TECHNICAL MEMORANDUM

Golder Associates Ltd.
#500 - 4260 Still Creek Drive
Burnaby, B.C., Canada V5C 6C6

Telephone: 604-296-4200
Fax Access: 604-298-5253

TO: Craig Goodings

DATE: February 9, 2006

FROM: Valerie Bertrand
Don Chorley
Cam Clayton
John Cunning
John Hull
Dan Walker

JOB NO: 05-1413-036A

EMAIL: **cclayton@golder.com**

RE: **RESPONSE TO KIVALLIQ INUIT ASSOCIATION REQUEST FOR ADDITIONAL INFORMATION**

The Nunavut Impact Review Board (NIRB or Board) has received Information Requests (IR) from the Kivalliq Inuit Association (KivIA), Indian and Northern Affairs Canada (INAC), Environment Canada (EC), Health Canada (HC), Natural Resources Canada (NRCan), Transport Canada (TC), the Government of Nunavut, Department of Environment (GN-DoE), and the Government of Nunavut, Department of Community and Government Services (GN-CGS) on January 20, 2006 and from Fisheries and Oceans Canada (DFO) on January 21, 2006 relating to Cumberland Resources Ltd.'s Meadowbank Project, in accordance with the IR process described in NIRB's letter dated December 20, 2005. All IRs are available for download from NIRB's ftp site at the following URL:

http://ftp.nunavut.ca/nirb/03MN107-MEADOWBANK_GOLD_PROJECT/02-REVIEW/08-FINAL_EIS/IRs/

KivIA's consultants have provided a Memorandum titled "Key Issues with Meadowbank Project FEIS", dated 14 January 2006. The Memorandum was presented by Mr. Luiz Manzo, Lands Director, Kivalliq Inuit Association. The Memorandum presents eleven issues. The following responds to what are interpreted to be requests for clarification.

BEST EMPLOYERS IN CANADA 2005 REPORT ON BUSINESS
CANADA'S 50 BEST MANAGED COMPANIES

1.0 RESPONSES TO INFORMATION REQUESTS

1.1 Information Request #1: Tailings Density

KivIA has requested additional information based on the following issue:

"Tailings will be discharged from the tailings embankment end, which is the preferred strategy from an environmental safety perspective. Comments relating to tailings density were made previously in the review of the DEIS for the Meadowbank Gold project. These comments were not related to the technical ability to achieve the proposed tailings discharge density of 49.5% solids by weight. This predicted in-situ density of 1.43 t/m3,which is judged to be far too high, given experience at other tailings facilities and the potential inclusion of at least 25% ice. A density of 1.2 t/m3 is suggested.

The comments are instead related to the practical aspects of operating a plant of this nature in this environment as a long term closed system when the operating tendency is to use fresh water in some areas to control the process and maintenance issues that are associated with high TDS levels in reclaim water. It is recommended to test the water balance at incremental levels of decreased densities of the final tailings flow to see how sensitive the water balance is to operating as a closed system for the complete life of mine."

1.1.1 Response

As detailed in Section 11.1.2 and Appendix C of the report titled "Mine Waste and Water Management" (report prepared by Golder Associates Ltd. for Cumberland Resources Ltd., October 2005), the water balance model assumes 20% ice bulking of the tailings in-situ. This corresponds to an in-situ density of 1.31 t/m^3 at a solids specific gravity of 3.1 and slurry solids content of 50.8%. Other mines in the north, such as Diavik, use between 20% and 30% ice bulking for planning purposes. Therefore, the use of 20% ice bulking is considered reasonable for planning purposes.

A stage-storage volume curve for the tailings storage facility was presented as Figure 7.2 in the aforementioned report. A discussion of the potential for ice entrapment, and the effect this may have on the available storage volumes was presented in Section 7.2 of the report. A stage-storage volume curve for the tailings storage facility, incorporating 10%, 20%, and 30% ice by volume was presented on Figure 7.9 of the same report, and indicated that the current design of the storage facility had the capacity to accommodate ice entrapment of up to 20% by volume, and up to 30% by volume with a nominal increase in the final surface elevation by 3 m above the height that would be require if no ice is entrapped. Therefore, using the suggested in-situ density of 1.2 t/m^3, there will still be sufficient volume within the tailings storage facility to account for ice bulking.

Testing the Water Balance Within the Process Flow-Sheet

Water is introduced to the process at the milling circuit. Tailings are thickened in the cyanide wash recovery thickener. Cyanide contained in the underflow from this thickener is destroyed in the CN destruction tank and the tailings, after CN destruction, are directed to the tailings impoundment area.

The process can run on fresh water as well as on reclaim water from the tailings impoundment area. Regardless of the source of water supply for the process, the process is designed for thickening the tailings with their density approaching or better than 50.8% solids. Initially the processing will be with fresh water with no reclaim so as to develop a reclaim water pool in the tailings impoundment area. Subsequently reclaim of the supernatant waters will be maximized. If due to environmental or operational difficulties, reclaim is less than projected in the water balance fresh water requirement will increase but without impacting the tailings density delivered to the tailings impoundment area.

1.2 Information Request #2: Water Quality of Tailings

KivIA have requested additional information based on the following issue:

“If the fresh water intake has to be increased into the system and the storage capacity for non-compliant water is exceeded, what can the operation do with no water treatment plant to bring water to compliance for release to the environment?

