

William Hill Consulting Mining Engineer

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QUARG

C/o Peter Wagner

23 Jade Bay Road

Bancroft, ON, K0L 1C0

Technical Peer Review – Blast Impact Analysis – Freymond Quarry

Township of Faraday – County of Hastings

Dear Mr. Wagner

Acting on Mr. G. Watts' request I have reviewed the Blast Impact Analysis (BIA) prepared by Explotech Engineering Ltd. (Explotech) for the proposed Freymond Quarry (FQ) dated December 13, 2016 (Ref.1.), which is a modification of the earlier BIA for the FQ prepared by Explotech dated February 18, 2014 (Ref.2.). The following is my technical review. My qualifications for writing this report are included as an appendix hereto.

SUMMARY – CONCLUSIONS AND RECOMMENDATIONS

In the preparation of a BIA for a quarrying operation there are three principal issues which affect the environment of the area surrounding the quarry, and all three should always be included in measuring the effects of blasting. The three are noise (overpressure), ground vibration and flyrock and wild flyrock. Noise can be a nuisance and sometimes psychologically damaging. Vibrations can be damaging to structures, wells, domesticated animals and wildlife etc. Flyrock and wild flyrock, fragments of rock propelled through the air by blasting, can be a nuisance, psychologically damaging, destructive to structures, but more importantly, cause injuries and even deaths.

The BIA on the FQ provides an in depth analysis of noise and vibration but **flyrock and wild flyrock is ignored**, except for a brief mention on page 17 of the 2014 version (Ref.2.) *"It will be aimed away from structures as much as possible"* and on page 19 (Ref.1.) appears to be only alluded to under the designation of *"fragmentation"* - *"which will be continually reviewed"*.

The BIA is incomplete without fully presenting an analysis of the dangers of flyrock and wild flyrock in as much or more detail as Explotech has dedicated to noise and vibration. **The BIA should be**

revised to include flyrock and wild flyrock as one of three principal issues with respect to the surrounding environment.

The foregoing modification of a BIA is not new to Explotech. In April 2014 Explotech Engineering Ltd. submitted such a report (Ref.3.) to their client with the opening paragraph stating *"In response to your enquiry regarding the potential for flyrock and wild flyrock from the proposed James Dick Hidden Quarry, this report expands on our earlier comments."* It appears that the client was also not satisfied with the lack of analysis on flyrock and wild flyrock in the BIA for their proposed quarry.

FLYROCK AND WILD FLYROCK

The importance of taking precautions for the possibility of a flyrock and wild flyrock incident cannot be understated.

Explotech appears to understand the importance, **but only at times**, as is demonstrated by a witness statement (Ref.4.) prepared by them for deposition at a trial which ended in a *"guilty of discharging flyrock and wild flyrock"* verdict concerning a serious flyrock and wild flyrock incident. *"We have applied the formulae as developed for the United States Bureau of Mines to predict expected range of flyrock and wild flyrock for products and patterns used on this blast. The validity of these equations for application in Eastern Ontario Quarries was confirmed by the Ontario Ministry of Labour in the early 1990's following a fatality resulting from flyrock and wild flyrock at an Ontario limestone quarry".*

The deposition concludes with the recommendation *"We strongly recommend that the hazard zone be increased to 500m when firing any future blasts"*. The "strong" recommendation of having a setback of 500m should be carefully noted with respect to what it implies in the case of the FQ. The 500m estimated by using the United States Bureau of Mines (USBOM) formulae was based on using an explosives load of about 5kg/m as compared to the charge proposed for the FQ of 6.5kg/m in the 2016 and 2014, BIA on page 14. The increased explosives load would require a setback in the range of 600m – 700m.

As a further indication that Explotech has a record of obscuring the dangers of flyrock and wild flyrock is demonstrated in two of their reports prepared for the Miller Braeside Quarry (MBQ) in the County of Renfrew.

