l'eau associés à la gestion des déchets miniers du projet Matawinie de la compagnie Nouveau Monde Graphite (NMG) à Saint-Michel-des-Saints (Québec, Canada). L'analyse visait les quatre questions suivantes :

- La caractérisation des contaminants contenus dans les déchets miniers est-elle adéquate?
- Y-a-t-il un risque d'écoulement et de contamination des eaux environnantes?
- Les mesures de prévention et de mitigation proposées sont-elles adéquates?
- Somme toute, quels sont les principaux risques pour la qualité des eaux environnantes à court et à long terme?

Suite à l'analyse de l'Étude d'impact sur l'environnement et le milieu social (EIES) du projet Matawinie[1], *Kuipers & Associates* conclut que :

- Le projet présente un risque élevé de contamination des eaux environnantes à court et à long terme (eaux de surface et eaux souterraines). Près de la moitié (46%)[2] des 107 millions de tonnes de résidus et de stériles miniers qui seraient générés contiennent des quantités significatives de minéraux sulfurés présentant un potentiel de drainage minier acide (DMA), tandis que le reste des déchets miniers contient peu ou pas de minéraux neutralisants. Par ailleurs, la minéralogie et les tests effectués à ce jour indiquent que la presque la totalité (89%)[3] des résidus et des stériles miniers présentent un risque de contamination élevé en fer, en cuivre et en zinc. Un volume significatif de résidus et de stériles miniers présentent également des risques de contamination en mercure, en plomb, en manganèse, en nickel, en fluore et en baryum.

- L'efficacité de la principale mesure de mitigation proposée pour confiner les déchets miniers et prévenir la contamination des eaux environnantes[4], soit « la co-disposition » des résidus et des stériles miniers riches à sec, avec une barrière capillaire en couverture, demeure hautement spéculative, non testée et non prouvée dans l'ÉIES. Cette mesure de mitigation demeure également non prouvée dans la documentation scientifique à une telle échelle, avec des résidus et des stériles miniers contenant de telles quantités de contaminants sulfurés et réactifs, dans un climat nordique et humide.

- Les prédictions actuelles de l'ÉIES concernant l'efficacité anticipée des mesures de mitigation prévues, tout comme les garanties financières prévues pour la restauration et le suivi à long terme, s'appuient sur des hypothèses hautement optimistes, peu prudentes, et ne prévoient aucune (ou très peu) de mesures de contingence dans l'éventualité d'échecs et de problèmes majeurs. L'ÉIES s'appuie sur un « meilleur scénario » (*« best case scenario »*), présumant que toutes les mesures de mitigation prévues fonctionneront, alors que l'ÉIES devrait plutôt considérer les « pires scénarios », et être en mesure de les gérer techniquement et financièrement, à court et à long terme.

- Somme toute, en comparaison de douzaines d'autres ÉIES de projets miniers au Canada et à l'international que nous avons révisées au cours des dernières années, la présente ÉIES sous-estime particulièrement les risques de drainage et de contamination des eaux environnantes, et à l'inverse, surestime l'efficacité des mesures de mitigation prévue. Le scénario principal présenté dans l'ÉIES s'appuie à la fois sur des hypothèses optimistes (peu prudentes) et des données et des analyses incomplètes. Si autorisé tel que proposé, nous sommes d'avis que ce projet présente des risques élevés de contamination de l'eau qui ne sont pas présentement identifiés dans l'ÉIES, et ce, tant pour les eaux de surface que les eaux souterraines, à court et à long terme (plus de 100 ans). Les coûts financiers et environnementaux associés à ces risques, à la fois pour les populations locales et pour l'ensemble de la société, ne sont pas pleinement pris en compte dans l'ÉIS.

- Nous sommes également préoccupés par la viabilité financière de ce projet et les multiples risques financiers et économiques que nous avons identifiés dans une étude précédente5, notamment un marché du graphite contrôlé par de grands joueurs internationaux, des revenus surestimés et, à l'inverse, des coûts de production sous-estimés.