In addition, water is to be pumped directly from the mine and tailings disposal areas into the lake without any provision for treatment. As a minimum, settling basins for suspended solids will be required during the summer and a water treatment plan for the winter.”

1.2.1 Response

It must be emphasized that there is no intention to pump water directly from the tailings disposal area into the lake without any provision for treatment.

As detailed in Section 7.1 of the report titled “Mine Waste and Water Management” (report prepared by Golder Associates Ltd. for Cumberland Resources Ltd., October 2005), the reclaim pond has been designed with a retention time of approximately 90 days to allow stabilization of the supernatant chemistry. In addition, the reclaim pumps will be placed on a floating barge which will be progressively moved during operations to maximize the withdrawal of clarified water and minimize the risk of entraining sediment. As such, the reclaim of water with high TSS values is not anticipated.

1.3 Information Request #3: Water Quality of Open Pits

KivIA have requested additional information based on the following issue:

"A tight water balance is predicted based on low inflows to the pits. Contingency plans need to be proposed should pit inflows be higher than predicted. Given that the lakes are underlain with unfrozen zones (taliks), fractured rock has been reported in a few drill holes and the embankments are to be built on lake sediments, higher inflows can be reasonably be expected.

Pit water quality during operations is a significant issue. Two important contaminants are expected to need addressing – sediments and ammonia.

The handling of TSS during the pumping out of the pool water within the containment dike requires more information and comment. Some general proposals on how to address water with high TSS…are made. It is recommended that…the susceptibility of lake bed sediments to produce high TSS water [be determined] and land storage areas and water treatment plant [be provided] for pumped pool water with unacceptable TSS concentration."

1.3.1 Response

Groundwater inflows to the open pits were predicted using a mine-scale hydrogeologic model which included a number of conservative assumptions. These included the following:

- The hydraulic conductivity of the rock from 150 m to 1000 m depth was assumed to be the same as that measured at 150 m depth (2 x 10^{-8} m/s) when in reality the hydraulic conductivity bedrock likely decreases with depth as has been observed in similar geologic environments in the Canadian Shield (Stevenson et al., 1996 a & b, Ophori et al. 1996, Ophori and Chan, 1994).

- The fractured rock zone associated with Second Portage Fault was assumed to be continuous and highly permeable throughout the model domain, while in reality such a thin fractured rock zone (~5 m) would likely have zones of low permeability that would limit the hydraulic connection along the fault.

In addition, a sensitivity analysis was conducted in which the hydraulic conductivities of both the bedrock and the fault were increased by a factor of 3. Results of the sensitivity analysis were used to establish an upper bound for the groundwater inflow that could be expected.

Predicted groundwater inflows derived from the mine scale groundwater model did not consider inputs from precipitation or inflow to the pit from flow through the dikes. As indicated in the Report on Design of Dikes with Soil-Bentonite Cutoff Wall, Meadowbank Gold Project (Golder, October 2003), cutoffs will be used to limit the amount of seepage of water through and beneath the dikes.

As detailed in Sections 10 and 11 of the “Mine Waste and Water Management” (report prepared by Golder Associates Ltd. for Cumberland Resources Ltd., October 2005), excess pit waters from the Portage pit and Goose Island pit in Years 1 to 5 will be used to meet the process water demand, with any excess directed to the attenuation pond. From Year 5 onwards, excess Portage Pit water is directed to Goose Pit to facilitate flooding of that facility. Vault Pit water is directed to the Vault Attenuation Pond, where it will be stored and treated in-situ, prior to release to the environment.

If necessary, water within the attenuation ponds will be stored and treated in-situ to increase residency time and promote the settlement of solids. The treatment of ammonia in ponded environments was discussed in a memorandum by AMEC Americas Ltd. dated October 12, 2005. A copy of the memorandum is provided in Appendix IX of the “Report on Mine Site Water Quality Predictions, Meadowbank Gold Project, Nunavut” (Golder, October 2005).

Prior to the construction of the tailings dike, Second Portage Lake will require dewatering down to elevation 105 m Above Mean Sea Level (amsl) within the area bounded by the east dike. The total lake volume to a lake level elevation of 133 m amsl is estimated to be 12.8 Mm^3 within the area to the west of the East dike. The dewatering volume is estimated to be 12.2 Mm^3, excluding the volume of water contained below elevation 105 m amsl (~ 580,000 m^3). The quality of water pumped from each basin will be closely monitored to ensure that TSS loadings to Third Portage Lake from dewatering operations do not exceed the guideline criteria.

Bathymetric data of Second Portage Lake indicates three separate basins; a Northwest Basin (~ 1.6 Mm^3), the Main Basin (~8.4 Mm^3), and an East basin (~ 2.5 Mm^3). Pool water will be withdrawn using pumps situated on a barge that is moored near the deepest portion of each basin to optimize withdrawal rate and minimize the risk of entraining sediment. In addition, silt curtains will be placed around the pumps to limit the uptake of TSS. With this approach it is anticipated that about 60%, of the total pool water volume (~7.3 Mm^3) will be of suitable quality to permit direct discharge to Third Portage Lake without further TSS management. This estimate is consistent with other similar mining operations in the north requiring de-watering of mining areas (R. Eskelson, Diavik, pers. comm).

