Proceedings of the 16th Annual British Columbia Mine Reclamation Symposium in Smithers, BC, 1992.
The Technical and Research Committee on Reclamation

MT. WASHINGTON RECLAMATION - A CRITICAL REVIEW

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Abstract

All mine reclamation programs should be under constant critical review in order to have most effective reclamation at minimum cost. Experiments should be identified as experiments. Ineffective reclamation results in negative perceptions of the mining industry's ability to control wastes. This paper critically reviews Mt. Washington reclamation to date, examines alternative solutions and makes recommendations for future control.

Mt. Washington Copper Co. Ltd. milled 392,000 tons of 1.16% Cu ore in 1964-67 from two pits and dumped approximately the same amount of waste rock in two main areas. Copper bearing acid water drains from the north pit area into Pyrrhotite Creek which eventually flows into the Tsolum River. Reductions in fish stocks in the Tsolum River have been blamed on the water quality.

Reclamation by the Ministry of Energy, Mines and Petroleum Resources to date has been a two year program of dump restructuring with clay capping, followed by two seasons of experimental bedrock cleaning and capping tests. To date no substantial improvement has been made in water quality.

Alternative solutions such as neutralization in place or downstream will be examined.

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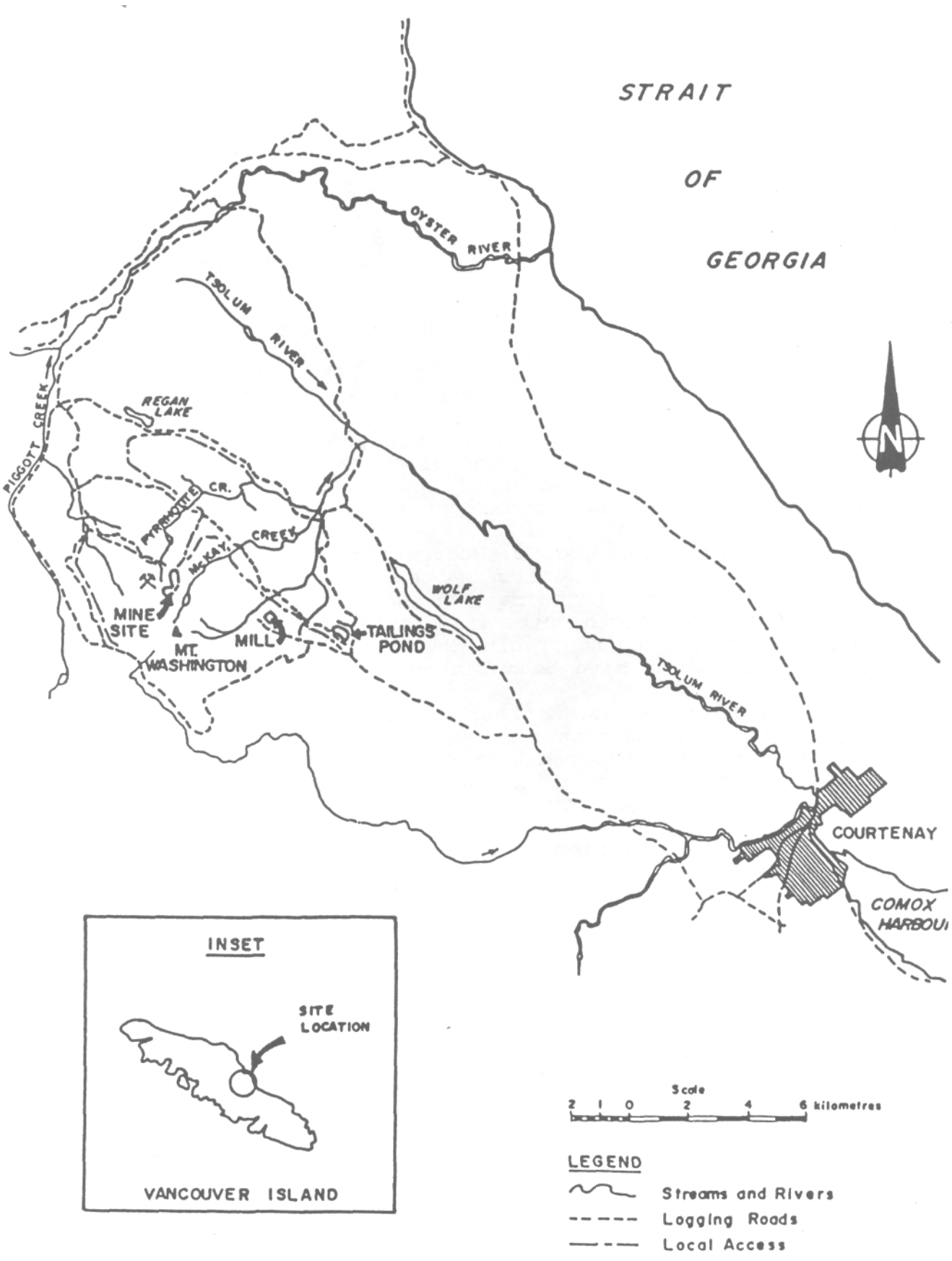

