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CONTAMINATED SITE LEGISLATION AND MINE CLOSURE

C. A. Wilson, P.Eng. and N.L. Sandstrom, P.Eng.

Morrow Environmental Consultants Inc.
5151 Canada Way
Bumaby, BC V5E 3N1

ABSTRACT

Environmental protection and restoration during mine closure has for many years been regulated under the Mines Act. The potential currently exists for mine closure to trigger the investigation and remediation requirements of the Contaminated Sites Regulation. In order to minimize or eliminate duplication of effort, the Ministry of Mines, Ministry of Environment, Lands & Parks, and the mining industry are currently working on a harmonized process.

In the meantime, Cominco Ltd. is proceeding with the closure of its Kimberley Operations, and has developed strategies for meeting CSR requirements by assessing its future land use plans, and by maximizing the use of data already collected to meet closure requirements under their reclamation permit.

The focus of the CSR investigation has been on potential impacts associated with contaminants not otherwise addressed under the reclamation permit. The large mine site was split into smaller areas for the purpose of investigating both soil and water (groundwater and surface water). The concentrations of targeted contaminants were characterized and delineated, and remediation strategies were developed which take full advantage of strategies already in place under the reclamation permit. A gap analysis of the existing hydrogeological model and chemical database has provided a framework for determining the need for additional sampling stations and/or analytical parameters under the current monitoring program.

INTRODUCTION

Although the process of mine closure and reclamation has been legislated in British Columbia by the Ministry of Energy and Mines (MEM) and its predecessors since 1969, legislation specifically dealing with contaminated site remediation was not introduced until 1982. Even so, it wasn't until the passing of the Contaminated Sites Regulation[1] in 1997 that standards were legislated that gave the Ministry of Environment, Lands & Parks (MELP) authority over the way contaminated sites were identified, investigated, and remediated. Now, some may say, "What's this got to do with me? I'm involved with a *mine,* not a contaminated site". But, if a mine (which includes various supporting facilities) can reasonably be defined as a contaminated site under the CSR, then it appears that when closing a mine there may now be two processes to follow.

[1] Waste Management Act, *Contaminated Sites Regulation,* BC Reg. 375/96, O.C. 1480/96, 1997 04 01.

Currently, MEM, MELP and the mining industry are reviewing existing legislation with the goal of developing a harmonized process that will satisfy each of their concerns. In the meantime, however, there are mines in the midst of being closed, and we must work within the current system to ensure environmental protection and maintain a healthy business climate for mining in BC.

Having to deal with two processes makes closing a mine more costly in time and resources. By way of addressing that concern, we'll share with you Cominco's strategy for meeting the requirements of both processes within the existing framework of the reclamation permit for their Kimberley Operations, and how Morrow Environmental Consultants Inc. is using data collected over several years to meet the requirements not only of the mine closure process (for which it was *originally* collected), but now those of the CSR. The steps we've followed so far are summarized below, and described in more detail in subsequent sections.

Step 1 - Established a trigger into the CSR process
Step 2 - Split the Kimberley Operations site into smaller areas for investigation
Step 3 - Reviewed the history of each area to determine past practices and potential contaminants
Step 4 - Confirmed the presence (or absence) of contaminants in soil and water
Step 5 - Developed strategies for remediation of contaminants

STEP 1 - ESTABLISHING A TRIGGER INTO THE CSR PROCESS

First, by way of overview, the CSR was not developed to make life miserable for mining companies. In essence, it was developed to ensure that lands which have been contaminated by certain types of commercial and industrial activities (past or present) are identified, and if necessary remediated, prior to transfer of the land to another owner (or occupant) or redevelopment of the land for another purpose. It's the "polluter pays" principle put into action.

The "Site Profile" is the primary "trigger" into the CSR process. With respect to mine closure, the CSR states that:

> *Subject to the regulations, an owner under the Mines Act, including the agent or manager of the owner, shall provide a site profile to a district inspector where the owner*

a) *applies for a permit or for revisions to conditions of an existing permit under Section 10 of the Mines Act, or*
b) *gives notice of intention to stop work in, on or near a mine prior to abandonment in accordance with the Health, Safety and Reclamation Code for Mines in British Columbia prepared under the Mines Act.*

There are, however, a few exemptions relevant to mine sites. The exemption most relevant to mine closure states that a person is exempt from the duty to provide a Site Profile if:

> *the site is the subject of a reclamation permit issued under the Mines Act, but only if the person has no reason to believe that there is contamination at the site that is not otherwise addressed in the reclamation permit.*

Cominco's Kimberley Operations (which span more than 90 years of mining operation) include not only the mine and concentrator facilities, but also at one time included a Fertilizer Plant, Iron and Steel Plants, and a number of support facilities for equipment fabrication and maintenance. It was suspected that some of these other industrial operations may have resulted in impacts to the environment by organic and inorganic contaminants that would not be addressed by the reclamation permit. On this basis, the closure of the mine would trigger the requirement for a Site Profile, thereby potentially triggering the CSR process.

