

# Outstanding Closure Liabilities at Brewery Creek Mine - September 2006



Report Prepared for  
**Alexco Resources Corp.**

Report Prepared by  
**SRK Consulting**  
*Engineers and Scientists*

**February 2007**

# **Outstanding Closure Liabilities at Brewery Creek Mine - September 2006**

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# 1 Introduction

SRK Consulting Inc. was retained in September 2006 to provide an independent engineer's review of the outstanding closure liabilities at the Brewery Creek Mine near Dawson, Yukon. This report presents the results of SRK's work.

The September 2006 review is the fourth in a series prepared under the terms of a reclamation security agreement between the Government of the Yukon and the site owners. The first two reports were prepared for Viceroy Minerals Corporation.

The methodology employed is consistent with that described in full in the first report, dated November 2003. Section 2 below summarizes the methods. Sections 3 and 4 present the resulting estimates of outstanding liabilities. Expected costs are covered in Section 3 and costs for possible mitigation measures are covered in Section 4. All of the calculations leading to the Section 3 and 4 estimates are presented in tables appended to this report. Section 5 presents a summary opinion of the outstanding closure liabilities at the Brewery Creek Mine, as of September 2005.

## 2 Methods

### 2.1 Site Visit

The undersigned conducted the three previous annual inspections in 2003, 2004 and 2005, but was unable to attend the site inspection in 2006. Mr. Dylan Macgregor conducted the 2006 inspection attended on behalf of SRK. The date of his inspection was August 29, 2006. All of the liability estimates presented herein are based on the state of the site as of that date.

Mr. Kevin McDonnell, Chief of Water Resources in the Government of Yukon Ministry of Environment, and Mr. Steve Januszewski, an engineer under contract to Government of Yukon, also participated in the site visit. Mr. Januszewski has prepared a separate report.

The site visit began with discussions with Mr. Brad Thrall, who oversaw the site decommissioning and reclamation work in 2006. Mr. Thrall, Mr. MacGregor, Mr. Januszewski and Mr. McDonnell then inspected the reclamation works carried out in 2006. Four ATVs were available for the inspection, which began at the BTC at the southwest end of the site and proceeded to the Lucky area at the northeast end of the site, with a visit to the Moosehead area on the return trip. All areas were accessed by ATV and then further inspected by foot. The weather was excellent, with scattered cloud and light breezes throughout the day.

### 2.2 Development of Liability Estimate

As was the case in the previous reports, the outstanding closure liability for the site was estimated in two components:

- Cost for activities needed to complete the expected decommissioning and reclamation measures.
- Costs for mitigation measures that might be required at some time in the future.

The methods and assumptions used in developing estimates for these two components are summarized in the following paragraphs, which are taken directly from the 2003 report.

## **Cost Estimate Spreadsheet**

*The cost estimates for both the currently planned decommissioning and reclamation measures and the mitigation measures were developed in a spreadsheet. For ease of comparison to earlier (and future) estimates, the spreadsheet was based on one presented in the “2001 Decommissioning and Reclamation Plan, Volume IV”.*

*The spreadsheet, like the “Volume IV” version, assigns direct costs to eight “cost centers”, namely Mine Area Reclamation, Site Facilities Removal and Reclamation, Leach Pad Detoxification, Manpower, General and Administration, Process Water Treatment, Leach Pad Reclamation, and Post-Closure Monitoring. This structure is common in closure cost estimates produced by industry, and is readily convertible to other structures such as the RECLAIM spreadsheet used by DIAND.*

*A printout of the cost estimate spreadsheet is attached to this report. Electronic copies are available upon request.*

## **Current Status and Standards for Completion**

*The “Volume IV” estimates for most of the cost centers were modified to take into account the current extent of completion and any deficiencies observed during the site visit. More details are provided in Section 3 below.*

*In assessing what activities would be needed to complete the expected decommissioning and reclamation measures, two sets of standards were taken into consideration. The first was the commitments made in the “2001 Decommissioning and Reclamation Plan” (including Volume IV). The second was the general standard of good mine closure practice elsewhere in Canada, as it is known to the undersigned. The “Draft Terrestrial Reclamation Standards for the Brewery Creek Mine” were also reviewed, and found to be generally consistent with both the plans set out in the “2001 Decommissioning and Reclamation Plan” and the standards of good practice elsewhere in Canada.*

