ACID MINE DRAINAGE

Mining & Water Pollution Issues in BC

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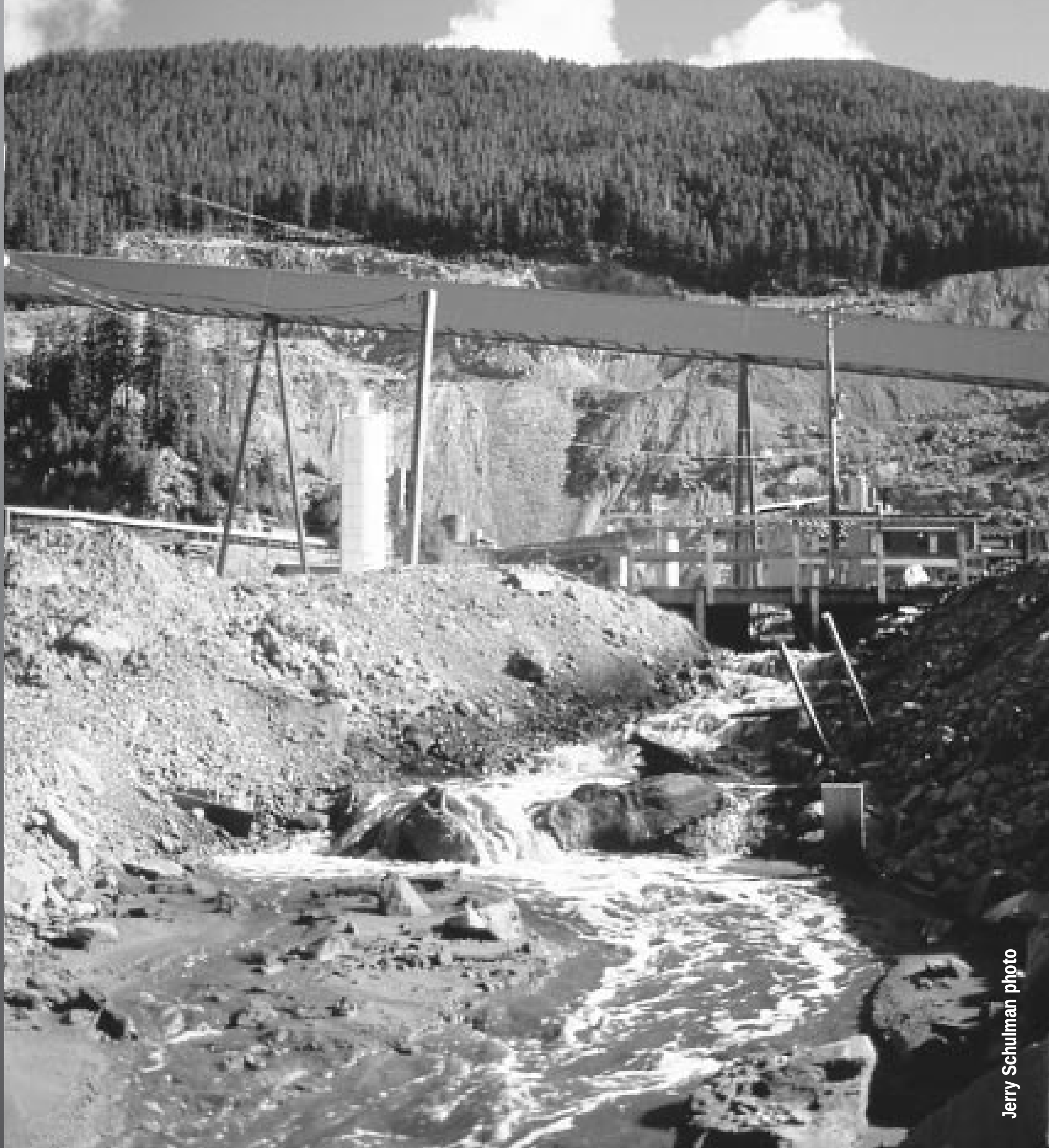

Jerry Schulman photo

Mining and Water Pollution

WATER IS ESSENTIAL TO LIFE ON OUR PLANET. A prerequisite of sustainable development must be to ensure uncontaminated streams, rivers, lakes and oceans.

As Canadians, we often take the presence of clean water for granted, forgetting its importance and assuming that it is always available. Unfortunately, the law and technology to protect this vital resource remains far from perfect. Increasingly, human activities threaten the water sources on which we all depend. Mining is one such activity. In fact, water has been called "mining's most common casualty."[1]

There is growing awareness of the environmental legacy of mining activities that have been undertaken with little concern for the environment. The price we have paid for our everyday use of minerals has sometimes been very high. Mining by its nature consumes, diverts and can seriously pollute water resources. Changes in laws, technologies and attitudes have begun to address some of the most immediate threats posed by mineral development, but there are still many areas of mining practices and regulations that need to be addressed.

For example, according to the 1993 BC State of the Environment Report, mine drainage is "one of the main sources of chemical threats to groundwater quality" in the province.[2] Groundwater supplies the drinking water of more than half the people living outside of Greater Victoria and Greater Vancouver.

For the sake of current and future generations we need to safeguard the purity and quantity of our water against irresponsible mineral development. We need to ensure the best pollution prevention strategies are employed in cases where the risks can be managed. But we also need to recognize that in some places mining should not be allowed to proceed because the identified risks to other resources are too great.

While there have been improvements in mining practices in recent years, significant environmental risks remain. Negative impacts

1 James Lyon, interview, Mineral Policy Center, Washington DC
2 BC State of the Environment Report 1993, pp.29-31

can vary from the sedimentation caused by poorly built roads during exploration through to the sediment, and disturbance of water during mine construction. Water pollution from mine waste rock and tailings may need to be managed for decades, if not centuries, after closure. These impacts depend on a variety of factors, such as the sensitivity of local terrain, the composition of minerals being mined, the type of technology employed, the skill, knowledge and environmental commitment of the company, and finally, our ability to monitor and enforce compliance with environmental regulations.

Increased mechanization yields increased mine waste management.

One of the problems is that mining has become more mechanized and therefore able to handle more rock and ore material than ever before. Consequently, mine waste has multiplied enormously. As mine technologies are developed to make it more profitable to mine low grade ore, even more waste will be generated in the future. This trend requires the mining industry to adopt and consistently apply practices that minimize the environmental impacts of this waste production.

"Once a mine is in operation water protection must remain the highest goal of the company, even if it means reduced mineral productivity. Adopting this common-sense ethic is the only way we can ensure that the golden dreams of mining do not turn into the nightmare of poisoned streams." [3]

In the right place — and with conscientious companies, new technologies and good planning — many of the potential impacts are avoidable. In fact, most mine pollution arises from negligence not necessity.