Jim Kuipers, l'ingénieur minier principal de Kuipers & Associates, a plus de 30 ans d'expérience dans le secteur minier au Canada, aux États-Unis et à l'international. Il est enregistré à l'Ordre des ingénieurs du Montana et du Colorado. M. Kuipers intervient régulièrement comme témoin-expert devant les tribunaux et les commissions d'enquête, au Canada comme aux États-Unis.

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1 Disponibles sur le registre des évaluations environnementales du ministère de l'Environnement et de la lutte aux changements climatiques du Québec http://www.ree.environnement.gouv.qc.ca/projet.asp?no_dossier=3211-16-019

2 38.5 Mt paragneiss mixte et 10.9 Mt de résidus très sulfurés

3 38.5 Mt paragneiss mixte, 10.9 Mt de résédus très sulfurés, 46.5 Mt de résidus désulfurés

4 Que ce soit le résultat de contaminants issus des drainages acides ou neutres

5 http://www.aplt.org/Expert.pdf (juin 2019)

1 INTRODUCTION

Mining Watch Canada retained Kuipers & Associates to review and provide professional opinions concerning the Environmental and Social Impact Study for Nouveau Monde Graphite's Matawinie Graphite Project. The Client asked that the review focus on the following:

- *Adequacy of the geochemical characterization program.*
- *Potential for discharge of contaminated water from project in the short and long term.*
- *Reliability of the proposed mitigation measures to protect surrounding waters in the short and long term.*
- *Key potential risks related to water quality.*

2 QUALIFICATIONS

I have an extensive background with more than 35 years involvement in mining metals and minerals including in the full-life cycle of exploration, project development, project permitting, construction, operations, reclamation and closure. I graduated in 1983 with a B.S. in Mineral Processing from Montana School of Mines. In addition to growing up in a mining family and gaining practical experience prior to entering University, I have worked as a senior engineer, chief metallurgist, mill superintendent, mine manager, project manager, and consulting engineer. Since 1996 I have been the principal consulting engineer with Kuipers & Associates. My work during that time has focused on providing technical expertise to public interest groups, tribes and first nations, and governments concerning mining and environmental concerns. The primary areas of expertise I have provided have included site characterization, water quality predictions, mine planning and mitigations, tailing storage facilities, mine reclamation and closure, site investigations and remediation, water treatment, financial assurance, and economic evaluations.

I am a registered Professional Engineer in Mining in the U.S. States of Montana and Colorado. I have been qualified as an expert witness in mining and related matters in numerous administrative hearings in the U.S. and Canada, and have been qualified as an expert witness in U.S. Federal and State Courts. I have expertise in geochemical characterization, mitigation, reclamation and closure plans and financial assurance cost estimates. I am the co-author together with Ann Maest of *Predicting Water Quality at Hardrock Mines Methods and Models, Uncertainties, and State-of-the-Art*[1] (2005) and *Comparison of Predicted and Actual Water Quality at Hardrock Mines*[2] (2006). My professional resume is attached as Exhibit A.

3 DOCUMENTS AND OTHER INFORMATION RELIED UPON

The primary documents I have reviewed in conducting this analysis are as follows:

> NMGMP ESIS 2019. Nouveau Monde Graphite Matawinie Project Environmental and Social Impact Study, by SNC Lavalin, April 2019. Volumes 1-6 and Addenda, found online
> http://www.ree.environnement.gouv.qc.ca/projet.asp?no_dossier=3211-16-019

In addition, I have relied on other documents as referenced in this report.

1 https://earthworks.org/publications/predicting_water_quality_at_hardrock_mines/

2 https://earthworks.org/publications/comparison_of_predicted_and_actual_water_quality_at_hardrock_mines/

4 GEOCHEMICAL CHARACTERIZATION

NMGMP ESIS 2019 *Section 4.6 Mining Waste Rock and Tailings Management* includes a summary of the geochemical characterization work that has been performed for the project and also describes the plan for mine tailings and waste management. *Appendix 4-3 Reclamation and Restoration Plan*[3] includes a report titled *Geochemistry Test Work Program* which describes the work that was performed as well as the results in more detail and is the basis for the comments contained in this section.

