



June 10th, 2010

Yukon Water Board Secretariat
Suite 106, 419 Range Road
Whitehorse, Yukon
Y1A 3V1

Attn: Carola Scheu
Manager, Yukon Water Board

Regarding: Yukon Government Intervention to Water Licence application QZ09-092

Please find attached Alexco's response to Yukon Governments' intervention of June 7th, 2010.

We have addressed each portion of Yukon's intervention in the original order presented. Of particular note within this response is the work we have conducted with respect to water quality modeling and a scientific review of the proposed discharge limits for the licence.

The discharge standards proposed in our licence application were based on composite annual modeling of metal loading and its potential effects on downstream aquatic life. Our past three years of operating experience has allowed us to collect a large volume of data as a part of our monitoring programs, which in turn has allowed refinement of our site wide loading model. Data is collected as a part of regular site care and maintenance as well as a part of closure planning for the district. Results of this monitoring and subsequent modeling have indicated that the downstream effects of point source pollution on the receiving environment are significantly lower than expected.

Additionally, our operational experience at the site shows excellent performance for parameters in the existing Type B licence at treatment sites under the current licence compliance regime.

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However, in response to concerns relating to the effect of yearly high and low flow impacts on the receiving environment raised by Yukon Government during our discussions with them, we have refined the water quality modeling. Quarterly flow data was used for the purposes of estimating receiving water quality during periods of high (Q2) and low (Q1) flow. This was achieved by calculating loads and resultant concentrations by quarter from both sources (Bellekeno Mine and sediment pond discharge) and both receiving environments (KV-41 on Lightning Creek, and KV-6 on Christal Creek).

A complete description of the methods used to calculate mass loads and predicted water quality is contained in the attached memo from Access Consulting (Attachment A). Moreover, the model workbooks used to develop the discharge criteria are included with this response to intervention for the Board's review (Attachment B).

Both receiving environments have long been impacted by past mine operation to levels that are beyond CCME guidelines for many parameters. The net effect of this is that any new discharges proposed must be shown to not cause an increase in toxicity to downstream aquatic biota over the current status.

We therefore engaged Minnow Environmental to review the revised modeled water quality. Minnow was tasked with determining toxicity effects on aquatic organisms in high, low and intermediate flow regimes in Lightning and Christal Creeks. Minnow's work shows that in order to continuously discharge at licence compliance limits during all seasons (i.e. during periods of both high and low flow), some parameters would need to be reduced from those originally presented in our application.

The general modeling calculations used to develop mass loads and subsequently predicted water quality were accepted and also used in modeling work conducted by Yukon Government. The work carried out by YG and Alexco to establish sufficiently protective water quality standards through the loading model was done in parallel and the results were compared. The comparison of these results, together with YG's rationale for lower discharge standards and the results of the toxicity assessment by Minnow contributed to the decision for us to fully accept the discharge standards proposed by YG.

Accordingly, we agree to adopt these reduced levels. Our work demonstrating the continued protection of downstream aquatic life using the new discharge limits is set out in the attached memo from Minnow Environmental (Attachment C). Ms. Cynthia Russel of Minnow Environmental will attend the hearing to answer questions that may arise from the contents of this response to intervention with respect to water quality.



a. Recommended effluent criteria for Bellekeno Adit 625 - Lightning Creek

YG Intervention: Yukon recommends that the water licence adopt the “Yukon’s Recommended Effluent Criteria” listed in Table 1 below.

Alexco Response: Alexco agrees with Yukon’s recommendation that the “Yukon’s Recommended Effluent Criteria” should be adopted for Lightning Creek. The rationale for accepting these criteria is outlined in the preamble to this response to intervention

YG Intervention: Yukon recommends that the water licence include provisions for reviewing and amending the effluent quality criteria to be consistent with the water goals and objectives developed for the receiving environment as part of the overall Closure Plan for the Keno Hill District, once these goals and objectives have been approved. These water quality objectives should include zinc and cadmium as well as the goals and objectives for any other contaminants identified in the Closure Plan.

Alexco Response: Alexco agrees with the recommendation that the water licence include provisions for review of the effluent water quality criteria in order to identify any significant divergence from the water quality goals and objectives developed for the receiving environment as a part of the overall Closure Plan for the Keno Hill District. Amendment provisions are found in the *Waters Act*.

b. Recommended effluent criteria for the Mill Site - Christal Creek

YG Intervention: Yukon recommends that the water licence adopt the “Yukon’s Recommended Effluent Criteria” listed in Table 2 below.