## **Viceroy Costs vs. Contractor Costs**

*The “Volume IV” estimates were based on productivities and unit costs achieved by Viceroy Minerals Corporation. However, the independent estimate of closure liabilities is to consider the case where Viceroy is no longer on the site, and the Government of the Yukon needs to bring a local contractor in to complete the work. The productivities and unit costs assumed in the “Volume IV” estimates were therefore reviewed and adjusted to values that are more typical of Yukon contractors. For most tasks, it was assumed that the equipment used by local contractors would be one to two classes smaller than that used by Viceroy.*

*Unit costs for equipment were obtained from the 2003-2004 edition of “The Blue Book”, an equipment rate rental guide produced by the B.C. Road Builders and Heavy Construction Association. All-found rates, which include all costs, expenses and profit were used. When the guide indicated a difference between rates for new and older equipment, an average rate was used. All of the unit rates were increased by 10% as a northern allowance. Costs for mobilizing the equipment to the site were also added to the estimates as a separate line item.*

## **Contingencies**

*The “Volume IV” estimates applied contingencies of between 10% and 20% to the estimated total costs from each cost center. It is important to understand what is meant by “contingencies”. In common usage, contingencies are provisions for something that might never come to pass. However, the contingencies in these estimates are likely to be required.*

*They are included to account for a number of costs and uncertainties that cannot be more explicitly detailed in this level of estimate.*

*The contingency percentages suggested in “Volume IV” are generally consistent with good practice elsewhere, particularly given the fact that there is now direct experience carrying out most of the required activities at this site. Some thought was given to increasing the contingency for Site Facilities Removal and Reclamation, on the grounds that there is as yet no site experience with this type of work and because costs of demolition projects elsewhere have proven difficult to estimate accurately. However, it was also noted that the current estimate takes no account of value that might be recovered from re-use or salvage of the site buildings. If that value were taken into account, it would act to offset cost overruns. The “Volume IV” contingency percentages were therefore accepted for all of the cost centers.*

### **Net Present Value Calculations**

*In preparing cost estimates for activities that can take place many years in future, it is important to take into account the effects of interest and inflation. The conventional way to do that is to use a Net Present Value or “NPV” calculation. In simple terms, the NPV calculation shows how much money one would need to set aside today in order to have enough money to carry out the future activities.*

*To complete the NPV calculations, all of estimated costs were set out on a timeline extending from 2004 to 2018. Costs were generally put in the earliest year when an activity might be required. That approach has the effect of resulting in a cautiously high estimate of the NPV.*

*The timeline of costs was then used to calculate the NPV of the estimates for each cost center and each mitigation measure, i.e. how much money would need to be set aside under each cost category. The interest rate used in such calculations is a question of policy, rather than engineering. Most corporate investors would use a relatively high rate, which would result in a lower NPV. In SRK’s experience, Canadian governments commonly use a much lower interest rate, roughly equivalent to the rate of return on long-term Government of Canada Savings Bonds.*

*The “Volume IV” estimates included an escalator for inflation. The escalator was applied to each year’s cost estimates. However, a simpler method is to recognize that inflation acts counter to interest, i.e. it requires one to put aside more money now to allow for the increased future costs. Inflation can then be accounted for within the NPV calculations. For example, an apparent interest rate of  $x\%$  and an annual inflation of  $y\%$  can be accounted for by simply assuming an “effective interest rate” of  $x-y\%$  in the NPV calculation.*

*That approach was used for the independent engineer’s estimate of the outstanding liability. An apparent interest rate of 5% was selected from tables of long term bond rates, and adjusted downward by an assumed inflation rate of 2%, resulting in the effective interest rate of 3% that was used in the NPV calculations.*

### **Mitigation Measures and Likelihood**

*Most of the closure activities at the Brewery Creek site are low risk. However, in the opinion of the undersigned, there are three areas where the uncertainties are greater. The three areas are the heap, the Lucky Haul road, and the Blue Dump. For each of those areas, mitigation measures that conceivably might be required at some time in the future were assessed and cost estimates were developed. Further details are provided in Section 4 below.*

*The likelihood that each of the mitigation measures will be required was then described using the terms “possible”, “unlikely” and “very unlikely”. The definitions of these terms were taken from SRK experience with qualitative risk assessments on similar projects:*

- *“Possible” implies that the event has happened elsewhere, perhaps several times, and could happen here;*
- *“Unlikely” implies that the event may have happened elsewhere, but only under conditions that are less favourable than here; and,*
- *“Very unlikely” implies that the event is theoretically possible, or at least cannot be ruled out given currently available information, but would require a remote combination of circumstances.*

