TECHNICAL MEMORANDUM

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TO:	Roger March and Craig Goodings	**DATE:**	March 21, 2007
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CC:	John Hull (Golder Associates Ltd.), Jim Koski (Meadowbank Mining Corp.) and Joe Murdock (Nunavut Water Board)	**VERSION:**	0
RE:	**WATER MANAGEMENT AND MONITORING PLAN FOR TYPE "B" WATER LICENCE NUMBER 8BC-TEH0708, MEADOWBANK GOLD PROJECT ACCESS ROAD, KIVALLIQ REGION, NUNAVUT**		

1.0 INTRODUCTION

Per Nunavut Water Board (NWB or Board) Type-B Water License 8BC-TEH0708 dated February 20, 2007, Meadowbank Mining Corporation, formerly known as Cumberland Resources Ltd. (Cumberland), is required to submit a Site Water Management and Monitoring Plan for the Meadowbank Gold Project Access Road within thirty (30) days following license issuance.

Specifically, the license stipulates:

PART B – GENERAL CONDITIONS, Item 3

The Licensee shall submit to the Board a Site Water Management plan, within thirty (30) days following the issuance of the licence, for Board approval, that includes but is not limited to the following:

> i. A description of the quantity and direction of surface water flow from the road and over the surrounding landscape, along with topographic maps that effectively delineate the movement of waters on site;

ii. A detailed description of the location and capacity of water retention areas that would allow for the management of surface water runoff from the road;

iii. A detailed description of the sampling locations along the access road where the water procured would provide the most representative analytical results, as determined by an appropriately qualified Engineer through a clear disclaimer outlining any limitations to judgment made by the Engineer, and of the quality of the surface water draining from the road surface;

iv. A description of the contingency measures that will be implemented in the event that the water quality does not meet CCME criteria (see Part I, Item 1 iv); and

v. Any further information that a qualified Engineer believes to be pertinent to describe the movement and quality of surface water draining from the access road.

PART I – CONDITIONS APPLYING TO THE MONITORING PROGRAM, Item 1.

The Licensee shall provide a Monitoring Program for approval by the Board, developed and signed by a qualified Engineer and/or geochemist, within thirty (30) days following the issuance of the licence. The proposed monitoring program, as determined by an appropriately qualified Engineer through a clear disclaimer outlining any limitations to judgment made by the Engineer, shall include, but not be limited to, the following:

i. An appropriate number of samples to be collected of runoff water from the access road and accumulated water in the quarries, and analyzed for geochemical characteristics, to confirm that the quarry rock used for construction is neither acid generating, nor leaching significant concentrations of metals;

ii. An appropriate number of samples to be collected of runoff water from the access road and accumulated water in the quarries, and analyzed for TSS to confirm that the sediment and erosion control measures are functioning properly;

iii. An appropriate number of samples to be collected of accumulated water in the quarries and analyzed for presence of by-products of explosives use to ensure that impacts of these chemicals to waters is within acceptable limits;

iv. A comparison of water sample results to the applicable guidelines provided in the CCME *Guidelines for Freshwater Aquatic Life* (dated December 2006) in tabular format, highlighting individual parameter results that have exceeded these guidelines;

v. Recommendations to mitigate the impacts to waters in the event that the results of the analyses performed exceed the CCME criteria;

vi. A description of the sampling methodology and the field sampling quality control/quality assurance plan, in accordance with INAC *QA and QC Guidelines for use by Class "B" Licensees in Collecting Representative Water samples in the Field and for submission of a QA/QC Plan (1996).*

The following summarizes a proposed Water Management and Monitoring Plan for the access road to address the Licence requirements detailed above. The objectives of this technical memorandum are to identify the direct impacts of the road material and road construction. The impacts to the receiving environment and monitoring of the receiving environment are discussed in the Aquatic Effects Management Program (AEMP) which is currently being developed.

The Water Management and Monitoring Plan proposed herein was developed at the request of Cumberland to address the requirements for the Type-B Water License 8BC-TEH0708 dated February 20, 2007. It is understood that the construction and operation of the access road, including the implementation of this Water Management and Monitoring Plan, are the responsibility of Cumberland.

2.0 SITE WATER MANAGEMENT PLAN

Cumberland is currently proposing to develop a mine located in the Kivalliq region (Nunavut, Canada), approximately 75 km north of the hamlet of Baker Lake. Cumberland has been actively exploring the Meadowbank area since 1995.