3 Carlos De Rosa and James Lyon, *Golden Dreams, Poisoned Streams.*, Mineral Policy Center, Washington DC, 1997

Waste from the Mining Process

ORE IS MINERALIZED ROCK CONTAINING A valued metal such as gold or copper, or other mineral substance such as coal. Open-pit mining involves the excavation of large quantities of waste rock (material not containing the target mineral) in order to extract the desired mineral ore. The ore is then crushed into finely ground tailings for processing with various chemicals and separating processes to extract the final product. In Canada the average grades of mined copper are under 1 per cent, meaning that for every tonne of copper extracted 99 tonnes of waste material (made up of soil, waste rock and the finely ground "tailings") must also be removed.

The amount of gold extracted per tonne of material disturbed is even less. Almost three tonnes of ore is needed to produce enough gold for one typical wedding band.[4]

The Canadian mineral industry generates one million tonnes of waste rock and 950,000 tonnes of tailings per day, totalling 650 million tonnes of waste per year.[5]

After being removed, waste rock, which often contains acid-generating sulphides, heavy metals, and other contaminants, is usually stored above ground in large free-draining piles. This waste rock and the exposed bedrock walls from which it is excavated are the source of most of the metals pollution caused by mining in British Columbia. In other regions of North America tailings may also represent a major source of heavy metals contamination of waterways.

Most mine pollution arises from negligence not necessity.

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4 Edwin Dobb, "Pennies from Hell," *Harper's Magazine*, October, 1996. p.40

5 Government of Canada, *The State of Canada's Environment*, Ministry of Supply and Services, Ottawa, 1991, p. 11-19

Types of Water Pollution from Mining

There are four main types of mining impacts on water quality:

1. Acid Mine Drainage

Acid Rock Drainage (ARD) is a natural process whereby sulphuric acid is produced when sulphides in rocks are exposed to air and water. Acid Mine Drainage (AMD) is essentially the same process, greatly magnified. When large quantities of rock containing sulphide minerals are excavated from an open pit or opened up in an underground mine, it reacts with water and oxygen to create sulphuric acid. When the water reaches a certain level of acidity, a naturally occurring type of bacteria called *Thiobacillus ferroxidans* may kick in, accelerating the oxidation and acidification processes, leaching even more trace metals from the wastes.

The acid will leach from the rock as long as its source rock is exposed to air and water and until the sulphides are leached out – a process that can last hundreds, even thousands of years. Acid is carried off the minesite by rainwater or surface drainage and deposited into nearby streams, rivers, lakes and groundwater. AMD severely degrades water quality, and can kill aquatic life and make water virtually unusable.

2. Heavy Metal Contamination & Leaching

Heavy metal pollution is caused when such metals as arsenic, cobalt, copper, cadmium, lead, silver and zinc contained in excavated rock or exposed in an underground mine come in contact with water. Metals are leached out and carried downstream as water washes over the rock surface. Although metals can become mobile in neutral pH conditions, leaching is particularly accelerated in the low pH conditions such as are created by Acid Mine Drainage.

3. Processing Chemicals Pollution

This kind of pollution occurs when chemical agents (such as cyanide or sulphuric acid used by mining companies to separate the target mineral from the ore) spill, leak, or leach from the mine site into nearby water bodies. These chemicals can be highly toxic to humans and wildlife.

4. Erosion and Sedimentation

Mineral development disturbs soil and rock in the course of constructing and maintaining roads, open pits, and waste impoundments. In the absence of adequate prevention and control strategies, erosion of the exposed earth may carry substantial amounts of sediment into streams, rivers and lakes. Excessive sediment can clog riverbeds and smother watershed vegetation, wildlife habitat and aquatic organisms.[6]

6 Carlos De Rosa and James Lyon, ibid, pp. 61-75

After the waste rock is removed and the ore is extracted, the ore must be processed to separate the target mineral from the valueless portion. Once the minerals are processed and recovered, the remaining rock becomes another form of mining waste called tailings. Mine tailings often contain the same toxic heavy metals and acid-forming minerals that waste rock does. Tailings can also contain chemical agents used to process the ores, such as cyanide or sulphuric acid. Tailings are usually stored above ground in containment areas or ponds (and in an increasing number of underground operations they are pumped as backfill into the excavated space from which they were mined.)

If improperly secured, contaminants in mine waste can leach out into surface and groundwater causing serious pollution that can last for many generations. As will be illustrated below, this is mining's legacy in many parts of BC and around the world.

7 Beverly Reece, "Perpetual Pollution," *Clementine,* (Winter 1995) Washington DC

The Legacy of Acid Mine Drainage

AMD IS THE MINING INDUSTRY'S GREATEST environmental problem and its greatest liability, especially to our waterways. An acid-generating mine has the potential for long-term, devastating impacts on rivers, streams and aquatic life, becoming in effect a "perpetual pollution machine."[7]

At the abandoned Mount Washington mine on Vancouver Island, open pits of sulphide-bearing pyrite ore lie exposed to the elements, along with 130,000 tonnes of waste rock. The sulphide sulphur in the ore continually reacts with air and water to form sulphuric acid, which leaches out the heavy metals, especially copper. This toxic copper leachate passes into Pyrrhotite Creek, then Murex Creek and from there into the whole Tsolum river watershed.

"Copper is the dreaded enemy of young salmonids," says Father Brandt, a local activist, fisherman, and director of the Steelhead Society. "It is a scientific fact that the amount of copper that finds its way yearly into the Tsolum

"Copper is the dreaded enemy of young salmonids. ...[copper] in the Tsolum watersheds kills young salmon and deters adult salmon escaping back to the river to spawn."

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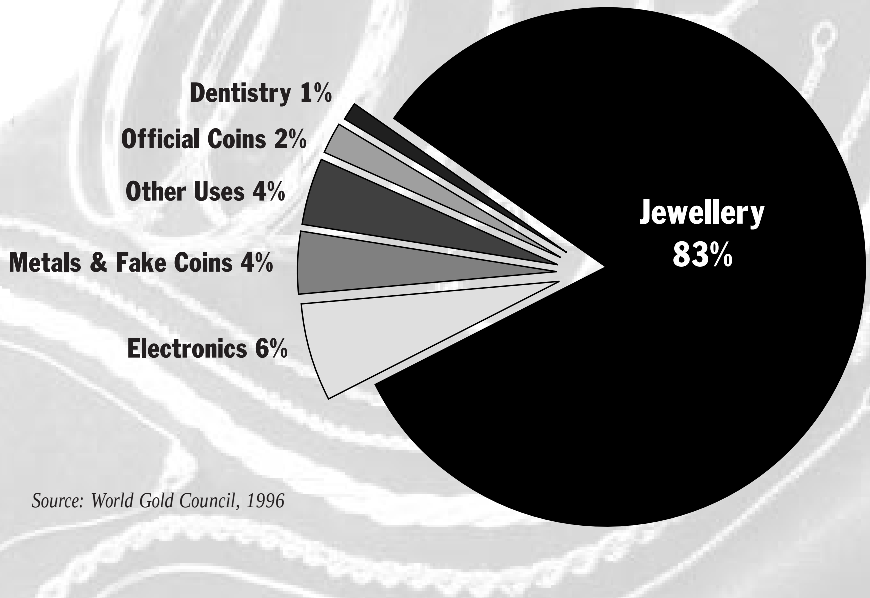
In the US, AMD and other toxins from abandoned mines have polluted 180,000 acres of reservoirs and lakes and 12,000 miles of streams and rivers.[8] It has been estimated that cleaning up these polluted waterways will cost US taxpayers between $32 billion and $72 billion.[9]

