

ABANDONED MINES IN ONTARIO

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Abstract

With the promulgation of Bill 71 in June 1991, the closure of mines in the province of Ontario must meet stricter environmental conditions. The legacy of open shafts and derelict sites should be brought to an end. A new Abandoned Mines Abatement Program was also introduced in 1991 to deal with clean-up of abandoned sites that have reverted to the Crown or that have no responsible owner. Work has commenced on a number of fronts that include inventory studies, acid mine drainage research, surface crown pillar monitoring and remedial work projects.

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Introduction

In Ontario, homes, schools, schoolyards, senior citizen's buildings, parking lots, roads, railway lines and commercial establishments have been built on top of abandoned mine workings. Residential communities and highways have been built downslope from tailings areas. Some communities are placed downwind from uncovered tailings containing toxic substances. All this has resulted in the abandonment of homes, closure of roads and highways, death and injury to people and animals and stress on parents, property owners, government officials and mining company staff. The media has had a heyday.

Over the last one hundred years many mines were built in remote locations in the province, which, at the exhaustion of ore reserves, were to be allowed to "return to the wilderness". Many mining communities, however, did not become ghost towns. Rather, they took root and flourished as regional transportation and supply centres or became the focus for long term regional prospecting and mining development. As community expansion encroached upon abandoned mining lands, civic officials had little direction from government or mining industry on potential hazards. Technical information or policy guidelines were non-existent or inadequate. Little was known fifty to sixty years ago about acid mine drainage or failure of surface crown pillars.

Commonly, accidents at abandoned mines are treated as isolated incidents by the media and civic authorities. There is now a growing awareness, particularly within the mining

community, that abandoned mine hazards pose a problem, worldwide. As a result, books have been written, associations formed and conferences held concerning abandoned mine issues. The Province of Ontario recently created an Abandoned Mining Lands Coordinating Committee to deal with the matter.

The abandoned mines legacy has not helped to foster a favourable public image of mining. Derelict buildings, barren landscapes, windblown tailings dust and threat of cave-ins serve as ammunition for the "not in my backyard" activists.

Recent advances in rock mechanics, revegetation techniques, tailings confinements, etc, are now providing us with the tools needed for acceptable rehabilitation of mining lands. Sharing these technologies through symposia such as provided by the B.C. Technical and Research Committee on Reclamation, enhance efforts to develop a clean mining environment in Canada.

Every abandoned minesite has the potential for being the stepping stone for the discovery of new mineral deposits. The use of "high tech" innovations such as fiber optics in deep diamond drill hole geophysics and better understanding of geological setting of ore deposits has demonstrated this point. It is important, therefore, that rehabilitation work at abandoned minesites does not result in the sterilization of the site for future exploration. The Ontario Abandoned Mines Program is administered through the Mineral Development and Rehabilitation Branch of the Ministry of Northern Development and Mines, which provides a balance to ensure effective reclamation, on one hand, and preservation of mineral potential, on the other hand.

Where feasible, attempts are being made to preserve Ontario's mining heritage. The province has provided assistance in developing and promoting popular tourism opportunities at abandoned minesites in Bruce Mines, Cobalt, Sudbury and Timmins.

Ontario - A Two-pronged Approach

After an analysis of the abandoned mines problem, the Ontario government took action to put an end to the legacy through legislation. The cleanup of abandoned sites was to be dealt with through an Abandoned Mines Abatement Program. The revision of the new Ontario Mining Act, known as "Bill 71", was developed through a public consultative process and promulgated June, 1991. Part VII of the Act, "The Operation of Mines", was prepared with the assistance of committee reviews from the mining industry and other government agencies. Advice was also provided by other provinces. Under Bill 71, proponents of "Advanced Exploration" projects and new mines must prepare closure plans (detailing rehabilitation plans) for provincial approval and post financial assurance. Existing mining operations are to be phased into this new system over a period of time.

The Abandoned Mines Program is overseen by the Ontario Abandoned Mining Lands Coordinating Committee. The Committee is headed by the Ministry of Northern Development and Mines with senior representation from the Ontario Mining Association and the Ministry of Natural Resources, the Ministry of Labour, the Ministry of Municipal Affairs and the Ministry of the Environment. In 1991, a ten million dollar fund was established by the

province and is managed by the Committee. An inventory of abandoned mines and related hazards is now under preparation. Crown land and municipal abandoned mine remedial work projects are financed from this fund.