Where necessary, additional TSS management practices will be used to ensure pool water meets with discharge quality criteria prior to release to the environment. These practices include a reduction in pumping rates, and the installation of silt curtains and/or baffles in the vicinity of exposed beaches to increase the flow path and residency time within each basin. Alternatively, one or more of the internal basins will be used as internal sedimentation ponds to provide temporary storage of pumped pool water until TSS criteria levels are achieved.

1.4 Information Request #4: Kinetic Testing

KivIA have requested additional information based on the following issue:

"Field cell results are not considered relevant because of the low proportion of fine grained material in the cells which raises issue and questions related to the impacts and mitigation plans required for ARD in waste rock, tailings, and the overall water quality during mining operations."

1.4.1 Response

The chemical impacts of tailings were evaluated based on chemistry and kinetic testing performed on tailings, not field cells. For waste rock, both field cells and crushed material have been used to bracket the range of probable water chemistry draining the various mine components that will contain waste rock (open pits, waste rock piles and dikes). Scale-up factors applied to field cells in the calculation of water quality considered the coarser size of these tests relative to those of laboratory tests, (a rock wetting factor of 1 was applied to field cell rates compared to 0.1 for laboratory tests). Considering the relatively short exposure time of field cells, leaching rates derived from these experiments are expected to provide an adequate assessment of near-term water quality effects from the bulk of the waste rock. As a conservative measure, ARD mitigation planning including treatment requirements, have been based on the poor-end water quality predictions (using laboratory-derived leaching rates). Similarly, the evaluation of impacts to the physical environment have also been based on poor-end predictions of effluent quality and dike leaching.

1.5 Information Request #5: Pit Dike Design

KivIA have requested additional information based on the following issue:

"Important preliminary information that is not provided in the EIS includes:

<u>Lakebed sediment properties (i.e. load-bearing characteristics) and consistency.</u> This can affect the release of TSS during embankment rock placement, stability of the dike embankment and water management of the large volume of pool water that has to be pumped out during a short period. These lakebed sediments can be expected to be poorly consolidated and range in size from very fine, high water content particles to large glacial deposited boulders. Exposed sediments will be subject to freezing resulting in upstream pressure build-up in unfrozen zones under the embankments. This is a serious design short- coming and could lead to failure by piping or structure settling.

<u>Boulder distribution within till below lake dikes.</u> The boulders that were found at Diavik considerably slowed the progress of constructing the cutoff wall and increase the cost.

The till core would be constructed from overburden pre-stripped in the open pit areas. A large amount of uniform till would be needed to construct the containment and tailings dikes before stripping and mining can start. How would this be done if much of the till is, at the beginning under water, completely water saturated and/or untrafficable? Rock is waste rock from the early stages of the Portage mine development.

It is unclear if enough material would be available since most of the pit area is water covered.

It is unclear how these structures would be built to good engineering standards and in time if the annual frost-free period is approximately two months? More detail is required.

The bentonite-till core is to be cut into bedrock without stripping the base clean (and dewatering the sediments). It is unclear how this can be done."

1.5.1 Response

It is recognized that the bottom sediments will introduce TSS into the water column during the advancement of the rockfill berms. It is planned to use silt curtains to manage TSS during embankment rock placement. Such methods to manage TSS during embankment construction are routinely used at other mining operations in the north. The construction methodology involves the use of widely spaced rockfill berms with till infill. Consequently, the working platform will be much wider than, for example, Diavik for cutoff construction. The water depths are shallow, generally less than 4 m to 6 m. Much of the East Dike will be constructed through water that is 2 m or less in depth. The fine lake bottom sediments will be displaced or incorporated into the pore space of the rockfill. The displacement or incorporation of the fine lake bottom sediments into the rockfill is not expected to present any significant stability issues especially when the embankment height is low.

Through the deepest section of the Goose Dike, along its southeast segment, dredging may be necessary. This can be achieved using a crane and clamshell dredging bucket if necessary.

The pore pressure in the upstream or lake side section to the cut-off would be equal to the lake surface head. Downstream or on the pit side, the pore water pressures will decrease as the cut-off zone drains. If freezing occurs from the top down into the sediments on the pit side and at the toe of the dike, then higher pressure in the downstream foundation could occur. However, these higher pressures are not related to the upstream dike section, but are a result of freezing. A simple, effective, and proven way to relieve these pressures is by installing de-pressurization wells around or at the pit side toe of the dike to relieve the pressure. Once freezing is complete to the rock surface, pressure build up will no longer be present. The dikes will be instrumented with piezometers, thermistors, and slope indicators to monitor dike performance. A rockfill berm can be used to increase the load on any downstream failure surface and maintain stability. Wells or drains could be used to relieve the pressure within the dike foundations. There are currently numerous precedent examples of successful dike construction in the north using similar construction methodology.

It is agreed that the distribution of boulders within the till will have some affect on the construction schedule in that it may take longer to construct certain sections of the cut-off. If this possibility is incorporated into the construction schedule, then it is not a design defect.

