

**ABANDONED MINES
IN
CANADA**



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SUDBURY, ONTARIO

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PREPARED FOR
MiningWatch Canada

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ABSTRACT

WOM Geological Associates Inc. was retained by MiningWatch Canada to undertake a survey of abandoned mine inventories in Canada. Questionnaires were sent to provincial and federal agencies, requesting information on inventories, number of abandoned mines, testing and remediation completed, and current management policy.

The term “abandoned mine” describes sites where advanced exploration, mining or mine production has ceased without rehabilitation having been completed. Public health and safety, environmental safety and aesthetic concerns are commonly associated with abandoned mines. Problems generally arise from one or a combination of four factors: mine closure with little or no reclamation, inadequate government policy, use of a site for a purpose other than mining, and lost or missing site data.

Response to emergencies at abandoned mines presents a special challenge. The preparation of an emergency response plan for abandoned and “closed out” sites requires a chemical and physical stability assessment of all features (tailings, crown pillars, etc.).

Detail of abandoned mine inventory work in Canada varies widely. Although more than 10,139 abandoned mines are on file, it would appear that only 60% have been field assessed. Many sites may be no more than shallow pits or trenches.

Recent improvements to policy, legislation, practice and technology are helping to bring an end to the legacy of abandoned mines. It is recommended that future inventory work examine all mine site features, not just toxic or waste materials. There is a need for risk assessment standards and documentation standards. Emergency response should be a component of mine reclamation plans. More resources are required to complete the assessment of abandoned mines and for safe storage of the data collected. The federal government must play a greater coordinating role for abandoned mines and mine reclamation. A Canadian Abandoned Mines Committee would lead to a greater sharing of information among all interested groups.

1.0 INTRODUCTION

The issue of abandoned mines with its public safety and environmental concerns resurfaces continually throughout Canada and around the world. In the past, the media and public usually considered mine subsidence or tailings spills at abandoned sites as isolated occurrences. Workers in the mining environment field have come to realize that abandoned mines pose threats to the environment and to public health and safety, and must be assessed. Attempts have been made in many countries to locate, study and correct problems at abandoned mine sites. A first step in rehabilitation is the identification, location and assessment of abandoned mines.

WOM Geological Associates Inc. has been retained by MiningWatch Canada to conduct a survey of abandoned mine inventories in Canada. The survey would include review of inventory work completed to date, field inspections completed, problems found and remediation completed. Policy and legislation dealing with abandoned mines and mine reclamation was to be examined.

Questionnaires were sent to all provincial and territorial agencies responsible for abandoned mines. Additional questionnaires were also sent to Natural Resources Canada, Atomic Energy Control Board, Indian and Northern Affairs Canada and Environment Canada. The following report is based on the information received from the various agencies and the author's some twenty years experience working in the field of abandoned mines. It provides a snapshot of the present state of abandoned mines in Canada.

2.0 WHAT IS AN ABANDONED MINE?

The Ontario Mining Act has used the term "abandoned" to describe sites where the proponent has ceased or suspended indefinitely advanced exploration, mining, or mine production on the site, without rehabilitating the site. Other terms commonly used in the mining industry include: inactive mine, orphaned mine, and unattended mine. The term "orphaned" mine has been used by some to describe sites without an owner. Sites described as "temporarily shut down" or "under care and maintenance" would imply that an owner is still actively managing the site.

In choosing a definition, the important point is the need to focus on public safety and environment problems, not on who owns the site. The term "abandoned" mine, as defined above, seems to best serve this purpose of this report.

3.0 THE IMPACT OF ABANDONED MINES ON SOCIETY

Problems arising from some abandoned mines include: public health and safety, environmental safety, and aesthetic concerns. Ironically many complaints from the public address the latter. Commonly, little attention has been paid to the "hidden hazards" posed by chemical and physical stability attributes.

The record shows that housing developments have been placed on arsenic bearing tailings areas, or on areas of unstable underground workings. Highways, railways, schools and even senior citizens' homes have been situated in areas of risk. Waterways and soils have been contaminated by toxic water leakages or by airborne materials. Examples of these types of problems can be found worldwide, not only Canada.