The surrounding terrain is typical of the barren-ground subarctic, dominated by many small lakes and ponds with indistinct and complex drainage patterns. Cumberland is currently constructing the Tehek Lake access road as an all-weather, private access road to provide year-round ground access to the site. The construction of the Tehek Lake access road includes 22 channel crossings; 9 of which will be bridge crossings, and 13 will be culvert crossings.

The road is being constructed as a field-fit and therefore detailed topography maps or final road grade information are not available at this time. However, upon completion of the road construction schedule for June 2007, appropriate maps and as-built drawings will be completed by Cumberland and submitted to the NWB. A digital photographic record of all the water crossings before, during and after construction is to be completed will also be provided.

It is understood that Cumberland, their construction company and engineering team will bear the responsibility to ensure that culverts, bridges and their abutments are properly installed and sediment control measures are planned and in place prior to melting and freshet.

2.1 Sediment and Erosion Control

The following sediment and erosion control protocols have been developed to maximize the protection of the existing watercourses during the construction phase.

Construction of the access road, and associated stream crossings, is to occur during the winter months when there is either no flow, or the channel crossings are completely frozen. As such, surface water flow is not expected along the road alignment or in any of the crossings during construction. The fact that the construction will be completed during frozen conditions should significantly mitigate any potential adverse effects from road construction on the water quality in the crossings. However, advance planning will be completed to ensure that appropriate sediment control measures are available and in place in the event that there is uncontrolled erosion and sediment transport within or towards fish-bearing waters during thawing and freshet. Given that this is a new road and all crossings will be subject to the highly erosive effects of spring freshet on newly disturbed soil and permafrost, the first freshet will be a particularly critical time.

The following general sediment and erosion control practices are applicable to the prevailing site conditions during the construction period of the proposed access road:

- Construction activities within the channel areas will be kept to an absolute minimum;

- Any required stockpiles of materials will be located away from watercourses and stabilized against erosion as soon as possible by temporarily covering with a geotextile or by placement of a perimeter sediment control structure;

- Disturbed areas will be minimized as much as possible;

- Any disturbed soils and slopes within or near the channels will be stabilized when possible with a permanent covering of clean shot rock underlain by geotextile to prevent loss of fines;

- Eroded sediments will be contained on site with additional erosion and sediment control structures as required;

- Upon completion of construction, all accumulated sediment, debris and work related material will be removed for proper disposal in completed borrow pits; and,

- Regular construction site inspections will be conducted to determine compliance with the above protocols.

Since it is not expected to encounter surface water runoff during the construction period, silt fences are not considered to be a necessary sediment control measure. However, turbidity curtains (or suitable alternative) will be installed in areas where concentrated flow does occur in the watercourse channels during the construction period.

Visual inspection of the crossings and along the road will be conducted at the onset of spring break up and at regular intervals during the open water season to ensure that these sediment and erosion control measures are functioning properly. Turbidity and silt curtains will be available to be deployed as required to control Total Suspended Solids (TSS).

2.1.1 Non Fish-Bearing Watercourses – Culverts

A total of 13 crossings along the access road are non-fish bearing and will be crossed using culverts. Although non-fish bearing, these crossings may connect to fish-bearing lakes or ponds downstream, and therefore, measures will be used to minimize the amount of sediment introduced into these channels.

The following mitigation measures will be taken during construction and upon spring freshet for the culvert crossings:

- The approaches to culverts will be armoured such that disturbed soils or permafrost are not subject to the erosive forces of water approaching the culvert, especially during freshet.

- Silt curtains will be installed downstream of the culverts to ensure that disturbed soils do not release sediment downstream during freshet.

- Daily monitoring (by visual inspection) of all culvert crossings will be completed during melt and freshet to ensure that active or potential sediment sources are identified and appropriate sediment control measures are undertaken.

Each of these watercourses crossed during winter construction will be visited prior to freshet to remove any surface materials remaining from road construction and culvert installation. These activities will be planned well in advance of typical thawing dates and spring freshet (mid-May) to ensure that the crossings have been properly executed and installed at an adequate location within the watercourse.

2.1.2 Clear-Span Bridge Crossings of Fish-Bearing Watercourses

A total four clear-spanning bridges will be installed along the access road alignment. Particular care will be taken during construction to ensure that the abutments do not intrude into the defined watercourse channel. Providing the abutments do not encroach on the channel, the watercourse should not be subject to erosion from constriction of the flow or erosion of fine materials around the abutments.

Notwithstanding the above, the abutments themselves may be exposed to high flows during freshet, and therefore will be armoured to resist the erosive forces of water and ice. As any fine materials located within the abutment armouring material may be washed away during freshet flows, the clear-span bridge crossings will be visually inspected during spring freshet to ensure that sediment is not being carried into the watercourse. If necessary, turbidity curtains or other sediment control means will be installed around the abutments prior to freshet.

