ABSTRACT

Highland Valley Copper’s reclamation program is driven by an End Land Use Plan developed in 1998. One of the goals of the Plan is to develop suitable end uses that will minimize the impact of the mine’s eventual closure, both on the environment and nearby communities. In 2002, landfilling was proposed as a new land use. The concept has now advanced to the point that a Project Approval Certificate for a large municipal landfill is expected from the Province in September 2008. This paper describes the project and the environmental review process.

INTRODUCTION

Mining activity in the Highland Valley began in 1962 with the Bethlehem Copper operation. This was followed by the Lornex Mine in 1972 and the Highmont Mine in 1979. All of these entities merged in a number of stages to form the present partnership, combining both their respective assets and environmental liabilities.

Located 80 kilometres southwest of Kamloops, BC, Highland Valley Copper (HVC) is now Canada’s largest base metal mine, with over 1,000 employees and producing over 300 million pounds of copper in concentrates per year. The operation remains as a partnership but is now essentially fully owned by Teck Cominco (97.5%).

To date mining activities in the valley have disturbed over 6,000 hectares with over 2,000 hectares now reclaimed. Reclamation on the site is governed by an End Land Use Plan that was first approved by the Province in 1998. The plan lays out at a conceptual level, eight categories of end land use, and provides the reclamation prescriptions necessary to achieve these uses. In developing the plan the operation attempted to find ways to promote the beneficial use of the site, consequently there are provisions for commercial crops and recreational activities. We were mindful however that none of the defined land uses would in any significant way offset the loss of economic and social benefits that will occur when the mine closes. During this time and up to 2005 the mine was expected to close in late 2008. Due primarily to sustained higher copper prices the mine life was extended to 2013 in the fall of 2005, and then to 2019 in early 2007.

In 2002, we were approached by Sperling Hansen Associates, a BC based engineering firm specializing in landfill design, with the concept of developing a landfill on a portion of our completed waste rock dumps.
Sperling Hansen had been involved in the development of a very successful small landfill at Taseko’s Gibraltar mine near Williams Lake.

After some initial resistance we began to see the potential opportunities of the proposal and proposed the concept as a new end land use to our then owners, BHP Billiton and Teck Cominco. BHP Billiton did not support the concept and there was no further activity until Teck Cominco acquired its current broad ownership in 2004. The idea was subsequently resurrected and received corporate support provided it could be “done right”.

Sperling Hansen Associates remain an integral part of the project and will have a long term involvement with any landfill operation developed on the site.

WHY A LANDFILL?

The proposal to develop a landfill project was driven by the impending closure of the nearby Cache Creek landfill which had been in operation since 1989. This operation was slated to reach capacity in late 2009, coinciding perfectly with a late 2008 mine closure.

The Greater Vancouver Regional District (GVRD) uses the Cache Creek facility to dispose of 500,000 tonnes per year (tpy) of municipal solid waste - approximately 40% of that Regional District’s production. To ensure capacity after the Cache Creek closure, the GVRD had purchased a ranch near the Cache Creek landfill in 2000 and had been attempting to permit a landfill on a section of that property. The proposal met with concerted opposition from First Nations and some local residents.

Highland Valley Copper believed that developing a landfill operation on a disturbed site would be less controversial and could develop broader support than the Cache Creek proposal. In addition to the 500,000 tpy of capacity required by the GVRD, we decided to develop a facility that was able to accept up to 600,000 tpy of municipal solid waste to enable it to operate as a regional facility.

REGIONAL LANDFILLS

Within the Thompson Nicola Regional District there are currently eight operating landfills of varying sizes and incorporating varying degrees of environmental protection. The same general situation exists in a number of the nearby regional districts. By offering a large facility that was capable of providing better economics due to the economies of scale, and that incorporated first class environmental protection, we felt that we would present an attractive alternative.

Regional landfills are widespread in the United States and two large landfills near the Columbia River service most of Washington and Oregon.
PROJECT DESCRIPTION

The project involves the phased construction of a landfill capable of receiving up to 600,000 tpy of municipal solid waste with an ultimate capacity of 55 million tonnes of material. The landfill will be primarily constructed on a small portion of the mine’s waste rock dumps and at completion would occupy 140 hectares, less than 2% of the current disturbance.

Bioreactor Operation - The landfill will be operated as a bioreactor. Leachate collected on the bottom liner will be re-circulated into the landfill to maintain optimum moisture conditions and thereby enhance the rate of organic decomposition. This approach has two principal benefits.

First, the accelerated decay of the landfill contents significantly reduces the contaminating lifespan of the facility allowing it to reach a stable state sooner after closure when resources are most likely to be available to address any problems.

Second, and perhaps most significant, the recirculation of leachate accelerates the production of methane the principal component of landfill gas. This is actually a good thing. The same amount of gas would be
generated with or without leachate recirculation. However the accelerated methane production makes it more cost effective to capture the methane and utilize it for energy production.