Abandoned mine hazards put people and our environment at risk. Abandoned mines present a bad image for mining in Canada and have been described as an "Achille's Heel" of the mining industry.

4.0 WHY DO WE HAVE AN ABANDONED MINES PROBLEM?

One might conclude that the main reason for abandoned mine problems, is because of unscrupulous miners or civic developers. As like most other activities in society, the great majority of officials have attempted to do good jobs, and some have done exemplary work. A few have performed in an unprofessional or unethical manner.

Four main factors exist for the creation of abandoned mine problems: Mining Related, Policy and Administration Related, Civic Development Related, and Data Related.

4.1 Mining Related

Mining exploration and development activities can leave behind the following problems: openings to surface, areas of potential collapse (subsidence), mine wastes, mine effluent, and surface structures and machinery. Upon closure, under normal conditions, mining company officials would place bulkheads in the openings, stabilize or fence off areas of potential subsidence, clean up and contain the mine wastes, treat the mine effluents and remove surface equipment and machinery. A number of elements have occurred to create the legacy of abandoned mines: Economic, Technical and National Security.

4.1.1 Economic

Unforeseen events, such as a sudden drop in mineral prices, insurmountable mining/milling difficulties, or infrastructure problems has caused many mining operation in Canada to close ahead of schedule, often leaving the company bankrupt and unable to properly close out the site.

4.1.2 Technical

Prior to the introduction of more advanced drilling equipment in the 1930's and 40's, mineral deposits had to be evaluated by the sinking of abundant of exploration shafts and test pits. Areas of open shafts and test pits were left behind. In the early history of mining in Canada, not much was known about the physical and chemical stability factors that would develop into problems years later. Crown pillars, the body of rock remaining between the surface and the mined out workings below, began to fail with time, causing unexpected subsidence problems. The recently developed science of rock mechanics can now better predict unstable rock masses and provide corrective procedures. Acid drainage and release of base metals into natural drainage systems is now better understood, and more easily remedied, thanks to advances in science and technology.

4.1.3 National Security

Several mines operated in Canada during the Second World War as part of the war effort and the need for strategic materials. For example, the Kam Kotia base metal mine, near Timmins, Ontario, was operated by the Federal Government as a source of copper. Previous to the "Lend-Lease Act" in 1941 and the entry of the United States into the war, gold mining in Canada was classed as a war industry. Gold production in Canada was essential for the purchase of many war necessities from neutral countries such as the United States. With the signing of Lend-Lease Act, a number of mining ventures were immediately closed down. Little was done in the way of reclamation in wartime years.

4.2 Policy and Administration Related

The Canadian mining industry spans five centuries of development. Few government mine reclamation policies and regulations existed in Canada until the latter part of the Twentieth Century. Legislation that existed in the mid-1900's, addressed the emplacement of bulkheads in openings to surface and the revegetation of tailings. Standards or guidelines were generally nonexistent. There were no or few requirements to clean up sites or to ensure the physical and chemical stability of mine wastes. Penalties for noncompliance were minimal. Nothing was in place to provide governments with financial security in the event a mining company went bankrupt and was not able to cover the cost of mine reclamation. Legislation did not address testing and remediation of suspected hazards on private property.

At the beginning of the twentieth century, some mining acts in Canada required prospectors to have discovered mineralized veins before being able to record a mining claim. This resulted in a proliferation of test pits and exploration shafts being sunk in search of such mineralization.

Mining company policy and government legislation was focused on worker health and safety issues, not on impacts to the environment. Some companies did however make considerable effort for mine closure, placing bulkheads in openings, fencing off areas, and producing detailed maps showing the location of all closed out features contained on the property.

Government management of mine environment issues, including abandoned mines, has been inconsistent. In some jurisdictions, mining environment is handled by the government environmental agency, while in others, it is handled by the mining department. In Ontario, the responsibility for the management of abandoned mines has been transferred to five successive departments within a period of forty years. Such approaches to mine environment management in Canada have, in some cases, produced gaps and overlaps of policy and regulations. This is not a problem restricted to Canada alone.