Inventory

Preliminary investigations in 1987 provided estimates of over 3000 sites throughout the province. A systemic approach is now under way using local consulting firms to search files in each of the Ministry's Resident Geologists' Offices. Every Mineral Deposit Inventory (MDI) file is being reviewed and flagged where there appears to be an (existing or potential) impact on the surface. Hazards are grouped as: openings to surface, surface infrastructure, toxic substances and areas of potential collapse. Each abandoned mine file is created by compiling information gained from the offices of the Ministries of Northern Development and Mines, Environment, Labour and Natural Resources. The original MDI file number is retained. This exercise is expected to be completed by 1992 with an anticipated 7,000 - 10,000 hazards flagged. The next step is to complete field inspections of sites identified by the MDI file search. While some flagged sites will be investigated by Ministry (MNDM) staff, the bulk of the inspections are expected to be done under contract. This work is scheduled to commence during the 1992 field season.

Remedial Work Program

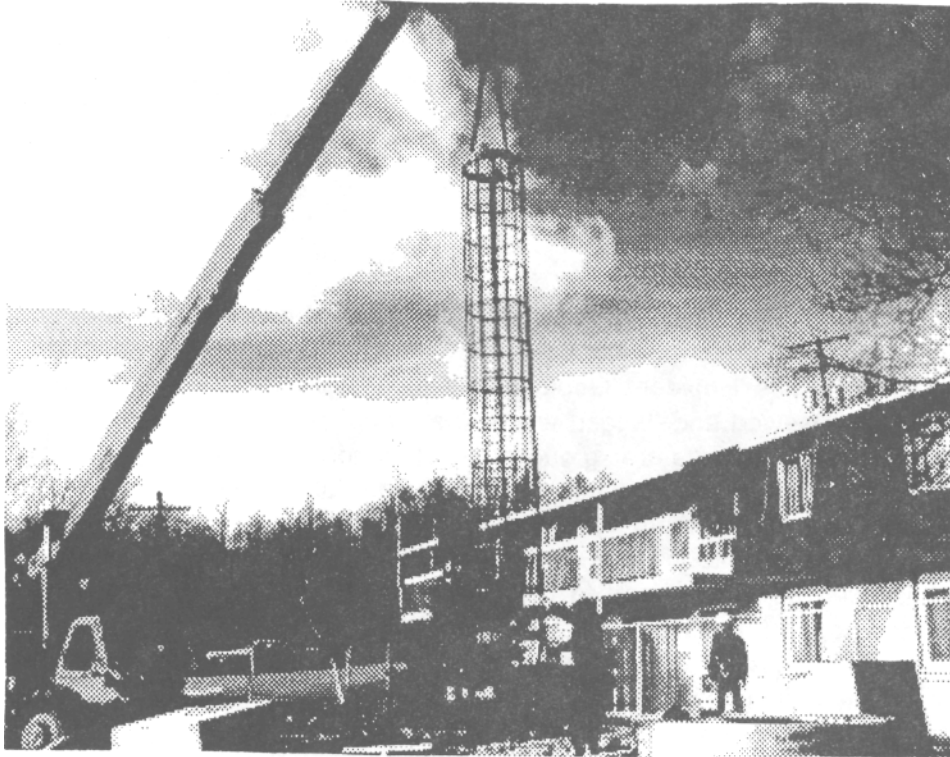
Abandoned Mine Hazards on crown land or sites where no responsible owner can be found, is dealt with on a prioritized basis. Sites found with serious risk to public safety are given highest priority. Special consideration is given for remedial work projects within municipalities (Mackasey, 1989). Grants are available to deal with situations where community infrastructure has overlapped on abandoned mining lands.

Geotechnical investigation commences with a review of all existing maps and reports. Where possible, residents and former mine staff are interviewed. Information gained, such as the exact location of former cave-ins and sightings of moisture vapour emanating from the ground, provide useful clues. Geophysical techniques including magnetic, seismic and ground probing radar surveys have been employed in Ontario (Carter et al., 1988). Air track and diamond drilling supplemented by down-hole video and sonar probes have helped to delineate geometry of underground workings. In one project, a mini-submarine equipped with aircraft lights, video cameras and sonar was used to map out flooded underground workings.

