March 2017

Ajax Mine Application for Environmental Assessment Certificate/
Environmental Impact Statement

"Round 2" Working Group Comments from
Ministry of Forests, Lands and Natural Resources Operations

This document contains a compilation of the "round 2" review comments that EAO received in memo or email format from the Ministry of Forests, Lands and Natural Resources Operations (FLNRO) during the review of the KGHM Ajax Mining Inc.'s (KAM's) Application for an Environmental Assessment Certificate / Environmental Impact Statement. For "round 2" comments received in tracking table format, please refer to the Working Group tracking table, located here:

https://projects.eao.gov.bc.ca/p/ajax-mine/docs?folder=231

For the purposes of documenting comments, EAO requires that the Proponent compile all written comments from Working Group members in a comment tracking table. The Proponent must provide responses to the Working Group submissions, in a table format or memo format as necessary, to EAO's satisfaction.

BRITISH COLUMBIA

File: 38000-40/ENVASS-AJAX

September 28, 2016

Tracy James
Project Assessment Manager
Environmental Assessment Office
2nd Floor 836 Yates Street
Victoria, British Columbia
V8W 1L8

Dear Tracy James:

Re: Ajax Mine Project – Review of Round 1 Responses

Introduction

I have reviewed the proponent responses to my Round 1 comments (FLNRO-001 through -063 and FLNRO-224 through -228) in the comment tracking table entitled *WG Tracking Table (MASTER 27Jul2016).*

I thank the proponent for their detailed responses. I have added a column to the tracking table (renamed *WG Tracking Table FLNR_DT)* to make notes regarding the adequacy of responses. The vast majority of responses require no follow up. The purpose of this letter is to provide a high level summary of the main issues, comprising a common thread through my (and other reviewers') Round 1 questions regarding hydrogeology and the proponent responses to those issues. A secondary purpose of the letter is to provide clarification regarding the *Water Sustainability Act* (WSA) and its applicability to the Ajax project.

Summary

The ability of the numerical groundwater model and the proposed groundwater monitoring network to accurately identify, predict and mitigate significant adverse effects, has been a concern expressed by more than one reviewer. Related to these comments, is the concern that insufficient monitoring wells are in place to adequately monitor for adverse effects or unpredicted impacts. Therefore, a key outstanding issue to be addressed by the proponent at this stage is to provide supplemental information on groundwater monitoring. It is suggested this may best take the form of a revised Groundwater Quality Management and Monitoring Plan (GWQMMP). This information is necessary to increase the Ministry of Forests, Lands, and Natural Resource Operations (FLNRO) confidence that the proponent has an adequate plan to

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ensure that potential effects to groundwater can be monitored and effectively mitigated during the project's lifecycle, and that adaptive management measures can be adequately informed.

Related to this, there needs to be a firm commitment to update and recalibrate the model annually (by a qualified professional with competency in hydrogeology) during construction and operation phases.

Background

Responses to FLNRO and other reviewers' concerns and questions regarding groundwater monitoring commonly deferred provision of the requested level of detail to the permitting stage, and indicated that adaptive management may take place. FLNRO understands that large mining projects of this nature may sometimes require this approach. However, augmentation of the proposed groundwater monitoring network does not require this approach.

The 48 monitoring wells listed in the GWQMMP is a small network for a site of this size. The network is considerably sparser when accounting for the fact that not all locations are monitored for both chemistry and water levels, not all are planned for monitoring during all phases of the project, the depth of investigation is up to 90 m in places, mine operations will require removal and replacement of several of them, and that several wells are at the same surface location (nested).

The size and complexity of this site, combined with the need to understand not just flow but potential geochemistry changes, warrants an increased density of groundwater monitoring locations near areas of interest. A statistical approach may help professional judgment in monitoring program design, as advocated by Ministry of Environment (MOE) 1998 *Guideline for Designing and Implementing a Water Quality Monitoring Program in BC* document, which is referenced by the proponent.

Information Requirement

At the current application review stage, a clear plan and commitment to monitoring well locations and areas is required. This would best take the form of a revised GWQMMP, updated with revised tables and maps outlining the rationale for locations and the planned augmentation of the network. The primary areas of concern to be addressed as part of an updated GWQMMP are listed below.

Jacko Lake

The revised GWQMMP needs to address hydrogeological issues in the vicinity of Jacko Lake.

As shown in the revised conceptual model and described in proponent response, seepage from Jacko Lake to the open pit will occur through bedrock and the highly conductive glaciofluvial sediments. Shallow groundwater flow in the vicinity of Jacko Lake is also anticipated to be influenced by the Tailings Storage Facility (TSF).