4.3 Civic Development Related

Until recently, little or no requirements existed in Canada for a developer or government agency to have regard for abandoned mines. As a result civic structures (building, roads, etc.) have been placed on or adjacent to sites without any testing for chemical or physical stability of the abandoned mine features. In many cases the developers were unaware that their project was being constructed on or near an abandoned mine site. Many developers assumed that such sites would be red flagged when they made application for necessary permits.

4.4 Data Related

During the operating life of a mine, records and maps are stored in fireproof vaults on site. Copies of the documents would be given to government agencies on a periodic basis and on closure of the mine. With unscheduled mine closures, this data was commonly not made available.

The bulk of the data provided to government agencies consisted of maps showing the location of underground workings and openings to surface. These maps were useful from a public safety perspective and emergency response. Some agencies have stored this information in provincial archives. Others have created microfiche files. Many maps were stored in cardboard boxes in basement storage areas. Information stored in unprotected areas has been lost due to fires, water leaks, etc. Cost cutting measures by some agencies have resulted in this information being discarded, including computer databases.

5.0 EMERGENCY RESPONSE

Abandoned mines commonly have no regularly scheduled inspections. In the event of mishap there is no one to sound an alarm, no emergency response team available (some agencies react on an ad hoc basis, but may not be knowledgeable about characteristics of mine sites), technical data about the site is not available, and no appropriate equipment on hand. Infrastructure such as roads and bridges may be no longer in place. In contrast, active mine sites have frequent inspections, trained emergency response staff, site data readily available, specialized equipment on location, and infrastructure in place.

A good emergency response plan for an abandoned mine would factor in all features present at the site: tailings dams, location of underground workings and openings to surface, waste dumps, surface structures such as headframes, etc. For example, the plan would evaluate the tailings area and attempt to predict what impacts would occur in the event of a catastrophic failure of the confinement structure. How far would the tailings flow and what physical damage (to homes, highways, waterways) could be done? Do the tailings contain any toxic materials? What impacts would these materials have on the surrounding environment? The plan would list all the persons to be contacted in the event of an emergency and the legislative authority enabling work to be done.

An emergency response plan can expose weak links (areas of risk) in the system, which in turn, lead to risk analysis for the abandoned mine. For example, the plan may reveal that a major highway crosses over a weak crown pillar. It may be determined that, if the crown pillar were to fail and cause the highway to collapse into the

mine workings, the financial loss (to commercial transportation plus repair of the highway) would far exceed the cost of remedial work on the crown pillar. The risk may be far too great to leave the site undone.

None of the above can be implemented with inadequate inventory data.

6.0 THE LEGACY OF ABANDONED MINES IN CANADA

The following data on abandoned mine inventories is derived from information provided by the questionnaires returned by government agencies across Canada. The survey indicates that an approximate total of 10,139 abandoned mines are on file. (Sites recorded in federal government inventory records are also listed in provincial/territory inventories and thus already included in the above total.) Some inventories include isolated small trenches and test pits as they fall within the definition of "mine" as described by legislation. The quality of inventory data, as demonstrated by the survey, varies greatly. Some jurisdictions have created computer databases that are, or planned to be, accessible to the public. Other jurisdictions have only paper files. Many abandoned mine sites have been recorded on the basis of library research only. While more than 60% of known abandoned mines appear to have had field inspections, most have had little or no test work for physical or chemical stability. Tens of millions of dollars have been spent by governments and companies to clean up and remediate abandoned mines across Canada, especially high profile sites. Much, however, still remains to be done.

6.1 INVENTORIES OF ABANDONED MINES IN CANADA

Newfoundland and Labrador

Investigation of the Potential for Groundwater Contamination Caused by Past and Present Mining Activities - report prepared for Environment Canada, 1988.

CIM publication - Once Upon a Mine: The Story of Pre-Confederation Mines on the Island of Newfoundland, is a source of information on the location of pre-confederation mines in Newfoundland.

Presently updating list of abandoned mines in the Province.

