



**TECHNICAL MEMORANDUM**

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**To:** Andrew Mitchel, Wolfden Resources  
Leslie Gomm, Gartner Lee Ltd. **Date:** May 31, 2007

**From:** Bruce Mattson, Stephanie Simpson **Project #:** 450-2

**Subject:** Lorax's Response to NRCan's Comments on the Adequacy of Wolfden High Lake Project Proposal

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In October of 2006, Lorax Environmental Services (Lorax), and Gartner Lee, submitted to the Nunavut Impact Review Board (NIRB) a *Geochemical Characterization and Source Loading Study* for the proposed High Lake Project on behalf of Wolfden Resources Ltd. The document provides projected use of explosives and associated annual nitrogen (N) losses at High Lake according to an equation taken from Ferguson and Leask (1988). The equation assumes the following:

**Residual N = 0.1% (projected ANFO use as N) + 8.5% (projected slurry / emulsion use as N) for mines that will use more than 1% but less than 20% slurry explosive**

The Ferguson and Leask (1988) formula is based on 15 sets of annual explosives nitrogen loss data for five mine sites in the Kootenay Coal Fields of southeastern British Columbia between 1980 and 1986 (Byron Creek Collieries, Westar-Greenhills, Fording Coal, Crows Nest Resources-Line Creek, and Westar-Balmer). The Ferguson and Leask study was instigated by Environment Canada in 1985 to investigate findings in a previous study by Pommen published in 1983. Pommen had derived a formula that overestimated the nitrogen release from explosives (6% N-loss), thereby exaggerating the potential impact to receiving water and delaying approvals for new mines (Ferguson and Leask, 1988).

Ferguson and Leask (1988) found that nitrogen loss at the five mine sites ranged from 0.1% to 4.3%. The mines that used <1% slurry in dry blasting conditions exhibited nitrogen losses of <0.3%, while mines that used 18 – 70% slurry in wet blasting conditions exhibited nitrogen losses of >1%. They further concluded that mine sites that use little slurry (<1% of total explosive as N) had a mean of 0.2% of the ANFO (expressed as nitrogen) while mines that use significant amounts of slurry explosives (>20% of total explosive as N) had a mean of 0.94% of the ANFO and 5.1% of the slurry. They then concluded that a transitional formula of 0.1% of the ANFO and 8.5% of the slurry seemed appropriate for mines that used between 1 and 20% slurry explosives. Their study suggests that the proportion of slurry explosive use (determined by wet or dry blasting conditions) is the key factor in predicting nitrogen release from explosive use at mine sites.

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Explosives used in mining have evolved since Ferguson and Leask (1988) developed their formulas. Emulsion is now generally used in place of slurry for blasting under wet conditions due to the inherent contamination problems associated with slurry use. In order to apply the nitrogen loss model to the High Lake Project, emulsion is considered equivalent to slurry. However, this is a conservative assumption since emulsion explosives or emulsion-ANFO blends containing >70% emulsion are considered to be water resistant and therefore more effective at reducing nitrogen loss (pers. comm. Mike Young, 2007)

The resulting average percentage of total nitrogen loss from total anticipated ANFO explosives used at the High Lake property was calculated by Lorax to be 1.58% for the first three years, when a higher quantity of emulsion is used, and 0.85% for individual subsequent years.

The methods to calculate potential nitrogen loss from explosives by Ferguson and Leask (1988) have also been used to calculate potential nitrogen losses by Western Canadian Coal for the Wolverine Environmental Assessment and Mine Permit Amendments for the Wolverine Coal Project (2005), by Tahera Corporation regarding the Environmental Cumulative Effects Assessment for the Jericho Project (2003), and by Pine Valley Coal Ltd regarding the Report and Recommendations of the Willow Creek Coal Mine Project Committee with Respect to the Issuance of a Project Approval Certificate Pursuant to the Environmental Assessment Act, R.S.B.C. 1996, c.119, and Fulfilling the Requirements of a Screening Report Pursuant to the Canadian Environmental Assessment Act, 1992 c.37 (1998).

On March 19, 2007, Comments on the Adequacy of Wolfden High Lake Project Proposal returned by NRCAN (and NIRB). In their response, NRCAN refers to a citation in a paper by Wiber et al., 1991, "It is well known that, even with good practices, there is a significant, 5-15%, loss during the use of ANFO", and requests that the 15% loss scenario be investigated to determine the impact as a worst case.

The NRCAN comment refers to a sentence in Wiber et al. (1991) that states, "All in all, surveys conducted in the past indicate that significant ANFO losses occur in mining. Indications are that, depending on the mine, the loss amounts to between 5 – 15% of the total ANFO used". The paper presented by Wiber *et al.*, (1991) does not provide any reference or details regarding the surveys, does not indicate whether the 15% represents the first few years of mine development when a greater nitrogen loss is expected, and does not indicate whether the 15% represents measurements made before or after best management practices were implemented at the mine sites.

Based on the paper by Wiber *et al.*, (1991) and another paper by Revey (1996) best management practices, including storage and handling, blast design considerations to ensure complete detonation, proper explosive selection, loading controls, and, most importantly, employee education, are the key to reducing nitrogen losses in mine water effluent. These are practices that will be undertaken by Wolfden during the operation of the High Lake Mine to manage nitrogen loss. At this early stage in the review process, applying a 15% loss scenario is overly conservative and would not accurately predict nitrogen loads expected from waste rock that will be stored at High Lake.

The Ferguson and Leask (1988) and Revey (1996) papers are provided for reference.

### References

- Ferguson, K.D. and Leask, S.M. 1988. *The Export of Nutrients from Surface Coal* Regional Program Report 87-12 Environment Canada Conservation and Protection Environmental Protection Pacific and Yukon Region West Vancouver, B.C. March 1988
- Pine Valley Coal Ltd, 1998. *Report and Recommendations of the Willow Creek Coal Mine Project Committee with Respect to the Issuance of a Project Approval Certificate Pursuant to the Environmental Assessment Act, R.S.B.C. 1996, c.119, and Fulfilling the Requirements of a Screening Report Pursuant to the Canadian Environmental Assessment Act, 1992 c.37*, March, 1998.
- Revey, G.F. 1996. *Practical methods to control explosives losses and reduce ammonia and nitrate levels in mine water*. Mining Engineering, Technical Papers. Pp 61 – 64.
- Tahera Corporation, 2003. *Environmental Cumulative Effects Assessment for the Jericho Project*, January, 2003.
- Western Canadian Coal, 2005. *Wolverine Environmental Assessment and Mine Permit Amendments for the Wolverine Coal Project*, May, 2005
- Wiber, M., Joyce, D.K. Connell R. Luinstra W. Michelutti, 1991. *Environmental Aspects of Explosives Use* presented to the Northwest Mining Association Spokane Washington USA December 1-3 1991
- Young, Mike. May 31, 2007. Professional Engineer with BXL Bulk Explosives Ltd. in Calgary, AB, (403) 259-0426.