For the purpose of this discussion the results of the geochemistry characterization program are summarized in Table 4.0. Additionally, the Geochemistry Test Work Program report included the following recommendations:

Further work in relation to geochemistry should comprise:

Further characterization of the mine wastes in consideration with the following:

- *Variability in total sulphide content and neutralization potential.*
- *If further kinetic test work is undertaken it should adhere to the following criteria:*
- *Representative of field conditions as far is practical (e.g. site-based barrel content, instrumented field-size, in-situ test cells).*
- *Representative of intended use (e.g. instrumented test cell to mimic co-disposal conditions, test cell or column test to mimic cover layer, etc.)*
- *Monitoring of drainage water around the co-disposition pile.*
- *Development of mine waste segregation in the operations manual to mitigate potential issues with acidic and leaching conditions.*
- *Development of a site wide water balance and water quality model using mine closure design and loading rates for mine waste materials.*

COMMENTS

1. The Geochemistry Test Work Program performed for the project in general conforms with accepted practice as described by MEND 2009 and GARD Guide 2012. It includes identification of the geologic lithologies, description of the sampling and laboratory test work program, mineralogy, static and kinetic leachate testwork. However, the program is presently preliminary as described in following comments, and not adequate to provide for an accurate assessment of potential environmental impacts to water quality from the proposed project.The information contained in the ESIS and report identifies the lithologic unit graphitic paragneiss as both ore and waste rock. However, the only information provided with respect to the quantity shows a combined figure for both ore and waste. The documents should clarify the quantity of graphitic paragneiss that will be waste rock, if any.

2. The sampling program (Appendix 4-3 Geochemistry Section 2.1) describes composite samples, however it does not provide any further information as to the rationale for or make-up of the composite samples. The ESIS should include detailed information such that the veracity of the geochemistry program can be determined. The lack of information on the approach and compositing of actual samples does not allow for a high degree of confidence in the results with respect to actual conditions that would occur that might be diluted by the use of composited samples. It should be noted that use of composite samples also adds to the uncertainties and mine water quality risks identified in Section 4.2 of the *Geochemistry Test Work Program* report, which recommends further characterization of mine wastes to address variability in total sulphide content and neutralization potential.

3 The English phrase Reclamation and Restoration Plan is used herein for the French phrase "Plan de réaménagement et de restauration."

TABLE 4.0 – SUMMARY OF GEOCHEMICAL CHARACTERIZATION PROGRAM RESULTS

Material	LOM Tonnage Est Mt	%	Sulfide Content	Acid Generation Potential	Metals Leaching Potential
Waste Rock					
Graphitic Paragneiss	not provided by proponent	0%	Significant sulphide content; minor to moderate net-neutralizing reactive carbonate minerals	PAG. Moderate sulphide oxidation kinetics	Potential for elevated acidity, iron, cadmium, copper, nickel and zinc
Mixed Paragneiss	38.53	63%	Significant sulphide content sulphide; moderate net-neutralizing reactive carbonate minerals	PAG. Slow sulphide oxidation kinetics	Potential for elevated iron, copper and zinc
Charnokitic Gneiss	5.91	10%	Low sulphide content	NAG. Non-acid generator over the long term	Potential for slightly elevated iron, manganese, fluoride, zinc and mercury
Meta-Gabbro	0.17	0%	Moderate sulphide content	PAG. Very slow sulphide oxidation kinetics	Potential for slightly elevated iron, copper and mercury
Biotite Paragneiss	3.17	5%	Moderate sulphide content	PAG. Very slow sulphide oxidation kinetics	Potential for slightly elevated iron, fluoride, copper and mercury
Overburden	13.20	22%	Low sulphide content; moderate net-neutralizing reactive carbonate minerals	NAG. According to static ABA data	Potential for elevated iron, barium, copper and zinc
Total	60.98	100%			
Tailings					
Sulphurized	10.92	19%	Significant sulphide content pyrrhotite predominant; minor net-neutralizing reactive carbonate minerals	PAG. Rapid sulphide oxidation kinetics	Potential for elevated acidity, copper, iron, manganese, nickel, lead, zinc and mercury
De-Sulphurized	46.54	81%	Low sulphide content; moderate net-neutralizing reactive carbonate minerals	Uncertain. Negligible to very low amounts of acidity generated over the long term	Potential for elevated iron, copper and zinc
Total	57.46	100%			