New model results from the proponent (0530_KAM) indicate more than double the base-case seepage from Jacko Lake could occur. It is noted, that the current monitoring plan has a total of

four monitoring wells installed explicitly to monitor "Jacko Lake-Open Pit Hydrogeological Connectivity", across as many different hydrostratigraphic units. All these exist at different plan view locations, some of which are within the footprint of the future open pit; therefore they will not be able to serve as continuous reference points throughout the lifetime of the project. None of these wells are included for monitoring during decommissioning and closure, although the groundwater system will take some time to re-equilibrate to the cessation of mining and dewatering.

Additional monitoring stations, informed by modelling, professional judgment, and if warranted, further investigations, need to be in place prior to relevant construction and operation activities to allow statistically defensible baseline (elevation, quality and spatial density) monitoring to occur, and to allow adaptive management decisions to be made in the future. As noted by other reviewers, shallow monitoring locations are spaced relatively far apart in the overburden, whose hydraulic conductivity can vary considerably over short lateral distances. And as noted in BGC-002, the proponent has indicated potential groundwater transport pathways between Jacko Lake and future mine infrastructure will be included for monitoring.

Bedrock monitoring stations (VWPs and monitoring wells) east of Jacko Lake and the open pit will be destroyed as the open pit progresses toward the lake. It is understood these locations will be preserved if possible but otherwise the proponent will replace them.

Edith Lake Fault Zone (ELFZ)

The revised GWQMMP needs to consider the ELFZ in the general case and specifically per the proponent response BGC-002. From that, it is understood the existing monitoring program will be augmented to "specifically consider the potential groundwater transport pathways along the ELFZ and between proposed mine infrastructure (TSF, WMRSF and SMRSF) and Jacko Lake". Currently the ELFZ footwall is mentioned as partial rationale for two nested groundwater monitoring locations (four monitoring wells). The ELFZ needs to be included as part of the overall groundwater monitoring program, as well as an individual hydraulic feature.

Summary

The proponent wishes to address ongoing reviewer concerns surrounding the model predictions and suitability of the monitoring network at the permitting stage. FLNRO requires a revised GWQMMP that addresses more general reviewer concerns in order to complete their evaluation of the application. Specifically, additional groundwater monitoring locations are to be proposed in an unambiguous fashion to address concerns surrounding groundwater seepage from Jacko Lake to the open pit, the ELFZ, and potential alterations to groundwater flow patterns and chemistry in the vicinity of the TSF and MRSFs, as those facilities develop. As the proponent has noted, there are potential hydraulic interactions between the proposed TSF, MRSFs, Jacko Lake and ELFZ.

This information will increase FLNRO's confidence in the monitoring plan's suitability to detect impacts at the scale at which they may occur, and better inform future adaptive management measures. The groundwater monitoring plan should also be designed to provide supporting data for groundwater license applications under the WSA, as applicable. Preparation of this plan now will also allow for additional baseline data collection to begin sooner.

The revised maps and tables can form part of an updated groundwater monitoring plan which will serve to better inform any potential adaptive management actions in the future.

The *Water Sustainability Act* and Groundwater

The *Water Sustainability Act* (WSA) was enacted February 29, 2016. It provides legislative authority to regulate groundwater. The following is intended to clarify some general expectations with respect to mines and groundwater use.

1. An authorization under the WSA (a licence or use approval) is required for the diversion of water to prevent it from entering a mine site. This includes the diversion of streams away from the mine site and the diversion of groundwater from dewatering wells to prevent groundwater from entering the mine.

2. An authorization under the WSA (a licence or use approval) is required for the diversion and use of water from a stream or groundwater for a water use purpose within the mine site, such as for construction, dust control, washing or processing purposes, regardless of whether the water is drainage water collected within the mine site, or water that is diverted from a stream or aquifer beyond the boundaries of the mine site.

3. Under Section 35 (3) of the Water Sustainability Regulation the diversion of groundwater from a drainage well at a mine site is exempt from the requirement to obtain an authorization provided that:
    - there is no use of the water for a water use purpose between the time it is diverted/collected and the time that the groundwater is discharged, and
    - the water must be discharged without causing a significant risk of harm to public safety, the environment, land or other property.

The Ajax application documents state that all water reporting to the open pit (Jacko Lake, groundwater and other seepage) is intended to be pumped to a collection pond and then be used in the process. Paragraph two, above, appears to most relevant to the regulation of water removed from the open pit at Ajax.

The WSA was approved while the proponent was already engaged in the Environmental Assessment process. As such an application for a use approval may be an appropriate interim step, until additional data is gathered to support a license application.