The till material to be used for the initial dike construction will come from pre-stripping activities in the area of the Third Portage peninsula, and not from below the lake surface. Information on the quantities of material to be used for construction of the dikes was presented in Table 2.1 of the report titled “Mine Waste and Water Management” (report prepared by Golder Associates Ltd. for Cumberland Resources Ltd., October 2005). Additional details of the material balance for the project were submitted to NIRB in a Technical Memorandum titled “Meadowbank Gold Project Internal Conformity to PHC Decision in response to additional requests for information with respect to Item #44 of the NIRB PHC decision.

The volume of till material available for use has been estimated based on overburden thickness as determined from borehole casing depths. For planning purposes, it has been assumed that only 50% of the till that is available from pre-stripping will be suitable for use as construction material. It was determined that sufficient quantities of till will be available from pre-stripping for use in the construction of the de-watering dikes.

The proposed methodology for the construction of the de-watering dikes has been described in detail in the report title “Design of Dikes with Soil-Bentonite Cutoff Wall, Meadowbank Gold Project” and dated 23 October 2003. The report was provided as part of Item #28 to address Pre-Hearing Conference Commitments made by Cumberland. Precedent examples for the proposed methodology include dikes constructed in Kirkland Lake, cofferdams used for the St. Lawrence River Project and described by Adams and Bazett (1963), and the Arrow (Hugh Keenleyside) Dam described by Casagrande, Golder, and Bazett (1969).

The annual frost free period at the site is two months; however the ice-free period of water is on the order of three to four months. The dikes will be constructed during the ice-free period of water. The abutment areas of the dikes may require special consideration in terms of construction as these areas will be critical to the overall performance of the dikes. Additional investigations may include trenching in these areas to better define foundation conditions. However, these studies will be implemented during detailed design engineering studies. The abutment areas will also be instrumented during the construction phase in order to assess the overall performance of the dike in these areas.

The collection of geotechnical data from drill core in the project area indicates that approximately the upper 0.5 m of bedrock is typically fractured. This material would be excavated using standard excavating equipment. Geotechnical data also indicate that competent bedrock is encountered rapidly beneath the surficially fractured bedrock.

1.6 Information Request #6: Tailings and Waste Rock Areas Design

KivIA have requested additional information based on the following issue:

“In the closure design for tailings and waste rock Meadowbank proposed to cover the tailings and waste rock with about 2 m of clean waste rock and allow these deposits to freeze and encapsulate them in permafrost. Meadowbank’s comment that the active layer is 1.3 m thick is not supported by their ground temperature data nor by published data.

Field observation have shown that 'dry' rock with no organic cover produces much thicker active layer (annual thaw) than the proposed 2 m cover (Holubec 2004). The Diavik project selected 3 m of clean rock and 0.5 m of till to cover the tailings and 3 m of clean rock and 1.5 m of till to cover waste rock that was identified as potential ARD.

However, it has to be noted that the likely climate at Meadowbank may start thawing of permafrost in about 100 years. Dependence upon permafrost for the purposes of closure is not considered a viable design for long term. The suitability of the proposed tailings and waste rock closure design should be carefully reviewed and alternative measures considered to address the predicted long-term thawed conditions."

1.6.1 Response

It should be noted that the predicted long-term climate conditions at the site indicate it will remain within the zone of continuous permafrost, even if climate change is taken into account (Woo, et. al, 1992), although degradation of the permafrost may result in a thickening of the active layer, and a lessening of the depth of permafrost.

Section 8.0 of the "Report on Permafrost Thermal Regime Baseline Studies, Meadowbank Project, Nunavut" (Golder, December 2003) states the following:

"*Based on the current site thermistor instrumentation, the depth of the active layer in the project area ranges from about 1.3 m in areas of shallow overburden and away from the influence of lakes, up to 4.0 m adjacent to lakes, and up to 6.5 m beneath the stream connecting Third Portage and Second Portage Lakes*."

This statement is based on the data collected from the site, and presented in the permafrost baseline report. The baseline report was provided to NIRB as part of Items 14 and 15 to address Pre-Hearing Conference Commitments made by Cumberland, and can be downloaded from the NIRB website at the following URL:

- http://ftp.nunavut.ca/nirb/03MN107-MEADOWBANK_GOLD_PROJECT/02-REVIEW/07-TECH_MTG_PHC/151._050728-CRL-MB-Commitments_Submission1-ITAE/Item14_15_ThermistorsGeothermalModeling/

The report contains all data relating to thermistor installations at the site. Thermal studies at the site were initiated during the 1996 summer exploration drilling program, with the installation of two thermistor cables in exploration boreholes drilled on Third Portage Peninsula. These studies continued with the installation of additional thermistor cables during field investigations in 1997, 1998, 2002, and 2003. To date, twenty two thermistor cables have been installed to characterize and monitor the thermal conditions and permafrost at the project site. The thermistors have been located to characterize the thermal regime at the project site both inland (away from the influence of deep lakes), as well as adjacent to lakes. The thermal regime at the site is well characterized. The site data clearly support the conclusions and statements made in the baseline report, and in the Final Environmental Impact Statement for the Meadowbank Project.

