



Memo To: Ross Zawada, Nevada Pacific Gold (Yukon) Ltd.

From: Rob McIntyre, R.E.T., Access Mining Consultants Ltd. (dba Access Consulting Group)

Subject: Recommendations for Further Investigation into Potential Process Efficiency Improvements for the Water Treatment Systems at Elsa, Yukon

Date: April 12, 2003

Background:

In the pursuit of cost efficiencies for care and maintenance operations at Elsa, Nevada Pacific Gold (Yukon) Ltd. is conducting a review of site expenses. UKHM Ltd. designed the water treatment system in the mid 1990's, as a short-term, temporary measure while more permanent solutions to the metal-rich mine effluent problem were developed. Considering the design parameters, it is somewhat fortunate that the systems continue to function today at all; certainly, there is room for process efficiency improvements.

It is understood that Nevada Pacific intends to begin working towards the design of a permanent treatment solution in the short and medium term. However, considering the length of time required to design, pilot test, receive approval, and implement a new system, it is likely that the use of lime application to attenuate zinc in mine discharges will likely be required for at least the next two to three years. This is the time period that will provide the basis for consideration of conceptual optimization techniques that will be discussed in the memo.

Qualifying Statement:

It should be noted that while Access Consulting Group ("Access") is very familiar with the systems in operation at the Elsa mines, and have in recent years discussed potential process improvements with different mine operators from time to time, we are not qualified to provide advice in the broader area of the treatment of mine effluent. The discussion and recommendations contained in this memo, therefore, are intended only to assist Nevada Pacific in the determination of aspects of the treatment systems that require further investigation, based on our experience. Opinions offered in this memo on mine safety issues at the Galkeno 900 adit are offered in a similar spirit, and are not intended to replace mine safety engineering advice.

This memo is not intended to replace specialist, water treatment engineering advice. We advise Nevada Pacific to engage the services of an expert mine effluent treatment specialist to develop and implement process efficiency measures. It is felt that the contents of this memo would be useful to such an expert. One such firm with which Access has had good experience on various projects is Canadian Environmental and Metallurgical Inc. ("CEMI") in Vancouver. Contact is: Mr. Sohan Basra, President. Ph. (604) 264-5536.

Basic Description of Current Water Treatment Systems:

Nevada Pacific is currently conducting lime treatment only at Galkeno 900, and it is unknown at this time whether or not treatment will be resumed at Bellekeno 600, and Silver King. The Valley Tailings Facility will presumably be treated upon onset of spring freshet conditions.

The following brief discussion in italics below has been taken from a report by R. McIntyre dated May 6, 2001, which was prepared for DIAND, while Access was under contract for site management. While the reference to quantities, compliance points, treatment sites, water supply points etc., are therefore reflective of site conditions and legal requirements during that time, the observations are nonetheless likely useful for those wishing to conduct further investigation into the treatment systems. Further, it is unlikely that more recent technical documentation of the system operation details has been prepared since the time that Access was managing the systems; certainly, none is available to the writer.

"The sole concern of the Water Resources and the Contaminants & Waste Branches of DIAND is to ensure continued environmental protection at the site through the reactivation and continued operation of the water treatment systems, consisting chiefly of the addition of lime to mine effluent waters at Silver King, Bellekeno, Galkeno 900, and the Valley Tailings.

In general, the treatment process involves continual lime addition to mine portal effluent water at Silver King, Galkeno 900 and Bellekeno in order to reduce zinc effluent concentrations to less than 0.50 mg/l, as required under Water Licence QZ96-001. Valley Tailings also require similar treatment over the spring freshet period that extends from May through June. The Valley Tailings Facility may also require additional lime treatment over the summer season, especially during significant rainfall events, which, according to site personnel, tend to entrain additional old tailings into the ponds, with the concomitant increase in zinc loading in the supernatant water.

Individual portal treatment sites are equipped with a 500-litre tank with attached circulating pump that dispenses a constant flow of lime slurry to mine effluent water. The treated effluent is then diverted through primary and secondary settling ponds before it is discharged to the environment. The water quality compliance point at Silver King is the secondary pond decant. However, due to stability and seepage problems with secondary

ponds at Galkeno 900 and Bellekeno, compliance points are currently placed at the primary decant. During winter months heat trace and electric heaters are in continual use at all portals to prevent ice plug development and facilitate an uninterrupted discharge for treatment.

Lime mixing, conducted within the Transport Garage at Elsa, involves the addition of quicklime (CaO), via an auger conveyor, into a slaking tank where water is added to produce lime slurry. Water, for lime mixing, is obtained from the Silver King portal and delivered to the transport garage, via truck, on a daily basis.

In total, approximately 9,000 litres of slurry are mixed and delivered daily, via truck, to Silver King, Galkeno 900 and Bellekeno. Slurry concentration is roughly 18 grams of quicklime per litre of water, equating to a consumption rate of 1.1 tonnes of quicklime per week. The consumption rate is expected to rise to 1.7 tonnes per week during spring freshet (May and June) when treatment will be required at the Valley Tailings.

Non-compliant Zn discharges are rare, but are caused by power outages, pump failures and plugged lime slurry lines, and were usually brought back into compliance within 24 hours.