It is understood that the proponent may wish to use water present in the historic open pits. FLNRO notes that the proponent's response to SSN-329 IR shows major ion chemistry of the east-west and west-west open pit to be substantially differentiated from Jacko Lake, and quite close in composition to that of PW-01. As such it appears to represent groundwater that has drained into the pit. Removal of this water would cause more groundwater to drain into the historic pits. Therefore, it should be considered a groundwater source rather than a surface water source.

To: Tracy James

The above comments do not represent a comprehensive assessment of the WSA applicability to the Ajax project.

Regards,

David Thomson, M.Sc., P.Geo.
Regional Hydrogeologist
Ministry of Forests, Lands and Natural Resource Operations

cc: Andrew Rollo, M.Sc., P.Geol. Regional Project Director, Major Mine Permitting Office
Mike Toews, P.Ag., Authorizations Manager, FLNRO
Susan Fitton, Senior Projects Manager, FLNRO
Gabrielle Matscha, RP Bio, Environmental Impact Assessment Section Head, MOE
Christa Pattie, P.Ag., Senior Authorizations Specialist, FLNRO
Bruce McFarlane, P.Eng.,Water Resources Hydrologist, FLNRO
Colleen Dreger, Water Stewardship Officer, FLNRO

From: Thomson, David A FLNR:EX
To: Zurakowski, Krysia EAO:EX; James, Tracy A EAO:EX
Subject: Ajax follow up
Date: Monday, November 21, 2016 10:49:17 AM

Hello – regarding the ongoing comments about hydrogeological aspects of the Ajax project, as discussed, I wanted to suggest a path forward that might satisfy some significant uncertainties expressed.

Much has been written about the ELFZ. One commenter noted correctly that several of packer tests performed in a borehole intersecting the ELFZ, including zones across the fault, were unable to achieve sufficient water flow to test the maximum hydraulic conductivity. Presently the proponent has modelled the ELFZ as a 50 m wide feature (one of three possible interpretations) with an assumed hydraulic conductivity. The actual hydraulic conductivity is not known doe to the test pump limitations. Given the proponent's uncertainty regarding the actual width and extent of the fault, as well as the unknown maximum hydraulic conductivity, a greater understanding of the feature and risks associated with that uncertainty is warranted. This can be done by performing a sensitivity analysis with hydraulic conductivities 10 and 100 times greater than the maximum assumed value. If that significantly impacts model calibration or effects modelling, in the consultant's opinion (and potentially peer-reviewed opinion) then the actual value should be determined by physically repeating the test, and then determining the impact on the model. Alternately, the proponent could directly proceed to re-enter the borehole to complete accurate testing, and then re-run the model with known values.

Another multiple-reviewer concern related to the project is potentially significant drainage of water from Jacko Lake under mining conditons. More specifically the concern is that there have not been enough pumping tests, or of sufficient duration, to obtain a representative understanding of groundwater flow under pumping conditions. Following the release of data collected by the proponent, an APEGBC-registered professional re-analysed the pumping test and determined drawdown had not stabilized, which is a requirement to properly determine aquifer parameters. In fact the drawdown rate had decreased toward the end of the test, suggesting recharge had begun to occur at that point. This re-analysis is a significant concern and suggests more data collection of this type is warranted.

Given that the well was originally drilled as a dewatering prototype well, and additional dewatering wells will be drilled, requiring the proponent to drill and test another deep well would not seem onerous. That well should be south of the existing PW01 between Jacko Lake and the future open pit, and subjected to a longer term test (ie, approximately 30 days). The results from that test would then need to be incorporated into the model and the model would be rerun to confirm alignment with previously predicted affects assessment. This could perhaps be done very early on in the mine construction, as a permitting condition. Further, additional monitoring well locations requested at the EA stage by FLNRO and others could be monitored during this long term pumping test to give greater confidence in the proponent's understanding of groundwater movement, and groundwater-surface water connectivity, and ability to adaptively manage other potential issues during mining. Additional new monitoring locations within or proximal to the ELFZ can also be monitored during the long term pumping test, as it likely will be within the radius of influence identified by the proponent.

I hope this helps
Dave

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File: 38000-40/ENVASS-AJAX

January 24, 2017

Tracy James
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2nd Floor 836 Yates Street
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Dear Tracy James:

Re: Ajax Mine Project – Review of Supplemental Correspondence BGC-022

I have reviewed the memo BGC-022 (December 13, 2016) and responded to specifically numbered comments in the tracking table supplied by EAO. Below is a general response to the other general comments provided in the memo.

The proponent has proposed a timeline for addressing issues raised in 0831_FLNR_HG, and compared the Ajax EA to two other recent EAs (BruceJack and KSM). While each Environmental Assessment is unique, and it is difficult to directly compare one to another, FLNRO note these other EAs are in a geographically remote part of the province, and predate the Mount Polley findings. One of the Mount Polley findings was that "the fundamental need is to improve the geological, geomorphological, hydrogeological and possibly seismotectonic understanding of sites proposed for tailings dams in B.C."