World Gold Consumption 1995



Source: World Gold Council, 1996

In Canada, there are an estimated 351 millions tonnes of waste rock, 510 million tonnes of sulphide tailings, and more than 55 million tonnes of other mining sources which have the potential to cause AMD.[10] Cleanup at existing acid-generating mines in Canada will cost between $2 billion and $5 billion.[11]

Not only is AMD treatment and collection very costly to the environment, it is a big bill for industry. According to T.D. Pearse Resource Consulting, "Site stabilization costs can be as high as $410,000 per hectare."[12] The U.S. Bureau of Mines estimates that the US industry spends over $1 million each day to treat acidic mine water.[13]

Unfortunately, the province of BC is prominent on maps identifying Canada's AMD pollution sites. The Mount Washington mine is only one of 25 mines (operating, closed and abandoned) in BC that are currently acid-generating,

8 Robert Kleinman, *Acid Mine Drainage: US Bureau of Mines Researches Control Methods for Coal and Metal Mines*, US Bureau of Mines, July 1989

9 Jessica Speart, "A Lust for Gold," *Mother Jones* (Jan-Feb 1995), p.60

10 Government of Canada, ibid, pp. 10-11

11 *Financial Post*, November 17, 1994

12 T.D. Pearse Resource Consulting, *Mining and the Environment*, March 1996, p. 14.

13 Robert Kleinman, ibid.

while at least 17 other sites have been identified as potentially acid-generating.[14] *See map page 13.*

By 1994, The BC State of the Environment Report noted that there were an estimated 240 million tonnes of acid-generating waste rock and 72 million tonnes of acid-generating mine tailings in the province. Each year, the stockpile of acidic and heavy metal-generating tailings and waste rock from mining in the province grows by 25 million tonnes.[15]

Based on the history of Acid Mine Drainage conservationists fear that several new and proposed mining developments with AMD potential could have significant negative impacts on BC's waterways and fisheries, most notably:

- Redfern Resources' Tulsequah Chief copper mine on the Taku River
- Taseko Mines' Fish Lake/Prosperity Gold project in the Chilcotin area,
- Princeton Mining's Huckleberry copper and gold mine
- Royal Oak's Kemess South copper and gold mine near the Finlay River by Mackenzie
- American Bullion's Red Chris copper mine south of the Spatsizi River,
- Manalta Coal Ltd's proposed open-pit Telkwa mine near Smithers' Telkwa River and Bulkley River.
- International Skyline's Bronson Slope Mine on the Lower Iskut River

When the mining industry argues that new mining development is "essential" to our way of life, it tends to understate the fact that we could and should achieve many of our metals needs through better re-use and recycling of existing metal products. When it comes to "precious metals" such as gold and diamonds, the end use poses even more questions about justifications for the ecological costs exacted. Some 83 per cent of the 3,200 tonnes of gold refined throughout the world in 1996 was used for jewellery.[16]

Once it starts, AMD can effectively sterilize an entire water system for generations to come — turning it into a biological wasteland and a huge economic burden.

Each year, the stockpile of acidic and heavy metal-generating tailings and waste rock from mining in the province grows by 25 million tonnes.

14 Bill Price and John Errington, ibid, pp. 68-69

15 *BC State of the Environment Report 1993*, Government of BC, Victoria, 1994, p. 25

16 Gilles Coutrurier, *Canadian Minerals Yearbook 1995*, Natural Resources Canada, Ottawa 1996 p.28.13

Acid Mine Drainage from the Mount Washington mine could go on for a thousand years or more.

While Acid Mine Drainage is not the only threat to waterways from mining, it is the biggest threat, because – as one mining consultant explained – “the present state-of-the-art does not provide any universal solutions” for AMD.[17]

Predicting Acid Mine Drainage

THE SCIENCE OF PREDICTING AMD IS STILL far from conclusive. The gap between the theoretical tests and the real world dynamics of AMD provides reason for caution when mines are assessed and permitted. The BC government, assisted by industry and conservationists, is working to codify the potential and limits of this science in a set of guidelines.[18] These technical guidelines are attempting to apply the leading edge of research on acid mine drainage around the world.

These guidelines will help to lay out the process for collecting the best information possible, and for planning to prevent AMD-related pollution. Nevertheless serious questions remain about a) how rigourously companies will follow this set of non-regulatory guidelines, and b) how we, as a society deal with the scientific uncertainties and ecological risks associated with our current approaches to addressing AMD. The answers to these questions will be measured by our children in the health of our water and fish.

To permit an identified acid generating mine means that we are asking future generations to take on the responsibility for toxic waste sites that are going to have to be managed for possibly hundreds of years. Predictions about the success of managing this waste in the long term are, at best, speculative.

When attempting to predict AMD, the questions that need to be answered include:

- What is the acid generation potential and neutralization potential of the different rock types that will be exposed during the mining process?
- What potential contaminants/metals occur in the rocks that will be exposed?
- Under what conditions will exposure and transport of the contaminants take place at the minesite?[19]

17 T .D. Pearse Resource Consulting, ibid
18 See, William Price and John Errington, op cit
19 Ibid, pp.13-14

To answer these and other critical questions on how the rock will react to disturbance, different tests are used. Generally these tests are referred to as "static" and "kinetic."

Static Testing

STATIC TESTING IS THE FIRST STEP IN understanding AMD potential at a proposed mine. This level of tests involve the description of different characteristics of rock types at the mine site, with an eye to finding those components that are likely to generate acid and those that may buffer or neutralize the acidic potential in the mine waste.

One of the main preliminary tests run in assessing acid potential is called Acid Based Accounting (ABA). This process measures the bulk amounts of acid generating and acid neutralizing materials in samples drawn from key areas in the proposed minesite. Minerals containing sulphur, particularly sulphides such as pyrite, have the potential to generate acidity when exposed to air and water; on the other hand, other groups of minerals,

Metals and the Environment

Depending on geological factors, the metals found in mining waste may include arsenic, cobalt, copper, cadmium, chromium, gold, iron, lead, silver and zinc. Metals are essential to life in trace amounts. In higher concentrations, however, they can be highly toxic.

