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Memorandum

To: Heather Saggers, President, NND DC

CC: Bill Dunn, P. Eng., Yukon Government, Energy, Mines and Resources

D. Ewing, Ewing Transport Ltd.

R. Trimble, P. Eng., EBA Engineering Consultants

Internal cc: D. Cornett, P.Biol, CCEP, T. Ritchie, P. Biol., D. Belanger, BSc. (Eng)

From: Rob McIntyre, R.E.T., AScT

Date: October 14, 2003

Re: **Galkeno 300 Flow Redirection Construction Memo**

The purpose of this memo is to report on the recently completed construction of Galkeno 300 flow redirection project. Ongoing monitoring and inspection is also described in this memo.

1. Background:

From its' previous knowledge and experience at the site, Access Consulting Group ("Access") was able to verbally advise the Government of Yukon ("YG") at the onset of YG's taking responsibility for the site, that the environmental impact of the Galkeno 300 adit, specifically the possible direct deposit of zinc into Christal Creek, warranted close observation. Accordingly, Access conducted a visual confirmation inspection and photo-documentation of the entire flow path, from the adit, down the hillside along the power line, and into Christal Creek this past summer.

Access explained its observations in correspondence to Mr. Bill Dunn, on September 02, 2003:

> *"To confirm our previous discussions, this letter is to inform you that as a result of our field inspection under the MERG project this summer, we are of the opinion that the flow from the Galkeno 300 adit very likely reports directly to fish bearing waters."*

Once YG was formally made aware that this situation existed, the issue was approached with some urgency, in order to deal with the matter prior to the onset of winter conditions.

On September 5, YG held a meeting with various Yukon and Federal Government Departments and agencies (notably, the federal Department of Fisheries and Oceans, and the federal Department of Environment) to discuss the situation. The collective decision of this group was then relayed to Access (who were asked to join the latter portion of the meeting).

Yukon Government's decision was to redirect the flow via pipeline into the forested dispersion area that it previously occupied (across the power line and into the hillside vegetation), in an attempt to re-establish the zinc attenuation mechanism that was reported on by D. Macgregor in his 1998 M.Sc. Thesis.

2. Methodology:

The field details to accomplish the direction provided by Government were arrived at during a discussion on site with Bill Dunn, P. Eng., YG Energy Mines & Resources, Dick Ewing, Ewing Transport, and Rob McIntyre, R.E.T., AscT, Access Consulting Group. After this discussion, Yukon Government authorized construction.

It should be noted that there due to the significant on-site experience of the contractor, and the significant on-site experience and engineering qualifications of the Yukon Government representative, there was no formal engineering design undertaken for this construction (i.e. there were no measurements taken, or engineering design calculations, surficial geological investigations, geotechnical observations or materials testing, surveying, or preparation of construction plans or specifications).

Early winter snowfall and freezing conditions were already being experienced on site by late September, but this did not unduly hamper the construction. The construction can best be described as a 'field fit' of a conceptual design, using a locally experienced heavy equipment contractor and locally experienced and qualified Yukon Government direction.

Construction was undertaken by Ewing Transport Ltd, with labour assistance from NND DC. A 300 meter long piece of 12" diameter plastic pipeline was brought to the Galkeno 300 adit from the Elsa Mill area, to be used to convey the water from the adit to the desired location. A "road" was constructed using locally obtained mine waste rock, to afford heavy equipment access to the terminus, and to place the pipeline in a constant slope. Earthen pads were placed to secure the pipeline at approximately 50-meter intervals, to hold the pipeline in place. The upstream end the pipeline was installed in an insulated plywood box that was constructed in such a manner as allow easy redirection of the flow past the pipe inlet collar and into a bypass channel if needed.

The bypass channel was excavated for a distance of approximately 15 metres, to the edge of the bank. From this point, redirected flow would occupy exactly the same path that it has taken since discharge from the adit began. The surrounding site was graded, and two old buildings that were deemed by Yukon Government to be safety hazards, were ordered burned. Please see photographs at the end of this memo, for some of the construction methods.

The terminus of the pipeline was embedded in an approximately 4 meter x 4 meter pad built of coarse (greater than 300 mm, some to 900 mm) riprap rock (mine waste from the Sime pits waste dumps), underlain by geotextile cloth, placed over original, undisturbed ground, as an energy dispersion mechanism. Plates # 5, 6, and 7 show the construction of this pad.

