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THE FIRST CERTIFICATE OF COMPLIANCE FOR A MINE SITE IN BRITISH COLUMBIA BHP MINERALS CANADA LTD. ISLAND COPPER MINE

R.H.J.North, P.Eng./P.Geo.

Keystone Environmental Ltd.
250-10691 Shellbridge Way
Richmond, B.C.
V6X 2W8

ABSTRACT

The Contaminated Sites Regulation implemented in April of 1997 by the Ministry of Environment, Lands and Parks (BCE), provides standards for the determination, investigation and remediation of contaminated sites in British Columbia. The BHP Minerals Canada Ltd. (BHP) - Island Copper Mine was the first mine closure to participate in the Contaminated Sites Regulation process and achieve a Certificate of Compliance (Conditional) in British Columbia.

Following mine closure, BHP wished to see the property utilized by another industrial operation that would contribute to the local economy. Since the mine was located on provincial Lands, BCE required that a Certificate of Compliance under CSR be obtained prior to a change in site usage and site lessee. BHP elected to pursue this option.

The application for the certificate was limited to the "Plant Site", a 90 hectare portion of the 750 hectare overall mine site. The Plant Site included the mill, maintenance buildings, crusher, mine dry, thickeners, tailings pipeline and administration offices. The paper describes the investigative efforts, remediation, and risk assessment work that were required to obtain the Conditional Certificate of Compliance. Of significance to mine sites is the determination of background levels of metal constituents at the site. Undisturbed soils do not generally contain concentrations of metals as high as soils subsequent to mining activities. Thus, it may be difficult to demonstrate elevated background metals concentrations in order to reduce the scope of remediation/risk requirements under the CSR. Proper planning that ensures adequate collection of pre-mining and closure site data is the key to achieving timely, cost-effective closure under the Contaminated Sites Regulation.

1. INTRODUCTION

This paper provides an overview of the process that the BHP Minerals Canada Ltd. (BHP) participated in to achieve a Conditional Certificate of Compliance (CCOC) under the Contaminated Sites Regulation (CSR) for a portion of the 750 hectare Island Copper mine site, located near Port Hardy, B.C. Island Copper was the first mine closure to participate in the Contaminated Sites Regulation process and achieve a Certificate of Compliance (Conditional) in British Columbia. The paper includes the following sections:

- Section 1 provides background information on the mine site and events leading to the decision to pursue a CCOC;
- Section 2 reviews the CSR process;
- Section 3 reviews the investigative efforts undertaken at the site;
- Section 4 outlines the means in which background concentrations can impact the issuance of a COCs at mine sites;
- Section 5 reviews the remedial actions undertaken at the site;
- Section 6 describes the human health and environmental risk assessment that was required to obtain the CCOC;
- Section 7 discusses the issuance of the CCOC; and
- Section 8 provides key points for consideration.

The BHP Island Copper mine is located approximately 16 kilometres south of Port Hardy, B.C. on Rupert Inlet. Island Copper began production in 1971 and was the third largest copper mine in Canada, employing more than 900 people at its peak. The mine produced copper concentrate containing 1.3 billion kilograms of copper, 31 million kilograms of molybdenum, 31.7 million grams of gold, 336 million grams of silver and 27,000 kilograms of rhenium. In its peak production year in 1989, the mine produced 263,200 tonnes of copper concentrate and 5,767 tonnes of molybdenum concentrate. The open pit produced from the mining operation was 1,320 feet below sea level, eclipsing the Dead Sea as the lowest point on land in the world.

BHP was not required to obtain a Certificate of Compliance (COC) or a CCOC for the mine site, as they may have elected to complete the requirements of their mine closure plan and vacate the site, other than continuing with site monitoring requirements stipulated by the Mines Branch. However, BHP wished to see the property utilized by another industrial operation that would contribute to the local economy. Since the mine was located on provincial Land, BC Environment's input was therefore required to indicate that the environmental condition of the property was suitable for the intended use of the new

operation. Given the potential change in site lessee, BC Environment required that a Certificate of Compliance be obtained. In the CSR, a COC or CCOC provides verification to a property owner or potential purchaser that the environmental conditions at the site are acceptable for the intended use. BHP elected to pursue the option of pursuing a certificate. Keystone Environmental Ltd. (Keystone) was initially contracted to identify and address potential site contamination issues for the purpose of mine closure and not the pursuit of a CCOC, since BHP intended to address potential site contamination issues regardless of their subsequent decision to enter the CSR process.

The portion of the mine site where a CCOC was sought comprised approximately 90 hectares of the 750 hectare total mine area. This limited portion of the mine site was known as the Plant Site. It contained the majority of supporting infrastructure for the mining operation including the mill, maintenance buildings, fuel storage and dispensing areas, concentrate storage and shipping facilities, tailings thickeners and pipeline and administration offices.