LOCATION MAP

Figure 1

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Introduction

When I proposed this paper I was asked "What is your angle?" The reason for this paper steins from a natural concern about an unsolved problem that affects all of us, but even more about the negative image and perception of mining as a contributor to pollution and a creator of unsolvable and costly problems. I am concerned that this problem has not been handled properly and that no immediately effective solution is proposed.

I am not a metallurgist, fish biologist or environmental chemist but I do have extensive experience with minerals and their chemistry. I also have a healthy scepticism of expert opinion. Our company holds the mineral rights on Mt. Washington, including those of the area under reclamation. We have been water sampling in the area since 1984 and offering advice on reclamation approaches since 1987. However our legal advice has been that if we were to undertake any reclamation ourselves that we could invoke legal responsibility in perpetuity.

Problem Background

Very likely before there was any mining at Mt. Washington the runoff from the mineralized area was acidic to some degree as there are natural ponds on the west side of the ridge with a pH of 5.0 or less and metallic copper is present in the weathered rock as evidence of leaching and precipitation. These moderately acidic water flows would have been diluted to tolerable levels by the much larger flows from McKay and Murex Creeks.

The mining carried out by Mt. Washington Copper Co. Ltd. in 1964 to 1966 (before any reclamation regulations were in place or even thought necessary) was in two adjacent pits. The south pit is dug into a steep bank. It has a low sulphide waste dump that is not producing much acid. The pit itself has a drainage that is alkaline with a pH of 7.5. This drainage deposits copper as essentially malachite (a copper carbonate) that coats rocks and logs in the stream channel. The north pit is essentially on a dip slope where the attitude of the mineralization nearly parallels the old surface slope. The north pit and adjacent dumps cover a much larger surface area than the south pit. A portion of the north dump from the north pit is over the topographic divide into the Oyster River drainage and although visually comprised *of* the same material as the rest of the north dump has not been identified as an environmental problem. Some areas in the north pit are generating acid from pyrite and marcasite which in turn is leaching copper from chalcopyrite which does not leach readily by itself. While some quantity of broken rock was left on the pit floor it must be recognized that the natural rock is highly fractured so that weathered and unblasted rock can be excavated with a backhoe to depths of six meters.

Despite the acid generating capability of some of the mineralization the tailings pond is reported to be remaining essentially neutral, although there has been some objection to the colour and lack of vegetation of the tailings pond.

Fish Habitat

The main environmental concern resulting from Mt. Washington leachate is the effect on fish and fish habitat in Tsolum River approximately 10 kilometres downstream from the mine site. Falls on Murex Creek approximately two kilometres above its confluence with the Tsolum River prevent fish migration up Murex Creek so essentially the fish habitat is only in the main Tsolum River.

Historically, there was a spring salmon run up the Puntledge River that has largely disappeared since Comox Lake was dammed and there was a large run of pink salmon (humpbacks) and some coho in the Tsolum River. The pink salmon fry leave for salt water before the spring freshet but coho fry linger and can be adversely affected. I can remember as a kid in the 1930s looking down from the bridge at Courtenay onto a river red with migrating red humpbacks going up to spawn. A fisheries tabulation from 1947 onward shows runs of over 100,000 pink salmon in 1951-52 but the run had dropped to an estimated 3500 by 1962, two years before mining started. Obviously something besides mining was affecting fish populations.

In 1984 federal fisheries biologist Bill McLean was quoted as saying it was dangerous and simplistic to blame copper as the only cause of the fish problem. He said other contributing factors are logging, drawing water for irrigation, commercial fishing pressures and the removal of gravel for the Comox airport in 1943-44 from the lower Tsolum River bed. He sticks by that statement today.