Alexco Response: Alexco agrees with Yukon’s recommendation that the “Yukon’s Recommended Effluent Criteria” should be adopted for Christal Creek. The rationale for accepting these criteria is outlined in the preamble to this response to intervention.

c. Meteorological data and water balance

YG Intervention: Yukon recommends the water licence include a condition requiring these estimates be updated with recent site meteorological data within three months of licence issuance. A report on the updated estimates and if necessary a revised water balance model be provided to the Water Resources Branch for review and confirmation of adequacy before being submitted to the Water Board for implementation.

Alexco Response: Alexco agrees with Yukon’s recommendation that the water licence should include a condition requiring that the model for lake evaporation and evapotranspiration be updated using recent site meteorological data. However, Alexco requests that this condition require this update to be submitted within 6 months of licence issuance.



This update should be submitted to the Board, with a copy to other interested parties, such as Water Resources, in order to keep them informed.

d. Bellekeno 625 Adit Water Treatment System

YG Intervention: *Yukon recommends that the proponent be required to submit a Bellekeno 625 Adit water treat system plan to the Water Resources Branch for review and confirmation of adequacy before being submitted to the Board for implementation. The Plan should include the items noted in section 5.1.1 Mine Waters during Operations, of the attached SLR report.*

Alexco Response: Alexco agrees with Yukon's recommendation that the water licence should include a condition requiring a water treatment system plan be compiled from information regarding the design, operations, maintenance and monitoring of the Bellekeno 625 treatment system and be submitted to the Board prior to beginning mining operations.

This update should be submitted to the Board, with a copy to other interested parties, such as Water Resources, in order to keep them informed.

e. Hydrogeologic Study of Mine Water at Closure

YG Intervention: *Yukon recommends that:*

the water licence include a condition requiring the proponent submit a hydrogeologic plan after licence issuance, but no later than six months before closure. The report shall be submitted to the Water Resources Branch for review and confirmation of adequacy before being submitted to the Board for implementation. The plan should include but not be limited to the following:

- *the results of the detailed hydrogeologic study;*
- *the predicted static water elevation after closure;*
- *the predicted rate of discharge from the mine after closure; and*
- *the basis for these determinations.*

If it is predicted that water will also discharge from the East Portal, a plan should be developed to control and treat this discharge and this plan should be submitted to the Water Board one year prior to closure.

Alexco Response: Alexco agrees with Yukon's recommendation that the water licence should include a condition requiring the proponent submit a hydrogeologic plan after issuance, but not later than six months before closure.

This update should be submitted to the Board, with a copy to other interested parties, such as Water Resources, in order to keep them informed.

f. Dry Stack Storage Facility Seepage



YG Intervention: Yukon recommends that the water licence include a condition requiring the proponent submit a Dry Stack Storage Facility subgrade assessment and liner report prior to the deposition of tailings. The report should be submitted to the Water Resources Branch for review and confirmation of adequacy before being submitted to the Board for implementation. The report should include but not be limited to the following:

- The results of a subgrade assessment to determine the need for a liner in order to prevent undesirable leakage to the ground water system.
- Designs for the liner if it is deemed necessary.

Alexco Response: Final design will include further subgrade assessment for the purpose of managing slope stability, and to determine specific locations of the drainage layers, ditches, and other upgradient water diversions. As mentioned in our previous response, a liner is unnecessary to prevent undesirable leakage to the groundwater system. However, Alexco has proposed to add a cemented layer under the tailings to address concerns from Environment Canada with respect to compliance with MMER, and this layer will include a collection sump for any seepage that may collect on the cemented layer. Final design for the cemented layer will be included in the final DSTF design.

g. Groundwater Data and Monitoring

YG Intervention: Yukon recommends that the water licence include a condition requiring the proponent submit a groundwater monitoring plan within six months of licence issuance. The plan should be submitted to the Water Resources Branch for review and confirmation of adequacy before being submitted to the Board for implementation. The groundwater monitoring plan should include, but not be limited to the following:

- i. General details including:
 - The results of the additional drilling that shall be done by coring methods to identify rock types and geologic features such as joints and fractures that may affect ground water flow patterns on the site;
 - Samples should be analyzed for pH, ammonia, conductivity (or TDS) and an ICP metals scan including arsenic, cadmium, copper, lead, nickel, silver and zinc.
 - Based on baseline groundwater quality, trigger levels should be developed that would be used to enact the adaptive management strategy and provide early warning of the need for mitigative measures and/or changes in facility design/operations.
 - Monitoring results should be reviewed after each sampling event, to identify groundwater changes, should they occur.