It has been stated in Section 7 of the Reclamation and Closure Plan (prepared by Golder Associates Ltd. for Cumberland Resources Ltd., October 2005) that the reclamation and closure plan for the project will require a commitment to adaptive management and monitoring during all stages of the mine life. The Mine Waste and Water Management report, and the Reclamation and Closure Plan (prepared by Golder Associates Ltd. for Cumberland Resources Ltd., October 2005) identify that for feasibility level studies it has been assumed that a capping of non-PAG rock, at least 2 m thick, will be placed over the Portage tailings and waste rock disposal facilities. It is recognized that the thickness of cover material may need to be adjusted, based on an adaptive management plan that will collect data during operations in order to develop the most appropriate closure plan for the existing site conditions. Section 4.5 of the Reclamation and Closure Plan includes a discussion of insulating cover designs, and discusses cover designs at Diavik and Ekati in the context of the Meadowbank Project. A discussion is also presented that considers climate change, and presents several options that would be considered in the detailed design phase of the project. Such systems would be designed to minimize water infiltration into the system, thus limiting the flux through the system.

It is common for northern projects to develop a series of instrumented test pads during operations to evaluate different cover systems. This approach is currently being undertaken at the Diavik mine site. In order to better understand the conditions in their waste rock piles, Diavik have setup an instrumented test waste rock pile which is the subject of a number of research projects with the data on conditions in this waste rock pile being used in future updates of the Diavik A and R plan.

It has been stated in the Mine Waste and Water Management report (prepared by Golder Associates Ltd. for Cumberland Resources Ltd., October 2005), and supporting documentation, that for the current climate conditions at the Meadowbank Site, disposal of tailings into the natural bedrock basin of Second Portage Lake, followed by permafrost encapsulation is clearly the best available option for disposing of tailings. Thermal modeling indicates that the tailings will tend to a frozen state, even when reasonable climate change predictions are incorporated into the modeling. A report by Golder Associates Ltd. titled "Thermal Modelling of the Tailings Deposit in the Second Portage Lake, Meadowbank Gold Project", and dated February 2004 was provided to NIRB as part of Items 14 and 15 to address Pre-Hearing Conference Commitments made by Cumberland, and can be downloaded from the NIRB website at the following URL:

- http://ftp.nunavut.ca/nirb/03MN107-MEADOWBANK_GOLD_PROJECT/02-REVIEW/07-TECH_MTG_PHC/151._050728-CRL-MB-Commitments_Submission1-ITAE/Item14_15_ThermistorsGeothermalModeling/

The development of an appropriate tailings management plan must consider the current conditions at the site. The site is located within the zone of continuous permafrost and therefore must be designed for these site conditions. Accepted climate change trends predict that even with climate change, the Meadowbank Project will remain within the zone of continuous permafrost (Woo et al. 1992, IPCC 2001, INAC 2003)), and hence tailings and waste rock piles will continue to a frozen state. It is generally accepted by members of the scientific community that climate predictions beyond 100 years are unreliable.

1.7 Information Request #7: Chemicals Management

KivIA have requested additional information based on the following issue:

"The tailings would be beach discharged as slurry following cyanide destruction using bisulphite. The details of the process to be applied were not provided. (This may be intended to be the industry standard SO2-air process. No details or test results are available in the documents provided on water quality expected from the tailings facility. Even if the cyanide destruction facility is state of the art and operates at a high degree of efficiency, some contaminants are expected to be discharge with tailings. These contaminants may be residual cyanide, cyanates, ammonia, thiosalts, heavy metals, and arsenic.

Some discharge to the environment will occur during the first three or more years of operations. After operations some discharge will also occur as the active frost zone will exceed the rock cover thickness. Again, water treatment before discharge needs to be considered. "

1.7.1 Response

Whole ore tailing decant water quality from the metallurgical test circuit (post cyanide destruction) is provided in Table 3-30, Tailings – Decant Water Quality, in the Golder Associates Ltd. report on "Static Test Results for Overburden, Mine Site Infrastructure Rock, Pit Rock and Tailings, Meadowbank Gold Project, Nunavut", and dated September 2005, a supporting document to the Final Environmental Impact Statement (FEIS; Cumberland, October 2005).

It is re-emphasized that there is no intention to pump water directly from the tailings disposal area into the lake without any provision for treatment. Water treatment before discharge has been discussed in the "Mine Waste and Water Management Report (prepared by Golder Associates Ltd. for Cumberland Resources Ltd., October 2005). The process plant will be converted to water treatment to treat water remaining in the tailings reclaim pond at the end of mine life. The strategy to minimize the requirements for water treatment have been outlined in Section 10.3.1.2 of Mine Waste and Water Management report. Portions of that section are summarized below.

To minimize water treatment requirements, it is proposed to operate the reclaim pond separately from the attenuation storage pond. During Years 1 and 2, stormwater will be attenuated in a basin at the northwest end of Second Portage Lake. A dike will be constructed in Year 3 across the northwest basin of Second Portage Lake to allow separation of the attenuation storage pond from the tailings reclaim pond. This will provide a storage capacity of approximately 800,000 m^3 in the northwest basin, up to the elevation of the current lake level (El. 133 m). Additional volume will be obtained by raising the dike crest and allowing some flooding of the surrounding shoreline. During the construction period, water will be managed through the use of sumps and drainage ditching, and will be directed to the reclaim pond.