The first is a BIA dated April 2007 (Ref.5.) prepared for the proposed extension of the present quarry operating boundaries in which the current operating practices are analysed, but again, **only with respect to noise and vibration but no mention of flyrock and wild flyrock**, and concludes that *"the proposed extension can be carried out well within governing guidelines set by the Ministry of the Environment"*. They accept that the then current practice *"separation distance of 300 meters that has been established between the proposed extraction limits and the nearest sensitive receptors"* as well as *"could be extracted to less than 200m separation distance"* without expressing any reservation. It should be noted that on page 13 of the Explotech report it is indicated that the explosive charge will be about 7kg/m which would require a setback distance of more than 500m.

The second report on the MBQ by Explotech is titled *"Blasting Accident – Braeside Quarry"* dated August 27, 2007 (Ref.6.), scarcely four months later. The "accident" as stated in the report *"the residence at*

1437 Usborne Road had been hit by fly rock. This residence is some 390 meters southwest of the blast" - "some stone was found in the yard". It was also reported by the residents (Ref.7.) that the blast cast flyrock and wild flyrock close to several other residences on Usborne Road. It should be noted that no recommendations were made by Explotech with respect to setback distances for flyrock and wild flyrock in the two reports on the MBQ. The investigation did not mention the shortcomings of their BIA which in effect predicted no flyrock and wild flyrock incident could occur.

A final example demonstrating that Explotech is well aware of the dangers of flyrock and wild flyrock can be found in a BIA report dated August 24, 1998 for the Tamagami Traprock Quarry in Best Township (Ref.8.). This BIA presents a balanced approach in the analysis of blasting impacts on the surrounding environment. The report includes an analysis of noise, vibration and flyrock and wild flyrock. Flyrock and wild flyrock is given special attention in an appendix which includes an analysis of the setback requirements using the USBOM formulae.

NOISE

The analysis and recommendations regarding noise appear to be acceptable. It has been my experience that proper setback distances for flyrock and wild flyrock will generally be sufficient to mitigate the effects of noise.

VIBRATION

The analysis and recommendations regarding vibrations could be in error of underestimating the magnitude of the vibrations. The reason for this statement is based on two previous documents prepared by Explotech. The concern I have is the choice of the constants used in the equation based on the USBOM formula for determining the magnitude of the vibrations at sensitive receptors. The constants, "k" given a value of 5175 and "e" given a value of -1.76 shown on page 14 of both BIAs are mainly derived from limestone quarries based on monitoring of blasts. The rocks in the FQ, which is located in in the Grenville Front, an area predominantly granitic and highly metamorphosed, are generally much harder and more brittle than limestone, up to 4.5 billion years old as compared to less than 600 million consequently may be quite different in the transmission of vibration. This statement is based on two reports.

The first report, a peer review by Golder Associates of the Miller Braeside Quarry BIA prepared by Explotech, dated April 2007 (Ref.9.), found that such an extrapolation understated the estimated magnitude by almost 100% when compared to actual in quarry blasting vibration measurements. The BIA for the FQ applied constants "k" and "e" which were slightly modified in the intervening years but results would only be in the range of 5% different.

The second report is the BIA presented by Explotech for the Tamagami Traprock Quarry, also in the Precambrian Shield, dated August 1998 (Ref.8.). On page 4 it explains that it "incorporated data collected from blasting in hard rock quarries in Northern Ontario (i.e. Sudbury, Timmins, and North Bay)" - "seismographs were used to collect the data". Based on the data Explotech then derived the "k" at 350 and "e" at 1.11 constants and applied them to the USBOM formulae to determine the setback distances

necessary for the safety of surrounding sensitive receptors. The constants if used with the comparable weights of explosives and distance demonstrate that the vibrations at the FQ would be approximately 50% greater than those estimated in the BIA.

GENERAL COMMENTS

The 1998 report on Tamagami Traprock BIA presented by Explotech (Ref.8.) is technically sound and should have served as a model for all future BIAs. The authors of the report (who no longer work for Explotech) dedicated one page to noise, two to vibrations and four to the analysis of flyrock and wild flyrock to establish suitable setback distances.

AUTHORS COMMENT

An old miner once said, "Ignoring flyrock is like a general telling his soldiers to forget about shrapnel because the noise and vibration are within acceptable limits". Flyrock and wild flyrock are shrapnel without the shards of bomb casing.