The annual report should include conclusions about seepage and ground water quality impacts and potential surface water quality impacts. The annual report should also include a discussion of proposed changes to the monitoring programs and any adaptive management actions to be taken to reflect the results of monitoring.

ii. *Details regarding the groundwater monitoring at the Waste Rock Disposal Area including:*

- *A program for monitoring seepage to groundwater from the waste rock disposal area, including triggers and adaptive management actions in the event that monitoring indicates seepage to be of concern.*

iii. *Details regarding the groundwater monitoring at the Dry Stack Tailing Facility including:*

- *a background water level monitoring program to confirm the single measurements taken so far and to better identify annual and seasonal ground water flow patterns;*
- *The location of monitoring points downgradient of the Dry Stack Tailings Facility should be based on revisions to the water table map, and include consideration of the influence of geologic features. Nutrients (NO₃, NH₄, TKN) and other landfill leachate indicators should be monitored.*

Yukon believes this information should be provided to aid in understanding ground and groundwater conditions at the site and in designing the groundwater and therefore recommends that it should be provided as part of the supporting information in the groundwater monitoring plan.

Alexco Response: Alexco agrees with Yukon Government's recommendation that the water licence include a condition requiring submission of a groundwater monitoring plan within six months of licence issuance.

h. Bioreactor

YG Intervention: *Yukon recommends that the licence include a condition requiring the proponent submit a plan that provides a description of the development and operation of the bioreactor process for mine closure. This plan should be submitted within one year of licence issuance. The plan should be submitted to the Water Resources Branch for review and confirmation of adequacy before being submitted to the Board for implementation. The bioreactor plan should include but not be limited to the following:*

- *The results of the tracer study and implications to the operation of the bioreactor*
- *A pilot bioreactor program that will inform the design of the full scale bioreactor; and*



- *Considerations and pros and cons for alternative long term treatment options such as running mine water through beds of crushed limestone or adding long lived carbon sources into the mine.*

Alexco Response: Alexco agrees with Yukon Government's recommendation that the licence include a condition that a bioreactor development and operation plan be submitted to the Board within one year of licence issuance.

This update should be submitted to the Board, with a copy to other interested parties, such as Water Resources, in order to keep them informed.

i. Monitoring Program

YG Intervention: *In Section 7 of attachment 2 to this intervention, Yukon's consultant recommended a number of improvements to the proposed monitoring program. Yukon recommends that the Board incorporate these recommendations into the water licence monitoring program.*

Alexco Response: Alexco has reviewed the monitoring recommendations by Yukon's consultant and the following comments are provided for only those recommendations that the company does not agree with.

SLR Recommendation: *Monitoring station KV-33 is part of the Mass Loading Model developed for Lightning Creek Watershed by Access (Element 2, Hope Gulch above KV-39). It is expected this model will be updated and refined as further monitoring results become available.*

Monitoring station KV-33 is not part of the proposed monitoring station included in the application. It is recommended monitoring station KV-33 be added to the proposed monitoring stations under the new Type A Water Licence Application so that the mass loading model can be updated accordingly (unless this station is monitored as part of the Long Term Monitoring Program for the parameters and at a frequency so that it can be used to update the mass loading models.

Alexco Response: Monitoring at KV-33 (Keno 700 Adit) is not relevant to understanding the effects from the Bellekeno project but is appropriate to understand the effects of other mines in the Lightning Creek drainage, and therefore the request is appropriate for closure planning but not the mass loading from the Bellekeno mine.

SLR Recommendation: *Monitoring station KV-74 (Bellekeno East Portal Location) is not part of the proposed monitoring station shown in the updated Table 7-2 (Revision 2). It is recommended this monitoring station be added.*



Alexco Response: As indicated in other responses, Bellekeno East Portal is far higher than the elevation of Bellekeno 625 (KV-42), therefore no flow is expected; however we will visually inspect this site as part of our physical inspection plan, and if any flow is observed, monitoring will commence.