3. The kinetic humidity cell test (HCT) work conducted for the project thus far has been based on analyzing the leaching potential for the various waste rock units and/or tailings products identified in Table 4.0. The ESIS fails to identify the duration for the HCTs and should be supplemented to include information from Section 3.5 of the report that identifies the length of time the HCTs were conducted. Additionally, Section 3.5 of the report includes mention of leach durations in the text (e.g. 40 or 50 weeks) that are not consistent with those suggested by the information from individual tests (generally less than 40 or 50 weeks). Section 3.5 also does not provide or discuss the protocol that was used to determine the test duration. The protocol or rationale used to determine the HCTs duration is necessary to determine if the tests were properly conducted to a meaningful end point.

4. As noted by the recommendations provided in Section 4.2 of the report, the laboratory HCTs conducted for the program thus far are not representative of field conditions or representative of the intended co-disposal conditions proposed to mitigate acid generation and metals leaching. This information is needed in order to develop a site wide water balance and water quality model using mine closure design and loading rates for mine waste materials as also recommended in Section 4.2 of the report. Without this information, the results presented in the ESIS should be considered preliminary in nature, and are not adequate to make an actual determination of the potential environmental impacts to water quality that might result from the proposed project.

5. We are familiar with the practice of using HCTs to predict lag-time for onset of acid generation as was performed and described in Section 3 of the report. The report and ESIS should both note that the use of HCTs to predict actual times is not standard, lacks actual proof of concept, and is highly subject to uncertainty. While the approach is useful to compare the lag times of different materials, the suggestion that it should be used to make determinative estimates is not supportable and brings the report as well as ESIS into question.

5 POTENTIAL FOR CONTAMINATED DISCHARGE

The ESIS should have provided a substantive analysis of the potential for contaminated discharges to occur from the proposed project over the entire mining life cycle including both short-term during construction and operations, but also over the long-term during reclamation and post-closure.

COMMENTS

1. The information provided in the ESIS and supporting documents is not adequate to identify or quantify the potential for contaminated discharges to occur from the co-disposal facility or co-disposal in the open pit mine over the short-term or long-term. As identified in the previous section, at present the project lacks geochemical characterization work necessary to address deposit variability with respect to sulfur, neutralizing potential, metals leaching potential, actual likely field conditions, and representation of the proposed co-disposal conditions. It also does not include a post-mining pit lake or site wide water balance and water quality model necessary to estimate long-term potential for contaminated discharges.

2. Based on the information that has been provided and is summarized in Table 4.0, the following describes the short-term and long-term potential for contaminated discharge from waste rock and tailings as well as with respect to co-disposal.

    A ***Waste Rock.*** The majority (63%) of the mass of waste rock is mixed paragneiss that contains significant sulphide content and only moderate net-neutralization potential. It is acid generating with potential for elevated iron, copper and zinc. The next highest quantity of waste rock, overburden, representing 22% of the mass of waste rock, has low sulphide content and is not expected to be acid generating. However, it has potential for elevated iron, barium, copper and zinc. Together these two units contain 85%

of the mass of waste rock that is proposed to be mined and will require disposal. The remaining waste rock consists of low to moderate sulphides, 10% non-acid generating and 5% acid generating, but all with potential for slightly elevated metals including iron, copper, manganese, fluoride, zinc and mercury. Based on the information provided the ESIS should conclude that the waste rock will contain significant potential for acid generation as compared to net-neutralization potential resulting in the waste rock producing acid drainage in both the short and long term, in which event it is likely that there will be potential for impacts to surface and groundwater quality primarily with respect to iron, copper, zinc and barium, as well as manganese, fluoride, and mercury.