2.1.3 Non Clear-Span Bridge Crossings of Fish-Bearing Watercourses

There will be a total of five watercourses crossings along the access road alignment where the bridge abutments will encroach into the existing watercourse. In these cases, flow constriction between the abutments will increase the erosive potential of the flow.

In an attempt to limit the release of sediment at these crossings, the extent of encroachment by the bridge abutments into the watercourse channel will be minimized as much as possible. The upstream approach to the abutments, and the abutments themselves, will be sufficiently armoured with clean coarse materials to resist erosion. Finally, the crossings will be visually inspected during spring freshet to ensure that sediment is not being carried into the watercourse. If necessary, turbidity curtains or other sediment control means will be installed around the abutments prior to freshet.

Given the high degree of channel constriction at certain crossings along the access road, it possible that flows will overtop the road during freshet periods. Regular visual inspection of the crossings during the freshet period will be completed to ensure that adequate sediment control measures are in-place to control sediment in such an event.

3.0 CHANNEL CROSSING INSPECTION AND MAINTENANCE PLANS

Once constructed, the watercourse crossings along the access road will be visually inspected on a regular basis to confirm their structural integrity, to confirm soil and permafrost stability, to confirm the crossings have been located adequately with respect to the watercourse, as well as to confirm there is minimal impact to fish habitat. This will involve two aspects:

- An erosion inspection program to monitor erosion and sediment transport at the channel crossings; and

- A crossing inspection and maintenance program to confirm the structural integrity and stability and adequate location selection of the crossings structure.

A habitat compensation monitoring program for fish-bearing watercourse crossings will be described in the AEMP monitoring plan being developed as part of the mine site management plan. This plan will include detailed habitat compensation sampling and contingency measures. The AEMP is currently being developed and will be available this summer.

3.1 Erosion Inspection Program

The watercourse crossings erosion inspection program has two main objectives:

(a) a regular inspection program to confirm that no significant erosion and sediment transport is occuring; and,
(b) an event inspection program to track the impacts of large storm events on sediment transport during the ice-free period.

Table 3.1 summarizes the watercourse crossings regular and event inspection schedule during ice free periods.

Table 3.1: Regular and Event Based Erosion Inspection Schedule

Regular Inspection Schedule		Event Inspection Schedule
Mid-May through June	July through October	Following large storm events
Twice weekly	Weekly	As required

The regular inspection program during the snowmelt and ice-free period is based on a schedule of visual inspections twice weekly during periods of high flow of the freshet (mid-May through June) and weekly during the remainder of the ice-free period prior to fall freeze up (July through October). Additional visual inspections would occur after large storm events.

3.1.1 Regular Erosion Inspections

It is important to inspect the watercourse crossings to confirm no downstream transport of sediments occurs due to erosion of the channel bed or scour around the crossings structure during spring freshet and the ice-free period. Visual observations of the crossings structure integrity will assess the erosion and scour potential or whether erosion or scour has already occurred. Results will be recorded regularly and reported annually. Remediation of any detected problems would be undertaken as soon as possible.

3.1.2 Event Erosion Inspections

Following a large storm event, visual observations will be made to assess whether erosion has occurred. Results will be recorded regularly and reported annually. Remediation of any detected problems would be undertaken as soon as possible.

3.2 Crossing Inspection and Maintenance Program

The watercourse crossing inspection and maintenance program has three main objectives:

(a) a regular inspection program to identify issues relating to watercourse crossings structural integrity and hydraulic function;
(b) an event inspection program to track the impacts of large storm events on watercourse crossings structural integrity and hydraulic function; and,
(c) a culvert location inspection program to ensure culvert crossings have been installed in the adequate location with respect to the watercourse.

Table 3.2 summarizes the watercourse crossing inspection schedule during ice-free periods.

Table 3.2: Regular and Event Based Crossing Inspection Schedule

Regular Inspection Schedule		Event Inspection Schedule
Mid-May through June	July through October	Following large storm events
Twice weekly	Weekly	As required

The regular inspection program during the snowmelt and ice-free period is based on a schedule of visual inspections twice weekly during periods of high flow of the freshet (mid-May through June) and weekly during the remainder of the ice-free period prior to fall freeze-up (July through October). Additional visual inspections will be planned after large storm events.

Table 3.3 summarizes the culvert crossings location inspection schedule.

Table 3.3: Culvert Crossings Location Inspection Schedule

Inspection Schedule
Mid-May through June
Twice weekly, for the first year.