Nova Scotia

Catalogue of abandoned mine openings initiated in 1984 at the request of the Nova Scotia Ombudsman. Being continuously updated. All mine openings have a UTM coordinate assigned along with an individual ID number.

New Brunswick

No formal inventories have taken place. Information on abandoned mines is on file but needs to be compiled. Presently in the stages of compiling a database.

Prince Edward Island

An inventory is not necessary as there is no history of mining in the Province.

Québec

Inventory of sites needing reclamation work, 1993-1994.

Inventory of industrial wastes, started in 1998.

Inventory of tailings deposits in Quebec, March 31, 1999.

Ontario

Computer database, Abandoned Mines Inventory System (AMIS) of all sites in the Province. Started in the 1980's and continuously updated.

Preliminary stability evaluation of unattended tailings sites in Ontario, 1991.

Inventory of site assessments conducted between 1991-1994.

Manitoba

A listing of mines that meet the definition is available.

Saskatchewan

1976-1977 Inventory of abandoned mines in Uranium City area, "Highgrade and Mine Site Environmental Inspections Uranium City Area 1976, 1977".

1988-1989 Inventory of abandoned mines in south (coal) and north (metal) "Abandoned Mines in Saskatchewan" Mines Pollution Control Branch, Saskatchewan Environment and Public Safety (now Saskatchewan Environment and Resource Management).

Alberta

Alberta Energy and Utilities Board coal mine database (includes some non-coal underground mines and oil sands mines).

Coal Mine Atlas showing all mines contained in database, most recent edition produced in 1994.

British Columbia

"Survey of Closed and Abandoned Mines in British Columbia for Acid Mine Drainage, March 1992.

*Currently initiating a complete database for closed mines for completion in early 2001. Presently do not have a comprehensive system for tracking closed mines.

MINFILE database contains information on historic mines.

District offices retain "as built" drawings of underground and open pit workings.

Yukon, Nunavut, Northwest Territories

The Northern Affairs Program (NAP), through its Waste Management Program has been assessing and remediating contaminated sites since 1991. Also, since 1992, NAP has maintained an inventory of all abandoned sites. Included in the inventory are abandoned mines. NOTE: Sites must be abandoned with no legally responsible party in operation - this does not include mothballed or inactive sites with an identifiable/known owner.

Atomic Energy Control Board

Inventory of "abandoned" uranium mining/milling sites that have significant quantities of "prescribed substance" present; i.e. tailings. Inventory started in the late 1970's and updated periodically. Concerned with calling these sites abandoned, orphaned or unattended. Would prefer to call these uranium sites containing tailings as "not formally regulated (licenced) by the AECB".

Environment Canada

Contaminated Sites Division. This group has just been re-established. It was previously managing The National Contaminated Sites Remediation Program, a cost-shared program, which ended in 1995.

Natural Resources Canada - CANMET, Mining and Mineral Science Laboratories

Computer database of selected sites provided by Nova Scotia, Ontario, Yukon, and Northwest Territories, compiled in 1990's.

Natural Resources Canada - CANMET, Envirolab

Northern Ontario Development Agreement (NODA) Environmental Project, 1996.

Summary of Canadian Mine Waste Data, CANMET Report of Results of a Workshop on Mine Reclamation, 1994.

6.2 NUMBER OF ABANDONED MINES IDENTIFIED AND ON FILE IN CANADA

Newfoundland and Labrador

39 mine sites on file.

Approximately 70% have been verified by field inspections.

All 39 sites listed in the 1988 report have been tested.

The 39 sites were assessed for groundwater contamination potential. Five were judged to have high potential, 26 moderate potential and eight low potential.

The majority of the properties have received some rehabilitation work, but have not been fully rehabilitated.

Nova Scotia

300 mine sites on file.

30% have been verified by field inspections.

less than 10% have been tested for physical and/or chemical stability.

the majority of sites tested were found to have problems.

remedial work has been done on one site.

New Brunswick

approximately 60 mine sites on file.

10%-20% have been verified by field inspections.

less than 5% have been tested for physical and/or chemical stability.

no comment on the number of sites found to have problems.

remedial work has been done on less than 5% of the sites.