B ***Tailings.*** The de-sulphurized tailings is estimated at 81% of the mass of total tailings. The report indicates it will have low-sulphide content and moderate net-neutralizing potential and suggests it has negligible to very low potential for acid generation. However, the de-sulphurized tailings have potential for elevated iron, copper and zinc. The sulphurized tailings consist of 19% of the mass of total tailings and contain significant sulfide content that is pyrrhotite predominant, resulting in rapid acid generation and potential for elevated acidity, copper, iron, manganese, nickel, lead, zinc and mercury.

3. Overall it is our conclusion based on the information contained in the ESIS and report that the waste rock and tailings units as described for the proposed project each have significant potential for acid generation and/or metals leaching. While additional information as identified in these comments is needed to reach a conclusion, the results suggest that any effort to commingle the material to address potential acid generation and metals leaching might have limited affect on mitigating potential for acid generation and/or water quality impacts given that potential for water quality impacts are evident in each of the individual units that would be used as proposed.

6 RELIABILITY OF PROPOSED MITIGATION MEASURES

NMGMP ESIS 2019 *Section 4.6.2 Mine tailings and waste management* describes the proposed management technique for tailings and mine waste rock. The approach assumes that 100% of the waste rock is potentially acid generating, together with 19% of the tailings. It assumes 81% of the tailings are classified non-acid generating. The approach would utilize encapsulation of the acid generating waste rock and tailings with the non-acid generating tailings in deposition cells. The approach is also proposed as a means to mitigate the potential for ignition of exothermic reactions that might potentially occur from high concentrations of the sulfide mineral pyrrhotite being present in the waste rock and sulphidic tailings. Alternatively, at a later point in the mine life, the co-deposition concept would be applied to backfilling part of the open pit.

Additional mitigation measures to be taken at mine closure are described in NMGMP ESIS 2019 *Annex 4.3 Redevelopment and Restoration Plan* (October 2019 resubmission). The measures identified in the plan can be summarized as follows:

- Access roads revegetation
- Tailings and waste rock co-deposition stockpile active cell closure, regrading, topsoil and vegetation
- Temporary ore stockpile regrading and vegetation
- Mining infrastructure dismantling and disposal, topsoil and vegetation
- Water collection ponds regrading, topsoil and vegetation including contingency for sludge management
- Water management infrastructure removal, topsoil and vegetation
- Security (hazard signs)
- Electrical infrastructure dismantling and disposal
- Pit reclamation consisting of regrading and vegetation
- Post-restoration follow-up consisting of geotechnical inspection of embankments, surface water, groundwater and pit lake water quality monitoring, vegetation follow-up, contaminated soil and sludge excavation contingency and environmental characterization costs for mud and soils.

Additionally, the plan includes a financial guarantee estimate. The estimate suggests a total of CDN $20.2M in direct restoration costs and applies an additional amount for indirect costs and contingency of CDN $5.3M for a total estimated financial guarantee of CDN $25.5M

COMMENTS

1. There is general acknowledgement by the mining industry that co-disposal is a relatively new technique for management of mine tailings and waste rock. It has only been proposed for a limited number of mining operations in northern cold climate locations in Canada and elsewhere. According to Habte and Bocking (2012), only one co-disposal facility (Greens Creek, Alaska) in cold climates existed as of 2012, with three projects proposing co-disposal in the commissioning or feasibility stage. The ESIS should note that there is only very limited short-term and no long-term data that can be evaluated to determine the effectiveness of co-disposal techniques in cold climates, and therefore no substantive conclusions can be reached as to their ultimate effectiveness in addressing acid generation and metals leaching.