The attenuation pond will receive the site contact water, including runoff and seepage from the waste rock disposal facility, treated runoff from the Portage and Goose Island pits, and runoff originating from the mill and airstrip areas. **Any process (tailings-related) water will be contained in the reclaim pond located within the actual tailings impoundment area.** Pit waters from the Portage pit and Goose Island pit will be first pumped to a water sump at the process plant. Water can be treated with lime, as required, and used to meet the process water demand. Any excess water, if it satisfies discharge criteria, will be directed to the attenuation pond. Reclaim water from the tailings impoundment will also be available to meet the process water demand, with excess water being returned to the reclaim pond.

Interceptor ditches along the eastern and northern edges of the waste rock storage facility will direct any contact water toward sumps. These sumps will either be pumped to the attenuation storage pond, or will be allowed to drain to the pond by gravity. A sump will be required to collect water from the southern edge of the Portage reclaim storage facility and pump to the attenuation pond during Years 1 through 4, or to the reclaim pond after Year 4. This will allow isolation of the tailings disposal facility from the general, site-wide water management plan. Runoff quantities from the Portage reclaim storage facility are expected to be low. Lime can be added to the collection sumps to adjust the water chemistry, if required, prior to discharge to the attenuation pond. It is noted that it may prove difficult to maintain gravity flow to the attenuation pond near the end of the mine life when the attenuation pond level rises above the current Second Portage Lake level (El. 133.1 m). An additional sump to the south of the rock storage area may be necessary at that time.

As mining continues, the reclaim pond will advance westward as the tailings beach advances. At the end of Year 4, the main basin will be filled with tailings. At this time, the mining of the Goose Island pit will be nearing completion. Pit inflow water and site contact water will then begin to be directed to the Goose Island pit for flooding. This will be done through existing pipelines that were used previously for pit de-watering of the Goose Island pit. Pit water within the Portage pit will be used for re-watering the Goose Island pit by pumping through a series of pipes. Alternatively, the Portage pit water could continue to be pumped to the storage sump at the plant site through existing pipelines, and subsequently allowed to flow through pipelines to the Goose Island pit. The former attenuation storage at the northwest end of Second Portage Lake will be used subsequently as the reclaim pond. Small perimeter saddle dikes will be constructed to allow the pond and tailings surface level to be raised above the current lake level so that sufficient process water volume requirements are maintained as necessary.

Cumberland plans an adaptive management approach which will involve the monitoring of tailings and waste rock piles during mining operations to confirm the assumptions on which the feasibility study have been based. This will include the installation of thermistors to monitor the development of permafrost in the tailings and waste rock. The reclamation and closure plan will be adjusted accordingly. As described in Section 4.5 of the Reclamation and Closure Plan (prepared by Golder Associates Ltd. for Cumberland Resources Ltd., October 2005), it is common to develop a series of instrumented test pads to be monitored during operations to evaluate different cover design strategies.

The cyanide destruction process will be SO2 air.

1.8 Information Request #8: Deep Water Issues – Flooding of Pits

KivIA have presented the following statement:

"During operations, mined out pits accumulate site and excess facility water. On completion of mining, the pits would be refilled with water from Third Portage Lake to equalize levels in the mined out pits to premining conditions. Consideration has been appropriately done on rate on refilling. Acid generation aid metal leaching has been reported on samples from the mineralized zones. Pit walls are expected to exhibit the same characteristics. The pits are expected to contain contaminated water on flooding – suspended solids and ARD products from exposed wall rock. Little to nothing can be reasonably done to prevent this contamination but the flooding of the pits will prevent acid generation to continue beyond flooding. The simple addition of lime could treat any residual acidity on closure. Should arsenic be present, ferric sulphate could be used to remove the arsenic. This agent would also help remove any residual heavy metals and suspended solids."

1.8.1 Response

The statements provided by the reviewer are in agreement with proposed and accepted treatment methodologies.

1.9 Information Request #9: Shipping and Marine

KivIA have requested additional information based on the following issue:

"There is no supporting documentation that outlines the impacts of marine transport on the environment in Chesterfield Inlet and Baker Lake or on the overall economics of the Meadowbank Gold Project.

The reviewers feel that the FEIS requires a completed marine plan, and documentation of the responsible person and or fund, as required under the Nunavut Land Claims Agreement Article 6, sections 6.2.2 and 6.2.3."

1.9.1 Response

Response to be provided separately by Cumberland Resources Ltd.

1.10 Information Request #10: All-Weather Road

KivIA have requested additional information based on the following issue:

"Cumberland's plan for the closure and reclamation of the all-weather road is the same as that for the Tehek Lake Access Road. (Reclamation and Closure Report, section 4.0; Access and Air Traffic Management Report section2.8). Once the ownership status of the all-weather road upon closure of the Meadowbank Gold Project has been determined, Cumberland's plan for the closure and reclamation will need to be more clearly outlined."

1.10.1 Response

Cumberland will update the plan for the closure and reclamation of the all-weather road from the mine (Meadowbank Gold Project) to Baker Lake at such time as the long term ownership of the road is agreed to and the long term maintenance needs are agreed to with the future owner. The following sections of reports will be updated – Reclamation and Closure Plan (prepared by Golder Associates Ltd. for Cumberland Resources Ltd., October 2005), Section 4.0, and the Access and Air Traffic Management Report (Cumberland, October 2005e), Section 2.8.