During the EA process there have been numerous questions and requests for clarifications by several Hydrogeologists involved in the process. After suspension of the official EA process, clarification requests continue to focus on similar issues, suggesting some consensus of thought within the professional community. Many of the proponent's responses to clarification requests since Round 1 have been responded to with future commitments 'as needed', if results warrant, upon review, etc.

Two primary subjects of BGC-022 - an updated monitoring plan, and fixed-frequency updating of the model - represent a way to address the various concerns and data gaps identified at the EA stage by multiple reviewers examining the baseline hydrogeology information presented by the proponent. Doing so provides assurance that key reviewer concerns with information gaps at the EA stage will be addressed at a later date, rather than being dependent on an unknown future process to evaluate future data that may or may not be collected.

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Persistent resistance to the idea of using the calibrated model to define thresholds or triggers for a defined action contrasts sharply with the proponent's expressed level of confidence in the model's ability to assess impacts and their proposed mitigations. Similarly, requests to commit to regular model updates have been met with a proposal to perform a model review and update every 5 years, if a review determines the need. The gap this presents is that there is no clear mechanism to verify the model predictions.

The proponent indicates an updated surface water and groundwater monitoring and management plan SWGMMP can not be provided until detailed engineering is done. It isn't clear how the lack of detailed engineering design inhibits the proponent from proposing approximate monitoring locations and depths to address reviewer concerns noted in FLNR_0831_HG and other correspondence, unless modelled groundwater flowpaths are expected to change once detailed engineering design is done. In fact, doing so may help ensure the monitoring needs are considered in the detailed engineering design process. For instance areas of increased model uncertainty can be targeted and preserved for additional monitoring through the design process, and ensure locations will not be destroyed and replaced. Also, since a minimum of one year of data is required to provide a useful set of data (quality and quantity), and it can take a significant amount of time for trace elements to stabilize in newly drilled wells, dealing with known existing gaps on an 'as needed' basis may not be adequate.

FLNRO continue to believe fixed-date updating and model recalibration during construction and operation phases is commensurate with a project of this scale and degree of information gaps. For instance, having only one short-term constant-discharge pumping test in the vicinity of Jacko Lake (the interpretation of which is the subject of additional IRs) is not adequate for our purposes; however it may be marginally adequate relative to understanding of impacts of decades-long lowering of the water table by ~100 m by dozens of passive drains and active dewatering wells. It is our opinion that further hydrogeological analysis discussed is required, and incorporation of additional hydraulic data and analyses should be done on a fixed-date basis.

Summary

FLNRO (and other parties') comments express concern about somewhat uncertain future commitments made by the proponent. These commitments have been made in response to queries about adequacy and accuracy of the baseline assessment, SWGMMP and the ability of the model to identify and predict significant adverse effects. Multiple reviewers also identify common hydrogeologic issues (eg, ELFZ), although there is not necessarily consensus with respect to the appropriate time to address them.

There seems to be consensus between all parties, including the proponent, to address the outstanding issues including the model updating, but the proponent consistently commits to action 'as needed', if results warrant, upon review, etc. EAO may be best suited to address the potential risks, if any, that this uncertainty presents through certificate conditions, and follow-up compliance and enforcement activities as required through all stages of the project.

It would be useful to summarize the various surface water and groundwater-related monitoring commitments made to date in various correspondences, their dependencies, and consider which ones may appropriately be deferred to which future stage (permitting, detailed engineering, pre-

construction and construction/operations) and under what conditions (e.g., based on third party review).

Previous comments regarding the applicability of the WSA did not and do not require further comment or response.

Regards,

David Thomson, M.Sc., P.Geo.
Regional Hydrogeologist
Ministry of Forests, Lands and Natural Resource Operations

AJAX Mine Proposal

Second round comments on responses from proponent and on new design information

Written By: Darren J. Bennett, Senior Regional Dam Safety Officer, FLNRO

Please refer to the attached annotated tracking table for follow-up ("round 2") comments to FLNRO-229 through FLNRO-235.

New comments:

In mid- to late June 2016, the "pump-around" design for Peterson Creek flows (Jacko Lake outflows) was removed from the plan for routing of Peterson Creek flows, as noted in document 0706_KAM_Peterson Creek Diversion System Update. The document goes on to assess options on the basis of cost and technical feasibility, selecting option B (gravity discharge in pipeline/culvert) as the preferred option. Additionally, 0706_KAM_Fish Habitat and Fishery Offsetting Plan provides greater detail of the design for the new concept. The comments below are new comments that pertain, for the most part, to the overall Peterson Creek diversion system update contained in the 2 above-noted documents.