The Tsolum River has been erroneously reported as being a DEAD RIVER. However federal fisheries report that 15000 to 18000 pink salmon return to the Tsolum annually and are on the increase, possibly due to reduced commercial fishing in the Straits. The 1991 return was apparently unusually strong possibly due to heavy rains at the end of July. Coho salmon fry are found in the Tsolum above the Murex confluence. Fisheries report that during and after the spring freshet algae and aquatic life are very reduced in the Tsolum but return later in the year.

The fact that the Tsolum River is NOT a dead river and never has been is not an excuse for allowing copper leachate to continue to flow into the river. If fish life is weakened by other effects there is no excuse for allowing another debilitating agent to add to the problem. A main reason for this paper is to advocate an immediate improvement in the water quality so Fisheries can confidently begin sustained enhancement.

Water Quality

Better Resources began water sampling on a preliminary basis in 1984 and sampled extensively at 10 sites in 1987 and 1988 and then intermittently at fewer sites in 1989, 1990, and 1991.

Ministry of Environment and MEMPR are both water sampling on a regular basis so we now only sample for our own control information.

These samples to the end of 1991 showed no significant improvement in water quality at Branch 126 sample site or in Murex Creek discharge to the Tsolum River. Pyrrhotite Creek at Branch 126 from 1987 to 1991 had a pH ranging from 3.8 to 4.7 and a copper content of 3.05 mg/1 to a high of 13.9 mg/1 with lowest values during high runoff dilution but during 1990 and 1991 the spring runoff copper at Branch 126 was 5 to 6.5 mg/1.

Water quality in Murex Creek at Duncan Bay main road just above the confluence of Murex Creek with the Tsolum River had a pH ranging from 5.9 to 7.0 with an average of 6.4 but copper content ranged from 0.004 to a high of 0.062 mg/1 in May 1989. It is important to note here that Pyrrhotite Creek which is the only significant copper carrier joins the much larger McKay Creek and Murex Creek to be called Murex Creek and is diluted at least 5 to 1 by them. Since the combined Murex Creek is the main source of water flow in the upper Tsolum River in May and June any elevated copper content could have significant effect on fish and aquatic life habitat.

Of particular technical interest is the rapid decrease in copper content in Pyrrhotite Creek between Branch 126 sample site and Pyrrhotite Lake less than one kilometre downstream. On July 10, 1990 four water samples from Phyrrhotite Lake had a pH of 5.1 and a copper content of 1.65 mg/1, while on the same date a Branch 126 sample had a pH of 4.2 and a copper content of 6.45 mg/1. Since Pyrrhotite Creek is the main source of water for Pyrrhotite Lake, there is obviously considerable deposition of copper and other elements in this short section of stream. A sample of orange sludge from Pyrrhotite Creek in the marsh section assayed 3981 ppm copper, 5.8% iron and 1.91% alumina. There is considerable sludge in Pyrrhotite Lake but we don't have an analysis of it.

Political Problem

Now let's look at the problems of the political handling of this situation. In our opinion, the wrong Ministry took the lead in this problem. The Ministry of Environment commissioned the original reclamation report which involved members of that Ministry, MEMPR, Federal Fisheries, Environment Canada and Consultants but no one from industry, including mineral title holders. The report was not released for nearly a year and the release coincided with much environmental agitation over Strathcona Park. Members of the public and claim owners had little time to review the proposals before the Ministry of Energy Mines and Petroleum Resources were charged with carrying out the recommendations of this report.

The 1987 reclamation report studied 17 alternatives and by a process of cost benefit analysis selected dump restructuring together with broken rock collection and clay capping as the best option. However estimates used in this analysis were so far off

that other options may have been selected if costs were realistic. The estimate for covering all the north dumps was less than $500,000 in a one year program whereas the actual cost for covering half the dump was nearly $1,000,000 in two years.

At no time was the public advised that this program was experimental and I really believe that those involved in the work hoped it would be effective. I know it is easy to criticize after the fact and I am certainly not questioning the integrity of the people working on the project. However, we have been critical of the methods used since we first heard of the proposal. Furthermore, we have continually pointed out that the government is operating this experiment on a double standard in that if it were industry's responsibility to control this effluent all Ministries would be requiring an immediate correction of the problem, not a five year ongoing experiment.

I would contend that considerable rock that has not been blasted, but only naturally fractured, has been excavated and moved, which if industry were doing it would be classified as mining. To the best of my knowledge this project was not subjected to any provincial project review process. Now I must introduce the comedy of Bill C-13, the Federal EARP. Since this project had federal money spent on monitoring wells and involves a fish bearing river, work could be halted until a Federal EARP has been conducted. A would not like this to happen as we all would like to see the problem cleaned up and off everyone's back.