2. As noted by MEND (2017) co-disposition, as well as co-placement of tailings and waste rock may offer environmental benefits for some mines, including eliminating or reducing the size of tailings facilities and "reduced potential for ML/ARD in waste rock dumps (if they are carefully designed)" (underline added) to accomplish high saturation of waste rock voids with tailings to reduce oxygen flow and hydraulic conductivity of the waste rock. MEND (2017) also notes that there are numerous issues to be addressed for implementation of co-deposition that are also applicable to co-placement of tailings and waste rock including:
    - Implementation issues with placing tailings and waste rock consistent with the requirements of the design;
    - Operational issues, including scheduling of waste rock and tailings production, and the increased workforce and management requirements (and associated costs);
    - The impact of the tailings and waste rock layers/cells on seepage patterns and water levels;
    - Impact of tailings on effective waste rock strength and overall facility stability;
    - Potential for long-term erosion and migration of cover materials for facility;
    - and level of actual acid generation and metal leaching mitigation.

    The ESIS should make note of the potential issues with co-deposition and address in particular the lack of actual real experience and results with respect to the technique that are available to address its effectiveness. The proponent should be required to provide additional details on the design and implementation including addressing the availability of the waste rock, de-sulphurized tailings and sulphurized tailings in the quantities needed to implement the proposed approach.

3. The ESIS should note that the Mine Effluent Neutral Drainage (MEND) program, which has been carried out since the 1980's, has conducted extensive research to assess the viability of methods used in acid drainage mitigation. Their most significant conclusion, as noted by Martin (2002) and still applicable today, is that "it is far easier (economic) to prevent ARD in the first place than to control it." Among the conclusions noted by Martin (2002) reached by MEND "From a number of existing sites where tailings had been placed in lakes in northern Canada, it was concluded that long term submergence of acidic wastes was probably the most effective means of ARD control." Considerable work has also been done on placement of impervious closure covers over tailings to prevent ingress of air and water. Sophisticated designs of multiple-layer covers, incorporating impervious zones, pervious capillary barriers and topsoil for vegetation growth, have been developed. Covers have been found to present the risk of long-term cracking or erosion, and to be ineffective in excluding air, so are often less favored solutions than submergence from the geochemical standpoint in sites where it is feasible to maintain a submerged condition (underline added)."

4. The ESIS should address an additional alternative that would focus on prioritization of submergence of the entire mass of sulphidic tailings that would be produced over the mine life in the open pit below the post-closure water table. This would include temporary storage of the sulphidic tailings material until such time as the bottom of the open pit becomes available either during or following the cessation of mining. The ESIS should also include the alternative of backfilling of the open pit with both the entire mass of sulphidic tailings and as much PAG waste rock as possible below the post-closure water level.

5. The Redevelopment and Restoration Plan is predicated on a best-case outcome where the proposed mitigation measures in terms of co-disposal and the proposed CEBC barrier cover result in no identified discharges and/or impacts to surrounding groundwater and surface water quality. Similarly, the proposed plan is predicated by a best-case outcome for pit lake water quality. In our extensive professional experience and as documented in our 2006 report titled *Comparison of Predicted and Actual Water Quality at Hardrock Mines* the use

of best-case outcomes in environmental assessments nearly always results in significant underestimation of actual mine discharges and impacts to surrounding water quality, and frequently result in underestimation of post-mining water management and treatment requirements, resulting in significant shortfalls in financial assurance. The likelihood of this occurring increases with the presence of significant acid drainage and metals leaching potential and the close, in this case immediate, proximity to sensitive water resources.

6. The ESIS must include a post-closure water quality assessment that includes reliable and complete geochemistry information and is based on a site-wide water balance that allows for analysis of climatic periods such as wet and dry cycles. It should include multiple scenarios including modeling the pit lake water quality and discharges from the co-disposal stockpiles based on a reasonable range of assumptions for water quality and discharge rates rather than only best-case outcomes. Based on that approach the ESIS should assume the "reasonable worst-case" results as a potential outcome and assess the impacts that might occur in that event. As noted by the Society of Mining Engineers (SME 2014), "Identification of potential mine wastes, their characterization, and prediction of their drainage quality are critical aspects of mine site design, operations, and closure planning. Failure to effectively conduct these evaluations for a mine site can result in long-term environmental compliance issues that may result in concomitant long-term financial liabilities (Maest and Kuipers 2005)."