Québec

1000 mine sites on file.

all sites have been verified by field inspections, except for 25 sites that could not be located.

physical stability has been tested at most sites and chemical stability has been tested at some sites.

700 sites have had security work and 95 tailings areas have undergone remedial work.

Ontario

6015 mine sites are on file

50% have been verified by field inspections.

less than 1% of the sites have been tested for physical and/or chemical stability.

the number of sites found to have physical or chemical stability problems is unknown.

the percentage of sites to have undergone remedial work is unknown.

Manitoba

number of abandoned mines identified and on file - N/A.

percentage of sites verified by field inspection - N/A.

percentage of sites tested for physical and/or chemical stability problems - N/A. The larger identified sites have been tested.

the number of sites found to have physical or chemical stability problems - N/A.

the percentage of sites to have undergone remedial work - N/A.

Saskatchewan

number of abandoned mines identified and on file - 505+ .

percentage of sites verified by field inspections - 100% of 405 coal mines, 37% of 100+ metal mines (100% for those with tailings).

percentage of sites tested for physical and/or chemical stability problems - ~ 5-10% chemical, 70-80% physical.
the number of sites found to have physical or chemical stability problems - coal-55 (physical), metal-30 (chemical and/or physical).
the percentage of sites to have undergone remedial work - coal-100%, metal ~ 23% (60% with tailings).

Alberta

number of abandoned mines identified and on file - about 2100
percentage of sites verified by field inspections - about 3/4 of the (very) small mines were inspected when in operation (records available) as well as a larger mine.
percentage of sites tested for physical and/or chemical stability - very few and only for physical stability.
the number of sites found to have physical or chemical stability - most, which was usually the reason for the 'recent' inspection.
less than 1% of all mines have undergone remedial work.

British Columbia

do not know how many mines are truly abandoned, likely very few.
preliminary estimate of historic mines indicates a total of 2900 mineral occurrences. MINFILE database has 247 metal mines which have produced over 10,000 tonnes. Of these, 176 produced 50,000 tonnes.
percentage of sites which have been verified by field inspections is not known. However, most of the mine sites identified are known to Ministry staff.
percentage of sites which have been tested for physical and chemical stability is not known. It is expected that many of the mines have been sampled by mining companies, Ministry staff or Ministry of Environment staff. Current work to produce a database will endeavor to find this data through a diligent search of regional and headquarters files.
*estimated that there are less than 20 historic mine sites with environmental problems.

Yukon, Nunavut, Northwest Territories

approximately 120 abandoned mines in the Yukon Territory; 3 in the Nunavut Territory; and 37 in the Northwest Territories.
all abandoned mine sites across the North have been visited and verified by field personnel.
in the Yukon Territory, 100% of mine sites with suspected chemical and/or physical hazards have been assessed.
in the Northwest Territories (including Nunavut) out of a potential 40 sites, 11 have yet to be assessed, with 29 assessments completed - 3 in Nunavut and 26 in NWT.
in the Yukon Territory, 45 sites were found to have physical or chemical stability problems. In the Northwest Territories, 22 of the 29 sites assessed - Nunavut 2 and NWT 20 - sites were found to have physical or chemical stability problems.
in Yukon - 2 sites - (5%); NWT - 10 sites (Nunavut 2 - NWT 8) - (34%) have undergone remedial work.

Atomic Energy Control Board

eight uranium mining/milling sites with tailings that are "not formally regulated (licenced) by the AECB" are on file.
100% have been verified by field inspections.
100% have been tested for physical and/or chemical stability problems.
most sites were identified to have some form of stability/chemical problems.
negotiations are currently underway between the federal and provincial government to establish the need for and cost sharing for remedial works at two sites in northern Saskatchewan. Four sites in the Elliot Lake area of northeastern Ontario have had very much remedial work done. All of these sites have treatment facilities authorized under OME (Ontario Ministry of the Environment) certificates of approval and have had major work done on the containment structures and covers. These sites are also undergoing a licencing process with

a “Prescribed Substance Licence” (PSL) issued to Rio Algom by the AECB to be in place sometime in 2000. Remedial work has been performed on two sites in the Bancroft, Ontario region.