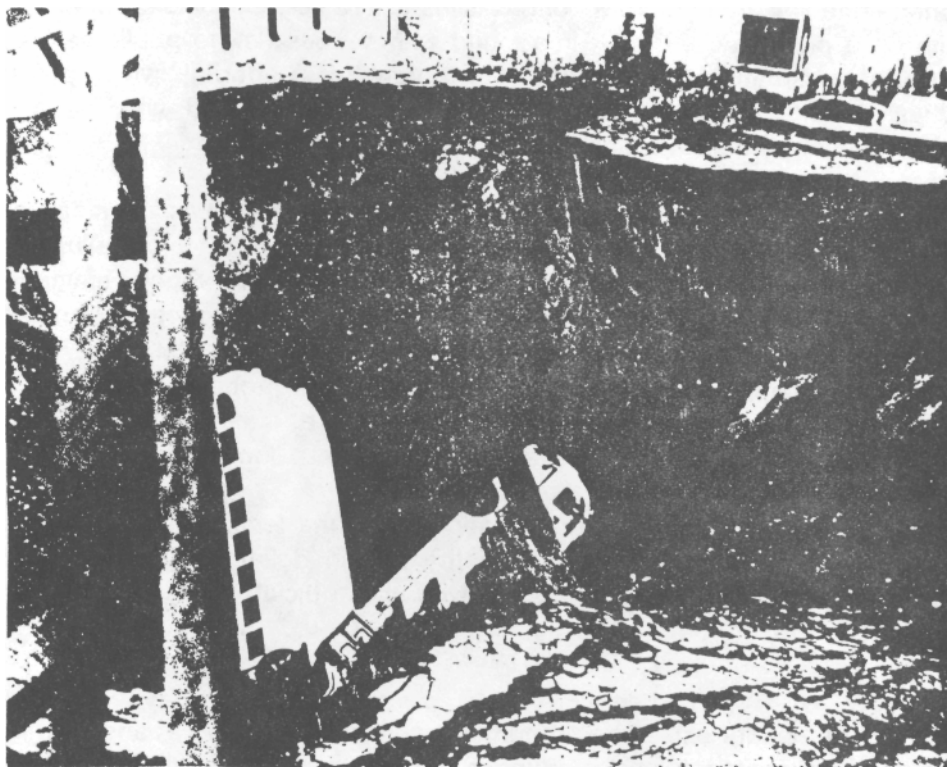
In Ontario, remedial work projects have ranged from the fencing and capping of shafts to highly sophisticated construction projects in the million dollar range. Community based projects are best planned out in cooperation with civic officials (Mackasey, 1989).

Public Safety

Two schools of thought exist when it comes to public safety and abandoned mines. Until recently the common approach was to maintain a low profile and quietly go about locating and remediating abandoned mine hazards. Strong arguments had been brought forth in the past that public information programs warning of the danger of abandoned minesites only served



Inspection cage designed for investigation of abandoned shafts.



Collapse of bus parking lot into abandoned mine workings, Timmins, Ontario, November, 1963.

to spark the interest and curiosity of the public. 'The more said about abandoned mines, the more people are drawn to visit them' was a common conception.

The high number of fatalities and other incidents by recreationists at abandoned mines in the United States has helped gain support for the second school of thought. Studies on public safety by such researchers as Cole, 1990, show that the general public is constantly being reminded that abandoned minesites are "neat" places to visit. From Saturday morning TV cartoons to detective and Western movies we are led to believe that abandoned mines can provide intrigue and possible hidden treasures for the adventuresome. Because of this, public awareness programs have been initiated by a number of U.S. agencies: the Bureau of Mines has produced a public service TV ad; Colorado, a warning poster for sites; Nevada, a video. Utah has developed an awareness program for school children including a children's colouring book that outlines the benefits of minerals and mining, built in with warnings of the dangers of playing around abandoned mines.

When the term "Emergency Response" is used the first thing that comes to mind is a team of people rushing off to deal with a tailings failure or some other mishap. Commonly overlooked is the amount of planning that must go on in advance. Response teams must be well equipped with data on the minesites. For example, at a tailings spill response, maps showing the location of a surface crown pillar would help prevent the inadvertent placement of heavy equipment across areas of potential collapse. Readily available, up-front information on composition of tailings would assist the team to predict what impact the spill would have on a receiving waterway.