1.11 Information Request #11: Climate Change and Permafrost

KivIA have requested additional information based on the following issue:

"The issue of not adequately addressing the potential that climate change may be higher than that used has not been addressed. Meadowbank used in their climate warming modeling an increase of the mean annual air temperature (MAAT) to be 5.5°C for the first 100 years and thereafter constant temperatures. More recent publications indicate that the MAAT rise will be greater than the 5.5°C per 100 years and the rise will continue at some smaller unknown rate.

It is realized that the present and proposed guidelines in draft form use long-term reclamation requirement but do not explain what long-term means. It is worthy to note that an Australian mine long-term design criteria for earth structures is 200 to 500 years and that the uranium industry has to design for 1,000 years.

Considering that Canada has adopted the "Precautionary Principle" (UN 1992) for the environment and that the Canadian northern regions have shown an appreciable MAAT increase during the last 20 years, a MAAT increase of about 8°C for the first 100 years could be reasonable and this could be followed by half the rate for the next 100 years."

1.11.1 Response

Requests for clarification of climate change and permafrost issued have been addressed previously in several instances as part of commitments made by Cumberland Resources Ltd. during the Pre-Hearing Conference Hearings. Specifically, a Technical Memorandum, titled "Item #56 – Meadowbank Gold Project – Tailings Thermal Modelling and Climate Change Effects" was prepared in response to questions raised during the PHC hearings. In addition to the aforementioned Technical Memorandum, raw thermistor data, a baseline permafrost report titled "Permafrost Thermal Regime Baseline Studies" (Golder, December 2003), and a report titled "Thermal Modeling of the Tailings Deposit in the Second Portage Lake" (Golder, February 2004) have been provided as supporting documentation to the discussion of climate change and permafrost at the site. These documents are publicly available at the following URL's:

- http://ftp.nunavut.ca/nirb/03MN107-MEADOWBANK_GOLD_PROJECT/02-REVIEW/07-TECH_MTG_PHC/151._050728-CRL-MB-Commitments_Submission1-ITAE/Item%2356_TailingsThermal/

- http://ftp.nunavut.ca/nirb/03MN107-MEADOWBANK_GOLD_PROJECT/02-REVIEW/07-TECH_MTG_PHC/151._050728-CRL-MB-Commitments_Submission1-ITAE/Item14_15_ThermistorsGeothermalModeling/

Discussion

A report titled "Implications of Global Warming and the Precautionary Principle in Northern Mine Design and Closure" (BGC, 2003), was prepared for Indian and Northern Affairs Canada, and provides guidance relevant to mine design in Nunavut. This report suggests that globally the average temperature may increase by about 2°C by 2100 due to global warming. The report also states that the increase may be double the global average for sites located at 50°N, and may be 3.5 times greater for sites located at 80°N.

These estimates suggest that the average annual temperature for the Meadowbank property, located at around 65°N, may increase by approximately 5.5°C by 2100. Thermal modeling carried out by Golder has applied the precautionary principle in accordance with the document "Implications of Global Warming and the Precautionary Principle in Northern Mine Design and Closure" (INAC, 2003). Golder have used an increase in Mean Annual Air Temperature (MAAT) of 5.5 degrees C per 100 years.

Additional questions of climate change effects were addressed by Golder Associates Ltd. previously in the Technical Memorandum titled "Item #56 – Meadowbank Gold Project – Tailings Thermal Modelling and Climate Change Effects", dated July 2005, as part of Item 56 to address Pre-Hearing Conference Commitments made by Cumberland. This document can be downloaded from the NIRB website at the following URL:

- http://ftp.nunavut.ca/nirb/03MN107-MEADOWBANK_GOLD_PROJECT/02-REVIEW/07-TECH_MTG_PHC/151._050728-CRL-MB-Commitments_Submission1-ITAE/Item%2356_TailingsThermal/

In that document, Golder presented a table summarizing climate change predictions used on a number of northern projects which have been reported in the engineering and scientific literature. For the sake of convenience, that table is reproduced here:

Table 1: Summary of Reported Climate Change Rates Used in Northern Projects Engineering Studies

Reference	***Increase in MAAT by year 2100 (°C)***	***Notes***
Implications of Global Warming and the Precautionary Principle in Northern Mine Design and Closure, INAC (2003)	5.5	Used in Meadowbank DEIS for site at 65° North Latitude
Hayley (2004)	4.7	Used in design studies for the Inuvik Regional Health Center. Reported as increase of 0.47°C per decade.
Hayley and Cathro (1996)	5.0	Used for Raglan Dam analyses.
Mackenzie Valley Land and Water Board (2002)	3.0	Used for the Ekati mine expansion
Diavik	3.2	Used for the Processed Kimberlite Containment Facility Design
Burn (2003)	6.0	For use in the Western Artic for pipeline design projects. Reported as increase of 1.75°C over a 29 year period
IPCC (2003)	0.8-5.2	Predicted range for change in the global average surface air temperature

The use of an increase in Mean Annual Air Temperature of 5.5ºC per 100 years is supported by current industry accepted climate change rates for northern projects. There is currently no strong evidence to support modeling a MAAT increase of 8°C for the first 100 years followed by half that rate for the next 100 years. Climate change predictions beyond 100 years are generally accepted by the scientific community as being unreliable. However, during the operational period of the mine monitoring of thermal conditions at the site will continue to confirm the assumptions on which designs are based, and to allow adaptive management plan to be implemented in order that site specific designs for closing of the site facilities may be developed.