The financial guarantee information provided is appreciated as in the event the proposed mining venture fails or is successfully mined to completion and then abandoned, it is the only means by which the public and government can be assured of the resources to conduct the necessary restoration measures. However, the present cost estimate for the guarantee is predicated by the best-case scenario portrayed in the ESIS that assumes the proposed co-disposal and CEBC covers and pit backfill and pit lake will all result in no significant impacts to water quality. The result is a financial guarantee that assumes no post-closure costs beyond that of reclamation and 10 years of monitoring. This walk-away approach is unwarranted where there is clearly a significant potential for impacts to water quality and the proposed mitigation measures unproven. As an alternative the financial guarantee should be based on a more conservative approach where potential for impacts to the pit lake water quality and from co-disposal facility discharges are acknowledged and included in the estimate. This would be likely to at least double the present estimated $25.5M financial guarantee, and might result in even greater costs being estimated. The financial guarantee should continue to be based on this conservation assumption until such time as the performance of the proposed mitigation measures is proven.

7 RISKS TO WATER QUALITY – CONCLUSIONS

- Based on the information contained in the ESIS we conclude there is a significant potential for generation of acid drainage and/or metals leaching from the 107 million tonnes of waste rock and tailings materials that would result from the proposed project, both in the short to very-long term. About 46% of the total tailings and waste rock material has significant to high sulphide content (38.5 Mt mixed paragneiss, 10.9 Mt sulphurized tailings), while the rest of material has moderate to no net-neutralizing reactive capacity. Nearly 90% of the total tailings and waste material has a potential for elevated metal leaching and contamination in iron, copper and zinc (38.5 Mt mixed paragneiss, 10.9 Mt sulphurized tailings, 46.5 Mt desulphurized tailings). There is also a significant risk for slightly elevated mercury, lead, manganese, nickel, fluoride, and barium.

- The proposed co-disposition method of mitigation in a surface facility is speculative in terms of both technical feasibility in terms of implementation, as well as with respect to benefits to water quality. The ESIS does not provide proof of concept and there can be no proof of the concept being proposed until it is actually constructed and tested over the long-term.

- The proposed effectiveness of mitigation measures and resulting post-mining restoration plan and financial guarantee estimate are based on an inadvisable best-case scenario wherein the proposed mitigation methods result in no significant impacts in terms of pit lake water quality or discharges from the reclaimed co-disposal stockpile that would impact water quality. Following mine reclamation, the plan assumes 12 years of monitoring followed by a "walk-away" scenario wherein no further liability for monitoring, maintenance or water resources exist.

- Based on our extensive experience in reviewing ESIS documents and water quality predictions, this particular ESIS has both underestimated the potential for discharges that could impact water quality, and at the same time has over-estimated the effectiveness of the proposed mitigation measures such as the co-disposition method and the co-disposition stockpile cover. The scenario presented in the ESIS is based on incomplete data and analysis, as well as near ideal assumptions and conditions.

- If the project were to proceed as proposed, we believe there would be a high likelihood of water quality impacts that are not predicted by the ESIS, and that would require additional mitigation measures beyond those proposed. In a reasonably probable worst-case event, there are likely to be significant water quality impacts that would require groundwater capture and treatment efforts to mitigate, which if unrecognized and not provided for in financial surety, could result in significant liability to the government and public taxpayers, not to mention significant impacts to downstream waters. There is a high risk of long-term (e.g. greater than hundreds of years) water management and treatment to result from this project that must be considered and costed.

- From an overall standpoint I have a high level of concern given the lack of financial capacity of this project/proponent, the financial risks associated with the graphite market, and the potential for significant environmental and social risks, that this project has significant potential to result in early closure or abandonment resulting in significant economic, environmental and social liabilities.

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