Environment Canada

files are organized by Region rather than type of contaminated site.

Natural Resources Canada - CANMET, Mining and Mineral Sciences Laboratories

139 mine sites are on file.

12 sites have been verified by field inspections.

all 12 (100%) have been tested for physical stability.

three sites were found to have physical stability problems.

66% (two sites) have undergone remedial work. Both had CANMET participation.

Natural Resources Canada - CANMET, Envirolab

6 abandoned mine sites have been identified and are on file.

100% have been verified by field inspections.

100% have been tested for physical and/or chemical stability.

all sites were found to have physical or chemical stability problems.

18% have undergone remedial work.

* CANMET 1994 report with “Summary of Canadian Waste Data” lists information on 97 active and 401 inactive tailings deposits in Canada.

7.0 PUTTING AN END TO THE LEGACY

In the last 20 years, Canadians have developed new policies, technologies and procedures for mine closure. A number of these advances are summarized below.

7.1 Legislation

Mining related Acts are in place for administration of abandoned mines and mine reclamation in Newfoundland and Labrador, Nova Scotia, New Brunswick, Quebec, Ontario, British Columbia and Yukon. Environment related Acts are used in Saskatchewan, Northwest Territories, Nunavut and Yukon. Alberta uses the Coal Conservation Act. Manitoba has a policy document in place. Environment related Acts also apply in Newfoundland and Labrador, Alberta and British Columbia. Nova Scotia makes use of the Criminal Code to deal with safeguarding open excavations. A number of Federal Acts apply: Environmental Assessment, Environmental Protection, Fisheries, and Atomic Energy Control Act.

Most jurisdictions require that closure plans be on file before mining operations can commence mining. In Ontario, penalties of up \$30,000 per day can be laid for offences under Part VII (Operation of Mines) of the Mining Act. Quebec requires that closure plans “contain an action plan for high-risk accidents that might occur on the mining site during rehabilitation and thereafter.” Several provinces and territories are currently reviewing environmental policy or amending Acts.

The Atomic Energy Control Board is expecting passage of a new enabling Act and regulations in 2000. With this legislation, the AECB will become the Canadian Nuclear Safety Commission (CNSC) and will have new better defined authority and responsibility to become more actively involved in the regulation/licencing of sites with significant radioactive substances resulting from nuclear operations present.

7.2 Financial Assurance

All provinces, NWT and Yukon have legislation in place to provide for financial insurance to be used for reclamation in the event the mine operator is unable to do so. It is expected that authority for establishing

appropriate levels of security for reclamation will be given the Nunavut Water Board under Legislation being prepared for Nunavut waters.

7.3 Priority Systems

Most provinces establish priority for allocation remedial work funds based on factors such as proximity to populated areas, public safety and environmental protection.

Two agencies, DIAND and Ontario Ministry of Northern Development and Mines have made use priority rating management tools for ranking sites. “Northern Environment Risk Assessment Strategy” (NAP) is used by DIAND. NAP is based on four basic factors: legal environmental liabilities, human health concerns including food chain and physical hazards, land claim obligations, and public concerns. MNDM has an “Abandoned Mine Hazard Rating System” (AMHAZ) that uses a methodology based on Multicriteria Analysis and Pairwise Comparisons. Hazard rating is based on five factors: public safety, public health, environment, social, and economic.

7.4 Storage of Data

Saskatchewan reports that it has an extensive archive of all mine plans. Alberta has abandonment plans and old reclamation plans residing in the Provincial Archives. Post 1972 reclamation data resides at Alberta Energy and Utilities Board and Alberta Environment. Nova Scotia plans to store data in a vault equipped with a halon fire suppression system. DIAND plans to store information on abandoned waste sites in a GIS based database. The remaining agencies use regular filing systems or computer databases to store information on abandoned mines.

7.5 Technical Standards

Technical standards are available (or in preparation) as published guidelines and/or regulations in all provinces and territories.