Lime sludge removal from settling ponds, using an excavator and suction pump, is also required at least twice a year (May and October) to maintain cost effective and compliant treatment systems. Once ice and snow have melted, lime sludge removal from all settling ponds should be completed as soon as possible to increase residency time for lime settling and zinc precipitation.

Considerations for Optimization:

There are four main areas of the water treatment operation that should be investigated with a view to implementing more cost efficient and reliable systems. These areas are discussed separately below.

1. Lime Application: Site Application System

- i. It is believed that the quality of the lime, coupled with inappropriate pump selection, is a factor in the life expectancy of the site treatment tank electric mixing pumps that are used to recirculate the slurry in the tanks. That is, imperfectly calcined lime, where residual pebbles of un-burnt limestone remain in the powdered lime product, are thought to be a factor in the frequent failure of the pump casings of these pumps. These particular pumps were designed for pumping water, not slurry; therefore the impeller-to-casing tolerances are minimal. Limestone pebbles may contribute to excessive impeller/casing wear. While the pumps themselves are relatively inexpensive, the downtime, related equipment damage, non-compliant discharge and employee time to

repair the systems & reinstate treatment are reasons to reconsider this aspect of the treatment system. A further aspect of the lime application system that should be optimized is the metering of slurry, including the slow reaction time for response to inaccurate application rates. Presently, lime is delivered to the adit flow in an un-metered fashion, and application rates are ad hoc.

Another issue of concern with respect to the lime application system is the poor condition of the adit entrance at Galkeno 900. Rotting timbers have not been maintained in a number of years, and the adit is collared in a steep slope, which is covered in loose talus, thus presenting the potential for cave in. One possible improvement is to construct an independent treatment shed, and move the lime tanks & pumping apparatus into this shed. The adit entrance could be sealed or blocked off to prevent inadvertent public/wildlife entrance.

Recommendation: Conduct a mine safety inspection at the adit entrance to Galkeno 900; consider construction of a stand-alone treatment shed.

ii.
iii. **Recommendation:** Investigate the acquisition of different pumps, designed for the more robust requirements of slurry pumping, or at least ensure that the specifications for lime purchase include maximum tolerance for particle size.

iv.

v.
vi. **Recommendation:** Lime addition should be metered to the effluent, complete with pH control and feedback to better control effluent treatment. Investigate specially designed metering pumps, with pH sensors linked to automated valve control, that could be used to rapidly and automatically adjust slurry application according to results.

vii.

Recommendation: Implement methods to improve lime mixing in Transportation Garage, including proper lime recirculating to ensure that lime is kept in suspension, and a transport tank that includes mixing while in transit.

2. *Sedimentation ponds*

- a. Sediment pond desludging is an area that should be improved. The existing method of desludging using heavy equipment is costly, risks damage to the pond structure itself, and tends to only be undertaken biannually, only after unacceptable performance has already been exhibited. Technical literature discussing lime treatment systems indicates that not only is the physical capacity of the ponds an issue, but chemical changes can also occur with time in settled sludge (apparently resulting from continued introduction of metal-rich mine effluent waters that begin to form complexes with metals already in the sludge), that can be detrimental to the ability of continued lime treatment to attenuate zinc levels. Ideally, the treatment system should use recycled sludge to optimize costs.

Recommendation: Investigate the construction of new sedimentation ponds at Galkeno 900, designed to provide increased retention time, efficient flow regime within the ponds to avoid short circuiting, and, most importantly, to provide for both primary settling, and secondary polishing. Design improvements could include construction of baffles in the ponds to direct the water flow throughout the entire pond volume. The design should incorporate a more efficient clean out system, possibly including a sump designed to incorporate eduction pumping, and eliminate the practice of entering the ponds with heavy equipment.

Remedial measures should be taken at Bellekeno 600 adit (assuming that this site will be treated) that are necessary to allow the secondary pond to be brought back into operation

- b. The Galkeno 900 adit and the Bellekeno 600 Adit treatment sites are only utilizing the primary ponds, as DIAND had ordered the mine owner (UKHM) to take the secondary ponds out of service, due primarily to their concern about potentially poor geotechnical stability. At Bellekeno 600, the primary pond currently loses all of its' effluent through seeps at the toe of the pond embankment; therefore the secondary polishing pond is not in service. One obvious solution, lining the pond, is not an option unless a new system of desludging that does not include requiring heavy equipment to enter the pond is instituted.

Recommendation: Investigate better sedimentation pond clean out methods. Investigate lime/sludge recycling methods and conduct cost-benefit comparison.



3. *Sludge Management:*

- a. Historically, the sludge that is removed from the sedimentation ponds has been brought to the Valley Tailings Facility for disposal. Cost of trucking the sludge from Silver King, Bellekeno and Galkeno is excessive. Also, this sludge could remobilize and enter pond Number 1 waters, which would then require further treatment.

Recommendation: Investigate more permanent/stable sludge storage area, preferably near the adit entrance, but possibly in the Valley Tailings Facility.

4. *Process Review:*

- a. As noted previously in this memo, the entire system and all of its components were designed for short term operation, and utilizing technologies available nearly a decade ago. Subsequent years have seen a number of independent, small-scale improvements, but the system as a whole is relatively unchanged.

Recommendation: Nevada Pacific should retain the services of a water treatment specialist to undertake a site visit to review the entire treatment system, and implement recommended system-wide upgrades.

Original sealed by:

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