### **Provision for Mitigation Measures in Outstanding Closure Liability**

*It could be argued that the estimate of outstanding liability should include provision for all of the above mitigation measures, regardless of their likelihood. The problem with such reasoning is that it is always possible to imagine a lower probability outcome requiring a more costly mitigation measure. Ultimately a policy decision is required to determine whether a probability is low enough that the risk can be accepted without a provision in the liability estimate. There is no single answer as to where the line should be drawn. It is clear that governments are less willing to accept risk than investors, and the line is drawn more cautiously when government is to be left holding the risk.*

*To come up with a basis for determining which mitigation costs should be included in the independent engineer’s estimate of the outstanding liability, reference was made to SRK’s experience with precedents involving government accepting mine closure-related risks. The precedents are three cases in British Columbia where the provincial government has participated in negotiations of final securities for closed mines.*

- *In the case of Equity Silver Mine, the negotiated security provides for perpetual collection and treatment of contaminated water, which is certainly “possible”, but does not provide for “unlikely” or “very unlikely” increases in contaminant concentrations.*
- *In the case of Britannia Mine, the provincial government negotiated with former owners of the property to pay for construction and operation of a water treatment plant. Again the plant was sized to handle “possible” current flows and chemistry, but not “unlikely” increases in either.*
- *In the third case, which is confidential, the owner was transferring the property to a third party and wanted an “exit ticket” from the provincial government. The negotiated security included provision for “possible” activities such as groundwater cleanup and collection of acidic pit water, but did not require provision for “unlikely” increases in acid generation.*

*On the basis of these precedents, only “possible” mitigation measures were included in the independent engineer’s estimate of outstanding liability for the Brewery Creek Mine.*

### 3 Estimated Costs for Expected Activities

Table 1 presents a summary of the estimated costs for the expected decommissioning and reclamation activities in each of the cost centers. The table shows both the undiscounted (no interest, no inflation) estimates and the NPV estimates.

The remaining cost items under the Mine Area Reclamation estimate include:

- Future mobilization and demobilization of equipment;
- Repairs to erosion damage;
- Re-seeding and fertilization of areas where previous work and natural re-seeding have not provided adequate coverage, plus re-tilling of the compacted surface over about one hectare of the Blue Waste Rock Storage area
- Maintenance of overflow and erosion control works in the Kokanee and North Golden areas;
- Scarification and re-contouring of the perimeter roads.

There was significant progress in Site Facilities Removal and Reclamation in 2004. The remaining cost items are:

- Approximately 50% of the removal of the Warehouse & Maintenance Shop Building;
- Removal of the Exploration Office, core logging facility and shipping trailers;
- Removal of the land application pipes;
- General site re-grading, growth media placement and erosion control;
- Seeding and fertilization;
- Continued land-farming of hydrocarbon contaminated soils in the Oil Storage Area and the Main Equipment Area;
- Final re-grading and reclamation of the pond areas, (when management of the heap effluent is no longer required).

The Process and Water Treatment estimate was set to zero in the 2005 estimate, and any further costs for treating heap effluent continue to be accounted for as mitigation measures (see Section 4 below). The Manpower estimate, which was revised in 2005 to allow for six months of site presence, was extended to cover the 2007 field season. The General and Administration estimate was set to zero for the base estimate, but remains in the contingencies. Work under Leach Pad Detoxification was complete in 2003.

Remaining cost items under the Leach Pad Reclamation estimate include:

- Construction of a breach and ditches to allow free drainage from the heap (once water quality is acceptable for direct release);
- Repair of erosion over an estimated 10% of the reclaimed area;
- Re-seeding and fertilization of an estimated 25% of the reclaimed area.



Post-Closure Monitoring began in 2004. The “Volume IV” estimates for the remaining years were generally retained, along with the changes made after the September 2005 inspection. Specifically, an additional allowance for preparing monthly and annual reports and an additional \$10,000 for monitoring of the Blue Dump was added in 2005. The cost for long-term nutrient addition to the BTC, which was in the original estimate, was moved to a mitigation measure in 2003.