1. From page 3 of 0706_KAM_Peterson Creek Diversion System Update – the section describing the hydrological design criteria states, " the system must be able to carry flows up to 300lps – the average flowrate for Spring freshet".
    - Please explain the rationale for not designing this system to peak flow conditions. If not designed to accept peak flow volumes the potential exists for elevated storage levels.

2. From page 157 of 0706_KAM_Fish Habitat and Fishery Offsetting Plan – "A concrete wall spanning the outlet channel with a 1 m wide by 0.4 m high orifice at the base will allow fish passage and open channel flow up to 0.3 m3/and will limit, (i.e. throttle) flood outflows from Jacko Lake into the Peterson Creek diversion system."
    - Where would this structure be located?
    - How would this structure function in peak flows?
    - Would the location and operation of such a structure affect the integrity/performance of the dam?

3. From page 157 of 0706_KAM_Fish Habitat and Fishery Offsetting Plan – "A manually operated gate will be included to provide additional flow control during flood events."
    - Where would this control be located?
    - What is the operational plan for this control in peak flow periods?

4. From page 3 of 0706_KAM_BCG-17
    - Please explain the rationale for reducing PMF from 9.65Mm3 (Knight Piesold) to 0.8Mm3 (Norwest).
    - Recognizing that PMF is a difficult value to determine, why was it such a large difference in outcomes?

5. Re: COK-SLR271 – The proponent response to the CoK question regarding fish habitat states the following: "the Peterson Creek Diversion System design has been changed to include a passive flow gravity culvert downstream of the Jacko Lake dam. The culvert design capacity will accommodate average freshet flows so that any excess water in Jacko Lake will be stored for

longer periods of time and thus flatten the hydrograph which will result in longer duration of adequate flows downstream."

- Note: This artificial retention of flood waters qualifies as storage of water purpose requiring a water licence.
- How does this water storage fit with the statement from FLNRO (Allocation) that this system is fully recorded (allocated), especially in the context of reduced inflows to Jacko Lake of approximately 75,000m3 per year (BGC-014), and losses at PC-02 of 235,000m3/year?

6. From page 2-3 of 0706_KAM_BCG-17 - "As noted in IR #MOE-012 and #SSN-309, an updated analysis has been conducted for the Peterson Creek Diversion System (PCDS) pumping system. There will be a single pump station with two independent pump sets inside. Both will utilize the same dedicated pipeline. Each pump set will have a separate duty, specifically:…"
    - Please explain how these pumps are necessary when the construction of a new dam will/should have a passive spillway that would be capable of passing PMF volumes.
    - Based on current water licensing, this PMF volume (and any volume stored above 892m elevation) needs to be passed over the 892m invert and sent downstream for licensee use and aquifer replenishment. Please explain the purpose and operational plan for these pumps.

Ajax Mine Environmental Assessment Certificate Application

Date: 26/08/2016

Name: Bruce McFarlane

Title: Water Resources Hydrologist

Agency/Organization: Ministry of Forests, Lands and Natural Resource Operations

Subject of comment: Surface Water Quantity

Category of comment: Round 2 Comments

Applicant Responses: BGC-013, BGC-015, BGC-017, C224-KA39-MEM-10-002

Overview of key issues in this memo:

- Quantification of water losses and risk to existing water licenses during drought – compensation of water rights.
- Standardized low flow metrics and surface water impacts
- Integration of groundwater changes from mine development into low flow metrics

Comment/Issue Description:

The previous memo from Bruce McFarlane prefaced the information request with reference to drought flow return period, "To understand this potential, the expression of quantified stream-flow losses in the report during the irrigation season and for low flows should be improved." The memo also included a reference that the 1 in 5 year monthly drought flow (monthly Q5) was not provided. Metrics of 7Q5 and 7Q10 were requested, but the applicant stated that they were unable to provide these due to limitations of their model. Instead of the requested metrics, the applicant responded with 5 and 10 year "dry" values, which correspond to 1.11 and 1.25 year return periods, respectively (BGC-013, tables FLNRO.185-1, 185-2, 188-1). These return periods are not sufficiently different than average values to adequately characterize risk of water losses from mine development to existing licences.

Satisfaction of Responses to memo questions, initial review:

1. Incompletely satisfied; low flow metrics still outstanding. There is a lack of clarity on how responses completed prior to design changes are affected by present design scenario. Values provided for monthly Q5, Q10, Q20, and Q50 appear to be high, rather than low flow estimates;
2. Incompletely satisfied; since the applicant could not provide weekly time increments (7 days), temporal effects were not available for the resolution requested;

3. Not satisfied; effects from groundwater were provided as averages, and the impacts to surface water flows for the metrics requested appear to be omitted;
4. Not satisfied; omissions as in 1. above.