At active mining properties, there is ongoing surveillance, onsite workforce, maps, equipment, supplies and a communications system. A failure is generally detected within minutes of its occurrence and a response team at work within the hour. At an abandoned minesite a failure may go undetected for hours or even days. There is no workforce or equipment at hand. Technical data may be hundreds of miles away. In some cases road access is difficult or no longer available.

The Ministry of Northern Development and Mines (MNDM), through the "Emergency Plans Act" is preparing emergency response plans for dealing with abandoned mine problems. Such plans will be created by MNDM with the assistance of other agencies. These plans should not only contain technical details on the past mining operations but also include up to date details on access, available equipment and other resources.

Management of Data

Technical data on many abandoned mines can be found scattered throughout a myriad of government agencies and industry offices. Information on underground workings may be with one agency and tailings dams with another agency. Some situations occur where files have been left in a heap on abandoned office floors.

The Ontario Abandoned Mines office has been making use of a computerized Abandoned Mines Inventory System (AMIS) to keep track of basic data on each site. This system, developed by Laurentian University (Koczkodaj, 1989) is used to keep track of basic information such as name, alternate names, coordinates, mine features and related hazards. References for more detailed sources of information are also listed.

Plans are underway to develop a more comprehensive database ("AMIS Phase II") making use of Geographic Information System (GIS) technologies. AMIS Phase II would be an interactive computer driven system containing digitized maps of underground workings, engineering drawings, technical reports and so on.

A proliferation of research papers on abandoned mines and reclamation have been published by many government agencies, universities and mining associations over the last fifteen years. Laurentian University has created a computerized database of over 4000 titles and abstracts on mining related reclamation paper. (Kelly, 1992). Access to this database can be had through use of a modem equipped desktop computer.

Monitoring

The most common form of monitoring is checking the obvious. Gates, fences and warning signs "disappear" from sites on an all too regular basis. Some barricades deteriorate with time. Shaft caps are removed or broken open by sightseers. Routine inspections and an ample budget can help alleviate the situation. Bill 71 has provided the Ministry of Northern Development and Mines with the ability to lay charges against anyone guilty of destruction of rehabilitation works.

Unattended tailings have become a major concern and Ontario has launched an inspection and testing program. Priorities are based on type of confinement structure, proximity of sensitive features (towns, drinking water supply, etc.) and presence of toxic materials. This work is proving to be difficult as in some cases access is difficult and site specific technical information is scarce.

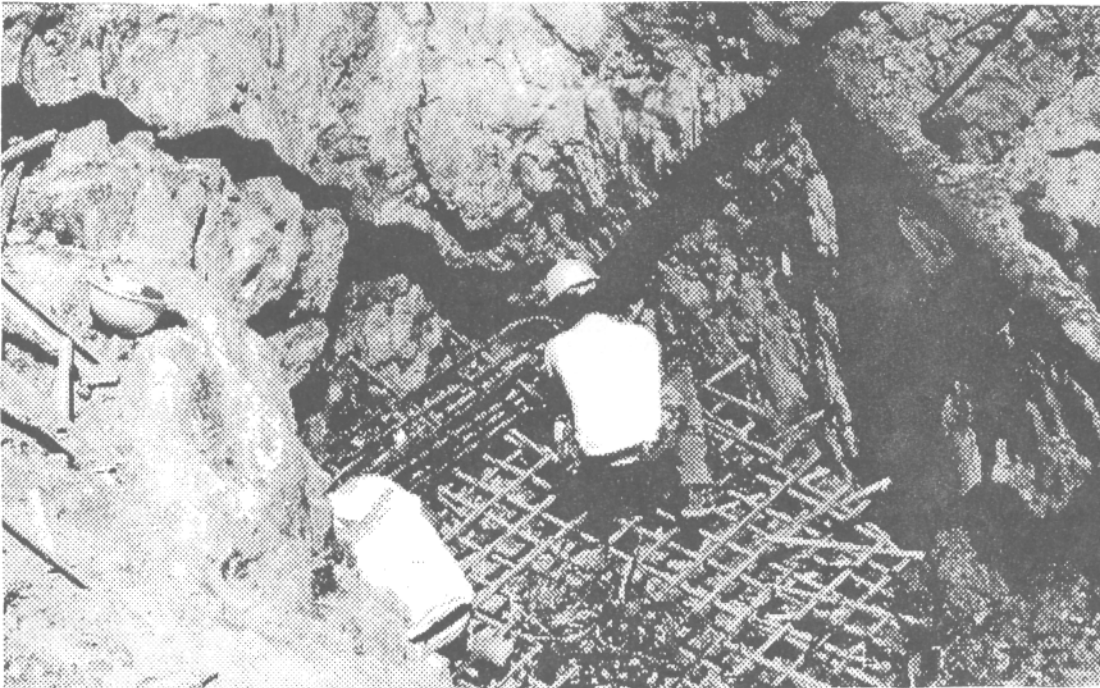
Progress is being made in the monitoring of surface crown pillars with the use of Time Domain Reflectometry (TDR), (O'Connor et al, 1989). Coaxial cables are grouted in place and deformation caused by progressive rock movement can be detected by TDR instrumentation. The Ministry of Northern Development and Mines has contracted the CANMET agency of Energy, Mines and Resources, Canada, to install TDR monitoring cables at several selected locations in the province. A similar program has been completed in Nova Scotia.

