

**Status of Karst Technical Review
Pertaining to Karst and Hydrogeological Issues
Duntroon Quarry Proposed Expansion
(March 12, 2009)**

INTRODUCTION

This document provides a summary of issues and status of concerns on karst hydrogeological issues following a review process which included document peer reviews, a field site visit, and several response/comment documents between myself and, principally, Jagger Hims Limited, the hydrogeological consultants for Walker Aggregates Inc. in the matter of the proposed Duntroon quarry expansion. During the course of this review, I have prepared several documents including the following:

- (1) “Technical Review of Karst Documentation Pertaining to the Proposed Duntroon Quarry Expansion, Clearview Township, County of Simcoe” dated April 8, 2008 (6 pages);
- (2) e-mail comments provided to Ms. Kathryn Pounder (NEC) dated October 15, 2008 (2 pages); and
- (3) “Comments on Jagger Hims Limited Response to Supplementary Karst Review Comments” dated November 26, 2008 (3 pages).

The latter response was timed in conjunction with a detailed modelling review/comment document prepared and submitted by Mr. Chris Neville, Papadopulos & Associates, Inc. (on behalf of the NEC). Joint meetings were held on November 20 and December 9 to discuss and clarify comments/issues and Jagger Hims Limited then issued a response on January 16, 2009.

ISSUES/CONCERNS TRACKING

I will not repeat the details of my concerns but will briefly summarize them below. In general it was concluded that the karst characterization work was well done and karst issues had been adequately incorporated into the hydrogeological modelling to the extent possible. Principal concerns of this first review (April 8, 2006) related to:

- 1) Surface water flows at spring SW2 and the associated water budget for Rob Roy wetland Unit 6;
- 2) Incorporating future climate change considerations into the final lake stage modelling to ensure appropriate mitigation of water supply to Rob Roy wetland Unit 6 as planned;
- 3) Undertaking monitoring of flows at additional springs as part of the adaptive management plan monitoring program (AMPMP);

- 4) Water balance confirmation of available water (precipitation over evaporation) to allow for filling of the existing and expansion quarries (and possibly the MAQ) quarry to ensure mitigation measures for the Rob Roy wetland Unit 6 and the ANSI A and B wetlands/recharge to SW9 – SW11 karst systems;
- 5) Potential effects of “high K” values north of the MAQ quarry in terms of final lake filling; and
- 6) Whether or not the hydrogeological modelling adequately describes impacts to percolation waters and spring discharges.

The first three of these concerns were addressed by Jagger Hims Limited in an August 26, 2008 response to which I addressed in a follow-up e-mail on October 15, 2008. In this e-mail I noted that item 1) had been fully addressed and resolved; item 2) was partially addressed with regard to incorporating more recent climate data but no attempt was made to address potential future precipitation/evaporation conditions; item 3) was addressed but no commitment to undertake further monitoring was given; items 4) to 6) were not addressed. I indicated that items 4) and 5) remained outstanding and that I would leave an assessment of item 6) to Mr. Neville who was undertaking a detailed review of the modelling work.

Items 4) and 5) were subsequently addressed in detail by Jagger Hims Limited in a detailed modelling addendum pertaining to the eventual filling of all three quarries in a response dated November 14, 2008. This document was discussed in detail at the November 20, 2008 meeting, following which I prepared a response dated November 26, 2008.

The supplemental lake filling modelling was greatly appreciated and resulted in three considerations on my part:

- A) The revised modelling indicated the need for berms (height not specified due to uncertainties associated with effects of the “high K” zone and it was suggested that the AMPMP should provide contingencies in the event of a failure of all or part of containment berm;
- B) To consider the use of grouting techniques to limit bedrock flow connectivity between the existing and expansion quarries as an alternate/addition to the use of berms; and
- C) To undertake further characterization of the “high K” zone to better characterize/model its effect on quarry filling.

These considerations were not discussed in detail at the December 9, 2008 meeting, however Mr. Neville had prepared a series of 9 modelling questions pertaining to the supplemental lake filling modelling document (as part of a larger modelling comment document submitted by Mr. Neville on November 20, 2008). These were discussed and it was indicated by Mr. Hims that the lake modelling was being updated and would be provided to us at a later date.

The latest response from Mr. Hims was a January 16, 2009 response specifically to Mr. Neville's November 20, 2008 comments (as elaborated and discussed at the two subsequent meeting discussions).

CURRENT STATUS

Attachment B of the January 16, 2009 response to Mr. Neville is titled "Response to Supplementary Karst Review Comments From Daryl Cowell, P. Geo." The date of this attachment is November 13, 2008 which is one day prior to a response of the same title from Mr. Hims to me for which I had already provided comments in my November 26, 2008 report. The timing of the two documents is somewhat confusing, however page A-27 of the January response suggests that Attachment B is in fact "an updated lake package".

The lake elevations presented in Attachment B are somewhat different to the earlier calculations with the existing quarry lake being slightly higher and the expansion quarry lake slightly lower in the November 14 response (in Table 9) than in the Attachment B response (Table 8). Also, Attachment B allows for a runoff component (Table 1) to the existing quarry to balance the water budget. However, the conclusions are identical in both responses with the exception of a re-write of the last sentence in paragraph 5 indicating a shift from monitoring during operation of the expansion quarry to further modelling.

Given that there are no substantive changes to the document I commented on in my November 26, 2008 submission, my "considerations" presented as A, B, and C, above still stand with the exception of amending consideration "B" to read: "to consider the use of grouting techniques as a contingency to limit bedrock flow connectivity to the "high K" zone if and where necessary."

I am inclined to agree that the final outcome of lake filling and wetland mitigation will require monitoring and further modelling but this should be specified in the AMPMP.

The current status of my original April 8, 2008 recommendations (1 – 6 above) are as follows:

- (1) Resolved;
- (2) Partially Resolved – although I agree with Jagger Hims Limited that it is not possible to quantitatively model lake levels given the uncertainties (with both climate change predictions and modelling) for future climate change, the current predictions suggest a decrease in Precipitation – Evaporation (P-E) during the later period of lake filling (for example, refer to <http://www.ucsusa.org/greatlakes/glchallengeclimover.html>). Given the importance of P-E to the water budget for each of the lakes, I believe that, as a minimum, the AMPMP should specifically address the issue in terms of on-going updating of the water budget for each of the lakes;

- (3) Resolved – the location of these springs upstream of a golf course pond and planned activities in this area by Walker Aggregates Inc./Jagger Hims as discussed in our November 20 meeting sufficiently accommodates this concern;
- (4) Resolved;
- (5) Refer to my “considerations” A, B (as amended), and C; and
- (6) Refer to comments/responses by Mr. C. Neville.

Respectfully Submitted
Daryl Cowell (P.Ge. #0791)