The 7Q5 summer low flow is typically used to understand the risks of licencing stream-flow, and the 1 in 5 year drought return volume for licensing storage. The AJAX mine environmental assessment must quantify the impact of mine development on low flow water supply so that compensation can be decided for existing water licensees. FLNR would be in a position to assist EAO in evaluating whether compensation to existing licence holders is warranted if the applicant can provide metrics that are consistent with those used by the ministry for water licensing.

Return period estimates in the response(s) do not adequately assess potential risk of water shortages and potential for compensation to licenced water users as a result of mine development. While monthly estimates for Q5, Q10, Q20 and Q50 were provided in the response, these appear to be increasing with increasing return period, and the values do not inform the risk of mine impact on low flows.

New comments:

- Responses lack consistency with the latest design proposal that includes deletion of the Peterson Creek Downstream Pond. For example Response BGC-017 explains a pumping scenario which we understand is no longer required with election of pond deletion. There should be a summary of response documents that cross-references reference to the old design scenario versus the new one.
- The culvert capacity of Option B, the recommended option, presented in C224-KA39-MEM-10-002 is stated to be 0.3 m^3/s, which quantity represents the average flow during spring freshet. Elsewhere (BGC-017), the PMF is estimated at 0.8 Mm^3 together with an explanation of the pumps' operation, and this event would flow into the open pit. It's not clear where the range of flows in between these two points will be directed.
- According to the applicant response, seepage losses from and reduced groundwater discharge to Jacko Lake will be mitigated by the Water Management Plan. This reference provides no additional detail or specific reference to an item in the plan as to what mitigation is proposed.

BGC-014 cites annual outflows from Jacko Lake to be 75,000 m^3 and below the dam to be 235,000 m^3; however, temporal changes to water supply under the current mine development scenario compared to pre-development [existing] conditions were not identified. These are needed to understand the effect and, therefore, the risk of losses on storage and base-flow licences throughout their respective periods of authorized uses.

Additional information/ clarification is requested as follows:

5. Provide 1 in 5, 1 in 10, 1 in 20, and 1 in 50 year return period estimates of Jacko Lake net inflows for mine operation and post-closure, that incorporates seepage losses and climate change effects for,
    a. Drought freshet volume in m^3;
    b. Monthly mean drought inflows; and
    c. Compare estimates in 5.a., above, with total licenced storage in Jacko Lake;
6. Provide estimates for mine operation and closure of changes in monthly mean water availability for 1 in 5, 1 in 10 , 1 in 20, and 1 in 50 year return periods and 7 day summer low flow at PC02.3 compared to existing conditions, incorporating changes in groundwater contribution, surface water availability, and any proposed mitigation measures;
7. Provide the total water deficit impacts to storage and base-flow licences for mine operation and post-closure compared to existing conditions, according to the corresponding locations of points of diversion, as authorized by the water licences;
8. Where will the flows exceeding culvert capacity below the dam be directed, and how will downstream base-flow licenses be impacted by flows exceeding that culvert capacity not being realized in lower Peterson Creek. Provide estimates of 1 in 5, 1 in 10, 1 in 20 year, and 1 in 50 return periods for monthly flood flows. Provide impacts as in 7., above.

Ajax Mine Environmental Assessment Certificate Application

Date: 25/01/2017

Name: Bruce McFarlane

Title: Water Resources Hydrologist

Agency/Organization: Ministry of Forests, Lands and Natural Resource Operations

Subject of comment: Surface Water Quantity

Category of comment: FLNR Response to BGC-020

Applicant Responses: BGC-013, BGC-015, BGC-017, C224-KA39-MEM-10-002, BGC-020

Overview of key issues in this memo:

- Quantification of water losses and risk to existing water licenses during drought.
- Stream-flow mitigation of water losses.
- Uncertainties and risk reduction.

Comment/Issue Description:

Overall, the responses to questions and concerns raised by this reviewer in Round 2 have been satisfied (see memo of 26/08/2016, Round 2 comments, FLNR Water Quantity). Estimates of water losses for annual, authorized storage, and irrigation periods have been provided for key locations in the watershed. Tabulations of the effects of the proposed mine based on the proponent's Water Management Model are reasonably thorough, and the explanations of calculations for net values allow comparisons between scenarios.

Some concern remains regarding reliability of the model results, as the data input to the model are limited in time and space and therefore, result in output values with inherent uncertainties. Flow values presented in tables, when summarized, can be difficult to reconcile because of variations amongst multiple scenarios. Averaged results can be useful metrics, but they often mask extreme values that increase understanding of risk. Much of the model uncertainty could be reduced by monitoring requirements incorporated into EA conditions. Several measures are provided below to help ensure that model results align with mitigation requirements in moving forward.