**Liner System** - Potential groundwater impacts are usually near the top of the list of concerns for new landfills. While the Highland Valley site offers an exceptional hydrogeological setting for a landfill, the project design calls for a triple liner system to contain the leachate generated within the landfill. The liner system would consist of a one meter thick layer of high clay till available on the site. A geosynthetic clay liner (GCL) will go on top of the till with a high density polyethylene geomembrane on the top of the GCL. Modeling indicates that this combination will be 700 times more effective than a till liner alone and 300 times more effective than a two component liner, which is the best system commonly used in Canadian landfills.

**Hydrogeologic Setting** - The hydrogeological setting in the Highland Valley is perhaps the best understood of any site in the province. Development of the Valley Pit, located approximately 2.5 km east of the proposed landfill has required an extensive dewatering program which currently involves over 70 wells. The dewatering program has resulted in an extensive depression of the groundwater table throughout the Highland Valley and turned the pit itself into a long term groundwater sink. It will take well over 100 years after mine closure for the pit to fill. During this period any leachate that did escape though the liner system will flow to the Valley Pit and the pit will both capture and dilute any leachate that arrived. Monitoring wells near the landfill will be used to detect leakage.

Figure 2 Aerial view showing landfill and current groundwater divides
Energy Production - As noted above, the decomposition of organic material generates methane in all landfills, and this process is accelerated in a bioreactor landfill. Methane is the principal component in landfill gas (LFG). At the Highland Valley landfill a LFG recovery system using horizontal collection pipes and vertical gas wells will be used to extract the LFG and draw it to a central location.

In general, there are two options to utilize the energy from the methane component of LFG. Conventionally the methane is burnt along with other LFG’s in an internal combustion engine that drives a generator to produce electricity. The electricity is either used where it is created, or sold and fed onto a power grid. The waste heat from the generators can also be used in some form of secondary process. For example the generator exhaust at the Vancouver landfill in Delta, BC, is used to heat a greenhouse complex.

The second option is to use a relatively new technology known as pressure swing adsorption to separate the methane from the other components in the LFG. The pure methane, “natural gas”, can then be used or sold. Highland Valley Copper is located near a major natural gas transmission line, and Terasen the local utility is interested in purchasing any product produced at the site.

Highland Valley Copper recently entered into a Memorandum of Understanding (MOU) with Questair Technologies, a BC based company that produces the purification units to further develop this concept. The MOU also includes Westport Innovations, another BC company, which manufactures large natural gas powered engines that could be used in the haulage fleet moving waste material. The use of LFG instead of diesel for material movement would reduce the greenhouse gas emissions from the project.

Greenhouse Gas Emissions - Waste disposal accounts for approximately 9% of British Columbia’s greenhouse gas (GHG) production, with most coming from landfill emissions. Organic material decaying under the anaerobic conditions within a landfill produces methane, a GHG 21 times more potent than carbon dioxide. Landfill gas recovery systems capture a portion of the LFG, up to 75% in the most advanced systems. When the methane is burned, either in flares to produce electricity, or as natural gas, the methane is converted to carbon dioxide leading to a reduction in equivalent GHG emissions. For the Highland Valley Landfill we are proposing a very aggressive LFG collection system and expect to achieve at least 75% capture efficiency.

To further reduce the GHG emissions from the site we are proposing the use of a biocover as a component of the cover system. Biocovers are fully developed composts containing methanotrophic bacteria that utilize methane as their source of carbon and energy. The bacteria convert methane into carbon dioxide reducing the GHG impact. Biocovers are applied over completed sections of a landfill either as final or intermediate covers. Methane not captured by the LFG collection system rises through the landfill and passes through the biocover material where it is oxidized by the bacteria.
ADVANTAGES OF HIGHLAND VALLEY AS A LANDFILL LOCATION

In addition to the hydrogeologic advantages discussed above, developing a landfill at HVC offers the following advantages over other potential greenfield sites:

- Brownfield site already disturbed
- No known endangered species
- Not in Agricultural Land Reserve
- Water table is far below bottom of landfill
- Nearest domestic wells 19 km away
- Virtually unlimited soil and rock resources stockpiled
- Heavy equipment will be available to move materials for many years

ENVIRONMENTAL ASSESSMENT PROCESS

The environmental assessment process in British Columbia is a well defined and, for the most part, efficient process. As noted on the EAO website, the process includes four main elements:

1. opportunities for all interested parties, including First Nations and neighbouring jurisdictions, to identify issues and provide input;
2. technical studies of the relevant environmental, social, economic, heritage and health effects of the proposed project;
3. identification of ways to prevent or minimize undesirable effects and enhance desirable effects; and
4. consideration of the input of all interested parties in compiling the assessment findings and making recommendations about project acceptability.