Research

Rehabilitation of active and abandoned minesites is an expensive business. Cost cutting innovations in monitoring, mine design and waste treatment, suitable for the Canadian scene must be encouraged and funded. The Ministry of Northern Development and Mines (MNDM) is actively pursuing this matter and is providing assistance on a number fronts. Cooperative ventures with Energy, Mines and Resources, Canada, such as the surface crown pillar conference held in 1989 and more recently the Northern Ontario Development Agreement (NODA) are helping to direct more attention to research. NODA, together with industry, is contributing nine million dollars (over the next 4 years) to furthering development projects which focus on technology, processing, research and environmental issues in mining. Ontario Environmental Youth Corps (EYC) grants administered through MNDM have enabled Laurentian University staff and students to develop a number of rehabilitation research projects. The "Mining Environment Database", as described by Kelly (1992), serves as



Kam Kotia revegetation test plots. Abandoned mine tailings research by K. Winterhalder, Laurentian University.



Capping of 115 foot shaft beneath residential street which was uncovered during municipal waterworks project.

one example. Four Mine Environment Neutral Drainage (MEND) projects were provided financial assistance through the Ontario Abandoned Mines Fund in 1991 for Acid Mine Drainage research. MNDM through The Ontario Heritage Fund recently provided Laurentian University with a three million dollar grant to establish a field station for reclamation and abandoned mines research. The Field Station, to be located in the city of Elliot Lake, is presently under construction with opening scheduled for the summer of 1992.

References

Carter, T.G., Busbridge, J.R., Mackasey, W.O. and Annon, A.P., 1988, "Investigations and remedial measures for reinstatement of highway collapse over old mine workings, Cobalt, Ontario, Canada"; *Mineworkings* 88, Proceedings 2nd International Conference on Construction in areas of Abandoned Mineworkings, Edinburgh; Edited by Forbe, M.C., Engineering Technics Press, Edinburgh; pp. 289 - 297.

Cole, A., 1990, Abstract "Television Public Service Announcements on Abandoned Mine Dangers"; Returning mined land to beneficial use, Proceedings 12th Annual National Association of Abandoned Mine Land Programs Conference, Breckenridge, Colorado; Edited by Meyer, C.M., State of Colorado Mined Land Reclamation Division, Denver; p145.

Kelly, G.J., 1992, "Laurentian's Mining Environment Database: The Process of building a research literature database and an invitation to enrich the existing collection"; this volume.

Kosckodaj, W.W., 1989, "Abandoned Mines Information System"; Laurentian University, Sudbury.

Mackasey, W.O., 1989, "Concepts on Dealing with Abandoned Mine Hazards"; Surface crown pillar evaluation for active and abandoned metal mines, International Conference Proceedings, Timmins, Ontario; SP89-5; CANMET, Energy, Mines and Resources, Canada; edited by Betournay, M.C., pp. 135 - 141.

O'Connor, K.M., Dowding, C.H. and Su, M.B., 1989, "Monitoring Rock Mass Deformation Using Time Domain Reflectometry", Surface crown pillar evaluation for active and abandoned metal mines, International Conference Proceedings, Timmins, Ontario; SP 89-5; CANMET, Energy, Mines and Resources, Canada; Edited by Betournay, M.C., pp. 123-132.