Clarifications and consideration of EA Conditions:

1. Stream-flow mitigation –The basis for referencing KAM licences in mitigation of stream losses is unclear. The proponent should identify which of their licences they refer to in their commitment to ensure that water supply in Peterson Creek is maintained for licences more senior than KAM, post-closure (p.2, p.42), as the priority date is critical. Moreover, if the KAM licences have as their source, Peterson Creek and the point of compensation input is located upstream of the affected licences, then the proposal has meaning. If not, then the benefit and mechanics of this commitment is less clear. Licences on Keynes Creek are insufficient to provide the compensation quantities that the report identifies.
2. Annual losses during operations at PC2.03 – Values should be consistent. What is the aggregate loss at this site for average conditions under the model? Values of 225,000 m^3 (p.22), 227,000 m^3, and 235,000 m^3 (p.40) are provided in the report, and 235,000 m^3 appeared in a previous memo. Is this value additive to losses on Jacko Lake, *i.e.* 225,000 m^3 plus ~75,000 m^3?
3. Environmental Flow Needs (EFN) – In-stream flows requirements have not been reviewed herein, but it appears that none of the mitigation proposals address EFN requirements (other than increasing the area of Jacko Lake). The *Water Sustainability Act* requires that a decision for new licencing considers EFNs. This value is not addressed by the compensation quantities within the BGC-020 report. The EA office should ensure that this information is provided and addressed in any mitigation proposal that involves new water licence applications;
4. Model uncertainties and monitoring – The proponent has likely developed a monitoring plan for many of the environmental values evaluated under the EA. The EA should require a monitoring plan for water quantity that intends to reduce uncertainties of the Water Management Model, including assumptions about stream-flow from tributary streams and net inflow losses on Jacko Lake. The plan should contain as a minimum the following:
    a. selection of monitoring variables that are outputs of the model (stream-flows), with expression of the uncertainties and dependence of compensation on model outputs, particularly where assumptions are based on limited data or model sensitivities are high;
    b. locations, frequency and duration of monitoring effort;
    c. expected outcomes of the monitoring plan;
    d. reporting intervals; and,
    e. recommendations to update mitigation instruments, such as permitting or reservoir release schedules, with the new information;

5. Storage Licencing – It is unclear whether additional storage may be licenced on Jacko Lake, but this desire by KAM appears fundamental to their compensation proposal. Provision of compensation flows below the dam would be technically complex without inclusion of a storage element in the flow continuum. The current design from the Water Management Plan also calls for temporary storage of flood flows in Jacko Lake that eclipse the capacity of the outflow culvert, requiring that the lake be surcharged. The report suggests that these operational details can be resolved at the permitting stage. The EA office should determine whether additional storage licencing may be authorized, and Water Stewardship staff should be consulted in that determination.

The compensation plan is comprised of a number of component options that are interrelated. The common element in all components is the feasibility of storage licencing. With appropriate input to EA certificate conditions from FLNR staff, the compensation plan could be technically feasible. Regardless, a decision granting additional storage on Jacko Lake is a statutory one, and one that is influenced not only by technical, but also social and legal factors. It may not be possible to verify the likelihood of authorizing the additional storage on the lake in advance of the permitting decision. This is necessarily a risk borne by the EA decision process.

Zurakowski, Krysia EAO:EX

From: Pattie, Christa M FLNR:EX
Sent: Thursday, November 24, 2016 3:30 PM
To: Zurakowski, Krysia EAO:EX
Cc: Dreger, Colleen D FLNR:EX; James, Tracy A EAO:EX; McFarlane, Bruce E FLNR:EX
Subject: KGHM Streamflow mitigation meeting- more info needed

Importance: High

Follow Up Flag: Follow up
Flag Status: Flagged

Hi Krysia,

Colleen and I have been working on reviewing the mitigation strategies and have held a number of meetings with peers/colleagues to discuss what has been proposed. Where we've landed at this point is that we need to understand **where and when** the anticipated losses will be distributed within the watershed in relation to the licensed points of diversion, and how this will impact each license holder based on their priority date. Please refer to FLNRO-187.1 in BCG-020 (pg 11) for the information that was previously requested by Bruce MacFarlane. We don't consider the response in Round 2 to sufficiently answer this question, and request that this information be provided prior to meeting to discuss mitigation options.

We also request:

- a graphical (i.e. map) depiction of where the losses will be realized in relation to the licensed PD's;
- hydrograph showing inflows to Jacko Lake comparing flows for the following time frames: existing , through operations and after mine life
- Hydrogrpah showing flows at PC02.3 comparing flows for the following time frames: existing , through operations and after mine life. This hydrograph should show base flows only, and not include releases from Jacko Lake dam.