SLR Recommendation: *In addition to the surface water quality mentioned above, groundwater monitoring stations should be installed downstream of DSTF and Waste Rock Disposal Facilities as recommended in Section 5.0.*

Alexco Response: As noted in other responses, groundwater monitoring from Waste Rock facilities should only be done if seepage is observed and monitored at concentrations that may affect the receiving environment. The appropriate monitoring approach for Waste Rock facilities is a staged program consistent with the Adaptive Management Approach. Routine visual inspections are completed across the Waste Rock facility including the investigation of any toe seepage. If seepage is evident, water quality collection and analysis is required to determine if the seepage is of concern. Any observed problematic trends of seepage water quality would then lead to the installation of lysimeter monitoring at intervals across the toe of the Waste Rock facility. The monitoring program for Waste Rock storage may be elevated to the level of installation of deeper groundwater monitoring wells, depending on the results of this adaptive management monitoring approach.

Groundwater monitoring wells are already installed downstream of the DSTF.

SLR Recommendation: *The updated water quality database provided by Access (Volume II, 1.3.6.6 Environmental Conditions Report, Appendix F: Digital Water Quality Monitoring Data Summary. Digital Copy Only) indicates that monitoring at KV-50 occurred only on five occasions. As KV-50 is the site identified as background on Christal Creek, it is recommended the frequency of monitoring at this site be increased to monthly, for a minimum of a year, prior to the mill construction and operation so that adequate pre-project baseline data can be collected. As per the paragraph above, it is unclear if KV-50 is located upstream of the new mill site inputs. Should a new background site need to be established, it is recommended this site be monitored monthly, for a minimum of a year, prior to the mil construction and operation so that adequate pre-project baseline data can be collected.*

Alexco Response: KV-50 is upstream of the mill layout footprint and any mill sedimentation pond discharge will be downstream of KV-50, therefore KV-50 is an appropriate background monitoring station. Alexco's monitoring data presented in our monthly and annual reports indicate 8 samples at KV-50, spanning a period of over 3 years. This frequency and duration is adequate for establishing background water quality for the purposes of water quality modeling and predictions. Alexco has proposed continued quarterly monitoring at KV-50 and this an appropriate frequency for continued monitoring.



SLR Recommendation: Studies evaluating the potential impacts of mine operation on fish population should be completed as part of the EEM program. A column for “Fish Study” should be added under the EEM Program in the proposed monitoring table. The design of the studies to be included as part of the EEM Program (sediment, benthic, fish) should be submitted to Environment Canada prior to the start of mine operations so that adequate pre-project baseline data can be collected, if required.

Alexco Response: The company will adhere to the monitoring requirements under MMER, including fisheries assessment contained within the Environmental Effects Monitoring. The first EEM study design is required to be submitted to EC within 12 months after the mine becomes subject to MMER. Fish and benthic studies are mandatory components of the EEM study design.

SLR Recommendation: The benthic program under the EEM should also be conducted at KV41 in addition to KV6. It is recommended the background locations also be monitored during this program (KV38 and KV50). KV 50 should be monitored prior to the start of mill operation if no benthic data exist for this location.

Alexco Response: The company must submit the EEM study design to EC for approval. The ultimate stations to be monitored under EEM will be determined by EC. It is likely that KV-41 will be included in the final study design. KV-50 is upstream of the mill and therefore the benthic community will not be impacted by mill discharge and therefore benthic sampling prior to mill operation is not necessary.

SLR Recommendation: Cyanide (WAD and total) should be added to the proposed external laboratory monitoring program. Cyanide monitoring will be required under the MMER.

Alexco Response: There is no cyanide usage in the mine or mill processes, therefore this requirement should not be included.

SLR Recommendation: Nitrite and sulphate were identified as potential contaminants of concern in Christal Creek and Lightning Creek, however, the dataset for sulphate and nitrite was too small to confirm if these two parameters should be considered contaminants of concerns. Nitrite and sulphate should be added to the proposed external laboratory monitoring program. The monitoring locations and frequency should be the same as the monitoring proposed for phosphorous.

Alexco Response: Nitrite has not been identified as a potential COC to our knowledge. Alexco agrees that the frequency of sulfate should be the same as phosphorous.

SLR Recommendation: Ammonia should be added to the list of parameters monitored monthly in the receiving environment downstream of the discharge including KV41, KV6, KV7, and KV8.



If ammonia become a contaminant of concern it is recommended nitrate be added to the samples collected from the treatment system and effluent discharge points to support the understanding of the ammonia breakdown process.

Alexco Response: Assuming the all of the ammonia were converted to nitrate, nitrate would be below the MMER concentration limit. Therefore ammonia monitoring alone should be protective.



Should you have any questions, please contact our office at (604)-663-4888.

Sincerely,

Alexco Keno Hill Mining Corp

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