During construction, no engineering inspection was conducted by, or under the supervision of, Access. Access relied upon the site experience and qualifications of Mr. Dunn, and of the contractor, and their close working relationship. Visual inspections were conducted on the following dates post-discharge:

- September 28th, R. McIntyre & B.Dunn;
- October 1st, T. Ritchie, ACG;
- October 2nd, RLM & R. Trimble, EBA Engineering Consultants

Photographs were taken at each of these site visits. No unusual, unexpected, or detrimental physical performance effects were noted on these visits. Preliminary observations of the downstream end of the flow (in the ditch alongside the Galkeno 900 access road) indicated that the redirected flow was continuing to enter Christal Creek at the same location. What will now be determined, through water quality monitoring and visual observations, is the critical question of whether or not the flow path between these points has been attenuated in zinc content. Access has conducted a visual inspection of the entire flow, from the pipeline terminus to Christal Creek, to provide accurate documentation of the new flow path. Observations, along with photo documentation, will be reported to NND DC as part of the planned monitoring and inspection program, as discussed later in this memo.

During this visit, Access will also prepare and plant two test plots of locally developed native grass seed and fertilizer mixes, using NND DC labour assistance. The goal of this test program is to determine the potential success of a revegetation program that should be undertaken over the entire disturbed site at Galkeno 300 (perhaps in conjunction with a property-wide revegetation project), perhaps as early as next summer.

3. Potential Unsatisfactory Results:

Although the risk of any significant adverse situations is deemed remote, some potential failures are nonetheless identified here, as a guide for inspection and monitoring:

- Possible significant permafrost degradation at pipeline terminus, or immediately down slope;
- Possible movement, distortion, rupture or breakage at the seams of the pipe due to temperature shifts, causing mine effluent to flow in an uncontrolled manner;

- Possible freezing of the effluent within the pipe, causing rupture of the pipe, and resultant uncontrolled discharge;
- Possible accelerated runoff erosion on graded area, and down pipeline "road";
- Possible glaciation of the water flow at the pipeline terminus discharge, leading to spring melt being deflected down the power line, away from the desired discharge area;
- Possible erosion or freeze/thaw-generated failure of the energy dissipation pad, leading to point source discharge causing unacceptable accelerated permafrost degradation and/or vegetation disturbance;

Unfortunately, the most likely failure of this installation that may occur is not a new, or drastic situation; it is that the system may fail to accomplish its' overall goal of attenuating zinc levels in the Galkeno 300 adit discharge. There is, of course, no guarantee that the installation will accomplish attenuation of zinc levels entering Christal Creek. This would represent essentially the status quo, which would then need to be further addressed by Yukon Government. It should be noted, however, that conclusions with respect to the possible lack of metals attenuation should only be made after allowing a significant period of time for monitoring. Therefore, it is recommended that the sampling and inspection program as described in this memo, be conducted for a period of at least one year.

Recommended action to be taken upon discovery of unsatisfactory results:

- If inspection/monitoring discovers failures or any unsatisfactory results such as those mentioned above, or other problems arise, the Galkeno 300 adit discharge should be redirected into the pipeline bypass channel without delay, until appropriate engineering inspection and recommendations can be accomplished.

4. Monitoring and Inspection:

A) Water Quality:

As part of the Galkeno 300 Flow Redirection Project, a sampling program was devised to monitor and provide insight into the attenuation of Zn by land application. A number of sampling/monitoring stations were installed at various locations in the anticipated flow path. The anticipated flow path was based on knowledge of the location of the proposed terminus of the pipeline, examination of macro and micro topographic conditions, and evidence of historic flow. The locations, grouped into fences, are described below.

Fence 1
At fence 1, approximately 60 meters from the discharge, three lysimeters were installed that enable the sampling of the soil pore water. In between the lysimeters, two drive-point piezometers were installed, which allow the sampling of ground water. In addition to the water sampling at Fence 1, soil samples were taken at each of the lysimeter locations. Once the flow has been established on the ground, surface water samples will be taken where there is evidence of flow.

Fence 2
Fence 2 sampling equipment was installed approximately 160m from the discharge. 4 drive-point piezometers were installed with the two lysimeters installed in between drive-points where there was historical evidence of flow. Soil samples were taken at each of the 4 drive-point installations. Again, once the flow has commenced, surface water samples will be taken where there is evidence of flow.