This information is critical for us to move forward in evaluating whether or not the proposed mitigation strategies will be feasible to mitigate for the losses of individual license holders.

Further, the proponent should only be considering priority dates of licenses rather than the existing dam release schedule that is in place for these license holders. The priority dates (First in Time, First in Right) are what inform who will be impacted as per legislation.

We also need the proponent to confirm what the values of the projected losses are that they intend to mitigate for- this is not clear to us.

We would also like to clarify for KGHM that they do not hold two water licenses on Keynes Creek; the license they hold is for 30,837 cubic meters (C102915). This may impact their views on whether diverting Keynes creek is a viable mitigation option for them, as their information referenced in the mitigation options document referenced a higher number than they would be able to divert.

Is the expectation at this point for us to respond to the Round 2 responses provided by KAM? We are not clear on this. We have started review of the responses and have some initial questions but may come up with more questions after we've had more time. Some questions we have now are:

- Do the tables showing streamflow values at PC02.3 reflect flow releases from Jacko Lake?
- Clarify the period used for freshet net inflow analysis and explain difference between Table 187.1-5 (1,409,400 m3) and Table 187.1-5 (1,258,760 m3 summed over Oct 1 – Jun 1). What period was used to calculate freshet inflows for storage. If the difference in corresponding average values for these table can be understood, then the return period analyses should be valid.
- Unclear how water losses (net inflows to Jacko Lake and baseflows at PC 2.03) will impact licences upstream of Jacko Lake and regulation.
- How are [average] losses at Jacko Lake of ~ 41,000 m3 rationalized in respect of ~235,000 m3 overall? To what cause can this difference be attributed (ie. where are the other losses realized)?

Finally, we would like to request that the hydrologist working on this data attends the meeting in person. So far it has felt non-productive to have conservation over the phone as communication is limited.

As mentioned, our ability to provide KGHM as response to their mitigation proposals is limited by the information we have received to date. I suggest postponing the discussion that is planned until more complete information has been provided, as per our request.

Thanks,

Christa Pattie, P. Ag
Senior Authorizations Specialist- Water
Thompson Rivers Natural Resource District
Ministry of Forests, Lands and Natural Resource Operations
Phone 250.371.6519
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Website: Living Water Smart: B.C.'s Water Plan

Zurakowski, Krysia EAO:EX

From: James, Tracy A EAO:EX
Sent: Thursday, October 6, 2016 4:41 PM
To: Wurtz, Sheryl FLNR:EX
Cc: Pratt, Gordon FLNR:EX; Pollard, Rachael E FLNR:EX; Zurakowski, Krysia EAO:EX
Subject: FW: Ajax comments (Range branch - grasslands and agriculture)
Attachments: FLRNO Wurtz Ajax October review.xlsx

Follow Up Flag: Follow up
Flag Status: Flagged

Thank you, Sheryl.

Tracy

Tracy James
Project Assessment Manager
BC Environmental Assessment Office
(P) 250-387-0232

EAO Environmental Assessment Office

From: Wurtz, Sheryl FLNR:EX
Sent: Thursday, October 6, 2016 4:31 PM
To: James, Tracy A EAO:EX
Subject: FW: Ajax comments

From: Wurtz, Sheryl FLNR:EX
Sent: Wednesday, September 28, 2016 9:29 AM
To: Pollard, Rachael E FLNR:EX
Subject: Ajax comments

All my comments are with respect to grasslands, the ALR, denying the significance of losses etc. I have been covering off Agriculture concerns as well as Range and grassland so it has encompassed water, ecosystem, range and forage.

1 – ALR land removal (temporary and permanent) was made very difficult to make sense of as well as the mitigation for any permanent land removal

2 – Will it be 'restoration of native grasslands' or 'reclamation of domestic grasslands' that will be the end goal. They seemed to use restoration and reclamation as if they are the same thing but they are not. There will be impacts to habitat types dependant on types of grasses they use and range management. They keep saying 'may use' and don't have a good firm plan to date and without that it is hard for the reviewer to provide input on chances of success,

appropriateness dependant on end land uses etc. I am pretty confident that they are really going for a domestic grassland in most cases with a few exceptions.

3 – Denial of the significance of the loss of 500 ha of grassland due to the open pit and mitigation options are not clear to me. This is a direct loss of AUM's. I have asked if they are planning to expect more AUM's from a smaller land base because they are seeding with domestics and they said no. So ?

4 – water needed for reclamation and success of seed germination. I discussed this with the water reviewers and they were unclear on this, had not thought about that need until I asked.

Sheryl Ann Wurtz, P. Ag.,
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(250)371-3782