CONCLUSIONS AND RECOMMENDATIONS

The BIA is incomplete without fully presenting an analysis of the risks associated with flyrock and wild flyrock in as much or more detail as Explotech has dedicated to noise and vibration.

The BIA should be **revised** to include flyrock and wild flyrock as one of three principal issues with respect to the surrounding environment.

The revised analysis should present the setback distances applying the USBOM formulae which has been proven effective over the last 40 years. Explotech is quite familiar with these formulae as demonstrated in previous documents (Ref.4.) and (Ref.8.).

I am quite aware that the Ministry of the Environment does not stipulate the inclusion of assessments of risks involved with flyrock and wild flyrock; however this is contradicted in their attitude taken in the prosecution of the parties involved in the flyrock and wild flyrock incident at the Pakenham quarry (Ref.4.). Good engineering practice dictates risks of flyrock and wild flyrock should be included in the BIA.

Yours very truly,

WILLIAM HILL CONSULTING MINING ENGINEER



William Hill B. Sc. P. Eng.



Cc.

Freymond Lumber Ltd. (c/o MHBC Planning)
113 Collier Street
Barrie, ON, L4M 1H2
bzeman@mhbcplan.com

Justin Harrow
Director of Planning
235 Pinnacle St.
P.O. Bag 4000
Belleville, ON, K8N 3A9

Faraday Council
29860 Hwy. 28 South
Bancroft, ON, K0L 1C0
office@faraday.ca

REFERENCES

- Ref.1. Blast Impact Analysis prepared by Explotech Engineering Ltd. for the proposed Freymond Quarry dated December 13, 2016.
- Ref.2. Blast Impact Analysis prepared by Explotech Engineering Ltd. for the proposed Freymond Quarry dated December 13, 2014.
- Ref.3. Letter report by Explotech Engineering Ltd. To The James Dick Group Inc. titled "Proposed James Dick Hidden Quarry Licence Application - Blasting Flyrock" dated April 2014.
- Ref.4. Crown Brief Statement of Rene Arthur Morin of Explotech Engineering Limited subject "Thomas Cavanagh Pakenham Quarry July 23, 2009 Flyrock Incident Investigation" dated September 25, 2009.
- Ref.5. Blast Impact Analysis prepared by Explotech Engineering Ltd. for the proposed extension of the Miller Braeside Quarry in County of Renfrew dated April 2007.
- Ref.6. Letter report by Explotech Engineering Ltd. titled "*Blasting Accident – Braeside Quarry*" dated August 27, 2007
- Ref.7. Report written by residents close to the Miller Braeside Quarry dating around August/September 2007. William Hill file available on request.
- Ref.8. Blast Impact Analysis prepared by Explotech Engineering Ltd. for the proposed Tamagami Traprock Quarry in Best Township dated August 24, 1998.

WILLIAM HILL EXPERIENCE WITH FLYROCK

In looking back over my 60 years in the mining business I believe now that I may be as qualified as one of few engineers to comment on flyrock. The reason for stating the foregoing is based on my work over the years involving open pit mines and as well as quarries and gravel pits which number well into the hundreds, in Chile for example, I can count at least 25 operations.

My firsthand knowledge of Flyrock in open cast mining started when I worked in Peru for the Cerro de Pasco Mining Corporation's McCune pit, shown in the image below, for 6 years starting as a foreman and ending as the manager of the operation. As you can see, the pit now is 2km long and 1km at its widest and about 300m deep having removed about 700,000,000 tonnes of ore and waste in the years since its inception in the early 1955's. Because originally all operations were underground the city of Cerro de Pasco (pop. 70,000) occupied most of the site where the open pit now exists. Throughout the last 70 years there has been a constant pushback of the city to provide the space required for enlarging the mine. My six years were a constant challenge and education in blasting, almost 1000 in number, with housing being so close. I believe that that experience alone qualifies me to comment on the subject. The Google earth image, below, shows the proliferation of houses, about 1000 homes within 100m of the pit on the eastern side. During the six years I had several incidents but no injuries mainly because we sent out guards to warn the residents. After six years however, I had an incident as a result of a hidden fault which damaged over 300 houses **so I know about the dangers of flyrock .**