2.0 REFERENCES

Adams, J.I. and Bazett, D.J. (1963) – Till Cofferdams Dumped in Water, the Engineering Journal (October 1963, Montreal), Vol. 46, No. 10, pp. 51-6.

Bazett, D. J. (1970). The Characteristics of Till Placed Under Water at the Arrow Dam. Commission Internationale des Grands Barrages, Montreal.

Bruce Geotechnical Consultants Inc. (BGC). 2003. Implications of Global Warming and the Precautionary Principle in Northern Mine Design and Closure.

Casagrande, A., Golder, H.Q. and Bazett, D.J. (1969). Design Construction and Testing of the Arrow Dam, presented on February 7, 1969 before the ASCE Water Resources Conference, New Orleans.

Cumberland Resources Ltd. (prepared by Golder Associates Ltd. for Cumberland Resources Ltd.). October 2005. Mine Waste and Water Management Report.

Cumberland Resources Ltd. (Cumberland). October 2005. Final Environmental Impact Statement (FEIS).

Cumberland Resources Ltd. (prepared by Golder Associates Ltd. for Cumberland Resources Ltd.). October 2005. Reclamation and Closure Plan.

Cumberland Resources Ltd. (prepared by Golder Associates Ltd. for Cumberland Resources Ltd.). October 2005. Project Alternatives Report.

Cumberland Resources Ltd. (Cumberland). October 2005. Access and Air Traffic Management Report.

Golder, H.Q. and Bazett, D.J. (1967). An Earth Dam Built By Dumping through Water, Ninth International Congress on Large Dams, Vol. IV, pp. 369-87.

Golder Associates Ltd. (Golder). October 2003. Report on Design of Dikes with Soil-Bentonite Cutoff Wall, Meadowbank Gold Project.

Golder Associates Ltd. (Golder). December 2003. Report on Permafrost Thermal Regime Baseline Studies, Meadowbank Project, Nunavut.

Golder Associates Ltd. (Golder). February 2004. Report on Thermal Modelling of the Tailings Deposit in the Second Portage Lake, Meadowbank Gold Project.

Golder Associates Ltd. (Golder). July 2005. Technical Memorandum RE: Item #56 – Meadowbank Gold Project – Tailings Thermal Modelling and Climate Change Effects.

Golder Associates Ltd. (Golder). September 2005. Report on Static Test Results for Overburden, Mine Site Infrastructure Rock, Pit Rock and Tailings, Meadowbank Gold Project, Nunavut.

Golder Associates Ltd. (Golder). October 2005. Report on Mine Site Water Quality Predictions, Meadowbank Gold Project, Nunavut.

Golder Associates Ltd. (Golder). December 2005. Technical Memorandum on Meadowbank Gold Project Internal Conformity to PHC Decision.

Indian and Northern Affairs Canada (INAC) . 2003. Implications of Global Warming and The Precautionary Principle in Northern Mine Design and Closure. March 27, 2003, 74 pp.

IPCC, 2001: Climate Change 2001: The Scientific Basis. Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change [Houghton, J.T.,Y. Ding, D.J. Griggs, M. Noguer, P.J. van der Linden, X. Dai, K. Maskell, and C.A. Johnson (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 881pp.

Ophori, D.U. and Chan, T. 1994. Regional Groundwater Flow in the Atikokan Research Area; Simulation of 18O and 3H Distributions. AECL-11083. Manitoba.

Ophori, D.U., Brown, A., Chan, T., Davison, C.C., Gascoyne, M., Schier, N.W., Stanchell, F.W., and Stevenson, D.R., 1996. Revised Model of Regional Groundwater Flow in the Whiteshell Research Area. AECL Whiteshell Laboratories, Pinawa, Manitoba.

Stevenson, D.R., Brown, A., Davison, C.C., Gascoyne, M., McGregor, R.G., Ophori, D.U., Scheier, N.W., Stanchell, F.W., Thorne, G.A., and Tomsons, D.K. 1996a. A Revised Conceptual Hydrogeologic Model of a Crystalline Rock Environment, Whiteshell Research Area, Southeastern Manitoba, Canada. AECL-11331, Whiteshell Laboratories, Pinawa, Manitoba.

Stevenson, D.R., Kozak, E.T., Gascoyne, M., and Broadfoot, R.A. 1996b. Hydrogeologic Characteristics of Domains of Sparsely Fractured Rock in the Granitic Lac du Bonnet Batholith, Southeastern Manitoba, Canada. AECL-11558, Whiteshell Laboratories, Pinawa, Manitoba.

Woo, M,, Lewkowicz, A.G., Rouse, W.R. 1992. Response of the Canadian Permafrost Environment to Climate Change. Physical Geography, 13, 4, 287-317

VJB/DWC/CJC/DRW/vee
05-1413-036A
N:\FINAL\2005\1413\05-1413-036A\TECHMEMO0209_06 - RESPONSE TO KIVALLIQ INUIT.DOC