Metals tend to dissolve and mobilize more easily in the acidic waters associated with AMD. For many rock types, metal leaching will only be significant if the acid levels drop below 5.5 or 6 on the pH scale. However, this is not necessarily the case for elements like molybdenum, zinc, cadmium, antimony and arsenic that can remain soluble at neutral or alkaline pH values.[20] Carried in water, the metals can travel long distances, resulting in the contamination of streams and groundwater.

When metals are in a dissolved form they are more readily absorbed and accumulated by plant and animal life, and therefore generally more toxic than when they are in solid form. "Sub-lethal" negative effects can occur as these metals concentrations settle into streams, stream beds and banks. Because the transfer or "uptake" of metals can occur to animal tissues and plants, they can be passed along to other living things in the food chain.

20 Bill Price and John Errington, *Draft Guidelines for Metal Leaching and Acid Rock Drainage at Mine Sites in BC,* October 1997, MEI, Victoria

"The treatment plant...doesn't stop the source of the pollution, but it would buy us some time. We don't want to wait forever for the river to come back."

such as carbonates like calcium carbonate, can buffer or neutralize acidity.

In ABA, the acid-generating and acid-neutralizing potential of multiple samples are compared, in order to see whether, in theory, they may balance each other out, and therefore not change the natural acidity level (or pH) in local streams and groundwater.

Unfortunately, ABA is a laboratory test and subject to the vagaries of test procedures. Even when large numbers of representative samples are taken from the proposed minesite, it does not account for many environmental and geo-chemical factors that in the field may alter the chemical interaction between the acidic and basic components of the rock.

Kinetic Testing

KINETIC TESTING IS A MORE SOPHISTICATED stage of testing, and is usually the next step after ABA. It attempts to deal with some "real-world" considerations affecting the rate of acid generation. Typical tests include "humidity cells" that can combine larger samples of mine waste with air, water and bacteria. Analysts can then observe the rate at which acidification occurs over longer periods of time (months). This may provide a better indication of whether mining wastes are likely to generate acid, but it cannot be relied on to precisely predict pH levels or metals concentrations into the future. There are a number of variables including the treatment of the bacteria which can skew the results. Interpretation involves subjective estimates which have been shown to limit the accuracy of predictions.

Kinetic testing is more expensive and time consuming than static testing. If rushed or carried out improperly it is subject to failure and the distortion of results.

Preventing & Mitigating Acid Mine Drainage

THE FIRST AND BEST LINE OF DEFENCE against AMD is to prevent the potentially acid generating material from mixing with air and water. With existing technology, AMD is virtually impossible to stop, once the reactions begin. We are then left with the long term, high cost of treating mine drainage water, effluent discharge, and the disposal of treatment sludge.

In those cases when a mine is considered an acceptable risk, the challenge is to isolate and contain the potentially toxic parts of the waste. Isolating waste products from the combination of water and air prevents, or at least slows down the onset of AMD. Containing the waste material and runoff (with liners, impervious pads, diversion and collection ditches, etc.) sometimes keeps the pollutants from running off the mine site into surrounding groundwater or streams.

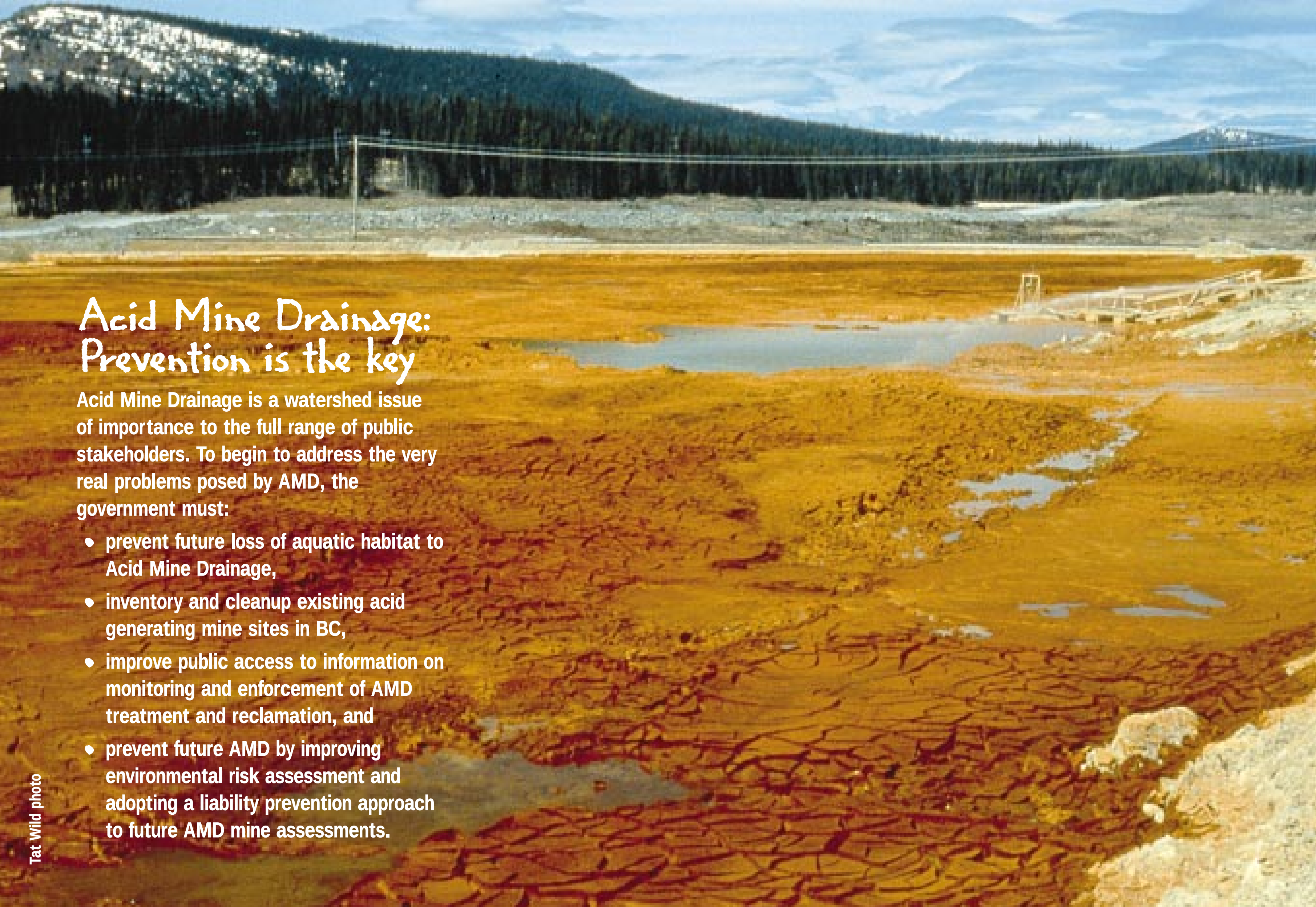
The most reliable strategy for preventing AMD is to submerge the waste rock or tailings under water (behind an impoundment or in a natural water body) to prevent exposure to oxygen. While this is an effective strategy that has been shown to work in the recent past, its success depends on keeping the water cover and dam structures intact forever. Maintaining the water cover behind the tailings dam in a high seismic area (at operations such as Westmin's Myra Falls Copper Mine in Strathcona Park) may prove to be a substantial challenge.