3.2.1 Regular Crossing Inspection and Maintenance

Regular inspection activities for each watercourse crossing will consist of:

- Visual inspection of its infrastructure to identify defects, cracks or any other risks to structural integrity. Particular attention will be paid to the inlet and outlet structures of culverts, and to bridge abutments and their foundations, as required

- Visual inspection to identify sediment or other debris accumulation impeding the free flow of water through the crossings. Maintenance operations will consist of hand removal of accumulated debris and repairing damages as soon as possible.

- Visual inspection of upstream and downstream channel to identify bed erosion or scour around the watercourse crossing structure. Particular attention will be paid to bridge abutments and abutment foundations as they are vulnerable to scour and erosion. Particular attention will also be paid to potential sources of sediment transport at the crossing.

Inspection results will be recorded and reported annually. Maintenance operations consist of undertaking remediation of any detected problems and repairing damage as soon as possible.

3.2.2 Event Crossing Inspection and Maintenance

Following heavy or prolonged rainfall storm events, visual inspection of each watercourse crossing will be completed to identify potential risks to the crossing's structural integrity, debris accumulation and whether erosion and scour have occurred, as described in the regular monitoring program.

Results will be recorded and reported annually. Remediation of any detected problems and necessary damage repairs would be undertaken as soon as possible.

3.2.3 Culvert Location Inspection

Following their installation, the culvert crossings will be visually inspected to confirm they have been properly executed and installed at the appropriate location with respect to the watercourse. It will be critical to inspection the installed location of the culverts during the first spring freshet period as the culverts are installed during the winter, when the watercourse crossings are not readily identifiable. Additional culverts will be installed, if necessary, should the inspection indicate that the culverts were installed in a location that does not optimally route watercourse flows.

4.0 WATER QUALITY MONITORING PROGRAM

Rock quarry geochemistry reports have been submitted that indicates that there are no water quality issues with the quarried rock. These reports include the following:

- *Geochemical Assessment of Potential Quarry Rock Along the Proposed Mine Access Road, Meadowbank Project Nunavut*, Golder, 2007 ;
- *Assessment of the Acid rock Drainage and Metal Leaching Potential of Rock from Potential Quarry Site Pit 6, Meadowbank Project Nunavut*, Golder 2007;

- *Assessment of the Acid Rock Drainage and Metal Leaching Potential of Rock Samples Collected from an Esker along the Tehek Lake Access Road, Meadowbank Project, Nunavut*, Golder 2007.

On completion of the road construction and then during spring freshet, the road alignment will be surveyed for seeps and water ponded in contact with the road. Water samples will be collected at all locations where road rock contacts surface water, as identified during this spring survey. The sampling locations will be identified on the as-built maps to be prepared as construction of the road is completed.

The freshet survey will also include the quarry sites from which construction rock was extracted. Currently, a total of 21 potential quarry sites have been identified, of which 11 may be used for construction. A sump will be constructed at each developed quarry to collect runoff water from the quarry area. A water quality sample will be collected from each sump. The actual sampling location(s) will be dictated by access and safety considerations but will be identified at the time of sampling by both GPS coordinates and the road map location.

In addition, when the road is completed, appropriate sampling locations will be set up stream and down stream from selected road crossings in order to confirm there are no water quality issues. Based on the quarry geochemistry no water quality issues are expected. In the event that the sampling program results exceed CCME criteria any significant resulting impacts to the aquatic environment will be captured in the AEMP monitoring plan being developed as part of the mine site management plan. This plan will include detailed sampling and contingency measures. The AEMP is currently being developed and will be available this summer.

4.1 Sampling frequency

Water quality will be monitored during spring freshet and on a monthly basis for the first ice-free period after construction, at all identified sampling locations where a sufficient volume of water is present to obtain a representative grab sample (Table 4.1 lists the sample volumes required for the various parameters to be analyzed). Analytical results will be provided to the Board in monthly reports. Sampling frequency will be re-evaluated after the first year (ice-free period) of monitoring. If further information is deemed to be required after the spring survey, it will be provided to describe the movement and quality of surface water draining from the access road.

4.2 Monitored Parameters

Proposed parameters for monitoring include: pH, hardness, conductivity, total suspended solids (TSS), oil and grease, sulphate, explosive residues (nitrate and ammonia) and the list of regulated total metals from CCME *Guidelines for Freshwater Aquatic Life* (dated December 2006): aluminum, arsenic, cadmium, chromium, copper, fluoride, iron, mercury, molybdenum, nickel, lead, selenium, silver, thallium and zinc.