Fence 3
Fence three sample points are all located on the old haul road roughly 600-650 meters from the discharge. 7 standpipe piezometers were installed monitoring ground water quality. Surface water samples will be taken along the haul road once there is evidence of flow.

Additional Sampling
In addition to the fences established in the land application, additional sampling and monitoring will be taken at various critical locations along the anticipated flow path. Up to four additional drive-point peizometers will be installed directly in the flow path, once its established location is determined.

Further to the groundwater sampling network as described above, surface water samples will be taken at the following locations:

- End-of-pipe discharge
- Upstream of culvert at Galkeno 900 road entrance.
- High volume stream discharging to ditch along Galkeno 900 access road.
- Upstream of culvert on Main Road (possible discharge location after flow redirection)

Any other evidence of new flows will be sampled. The weir level at Christal Lake will also be monitored for flows, to correlate with flow measurements at the adit, as described later in this memo.

Sampling and Monitoring Schedule:

Environmental Baseline sampling was undertaken prior to the flow redirection into the discharge area. Samples were sent to Environment Canada in Whitehorse for the soil and water analyses. It is proposed that sampling will continue on a monthly basis for the next 6 months (the time remaining in Access' contract).

As noted previously in this memo, it is recommended that this sampling program be conducted for at least one year, to enable accurate conclusions to be drawn about the performance of this installation.

B) Pipeline & Receiving Environment Physical Performance

In conjunction with regular monthly water quality sampling events as described above, the following inspections will be undertaken to assess the physical performance of the system:

- Visual inspection and photo-documentation of near-terminus local forest cover for signs of permafrost degradation (e.g. leaning spruce trees, side hill slumping or slope failures, vegetative mat disturbance, surface flow excessive turbidity, etc.);
- Visual inspection and photo-documentation of the entire down slope flow path, to document any changes, redirection, excess water ponding/accumulation, permafrost degradation, etc.
- Visual inspection and photo-documentation of the entire pipeline for signs of movement, distortion, rupture, etc., including earthen placement pads;
- Visual inspection and photo-documentation of the pipeline "road" to assess physical stability (slope failures, erosion, etc.);
- Visual inspection and photo-documentation of surface runoff during spring freshet, to assess performance of runoff control features of the pipeline "road";
- A battery powered Data logger instrument will be installed in the pipeline at the adit, to enable continuous monitoring and documentation of discharge flow, for comparison with various downstream flow measurements (e.g. above Christal Creek, below the Highways ditches); Monthly downloading of the data will take place during water quality sampling events as described above. This will also enable metal loading calculations, and my possibly be required to facilitate future engineering design, should further work be required (such as calculations for ditching or pipeline conveyance of flow to Galkeno 900 for treatment, for example)

Reporting of findings, observations, and documentation will be forwarded in monthly reporting to Mr. Bill Dunn, P. Eng., Yukon Government Project Manager. Although there is an emphasis on conducting the project in the most cost effective manner, we do not recommend that site security, labour, or water sampling personnel undertake the sampling and inspections as described above. Access will utilize qualified professional staff to undertake this work, augmented with specialist engineering assistance on an as needed basis (budgetary allowance for EBA Engineering Consultants Ltd. has been previously approved, for the routine water quality budget). Prior approval will be sought prior to implementing any further inspection, monitoring, or measurement equipment installation.

Respectfully submitted,
Access Consulting Group
A registered trade name of Access Mining Consultants Ltd.

Robert L. McIntyre, R.E.T., AScT
Technical Manager, Elsa Project

Photos:

Plate 1: Galkeno 300 Adit – upper end of pipe install trench

Plate 2: Construction of pipe "road", looking towards power line past old Load out Facility, adit discharge staining in foreground

Plate 4: Removal of dangerous building (old load out facility) by burning

Plate 5: Installation of geotextile blanket over ground at pipe terminus location

Plate 6: Showing placement of riprap on top of geotextile at pipe terminus, for energy dissipation.

Plate 7: Pipe terminus pad

Plate 8: Typical Lysimiter installation

Plate 9: Typical Drive point Installation at Galkeno 300

Plate 10: Typical Piezometer installation on old haul road below Galkeno 300; note use of steel protection pipe for installation in coarse rocky ground