The obvious impacts of filling natural water bodies with mine waste make this waste storage option less desirable in most cases than the construction of an artificial impoundment or dam. An impoundment or dam, however, is more prone to leak, overflow or fail and will require long term maintenance.

Knowing when to say no...

In some cases the best prevention strategy may be to not approve development of high risk mine proposals when they endanger valuable waterways, habitat and fisheries.

This was a primary consideration when a Protected Areas decision in the Tatshenshini Valley prevented the construction of a massive acid-generating copper mine in what was to become a World Heritage Site. In that case the extraordinarily high ecological and economic risks were deemed unmanageable and therefore unacceptable by both the US and Canada.

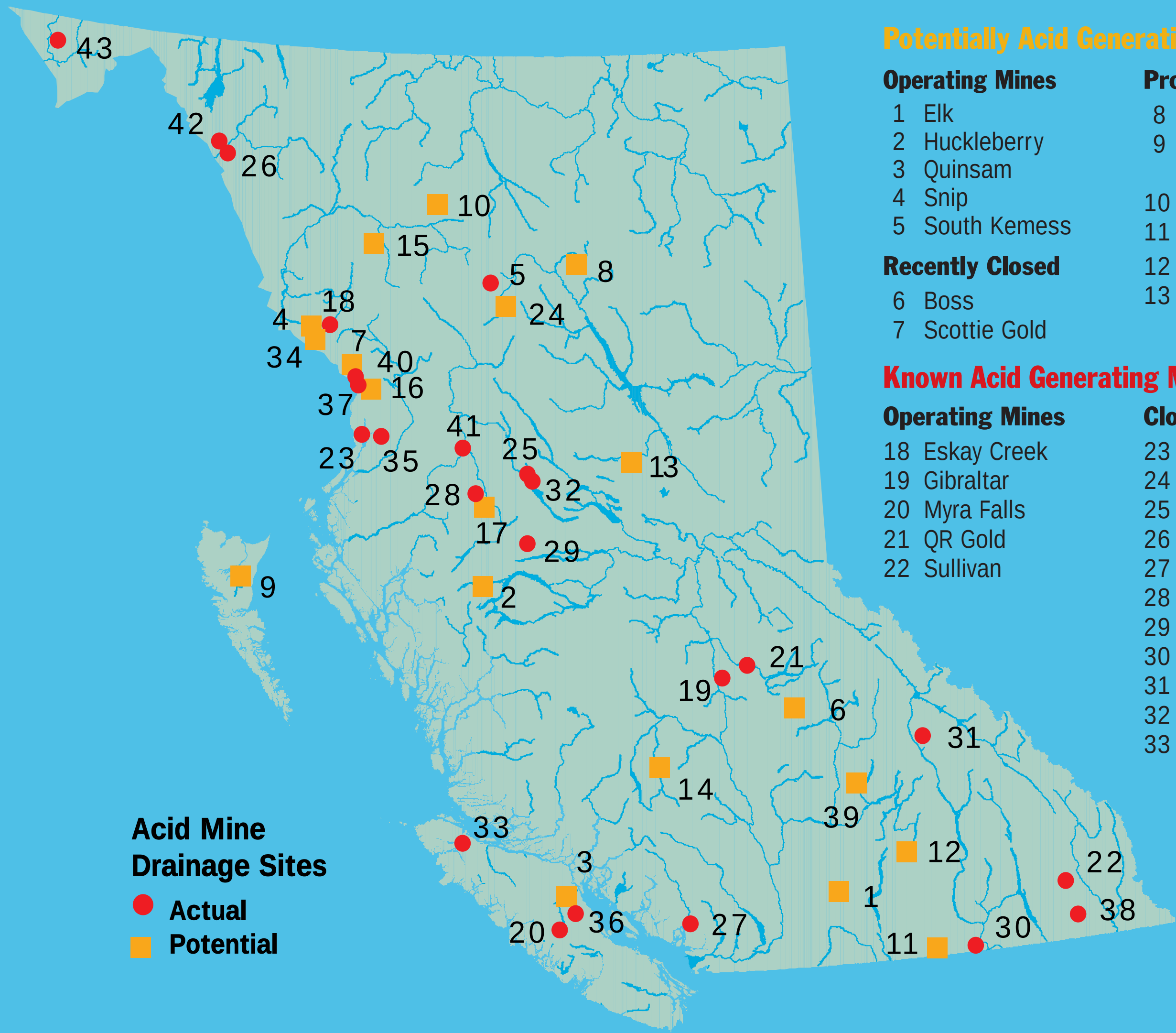


Acid Mine Drainage: Prevention is the key

Acid Mine Drainage is a watershed issue of importance to the full range of public stakeholders. To begin to address the very real problems posed by AMD, the government must:

- prevent future loss of aquatic habitat to Acid Mine Drainage,
- inventory and cleanup existing acid generating mine sites in BC,
- improve public access to information on monitoring and enforcement of AMD treatment and reclamation, and
- prevent future AMD by improving environmental risk assessment and adopting a liability prevention approach to future AMD mine assessments.

Tat Wild photo



Potentially Acid Generating Mines

Operating Mines

1 Elk
2 Huckleberry
3 Quinsam
4 Snip
5 South Kemess

Recently Closed

6 Boss
7 Scottie Gold

Proposed Mines

8 Cirque
9 Harmony Gold (Cinola)
10 Kutcho Creek
11 Lexington
12 Lumby Muscovite
13 Mount Milligan
14 Prosperity (Fish Lake)
15 Red Chris
16 Red Mountain
17 Telkwa Coal
42 Tulsequah Chief (Redfern)

Known Acid Generating Mines

Operating Mines

18 Eskay Creek
19 Gibraltar
20 Myra Falls
21 QR Gold
22 Sullivan

Closed/Abandoned

23 Anyox
24 Baker
25 Bell
26 Big Bull
27 Britannia
28 Duthie
29 Equity
30 Giant Nickel
31 Goldstream
32 Granisle
33 Island Copper
34 Johnny Mountain
35 Kitsault
36 Mount Washington
37 Premier
38 Saint Eugene
39 Samatosum
40 Silver Butte
41 Silver Standard
42 Tulsequah Chief (Cominco)

Exploration Site

43 Windy Craggy

Sources: MEI Acid Rock Drainage Policy, June 1997; Draft Guideline for Metal Leaching and ARD at Mine Sites in BC, BC Ministry of Employment and Investment, Reclamation Section; BC Minfile, BC Ministry of Employment and Investment, Geological Survey Branch

Lessons from the Past

WHEN MINES ARE NOT DESIGNED TO PROTECT the environment after closure, the cost to all concerned has been high. At Placer Dome's Equity Silver Mine, near Houston BC, 42 million tonnes of tailings are being held underwater to prevent contact with air, which would cause AMD. The company also re-contoured the slopes of the waste dumps and placed a compacted glacial till cover on the surface to reduce the infiltration of water through the acid-generating waste rock. Nonetheless, infiltration is occurring at high rates that are tied to changes in rain and snow levels, resulting in higher than predicted costs for treatment of acid generation. Despite the best efforts of the experts working on it, Equity Silver Mine will need pollution treatment measures applied for many centuries.