**Table 1. Cost Estimates for Expected Decommissioning and Reclamation Activities**

<b>Cost Center</b>	<b>Undiscounted Costs</b>	<b>Net Present Value Costs</b>
Mine Area Reclamation	\$ 132,000	\$ 127,000
Site Facilities Removal and Reclamation	\$ 119,000	\$ 114,000
Leach Pad Detoxification	-	-
Manpower	\$ 93,000	\$ 89,000
General and Admin	-	-
Process Water Treatment	-	-
Leach Pad Reclamation	\$ 37,000	\$ 36,000
Post-Closure Monitoring	\$ 512,000	\$ 418,000
Subtotal Direct Costs	\$ 893,000	\$ 785,000
Contingency	\$ 103,000	\$ 91,000
<b>Total</b>	<b>\$ 996,000</b>	<b>\$ 876,000</b>

## 4 Estimated Costs for Mitigation Measures

Table 2 presents a summary of the estimated costs for possible mitigation measures, and the likelihood that each mitigation measure will be needed. The terminology used to describe likelihood is defined in Section 2.2.

In the heap area, requirements for future management of drainage from the heap are becoming less uncertain. Figure 1 summarizes water quality analyses of heap effluent and direct discharges from the ponds, and demonstrates that concentrations continued to be stable in 2006. Contaminant concentrations in the heap effluent samples (Station BC-28a) and the pond discharge (Station BC-28) have generally been in compliance with direct discharge criteria since 2004. The only exceptions were a weak acid dissociable cyanide concentration of 0.6 mg/L in the June 2005 sample (exceeding the 0.25 mg/L criterion) and an arsenic concentration of 0.7 mg/L in the August 2005 sample (exceeding the 0.5 mg/L criterion).

Various mitigation measures for the heap drainage were considered in the September 2003 report, including construction and operation of a large biological treatment cell. Viceroy constructed the large biological treatment cell in 2005, and the effluent monitoring data from August and September of that year that it was capable of reducing cyanide and arsenic concentrations to levels acceptable for discharge (Station BTC in Figure 1). The 2006 monitoring data show that the system continues to be effective in that regard. However, the contaminant concentrations in the untreated pond water are now similar to those in the treated water, suggesting that further use of the biological treatment cell will be limited. As Table 2 indicates, an additional year of treatment is now considered to be “possible”, an additional two years of treatment is considered to be “unlikely”, and five years of treatment is considered to be “very unlikely”.

The portion of the Lucky Haul Road that showed signs of slope failure during the September 2003 inspection was remediated in 2004 and 2005. However, other areas of instability were noted in the 2005 inspection, and the 2006 inspection noted that the exploration road to the Bohemian deposit has undercut the previously unstable area. Possible mitigation measures include regrading with a dozer, pulling material back with an excavator, and re-seeding. The likelihood that such measures will be required remains “possible”.

Monitoring of the Blue Dump cover continues to show low infiltration rates. Although the 2006 infiltration was greater than in the previous years, the three-year average rate of infiltration is only 6% of precipitation. The possibility that Blue Dump cover improvements will be needed therefore continues to be “very unlikely”.

**Table 2: Cost and Likelihood Estimates for Possible Mitigation Measures**

Mitigation Measure	Undiscounted Costs	Net Present Value (NPV) Costs	Likelihood that Measure will be Needed
Operate heap effluent BTC for one year	\$ 152,000	\$ 146,000	Possible
Operate heap effluent BTC for two years	\$ 303,000	\$ 286,000	Unlikely
Operate heap effluent BTC for five years	\$ 758,000	\$ 675,000	Very Unlikely
Additional stabilization of Lucky Dump	\$ 36,000	\$ 34,000	Possible
Construct improved cover on Blue Dump	\$1,074,000	\$1,033,000	Very Unlikely

## 5 Estimate of Outstanding Liability

Table 3 summarizes the undersigned independent engineer’s opinion as to the outstanding closure liabilities at the Brewery Creek Mine, as of September 2006. The estimate includes the full cost of the expected decommissioning and reclamation activities, as well as provision for the “possible” mitigation measures.

**Table 3: Outstanding Closure Liability at Brewery Creek Mine as of September 2006**

<b>Category</b>	<b>Outstanding Undiscounted Liability</b>	<b>Outstanding Net Present Value Liability</b>
Expected Decommissioning and Reclamation Activities	\$ 996,000	\$ 876,000
Possible Mitigation Measures (Operate heap effluent BTC for one year and additional stabilization of Lucky Dump)	\$ 188,000	\$ 181,000
Total Outstanding Closure Liability	\$ 1,184,000	\$ 1,057,000