The process has two distinct phases, pre-application and application review.

Pre-application - Once a project is designated as being reviewable it enters into the pre-application phase. During this period proponents are expected to begin consultation with the local communities and First Nations about the project and to identify issues and concerns that will need to be addressed in the project design.

During this period the EAO establishes a Working Group made up of representatives from various government ministries, local communities, regional governments and First Nations. The role of the Working Group is to assist the EAO with the process by reviewing and commenting on material submitted by the proponent and the proponent’s responses to issues raised by the public and First Nations throughout the process.

An important part of the pre-application phase is the development of the Terms of Reference for the review. This essentially involves developing the Table of Contents for the Project Application. Proponents are also required to commit to what will be covered in each of the sections of the Application.
Once drafts Terms of Reference have been developed, there is a public comment period whereby comments on the adequacy of the Terms of Reference are received and considered by the EAO.

After the Terms of Reference have been approved, proponents conduct any necessary fieldwork or engineering design to address all of the required areas and then submit a completed Application for review. This application is screened by the EAO and the Working Group to ensure it meets the requirements of the Terms of Reference. If the Application is accepted, the process enters the Application Review phase.

**Application Review** - Copies of the Project Application are distributed to all members of the Working Group and to all identified First Nations. At this time the proponent begins another round of public and First Nations consultation to describe the contents of the Application, the issues studied and the steps proposed to mitigate any identified impacts. First Nations, the Working Group and the public are asked to review and comment on the application and there is usually a formal public comment period. The proponent then responds to comments or issues identified during this process. Ultimately the findings of the review are documented in an assessment report that is referred to two cabinet ministers for a decision on whether the project should be approved.

**PUBLIC & FIRST NATIONS CONSULTATION**

**Public Consultation** - Over the course of the project, HVC held a series of public meetings in Logan Lake, Merritt/Lower Nicola and Ashcroft, the three communities most likely to be impacted. In general the tone of the meetings followed a similar pattern. Early meetings brought out the Not In My Back Yard (NIMBY) crowd who were opposed to the idea for a variety of reasons without having heard anything about the concept. At the first Logan Lake meeting one gentleman even wore a sign labeled NIMBY on his chest. Over time as an understanding of the project grew, the meetings became less controversial and a more open discussion of issues took place. While it would be wrong to say the project developed universal consent in any community, our view is that the majority of the citizens of Logan Lake (the most affected community) support the project and can see the benefits from a continued economic activity at the site after mining is completed.

**First Nations Consultation** - Seventeen individual First Nations and three tribal organizations were identified by the EAO as having potential interests in the Project. HVC began a program of information sharing and consultation with the identified First Nations in the summer of 2004, a process that has continued until today. Several First Nations have been actively involved with the project throughout the process while others have had varying degrees of involvement over the period.

Interestingly, but not surprisingly, the issues raised by First Nations were in most cases the same as those identified in the public consultation process. The one notable exception was the complex issue of Rights and Title that is at the forefront of virtually every project evaluation in the province In some cases it has been possible to work productively through the issue by developing a relationship that acknowledges both the significance of the rights and title issue but that also recognizes that it cannot be resolved by an
individual first nation and HVC alone. In other cases the depth of concern over the issue has prevented effective consultation.

Groundwater concerns were near the top of the list for every group we talked with. To help address these concerns we were able to fund an independent review of the groundwater aspects of the project that was conducted for, and managed by, three First Nations and the District of Logan Lake. The review made seven recommendations (all of which were acceptable to HVC) and concluded that there would be no unacceptable impacts to groundwater from the project.

Highland Valley Copper provided additional funding to a number of First Nations to enable their involvement in the review process.

CURRENT STATUS

At the time of writing, the Environmental Assessment Office was finalizing the Assessment Report that will be forwarded to the two Cabinet Ministers who will make a decision on issuing a Project Approval Certificate. A decision on the project is expected in September 2008.

The GVRD has for a number of reasons formally abandoned the idea of a new interior landfill, deciding to focus on short term waste movement to the United States with the long term goal of developing incinerators within the regional district.

We have identified potential tonnage for the project from a number of other sources and remain confident that the GVRD will reconsider the use of a facility in the Highland Valley after we receive a Project Approval Certificate.

ACKNOWLEDGEMENTS

There has been a great team involved in the design and review of this project and we would like to thank them all for their contributions. Don McCallum from Gartner Lee Ltd. deserves special recognition for his role in coordinating the EA process and keeping us all on track.

REFERENCES


Highland Valley Copper, 2008, Application for Environmental Assessment Certificate Highland Valley Centre for Sustainable Waste Management. 125 p + Appendices

Additional information on this project can be found on the BC Environmental Assessment Office website http://a100.gov.bc.ca/appsdata/epic/html/deploy/epic_project_home_263.html