Island Copper, like most mine sites, was largely a self-sufficient operation providing its own maintenance, transportation and fueling facilities and water source and power substation. Consequently, in addition to strictly ore-related contaminants (i.e. metals), potential site issues are highly variable both with respect to type and size of issue. Areas of potential concern varied in magnitude from a single underground fuel storage tank (UST) to the main fuel tank farm on the site where several large above ground tanks (ASTs) stored hundreds of thousands of litres of fuel. The nature of potential constituents of concern on the site included hydrocarbons, metals, reagents, solvents, PCBs and asbestos.

2. CONTAMINATED SITES REGULATION PROCESS

A site is considered contaminated, under the CSR, if concentrations of constituents in the site soils, surface waters or groundwaters exceed numerical standards provided in Schedules 4, *5* and 6 of the regulation and they also exceed local background concentrations. Constituents such as metals could exceed the numerical standards; but if the concentrations were less than background levels, then the site would not be considered contaminated. This is of particular importance to mine sites. Background is further discussed in Section 4.

In order to receive a COC for a contaminated site, a proponent must demonstrate that the site has been remediated to numerical standards in the CSR or background levels. If it is not technically or economically feasible to remediate the entire site, as was the case at Island Copper, then a risk assessment

may be performed in order to obtain a CCOC. The risk assessment determines if site contaminants pose an unacceptable risk to human health or the environment at the site. If the site contaminants present an unacceptable risk, then risk management tasks, such as engineering controls, administrative controls or further remediation, are required to prevent exposure at unacceptable levels. If they do not, then further work is not required and BCE will issue a CCOC.

Prior to performing a risk assessment or obtaining a COC or CCOC for a contaminated site, several phases of work need to be completed. These include:

- Identify present and historical site activities that may represent an environmental concern;
- Perform a preliminary site investigation including the collection of samples for analysis to evaluate the potential impact of site activities highlighted in the first phase of work;
- Conduct more detailed investigation of those areas that were identified as contaminated in the previous stage; and
- Complete remediation of those areas not amenable to risk assessment.

There are fees associated with the review of documents by BCE and the issuance of a COC or CCOC. These fees are based on two factors: the size of the site (small, medium or large) and the nature of site contamination (simple or complex). It is reasonable to suspect that all mine sites will likely be designated as large sites, which are defined as having an area greater than 12,000 square metres. Even in Island Copper's case, where only a minor portion of the mine site was involved, it was still classified as a large site. Secondly, the number of different types of contaminants present and the number of different media effected determines whether a site is defined as "simple" or "complex". In order to be classified as simple there can only be one type of contaminant (e.g. metals) and primarily soils are the medium impacted. If other media are significantly impacted or if other contaminants are also present at levels exceeding CSR standards, then the site is generally classified as complex. The Plant Site was classified as a large complex site, as will be likely for most mine sites. Large, complex sites are the highest category of fees paid to BCE for services related to the CSR.

3. SITE INVESTIGATION

BCE requires a phased approach to site investigations, beginning with a site reconnaissance to review current site activities and also the performance of a review of historical activities that may have impacted the site soils and/or waters. The phased approach is beneficial since it continually focuses investigative efforts by avoiding potential over-investigation in low risk areas and concentrating on areas of higher risk

and potential concern. This results in a more cost effective investigative program that is particularly critical on a large mine site, where investigative efforts can be extensive and if not focussed can yield data of little value at great expense.

Twenty-one separate areas of potential concern were identified in the initial phase of the investigation on the Plant Site. To investigate the potential impact on the site from these areas of concern, individual preliminary site investigations of each area were designed and implemented in the fall of 1995. These programs involved the collection of soil samples for analysis and comparison to the draft CSR standards available at that time. The preliminary investigation consisted of collecting approximately 50 surface soil samples and the excavation of 21 test pits with the collection and analysis of multiple soil samples in each test pit. Investigation analytes included light and heavy extractable petroleum hydrocarbons (LEPH/HEPH), polycyclic aromatic hydrocarbons (PAHs), volatile petroleum hydrocarbons (VPH), benzene, ethylbenzene, toluene, xylenes (BETX) and metals. The most common analytes in the investigation were metals and LEPH/HEPH. Hydrocarbons were prevalent because of the fuel storage and dispensing areas located on the Plant Site.

Based on the results of the preliminary site investigation, more detailed investigation programs were designed and performed in the spring of 1997 in those areas where contamination was previously identified. The detailed investigations were performed to delineate the extent and nature of contamination with the goal of assessing the need for remediation. The detailed investigations included the collection of several groundwater and surface water samples in addition to substantially more surface soil and subsurface soil samples. A drill rig was employed in the detailed investigation to install several groundwater monitoring wells and provide a means for examining and sampling soils at depth in certain areas.