In Cominco's case, the assessment and remediation of specific areas of their Kimberley Operations was actually initiated in advance of the CSR. For example, Cominco applied to MELP in 1995 for a letter of approval to place demolition waste from one area of the site into a waste rock dump. As a condition of issuing the approval, MELP required that Cominco undertake a "contaminated site assessment" of the area prior to demolishing the structures. The focus of that assessment was organic contaminants originating from historical maintenance and fuelling activities, rather than metals which are known to be present in waste rock.

The application for that type of approval would now trigger the CSR. Examples of other activities (not related directly to mine operation or closure) that may trigger the requirement to submit a Site Profile on a mine site include applying for certain permits (e.g., demolition, development) or applying for changes in land use (e.g., rezoning).

It may be somewhat of an aside, but it is also useful to note here that there are "Orphan Sites" provisions in the CSR which may be triggered, for example, at abandoned mine properties.

STEP 2 - SPLITTING THE SITE INTO AREAS

The area of land disturbance at the Kimberley Operations site (mine, associated facilities and waste impoundments only) is in the order of 1,020 ha. There are a number of reasons why it was necessary to split the site into smaller areas for the purpose of investigation and remediation. These include:

Historical land use: A number of very different types of mining and/or industrial activities, (which resulted in various potential contaminants of concern or PCOCs), were undertaken at different locations and at different times. Strictly from a land use perspective, it was practical to divide the site into three areas in order to focus assessment of the PCOCs related to:

- the Sullivan Mine (including equipment fabrication/maintenance facilities);
- the former Iron, Steel, and Fertilizer Plants (the "Idle Plants") and associated waste impoundments; and
- the Sullivan Concentrator and associated waste impoundments.

Topographical/Hydrogeological Considerations: Groundwater is the matrix of greatest potential concern at this site (as at any ML/ARD[2] mine site). Obviously, one cannot always impose the same "site boundaries" to groundwater as one can for soil, as groundwater flow and contaminant transport are controlled by subsurface geological and hydrogeological features rather than the physical locations of former (or present) facilities. At the Kimberley Operations, the most practical approach to groundwater investigation was to split the site into two areas:

- the Idle Plants/Sullivan Concentrator area, including all associated waste impoundments;
- the Sullivan Mine

CSR Review Fees: The CSR process outlines specific requirements for site investigation and remediation. Fees are levied for review of documents at each step of the way. Cominco wished to minimize the fees paid by minimizing the number of reports requiring review. Since reports would be generated for each area within the Kimberley Operations site, it was therefore

[2]Metal Leaching/Acid Rock Drainage

preferable to minimize the number of areas. Cominco and the local MELP had different views on what was necessary and reasonable in terms of the number of areas. This required discussion and negotiation to determine an approach acceptable to both.

STEP 3 - REVIEWING HISTORY OF EACH AREA TO DETERMINE PAST PRACTICES AND POTENTIAL CONTAMINANTS

Before going further, it is important to describe Cominco's general strategy aimed at harmonizing the processes of site remediation (as per CSR) and reclamation (as per their reclamation permit under the Mines Act). This strategy was developed even before the CSR was passed, based on the position which the local MELP (Cranbrook and regional staff in Nelson) was taking with respect to the Kimberley site - i.e., there was a reasonable suspicion on MELP's part that contamination (both mine related - metals and ARD, and non mine related - organics) existed on the site and the potential existed for off-site migration.

Cominco developed their strategy for investigation/remediation of the Kimberley Operations site, and presented it to the MELP in early 1997. By that point, some investigation and remediation work had been initiated (as noted earlier), based largely on Cominco's desire to include the costs of such work in their operating budgets.