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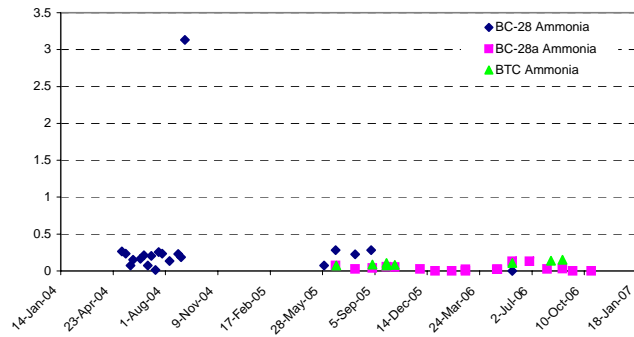
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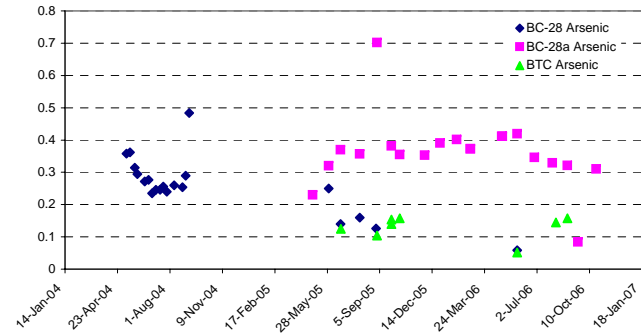
## Figures

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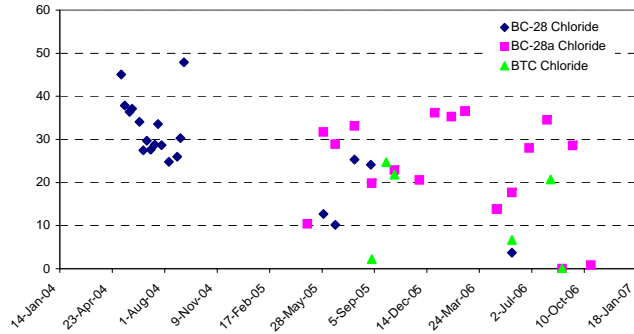
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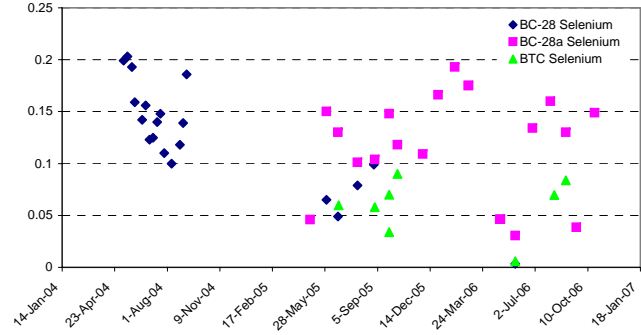
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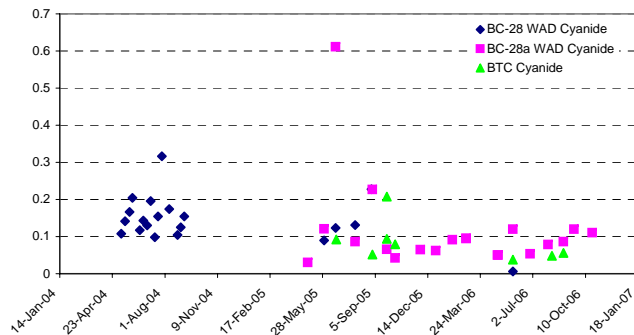
**Chloride**



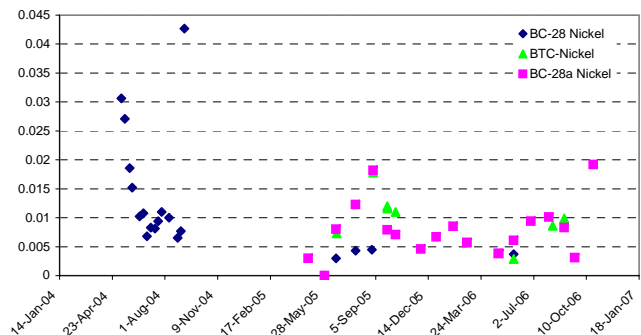
**Selenium Criteria** Land App - 0.75 mg/L Direct Discharge - 0.25 mg/L



**WAD Cyanide Criteria** Land App - 0.25 mg/L Direct Discharge - 0.25 mg/L



**Nickel Criteria** Land App - 0.8 mg/L Direct Discharge - 0.5 mg/L



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**Attachment 1**  
**Liability Estimate Spreadsheet**

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