The detailed investigation also included an examination of the acid rock drainage (ARD) potential of surface soils in areas within the Plant Site. The potential ARD issues on the Plant Site are relatively minor compared to the potential ARD generally attributed to mine site features such as waste rock dumps. However, it was considered necessary to assess ARD potential on the Plant Site due to the concern of potential metals in the surface soils or exposed bedrock impacting the surface water drainage courses flowing over the Plant Site to Rupert Inlet.

4. DETERMINATION OF BACKGROUND CONCENTRATIONS

Under the regulation, a site is considered contaminated if constituents in site media exceed numerical standards or background levels. If concentrations in site media can be shown to be comparable to background levels, then a site is not considered contaminated, even if concentrations exceed standards in the CSR. In the case of metals contamination, this has been presented by certain parties to the mining industry as a potential way to reduce the potential impact of the CSR standards on mine site contamination. However, background is considered the concentration of constituents in soils, surface waters and groundwaters prior to the initiation of mining activities. Island Copper, like other mine sites, had acquired soil data from geochemical soil sampling of overburden soils during pre-mine exploration activities. Although concentrations of key metals such as copper and molybdenum were elevated in some samples, they were not sufficiently elevated to significantly reduce the volume of soils that were considered contaminated with metals.

Thus, the benefit of background concentrations to mine site contamination may be limited. Mine sites generally have overburden soils overlying the orebody. Therefore the concentration of metals in ore do not enter into the calculation of background. Consequently, mines need to prepare to address elevated metals concentrations in soils by means other than background. At Island Copper risk assessment was used to address the elevated metals in surface soils and groundwater and ultimately reduce the amount of site remediation required.

5. SITE REMEDIATION

The initial objective of remediation on the Plant Site was to remediate all potential constituents of concern to levels less than the CSR numerical standards. This objective was not considered practicable due to the extent of metals in the soils on the Plant Site. Hydrocarbon remediation was performed but it was also not reasonable to remediate all hydrocarbon contamination on the Plant Site to regulatory standards. Consequently, remedial objectives were modified and a risk assessment was chosen as the best approach to address remaining metals and hydrocarbon contamination.

The objective of metals remediation was to address those areas with evidence of significant metals contamination in soils including fugitive ore concentrates and potential Special Wastes. Several remediation methods were employed on the Plant Site. They included:

- excavation and disposal of contaminated soils;

- bioremediation of hydrocarbon contaminated soils;
- engineered improvements to site drainage features;
- installation of temporary remediation structures; and
- use of natural remediation systems.

Significant effort was placed on utilizing onsite remediation options to reduce offsite disposal and associated costs. Eventually, all remediation was successfully completed without the offsite disposal of any contaminated soils. It was also considered important to provide passive remediation systems for any long term remediation required on the site, since maintenance personnel would not be available.

Those soils that were identified as containing potential copper concentrate residue or that were particularly elevated and therefore considered an ARD risk were disposed of in the open pit prior to filling of the pit with sea water. This option will effectively reduce the metals mobility by placing them in a reducing environment present at the bottom of the Pit Lake.

Bioremediation was employed as the remediation method for the majority of petroleum contaminated soils. Approximately 4,000 cubic metres of petroleum hydrocarbon contaminated soils related to fueling structures and a waste oil pit were successfully treated in a bioremediation cell within a period of only four months. Subsequent to remediation of the soils to levels acceptable on industrial/commercial sites the soils were replaced on the site as fill.

Certain areas of the site where soil contamination was present and it was not considered feasible to excavate or actively remediate the soils provided an opportunity for development of more innovative approaches to remediation. In an area where free product hydrocarbons were present at depth with associated contaminated soils, it was decided that the contamination, which was discharging via contaminated seepage from an embankment, would be collected, directed through an oil water separator and discharged into a wetlands system prior to entering Rupert Inlet. This system has been effective in removing contamination and is expected to provide sufficient protection to the marine environment until the contamination source dissipates.

6. RISK ASSESSMENT

Risk assessment is the process of quantifying risks (carcinogenic and non-carcinogenic) to receptors potentially in contact with site constituents. Human health risk assessment specifically addresses the risks

to humans posed by site contaminants. Ecological risk assessment evaluates the risk to potential terrestrial and aquatic receptors. The risks are compared to provincial guidelines for accepted risk levels, in order to determine if further action is required.

In performing a human health risk assessment, the use of the site is key to determining the risk, since receptor selection is based on site use. The Plant Site is to remain as an industrial site with the occupation of a new industrial operation. Therefore workers at the site were the primary receptor evaluated. The potential exposure pathways evaluated for the human health risk assessment at the site included:

- Incidental ingestion of metals in soil;
- Dermal contact with metals in soil;
- Inhalation of metals in soil particulates;
- Inhalation of vapour from hydrocarbons in groundwater;
- Inhalation of vapours from hydrocarbons in surface waters; and
- Dermal contact with hydrocarbons in surface waters.