Mount Washington, a very small mine with a very large cost.


Charles Brandt photo

At the Mount Washington Mine near the Tsolum River, governments have been trying to stop the AMD since 1988. But, says Father Charles Brandt, "today, there is as much copper in the river as there was ten years ago."

The first attempt to control the AMD at Mt Washington was to gather all the waste rock into one great pile, mix it with lime, and then cover it with one metre of till, which is a glacial deposit consisting of gravel and clay. "It was a beautiful piece of work," says Brandt, "but it didn't work." Overlooked at the time was the metals leaching from groundwater moving through the fractured bottom of the old pit.

AMD experts have since considered diverting the water so that it goes around the Mount Washington mine; grouting the mine floor by pouring concrete into it; or putting the whole thing underwater by building a dam.[21]

Now, says Brandt, "there's a big effort to reclaim the mine and enhance the river." The federal Department of Fisheries has put up $450,000 to study the Tsolum River, and Environment Canada has commissioned a study on the mine itself.

They're considering passive treatment of the AMD by running the leachate through wetlands," says Brandt, "and they're looking at active treatment: running a pipeline down the mountain to bring the leachate down to a treatment plant using alkaline and sludge measures.

"It would cost three to five million dollars for the pipeline," Brandt estimates, "but the river might get kick-started and the fish would come back again.

"We know the treatment plant would work," says Brandt. "The problem with it is that it treats the effluent, and it doesn't stop the source of the pollution, but it would buy us some time. We don't want to wait forever for the river to come back."

21 Interview with Father Charles Brandt, May 1996

Other mines, including the proposed Tulsequah Chief project in northwest B.C., have proposed "paste backfilling" to prevent AMD —combining the tailings with concrete and pumping it back into the expended mine shafts. But the success of this method depends on being able to put all the tailings back into the mine — in many cases only about 60 percent of the material taken out of a mine will fit back into it. As well, if the tunnel walls are fractured there will be drainage out of it, and the resulting AMD may pollute groundwater. The technical complexities and uncertainties of this method pose many challenges and raise doubts regarding its long term reliability.

A mitigation strategy proposed by a number of current mines (both coal and metal) in BC is the use of blended dumps *(see Telkwa page 22)*. The theory is that the combination of potentially acid and potentially neutral waste products will result in inoffensive (non-toxic) drainage. In coal mining, under certain blending criteria, there have been some examples of successful dumps. However, hardrock/mineral mines have not, so far, shown evidence of success using this method. The problems in applying the practice to BC are multiple.

- The science in predicting the highly complex geochemical variables at work is unreliable at this time.
- The process of blending is subject to human error in identifying and correctly mixing the two (acid/alkaline) components.
- There is a lack of any systematic track record to allow for comparisons between blended dumps tried in other regions with newly proposed dumps.[22]

Using the ocean as a dump for mine wastes from the Island Copper Mine leaves many ecological concerns.

For these reasons conservationists view blended dumps as an experimental technology at best, that should not be used in sites where failure will pose ecological or economic costs beyond the minesite.

One worrisome approach to AMD prevention is the concept of submarine disposal of mine waste. Some mining companies say dumping the tailings and waste rock into the oceans is a cost-effective and safe way of disposing of it. The concept is that the waste rock is deposited below the surface, where the lack of oxygen and sunlight eliminates chemical reactions.

While it is true that the lack of oxygen prevents the acidification process from starting, there may be other affects on aquatic life on the sea floor. BHP Minerals' Island Cooper Mine near Port Hardy utilized marine dumping of its wastes for years until the mine closed in 1996. Studies of the aquatic life on the sea floor at the site show low abundance and diversity of organisms. [23]

22 Price and Errington, ibid, pp. 37-38
23 Environment Canada, *Briefing Document on Metal Mine Submarine Tailings Disposal*, March 22, 1996

The Tsolum River Experience: Short-term mine, long-term costs

THE TSOLUM RIVER ON VANCOUVER ISLAND used to run clean and clear from its source near Mount Washington to the Courtenay estuary. For thousands of years, the river provided rich runs of coho, pink, chum and cutthroat salmon, as well as steelhead trout that weighed up to 23 pounds.

The river was rich with life, sustaining human communities and the entire ecosystem through which it flowed. Impacts on the river started in the post war era when logging and irrigated agriculture moved into the watershed, gravel was mined from the riverbed in the lower reaches and then, in 1964, the Mt Washington Copper Mining Co. moved into the upper Tsolum watershed.

The company began a small open-pit copper mine adjacent to the Tsolum River. During three years of operation, the company excavated 360,000 tonnes of ore and 940,000 tonnes of waste rock before abandoning the mine in 1966.

It was a small mine, high up in the mountain, disturbing an area of only 13 hectares. But it left behind a toxic legacy that has spread far beyond the mine's perimeter.

Father Charles Brandt moved to the Tsolum River area back in 1965 – "when they were still bringing the ore down," as he recalls.[24] Over the past 30 years Brandt has watched the demise of the fishery. His observations are backed up by a recent government research report that states: "After 1966, the coho escapement has declined steadily from 15,000 to a low of 14 in 1987. The coho are particularly vulnerable to toxicity caused by acid mine drainage as they reside in the system for up to 14 months after hatching."[25] Trout are thought to be as vulnerable to the changes in water quality because of their long residence in fresh water.

Despite expensive, publicly funded restocking efforts, government reports show "virtually no salmon" living in or returning to the Tsolum River. And, says Brandt, "the wonderful steelhead runs are also gone from the river—a tremendous loss."

Despite expensive, publicly-funded restocking efforts, "virtually no salmon" are living in or returning to the Tsolum River.

24 Father Charles Brandt, op cit

25 *BC Environment Water Quality Branch, Water Quality Assessment and Objectives for Tsolum River Basin,* BC Ministry of Environment Lands and Parks, April 1995. P. 11-12

"By 1985", says Father Brandt, "the Tsolum River was as good as dead." With its demise came the loss of the Tsolum river fishery of pinks, coho, chum and steelhead, which had generated as much as $2 million per year for the community.

The government's watershed assessment concluded that "the fisheries resource is believed to have declined [by 90 per cent] predominantly because of Acid Mine Drainage from Mount Washington."[26] It has been estimated that the loss of the fishery, combined with millions of taxpayer dollars spent for mine clean-up, have cost at least $60 million so far.