I know the government would have liked to see a walk away solution - a cure for all time, and industry would certainly enjoy such a solution, but we must recognize that this may not be possible.

Reclamation to Date

Many papers have been delivered on the progress of the reclamation by MEMPR at Reclamation symposiums, site show and tells and at other technical gatherings so I will confine my remarks to criticisms.

The broken rock gathering, dump resloping and clay covering in 1988-89 did not improve the water quality emerging from the dump toe. A total of 1500 tons of "0.5cm crushed limestone was mixed with the reworked dump rock but since it was covered by hopefully impervious clay cover there should be little water passing by this limestone to neutralize water flowing through the lower part of the dump. A limestone dam in the creek below the workings was built using the same crushed limestone which quickly plugged so that the majority of the flow passes over the dam rather than through it.

Before the dump moving and clay covering was completed in 1989 it was realized that most of the copper loading was coming from the old pit area, not the dumps, but it was decided to complete the original recommendation.

Bedrock cleaning and experimental capping of removed rock piles in 1990 and 1991 must result in some beneficial effect by keeping water out of acid generating rock. However as I commented earlier, some unblasted material is being excavated, exposing fresh sulphides.

There was a reluctance to use much lime before 1991 because the effectiveness of the experimental clay cover and other methods could not be independently measured.

In 1990 a small quantity of calcium hydroxide was hauled from an acetylene plant at Nanaimo to the site but part was buried in a ditch and the rest left in a pile that did not dissolve into the water system. In 1991 six loads were hauled on site and some was used in wash down water which rapidly painted exposed bedrock with green copper carbonate. However the majority of this lime still remains in a pile. At one point during heavy rains in late July the pH at Branch 126 reached 6.5, but this might not have been high enough for long enough to have much downstream effect. Now that some lime has been added we can stop trying to measure which attack has the best effect and get on with the business of improving water quality.

Alternate Reclamation

Neutralization can only be effective if lime is distributed so that it contacts and coats acid producing rock and neutralizes most or all of the ground water drainages. (It is interesting to note that dump leaching of copper at Gibraltar Mines is dropping off dramatically, attributed by some to dump rock coating.)

Neutralization using calcium hydroxide from Nanaimo could be done by spreading lime widely over the surface as a pumped slurry, but would be most effective if pressure pumped through boreholes in the pit. Existing piezometer holes could be used. A combination of surface coating and borehole pumping should be most effective as sludge would largely be retained in the dumps and eventually help seal the dumps.

Neutralization downstream could be carried out with an elaborate lime plant, by limestone filter dams or by rough dumping of lime slurry in the creek. All of these methods would produce downstream sludge.

Neutralization of Pyrrhotite Lake by helicopter application of lime slurry three times a year could be very effective and would contain the sludge in Pyrrhotite Lake. We did a bathometry survey of Pyrrhotite Lake and its volume of 170,000 cubic metres is one third the annual flow of Pyrrhotite Creek so two neutralizations in the spring and one in the fall should suffice.

The lime requirement to raise the pH of the annual flow of Pyrrhotite Creek to 8.3 (sufficient to precipitate most copper) from a pH of 3.9 as sampled at Branch 126 would require 10,000 kg of CaO or one truck load of Nanaimo calcium hydroxide. To neutralize Pyrrhotite Lake with its higher pH should require less. I have roughly calculated that this would cost under $20,000 annually.

Industry Involvement

As I said earlier, if it were the mining industry's problem, they would be required to make water quality acceptable immediately. However, indirectly it is industry's problem because any unsolved problem relating to mining eventually translates into more regulation, delay and expense. I call on all industry experts to help MEMPR solve the Mt. Washington problem.

The mining industry must continue to be innovative in solving environmental problems. For instance combined tailings and waste dumps may be possible where alkaline tailings are used to fill the voids in waste dumps thereby preventing oxygen circulation and possibly reducing land use as well.

Summary

What I would like to see result from this paper are:

(1) The Ministry of Energy, Mines and Petroleum Resources and the mining industry to be proactive in setting standards and correcting problems so that another ministry's involvement, such as the Ministry of Environment, is unnecessary.

(2) There be no double standard whereby government can do less than industry would be required to do.

(3) There be no public distortion of problems. The Ministry should join with industry in correcting misinformation. The Ministry should be a strong advocate for the success of the industry.

(4) Experiments should be publicly identified as such and only carried out where no problem will result or continue.

(5) Finally, and most important, that we join together in attaining an acceptable water quality from Mt. Washington in 1992.

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