The strategy presented to the MELP recognized a number of facts:

- Cominco is following a closure process which is in accordance with requirements of the Mines Act, the Health, Safety and Reclamation Code for Mines in British Columbia, and their reclamation permit;
- within that process, investigations and plans are reviewed and endorsed by the Sullivan Public Liaison Committee and, on approval by the Reclamation Advisory Committee, plans are incorporated into their *Decommissioning and Closure Plan* and the reclamation permit;
- MELP is represented on both these committees, and also administers a wide variety of permits for the site including those associated with effluent discharge, landfills, PCB and other Special Waste storage, and air emissions.

On the basis of MELP's level of participation and knowledge of reclamation activities already underway, Cominco proposed that development and review of remediation/risk management

plans according to the CSR *be limited to contamination concerns not addressed by the existing mine closure process.* In essence, they proposed to focus contaminated site investigations on organic and inorganic contaminants within specified industrial and waste storage areas and on the potential for off-site migration of contaminants via groundwater and surface water flow paths.

Other elements of Cominco's strategy which have guided the approach to investigation and remediation include the following:

- Cominco intends to retain ownership of much of the site as dormant industrial land, so that they will not require a Certificate of Compliance or Conditional Certificate of Compliance.
- Soil sampling frequencies were lower than those recommended in MELP guidance documents that accompany the CSR, based on:
    - > the body of data available on soil quality in many areas (e.g., in waste impoundment or landfill areas);
    - > the fact that it was relatively easy to visually identify the "contaminants" (e.g., process wastes) in many of the areas investigated; and
    - > Cominco's intent to retain ownership and control access to certain areas of the site.
- Due to the size and complexity of the site, the natural background conditions, and the extensive mining and industrial history, the application of the numerical soil standards provided in the CSR would not be appropriate. Rather, the development of site specific standards, likely based on a risk assessment approach, was considered the more reasonable approach.

We completed comprehensive historical reviews of each of the three primary land use areas described earlier. These reviews are called "Stage 1 Preliminary Site Investigations" (or PSIs) under the CSR, and the primary purpose is to identify past and/or present land uses which may have resulted in contamination to soil, water, or air. In keeping with Cominco's strategy, our primary focus was on PCOCs not already addressed within the mine reclamation permit, although a comprehensive understanding of all site operations was necessary to confirm that all PCOCs were identified.

For the most part, hydrocarbons (fuels, lubricants, solvents) comprised the primary organic contaminant group, and to a lesser extent PCBs (transformer oils), paints, and wood preservatives. PCOCs associated with mining operations were also identified in the Stage 1 PSIs, to ensure completeness in terms of identifying potential "contaminants" associated with past practices. For each area, the results of the Stage 1 PSI provided a framework for decision-making with respect to the next step, which is intrusive investigation.

STEP 4 - CONFIRMING THE PRESENCE/ABSENCE OF TARGETED CONTAMINANTS

The CSR outlines a phased approach to intrusive investigation, which is typically the preferred approach to the delineation of contamination. However, in recognition of the fact that MELP has the power to require further work if they are not satisfied with the level of investigation completed, it has been Cominco's approach (even before the CSR) to work through the investigation and remediation of impacted areas based on regular discussions and input by MELP. Under the CSR, MELP comment can be formally solicited through the review of documents (for a fee), but the local Cranbrook MELP staff have met with Cominco and MECI at regular intervals on a more informal basis to review the scope and progress of the investigation and/or remediation work. This has worked well, and serves to establish transparency of process and confidence that work completed will be accepted down the road when the formal document review takes place. Progress related to this investigation/remediation work has also been communicated to the Sullivan Public Liaison Committee, thereby avoiding a parallel process of public notification.

Without going into too much detail, a phased approach was taken for intrusive investigation of soils at each area. Analytical results were compared to the CSR numerical soil standards which apply to industrial land use, in keeping with Cominco's intention to maintain care and control of most of their property, particularly lands within the fence line of the industrial facilities. The CSR numerical soil standards are useful for comparison during investigation, but risk based site specific standards would ultimately be more meaningful for remediation at a mine site. The approach (particularly with respect to the level of investigation - i.e., numbers of samples, spacing) was different depending on whether the PCOC was:

> related to mine waste (already managed under the reclamation permit);

> related to an industrial process but the contaminated material could be managed with mine waste of like characteristics (e.g., if it was acid generating the material could be managed with other like waste); or
> organic in nature (full delineation was completed to allow for physical removal or other method of remediation).