The Tsolum River's wild salmon became the big casualty at the Mount Washington mine site.

Ric Careless photo

The Britannia Mine: Costs of Coastal Contamination

ANACONDA OPERATED ITS BRITANNIA COPPER mine near Squamish from 1927 to 1974, but the abandoned mine's AMD threatens to pour into Howe Sound forever. Every day, millions of litres of contaminated water from the mine flow into the ocean inlet via Britannia Creek and a large underwater outflow pipe.

A BC Environment spokesperson stated in 1996 that "there's no life in the creek," and added that the mine's toxic water has had a similar effect on and around Britannia Beach.

Robert McCandless, a mining specialist with Environment Canada, has said that "there are huge areas devoid of life" and that the mine is largely responsible for the disappearance of fish and shellfish from the area. By May 1997, it was reported that the only sign of life in Britannia Creek is some algae on rocks.[27]

For many months of the year, rainwater and snowmelt pour into the mine and, through the AMD process, leach metals and acidic water out

26 ibid, p. viii
27 Glenn Bohn, "Metals Pour into Howe Sound From Old Mine," *Vancouver Sun*, (May 31, 1997, p A16)

of some 160 kilometres of tunnels. The copper and zinc-laden AMD pours into the ocean—as it has since the mine was abandoned.

Estimates of the clean-up costs for Britannia mine vary. Ian MacDonald, a senior environmental protection officer with the BC Environment ministry has estimated it could be several tens of millions." [28]

Equity Silver: Long-term high costs of failed pollution prediction

SOUTH OF HOUSTON, BC LONG-TERM landowner Glenda Ferris has, over the last 16 years, learned about AMD issues firsthand. She's the first downstream user of water affected by Placer Dome's Equity Silver mine, which operated from 1980 to 1994. That operation resulted in 42 million tonnes of tailings and 80 million tonnes of waste rock in three dumps that are acid-generating. The tailings are kept behind a large dam and under water cover that must be maintained forever. The waste rock dumps have been covered with a $5 million compacted glacial till layer in an effort to slow down the infiltration of water and oxygen that would feed the AMD process *(see below)*.

Ferris, a member of the Equity Silver Mine Surveillance Committee since 1982, scoffs at the idea frequently put forward that mining is a temporary land use. "If you're dealing with open pit mines, you're going to have permanent transformation of the land." [29]

The Equity Mine is at the top of two watersheds, where streams flow into lakes on either drainage and from there into the Bulkley River. The Bulkley and Skeena Rivers are among the richest salmon fisheries in BC. Four kilometres of streams and nearly one hundred hectares of wetlands have been lost to the minesite, tailings impoundments, waste rock dumps and runoff collection systems. Contamination of the local lake and stream sediments has been documented and will remain an ongoing issue.

The acid-drainage from the Equity mine flowed into Buck Creek in 1982 until a partial containment system was constructed. Again in 1983 AMD affected water quality in Buck Creek and Goosley Lake. In 1983 the company plead-

Four kilometres of streams and nearly one hundred hectares of wetlands have been lost to the minesite, tailings impoundments, waste rock dumps and runoff collection systems.

28 quoted in Margaret Munro, "Potent Bacteria Utilized to Harvest Metals While Cleaning Water from Brittania Mine," *Vancouver Sun* (June 13, 1996)
29 Interview with Glenda Ferris, May 1997

ed guilty to destruction of fish habitat and was fined $12,000. Later that year a huge collection system including ponds, sumps, and ditches linked with a series of pumping stations was finally put in place. This system directed AMD to the treatment plant which neutralizes the acidity of the drainage with powdered lime that settles the heavy metals into a sludge.

Says Ferris, “You can never get rid of heavy metals created by AMD, you can only change the storage of the metals from an acidic water flow to a more stable sludge.” Even then, a safe place must be found to store the sludge, which in this case ranges between 90,000 and 120,000 cubic meters annually. At the Equity site, AMD sludge is being stored in the remaining “main zone” pit left empty after mineral excavation. Storage volumes may exceed the capacity after a few centuries.

Equity Silver was the first mining operation in Canada to be required (under the BC Mines Act) to post a bond for maintenance of an AMD problem, in perpetuity. The bond now stands at $25 million to guarantee payment of costs for this site.

The cost of collection and treatment for 1997 was $1.5 million. Placer Dome pays that through the bond agreement but, as Ferris points out, the risk of heavy metal contamination over time still stays with the watershed and the people downstream. It is conservatively estimated that Equity mine will have to be maintained and monitored for AMD for centuries.

Heap Leaching and Cyanide

AN EXTRACTION METHOD THAT IS INCREASINGLY common for gold extraction is referred to as “heap leaching.” There is limited use of this method in BC, however it is expanding rapidly in areas such as the western United States. It is a trend worth monitoring for the future.

“Cost-effective” thinking is behind this gold-extraction method. Crushed ore or gold-mine tailings are piled up on top of a synthetic liner and then sprayed repeatedly with a cyanide solution. As much as 75 gallons of the solution is applied each day for every square foot of the ore heaps, which can weigh millions of tonnes each.

The cyanide solution trickles through the ore, bonding to the gold and other metals, and then sinks to the bottom of the heap. There it flows into collection ponds, after which the gold is recovered from the solution by adsorption onto carbon/charcoal.

Short term exposure to high levels of cyanide, by inhaling, drinking, or eating contaminated substances, or by skin exposure is very toxic and sometimes fatal. Lower level, (sub-lethal) exposure over time can also cause problems with breathing, nervous system disorders and the digestive tract.[30]

Heap leaching carries a high environmental price: across North America the resulting pools of cyanide kill thousands of migratory birds that drink from them. Leaks from these pools also contaminate groundwater. The liners beneath the ore heaps — usually made of high-density polyethylene — have a tendency to tear and rip from a variety of factors including carelessness in depositing the ore, and from natural factors such as ice build-up which is a particular problem in northern regions.

The ore heaps may reach to as much as 150 feet in height—a massive weight of material bearing down on the leach pad liner.

At Galactic Resources Summitville heap-leach gold mine in Colorado, the leach pad was leaking only six days after the first cyanide hit the heap. From there the problems multiplied and by June 1990 cyanide had killed the Alamosa River for 17 miles downstream of the mine. U.S. taxpayers have been saddled with the $110 million clean-up of the mine site, abandoned in 1992 by its Canadian owners.[31]

While cyanide heap-leaching is cheap and allows gold production from ore bodies once considered too meager to mine, it can have devastating effects on waterways, aquatic life and other wildlife. Such losses need to be factored into the economic accounting before a mine is permitted.

By June 1990 cyanide had killed the Alamosa River for 17 miles downstream of the mine. U.S. taxpayers have been saddled with the $110 million clean-up.