The human health risk assessment concluded that risks to all potential receptors were within acceptable levels. Consequently, further remediation or risk management was not required based on the results of the human health risk assessment.

The ecological risk assessment conducted at the site involved an evaluation of the potential risk to both terrestrial receptors on the Plant Site and aquatic receptors in Rupert Inlet. Specific receptors were chosen with approval from BCE for ecological risk evaluation. They included the plant Salal, earthworms, deer mice, raccoons, black-tailed deer, dungeness crab and benthic invertebrates. Specimens of salal, deer mice and earthworms were collected and analyzed. Coincident with the plant samples, soil samples were also collected and analyzed to evaluate the potential uptake of metals from the soil by plants. Foraging ranges were also estimated for the animal species since they would likely spend only a portion of the time on the Plant Site and consequently only derive a portion of their total food intake from the Plant Site. The ecological risk assessment concluded that the risks to mammals, soil invertebrates and plants on the Plant Site were low.

The component of the ecological risk assessment which evaluated potential risks to aquatic receptors largely relied on the abundant marine monitoring data acquired by Island Copper over the operating life of the mine. These data provided the means to apply a "weight of evidence" approach to the evaluation of risk to the aquatic habitat in Rupert Inlet in the vicinity of the Plant Site. The monitoring data revealed

that the aquatic community not only showed no evidence of impact from the Plant Site, but that the proliferation of certain species has increased over pre-mining levels. Consequently, the ecological risk assessment concluded that the risk to the surrounding environment was low from contaminants present on the Plant Site.

7. ISSUANCE OF THE CERTIFICATE

The process of obtaining this first CCOC for a mine site was iterative. All parties including BHP, BCE and Mines were meeting regularly and discussing issues as they arose in an effort to maintain progress towards the goal of obtaining a certificate. Following completion of the investigative efforts, site remediation, and risk assessment work, BHP applied to BCE for a CCOC. On May 4, 1998 a CCOC was issued by BCE for the Plant Site. The only significant ongoing condition on the CCOC is the requirement for surface water quality monitoring at several points at the Plant Site. This water quality monitoring requirement will likely cease in several years, once sufficient data are collected to confirm no adverse impacts are occurring.

8. KEY POINTS FOR CONSIDERATION

There were many key points that arose from the process of obtaining a CCOC for the Plant Site at BHP Island Copper. These points are considered applicable to other mine sites that may seek or be required to enter the CSR process.

1. Investigative data must be obtained in all media present on the site even if technical evidence supports limited investigation. As an example, the installation of monitoring wells at Island Copper was not considered of value to determine groundwater flow patterns in the overburden since there was evidence that groundwater flow was controlled by the topography of the bedrock surface based on observations during excavation and known contaminant flow patterns. However, BCE required installation of monitoring wells in all overburden areas to provide groundwater quality data and groundwater elevations to define groundwater flow patterns supported by data obtained from monitoring wells or piezometres.
2. Establishing background concentrations on a mine site prior to initiating industrial activities is important. It does not guarantee, however, that the amount of soils considered contaminated on a mine site will be reduced or eliminated.
3. Risk assessment is an extremely valuable tool that provides assessment of risks to human health and the environment by allowing incorporation of site specific factors. The greatest value seen for risk

assessment at mine sites is in addressing potentially large areas of marginally contaminated materials. At Island Copper, heavily contaminated materials such as soils containing concentrate and ARD producing materials were remediated. However, most of the remaining Plant Site area contained copper and molybdenum in surface soils at concentrations above CSR standards. With risk assessment, BHP was able to avoid remediating these soils, thereby eliminating a difficult and expensive task.

4. It is important to phase investigations in order to continually focus efforts and to reduce costs. Site-wide grid-sampling programs are generally ineffective and expensive. There is considerable value in initially performing a qualitative assessment of relative risks from areas or issues of concern on large and varied sites such as a mine sites.
5. Mine sites may have features that can be utilized in site remediation. At Island Copper, the former open pit was available for the disposal of soils contaminated with metals.
6. Mines sites are highly variable, both with respect to size and potential issues. This will be reflected in the degree of investigation and remediation required. What is critical, is that proper planning be performed to ensure that investigations are conducted efficiently, cost effectively and completely.

We are hopeful that the next mine site, entering into the CSR process, will benefit from the experience of BHP Island Copper. Their patience and determination to obtain a CCOC for the Plant Site enabled a new industrial operation to occupy the site and provide continued economic opportunity to the local community.

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