With respect to water, the approach taken was to maximize the use of the existing groundwater and surface water monitoring and chemical database, as well as the existing hydrogeological model which was developed for waste impoundments associated with the Kimberley Operations. The purpose of the model and chemical database was to define pathways for contaminant transport through groundwater, establish a cost effective monitoring well network, and if necessary, develop information to design systems for groundwater interception and collection. This work has been done in accordance with reclamation requirements, and is an integral part of Cominco's Decommissioning and Closure Plan. While not completed in specific response to requirements under the CSR, this work is entirely consistent with the requirements for groundwater investigation and remediation that are intended under the CSR. We conducted a "gap analysis" of the model and database to determine the following:

- Is the monitoring network adequate to assess groundwater (or surface water) impacts from all the areas of potential concern identified in the soils investigation?;
- If not, where would additional sampling stations need to be established in order to assess on-site and/or off-site impacts?; and
- Are all of the identified PCOCs represented within the existing analytical program, and if not what parameters need to be added in what areas?

STEP 5 - DEVELOPING REMEDIATION STRATEGIES

With respect to soils, areas impacted by organic contaminants are relatively few, and for the most part it has been most cost effective to remove impacted soils and dispose of them in permitted landfills. In such situations, the CSR numerical standards for industrial land use have been used to guide and confirm the remedial effort. In areas impacted by metals, deposits of process wastes have been removed and consolidated in waste impoundments (where possible). Reclamation works, in terms of engineered cover systems, are also considered valid

remediation strategies, recognizing the need for verification of effectiveness by way of monitoring, and for evaluation of impacts by way of risk assessment.

Since groundwater represents the greatest long term challenge with respect to management and control of migration to off-site receptors, the gap analysis described above is key to establishing a true harmonization of objectives between the CSR and the mine reclamation process with respect to groundwater remediation. Strategies in place already include capture and treatment systems, engineered cover systems, monitoring of receiving bodies, and upstream diversion to minimize or prevent impacts. Longer term strategies will be developed in consideration of site specific factors and an assessment of risks to downgradient receptors.

HIGHLIGHTS OF THE PROCESS TO DATE

By way of summary, we offer a few comments which may be helpful to others facing uncertainty with respect to the process to follow in the current regulatory climate.

- Determine the applicability of the CSR to the specific requirements of your mine closure plans. There may be triggers related both to mine closure, and also to other decommissioning, demolition or divestment activity unrelated to mine closure.

- Understand the regional variations and preferences of your local MEM and MELP representatives. While Victoria sets policy, there remain differences, at least at the present time, in how the process is followed in various regions. Make sure that those with the necessary level of knowledge of CSR requirements are participating in the Reclamation Advisory Committee. (It is interesting to note that the March 1998 document entitled *Application Requirements for a Permit Approving the Mine Plan and Reclamation Program Pursuant to the Mines Act R.S.B.C. 1996, C. 293* devotes a section to *Contaminated Sites Legislation Requirements).*

- For new mines, conduct a comprehensive baseline assessment of site conditions prior to opening. This will help to avoid uncertainties and additional costs associated with establishing background conditions. (This uncertainty at older mining sites can result in great difficulties, and expense, trying to demonstrate background or "naturally occurring" concentrations of metals and other parameters - parameters which resulted in the business

decision to site the mine there in the first place). Some of this information is collected during exploration activities; ensure that it is not lost.

- Record Keeping! Develop and maintain an organized data management system for all data collected as part of permit compliance. This data may be of tremendous benefit if you must conduct CSR related investigations.

- Establish an archive and document all mine and related activities over the life of the mine. Keep track of knowledgeable transferred or retired employees. Cominco's archives in Kimberley were exceptional, and greatly assisted us in confidently reconstructing the history of operational and waste management practices at the site over its 90 year life.

- With respect to metals (and related parameters) in soil at Cominco's site, there is no doubt that the level of investigation completed to meet the requirements of the CSR has been much more rigorous (and costly) than what would have been undertaken to meet the requirements of the reclamation permit. This is largely due to the requirement to characterize and delineate "contamination" and compare concentrations to numerical soil standards. The question which remains to be answered by the government/industry task force is whether the protection of the environment is equally ensured by the reclamation permit, where the impact of residual metals in soil (e.g., uptake of metals by plants and animals) is investigated more from the perspective of the receptor. On the one hand (CSR), the source of contamination is thoroughly characterized and compared to numerical standards, and on the other hand the focus is on impacts to receptors from (for example) engineered cover systems without rigorously characterizing the underlying soil conditions in terms of concentrations and volumes.

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REFERENCES

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