30 Jim Lyons and Carlos De Rosa, *Golden Dreams, Poisoned Streams,* Mineral Policy Center, Washington 1997, p 243.
31 Richard Manning, "Going for Gold," *Audubon Magazine,* (Jan–Feb, 1994, p.73)

Telkwa: Assessing The Real Costs of Mining

Coal mining would bring fisheries and AMD concerns to Telkwa

THE ONGOING LEGACIES OF MOUNT WASHINGTON Mine, Britannia Mine, Equity Silver Mine and other acid-generating mines in B.C. cannot be overlooked when new projects like Manalta's Telkwa Coal Mine are considered.

Ivan Thompson, a Smithers resident and director of Driftwood Foundation, says, "acid drainage is a major issue at the proposed Telkwa Coal project. They want to build four open pits, plus some 'satellite pits' within a few kilometres of two rivers: the Telkwa River and the Bulkley River. There is acid drainage material there, and fault fractures in the bedrock close to the river. The project has a high probability for AMD."

East Kootenay Environmental Society photo

Not only are there some communities that draw their water from the rivers, says Thompson, but these are tributaries that flow into the Skeena River. The Skeena salmon fisheries are second only to the Fraser fisheries in importance in the province. "This is a tremendously important salmon fishery and several First Nations have traditional jurisdiction over the area," Thompson says.

At the proposed Telkwa open-pit coal mine, Manalta Coal Ltd. intends to mine up to 1.5 million tonnes of high quality, low ash, bituminous coal per year for the next 25 years. New infrastructure at the site will include a five kilometre haul road, an eight kilometre haul road, a bridge over the Telkwa River, power lines, a coal washplant, mine service facilities, and a loading facility.

The company proposes a tailings disposal area of 100 hectares for the duration of the mine. Admitting that certain waste material has the potential to generate acid rock drainage, the company's Project Application claims that "selective handling of specific materials will alleviate this risk. Mine plans have been developed to minimize the amount of material that can be backfilled into the pits. Manalta also proposes a comprehensive reclamation plan in which waste rock dump areas will be recontoured and covered with previously salvaged till and soil material that will support future land uses such as forestry and agriculture...Most of the final pit areas that cannot be backfilled will be reclaimed to wetlands, small lakes, and isolated rock walls."

The language sounds reassuring, but needs a translation.

In her April 1997 review of Manalta's project for the B.C. Environmental Assessment Office, Rosemary Fox identified several unacceptable features of the mining proposal. She calls the decision to use blended dumps at Telkwa Mine "especially disturbing", in view of the fishery values at stake. Fox points out: "The lower layers will be particularly vulnerable to the onset of acid generation as water from [precipitation] accumulates and creates wet-dry cycles at ground level. Acid generating 'hotspots' are also likely in unevenly blended areas within the dump."[32]

The company's plan to use two unproven measures — blended dumps and dumps with compacted till covers — fails to provide assurance that AMD can be prevented.

"I think this [Telkwa Mine] has the potential to have a real impact on water quality and aquatic biological systems," says Rosemary Fox. "We've got a really important fisheries resource in the Telkwa and Bulkley river systems. These are major salmon and steelhead rivers, and they are likely to be put in jeopardy by this project."

Beyond its impact on the local watershed, the coal from Telkwa has other environmental implications. Coal is one of the largest

The risk of heavy metal contamination hangs over the watershed and the people downstream. It is conservatively estimated that Equity mine will have to be maintained and monitored for AMD for centuries.

32 Rosemary Fox, correspondence to the BC Environmental Assessment Office, *Telkwa Review* April 1997

contributors to greenhouse gases and global climate change.

As Rosemary Fox observes in her comments on Manalta's proposed Telkwa Coal Project, a proper environmental assessment needs to weigh all the costs against all the benefits.

AMD jeopardizes not only fish, but the animals who feed on them.

James Katz photo

Mining, Water and the Law

IN BC, THE REGULATIONS FOR PREVENTING and managing the impacts of mine waste are captured in a range of laws including the federal Fisheries Act, the BC Waste Management Act, the BC Mines Act, and both the BC and Canadian Environmental Assessment Acts.

Unfortunately, significant reductions in federal and provincial government budgets have affected the capacity to administer, monitor and enforce existing laws and policies. As a result, there have been ongoing water quality and waste management problems at many mines, including the recently approved Huckleberry and South Kemess mines. There have been a number of preventable accidents including massive sediment loading into fish-bearing streams, the building of roads with acid generating waste rock, non-compliance with waste handling plans, and repeated violations of water quality standards.

Alan Young, of the Environmental Mining Council of BC, notes that "over the last year, we have seen an inability in regional government offices to monitor and enforce environmental standards at several mine sites. The agencies do not have the resources to do the job, and unfortunately, some companies don't seem to respond unless penalized. Without enforceable standards we are faced with decreased corporate accountability, and increased ecological liability."

According to Young, "we can pay now or pay later, and history has shown us that, especially with mining, clean up is always more expensive than prevention. Good companies understand this concept, but the laws are not there for the good guys."

The Mining Association of BC has expressed its vision for environmental regulation in the form of its "Public Policy for Mining." This vision calls for increased self regulation and de-regulation of environmental standards, limited liability for environmental damage and increased right of access to the land base.

This deregulation approach favoured by the industry would further reduce accountability, consistency and transparency with respect to protecting ecological values like clean water and healthy fisheries.

Despite protests by some companies that standards would be met voluntarily, and that self regulation is "more efficient," there is little evidence to suggest that this will result in clean, safe water. Without an effective regulatory base, voluntary measures have not, and will not deliver reliable, consistent safeguards and environmental performance improvements.

Recent surveys of business leaders have confirmed the importance of strong laws and regulations in achieving environmental protection. In 1994 and again in 1996 KPMG Management Consultants conducted surveys of over 300 businesses and municipalities questioning them about their environmental management programs. In both surveys, over 90 per cent stated that their primary motivation for establishing environmental management systems was compliance with regulations. Approximately 70 per cent cited potential directors' liability, a factor also related to environmental laws. Only 25 per cent claimed to be motivated by voluntary programs."

Deregulation favoured by the industry would further reduce accountability, consistency and transparency with respect to protecting clean water and healthy fisheries.

Acid Mine Drainage: What can we do?

As concerned individuals committed to the protection and respect of our natural world, we must:

- identify operating or abandoned mine sites in our regions,
- learn about how mine sites are being monitored, what permits have been issued, and how citizens are involved in decision making.
- get more information about AMD and other mining issues across BC and in our community, and
- insist that prevention of AMD is the only acceptable and responsible strategy.

BC Wild

Environmental Mining Council of BC

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For further information on mining issues, please contact:
Environmental Mining Council of BC.
1216 Broad Street Victoria, BC V8W 2A5
Phone: 250-384-2686, Fax: 250-384-2620
E-mail: emcbc@miningwatch.org