4.3 QA/QC

The QA/QC program is designed to identify and minimize the impacts of potential sampling and analytical errors the monitoring program. The QA/QC program is based upon an industry standard frequency of 1 field duplicate, 1 trip blank and 1 filter blank for each 10 samples and each sampling event. This will apply to the AEMP, quarry, and seep sampling programs. In addition, the following will be adhered to:

- All sampling programs will be overseen and reviewed by a qualified Engineer or Geoscientist,

- All sampling, sample preservation and analyses shall be conducted in accordance with methods prescribed in the current edition of *Standard Methods for the Examination of Water and Wastewater*, or by such other methods approved by the Board, and

- All analyses shall be performed in a laboratory accredited according to ISO/IEC Standard 17025. The accreditation shall be current and in good standing.

4.4 Sampling Method

Surface grab samples will be collected from the monitoring locations during ice free periods. Table 4.1 summarizes the monitored parameters, minimum sample volumes, container, preservation, and holding times as specified by USEPA Methods for Chemical Analysis of Water and Waste Water (EPA-600/4-79-020, 1979) and the analytical method and method detection limits are from CANTEST, the laboratory currently conducting all water analyses for the Meadowbank Project.

5.0 CLOSURE

We trust the information contained in this document meets your requirements at this time. Should you have any questions relating to the above, please do not hesitate to contact the undersigned.

Yours very truly,

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Table 4.1: Summary of Analytes for the Water Quality Monitoring Program[a].

Parameter	Min. Vol. (ml)	Bottle[b]	Preservation	Holding Time	Analytical Method	Detection Limit
pH	25	P,G	None	Immediately (on site measurement)	4500-H (1)	0.01 su
Conductivity	50	P	Unfiltered, cool 4°C	28 days	2510	1 uS/cm
Hardness	-	P	HNO3 – pH below 2	6 months	-	1mg/L
Mineral Oil and Grease	1000	G (amber)	Unfiltered, cool 4°C, HCl (optional)	7 days w/o HCl; 28 days with HCl	5520	2 mg/L
NO3_N	100	P,G	Unfiltered, cool 4°C	48 hrs	4110	0.05 mg/L
NH3_N	400	P,G	cool 4°C, H_2SO_4 – pH below 2	28 days	4500-NH3	0.1mg/L
SO_4	50	P,G	Unfiltered, cool 4°C	28 days	4110	0.5 mg/L
TSS	1000	P	Unfiltered, cool 4°C	7 days	2540 D	1.0 mg/L
F	300	P,G	None	28 days	4110	0.05 mg/L
Ag	200	P,G	Filtered on site, HNO3 – pH below 2	6 months	ICP/OES or ICP/MS	0.05 µg/L
Al	200	P,G	Filtered on site, HNO3 – pH below 2	6 months	ICP/OES or ICP/MS	1.00 µg/L
As	200	P,G	Filtered on site, HNO3 – pH below 2	6 months	ICP/OES or ICP/MS	0.20 µg/L
Cd	200	P,G	Filtered on site, HNO3 – pH below 2	6 months	ICP/OES or ICP/MS	0.04 µg/L
Cr	200	P,G	Filtered on site, HNO3 – pH below 2	6 months	ICP/OES or ICP/MS	0.20 µg/L
Cu	200	P,G	Filtered on site, HNO3 – pH below 2	6 months	ICP/OES or ICP/MS	0.20 µg/L
Fe	200	P,G	Filtered on site, HNO3 – pH below 2	6 months	ICP/OES or ICP/MS	0.01 mg/L
Hg	100	P,G	Filtered on site, HNO3 – pH below 2	28 days	CVAA	0.02 µg/L
Mo	200	P,G	Filtered on site, HNO3 – pH below 2	6 months	ICP/OES or ICP/MS	0.10 µg/L
Ni	200	P,G	Filtered on site, HNO3 – pH below 2	6 months	ICP/OES or ICP/MS	0.20 µg/L
Pb	200	P,G	Filtered on site, HNO3 – pH below 2	6 months	ICP/OES or ICP/MS	0.20 µg/L
Se	200	P,G	Filtered on site, HNO3 – pH below 2	6 months	ICP/OES or ICP/MS	0.20 µg/L
Tl	200	P,G	Filtered on site, HNO3 – pH below 2	6 months	ICP/OES or ICP/MS	0.02 µg/L
Zn	200	P,G	Filtered on site, HNO3 – pH below 2	6 months	ICP/OES or ICP/MS	0.001 mg/L

[(a)] USEPA Methods for Chemical Analysis of Water and Waste Water, EPA-600/4-79-020.

[(b)]P: plastic bottle; G: glass bottle