7.6 Mining Environment Policy and Codes of Practice

Many mining companies operating in Canada now have environmental staff and policies. The Mining Association of Canada and some provincial and territorial mining associates also have policy statements and guidelines for their members to follow. Some companies operating in Saskatchewan are working toward ISO 14000 certification. The Province of Ontario has prepared a draft Rehabilitation Code of Practice as an amendment to the Mining Act.

7.7 Long Term Management of “Closed Out” Mines

All provinces and territories have policies or legislation addressing long term management or institutional care of “closed out” mines. The Atomic Energy Control Board would only release a property from licence under conditions acceptable to a province (including an appropriate monitoring/maintenance/remedial fund). The site would then revert to long term institutional control by the province.

7.8 Data Sharing

It would appear that all agencies make abandoned mines information available on request. Some departments have, or plan to have computer databases for the distribution of information. Nova Scotia has data available on the Internet. British Columbia is planning to post abandoned mines data on the BC MINFILE Internet site. The Treasury Board Secretariate of Canada plans to have a database of all federal contaminated sites by the fall of 2002. Alberta publishes a Coal Mine Atlas.

7.9 Leadership

Canadians have started to work closely together to encourage new technologies and approaches to mine reclamation issues. For example, the Mine Environment Neutral Drainage program (MEND) managed by the CANMET agency of Natural Resources Canada, has brought together some of the best reclamation scientists in Canada (industry, university, government) to work on the problem of Acid Mine Drainage. The British Columbia Ministry of Energy and Mines hosts an annual Mine Reclamation Symposium. Laurentian University maintains an Abandoned Mines database on the Internet and offers a Fellowship for graduate studies in the field of mining and

the environment. The Canadian Land Reclamation Association has an awards program for excellence in reclamation.

8.0 RECOMMENDATIONS

8.1 Inventory Focus: A number of government agencies use site descriptors of “toxic”, “contaminated” or “waste” to categorize abandoned mines. Waste materials are only one component of a broad spectrum of features that may be present at abandoned mines. A narrow focus inventory approach may result in the remediation of only those features that pose an obvious threat to the environment. It is important that both public safety and environmental hazards be identified. Abandoned mine inventories have to be broadly focused so that site assessments address chemical and physical stability issues. Environmental damage can still be inflicted by sites free of toxic wastes. For example, subsidence caused by catastrophic failure of unstable mine workings could put chemical plants or industrial transportation corridors at risk.

It is suggested that the most thorough inventories are those based on mineral deposit records. Library research would determine the likelihood of public safety or environmental impact of past exploration or mining activity for each mineral occurrence. Those sites having potential for hazards would then be field checked and appropriate remedial action prescribed.

8.2 Data Storage: It is essential that maps and other important records of “closed out” and abandoned mines be put in places of safekeeping. It makes good sense for emergency response planning.

8.3 Data Sharing: Agencies should ensure that information on abandoned mines is known and available to all services involved with land use planning. Abandoned and “closed out” sites should be red flagged.

8.4 Standards: There is a need in Canada for the development of “standards for risk assessment”, and “documentation standards” for abandoned sites.

8.5 Canadian Abandoned Mines Committee: A working level committee should be created to exchange information on legislation, technical standards, databases, priority rating systems, financial assurance, etc. Membership would consist of technical representatives from provincial, territorial and federal agencies, as well as, representatives from various stakeholder and environmental groups.

8.6 A Federal Role: It is well understood that provinces in Canada have jurisdiction over mining. The concept of environment, however, was not considered at the time of Confederation. Environmental management in Canada when applied to mining is thus a complex matter, having shared federal and provincial jurisdiction. As part of the federal role, it is recommended that Natural Resources Canada be given a coordinating function for mine reclamation technology standards. The CANMET agency of Natural Resources Canada has a proven track record of dealing with abandoned mines and mine reclamation. This agency could

provide leadership for technology transfer of inventory, testing, monitoring and reclamation standards. The MEND model could be utilized with the involvement of specialists from industry, universities/colleges, government, and the public.

8.7 Resources: More resources are required to adequately inventory and assess abandoned mines in Canada.

8.8 Emergency Response Planning: All jurisdictions should develop policies and procedures for emergency response to emergencies at abandoned and “closed out” mines.