



**CAPACITY BUILDING FOR A NATIONAL INVENTORY OF  
ORPHANED/ABANDONED MINES IN CANADA**

**FINAL REPORT**

**Prepared for the:**

**NATIONAL ORPHANED/ABANDONED MINES INITIATIVE  
ADVISORY COMMITTEE**

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## **Capacity Building for a National Inventory of Orphaned/Abandoned Mines in Canada**

## **DISCLAIMER**

The purpose of this document is to provide the reader with a review of the current state of databases and definitions related to orphaned and abandoned mine sites in Canada, along with recommendations for definitions and terminology for a national database that will accommodate the requirements of all jurisdictions. The information provided is based on the opinions of the author, and should not be construed as endorsement in whole or in part by the various reviewers or by the partners in the National Orphaned/Abandoned Mines Initiative (the Government of Canada, Provincial and Territorial Governments, The Mining Association of Canada, contributing mining companies and mining associations, the Assembly of First Nations and participating non-governmental organizations).

The reader of this report should assume full responsibility for any action taken as a result of the information contained in this document. The author, the members of the National Orphaned/ Abandoned Mines Advisory Committee and Task Forces, and Natural Resources Canada (through the National Orphaned/ Abandoned Mines Initiative) make no warranty of any kind with respect to the content and accept no liability, either incidental, consequential, financial or otherwise arising from the use of this publication.

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## 1.0 Executive Summary

Cal Data Ltd. has completed a review of Canadian and international efforts to inventory orphaned and abandoned Mines. As a result of this review a database delivery model and high level definitions have been proposed. Summaries of the results of a previous NOAMI Information Gathering Task Group survey, the investigation of more than 50 World Wide Web sites dedicated to this topic and more than 14 personal conversations with representatives from Canadian provincial, territorial and federal jurisdictions have been documented.

All Canadian provinces with a history of mining, territories and several federal agencies maintain their own inventory of mining and exploration sites that pose a risk to human health and safety or the environment. Many of these inventories only contain the sites that are known to pose a risk and are now the responsibility of the jurisdiction. There is a large discrepancy in the level of detail and completeness of these inventories from jurisdiction to jurisdiction. The concept of a national database must account for these gaps in coverage, detail and standardization. A system that builds on the strengths of the individual inventories and does not impact their current operational status is recommended.

A high level inventory that includes all inactive mineral sites, is web-based and has a map interface is recommended. A Mineral Site includes metallic and industrial minerals as well as coal but excludes granular resource sites. Such a system would act as an index to the existing inventories maintained within the provinces, territories and federal agencies. Internet links would be utilized to make the investigation experience of the user virtually seamless between the national database and the component databases. A high level, all inclusive database would provide uniform representation of inactive mineral sites from all jurisdictions irregardless of their level of database development. Such systems have been proven operational with existing commercial off the shelf software. The review of existing inventory systems has shown the value of a map interface, especially for users without expert knowledge of the local land designation system and details of the inventory metadata.

The proposed high level definitions:

- *Mineral Site*
- *Active Mineral Site*
- *Inactive Mineral Site*
- *Terminated Mineral Site*
- *Neglected Mineral Site*
- *Legacy Mineral Site*
- *Orphaned/Abandoned Mineral Site*

are designed to avoid most existing inventory definitions which could be in conflict. They are also to provide the inclusion of all sites with significant surface disturbance that are

not actively being operated or maintained. More descriptive definitions become relevant to particular databases and differences in meanings begin to arise.

The review determined that on an operational level most jurisdictions are not enthusiastic about a national inventory. This reaction is not due to the concept but rather to a fear that any such effort will deflect their current efforts. Successful standardized multi-jurisdictional database efforts that have succeeded have relied on significant incentives for the participants' involvement. At present it is unlikely that a significant incentive program will be available to encourage involvement in a national effort so a non-intrusive effort is required. However, there is an acknowledged requirement on the part of the public for such an inventory.

The proposed system of an umbrella (index style) inventory system linked to existing jurisdictional inventories over the Internet satisfies these constraints.

## Résumé

Cal Data Ltd. a examiné les efforts menés au Canada et à l'étranger pour créer un répertoire des mines orphelines et abandonnées. Par la suite, un modèle de bases de données et des définitions globales ont été proposés. Le résumé des résultats d'une étude précédente réalisée par le groupe de travail chargé de la collecte d'information de l'Initiative nationale pour les mines orphelines ou abandonnées (INMOA), l'examen de plus 50 sites Web sur ce sujet et plus de 14 entretiens individuels avec des représentants provinciaux, territoriaux et fédéraux ont été documentés.

Les provinces canadiennes qui ont une histoire minière, les territoires et plusieurs organismes fédéraux tiennent leurs propres répertoires de sites d'exploitation et d'exploration minières qui posent un risque pour la santé et la sécurité humaine ou l'environnement. Un grand nombre de ces répertoires ne contiennent que les sites dont on sait qu'ils posent un risque et qui relèvent maintenant d'une juridiction donnée. Il y a aussi de grands écarts dans le niveau de détails et l'exhaustivité de ces répertoires, d'une juridiction à l'autre. Le concept d'une base de données nationale doit tenir compte de ces écarts de couverture, de détail et de normalisation. On recommande un système qui tire parti des forces des répertoires individuels et n'a pas d'incidence sur la situation opérationnelle actuelle de ces répertoires.

On recommande aussi de créer un répertoire Internet global, avec interface cartographique, qui comprend tous les sites minier inactifs. Par site minier, on entend les sites de minéraux métalliques, de minéraux industriels et de charbon, mais non les sites de ressources granulaires. Un tel système servirait d'index des répertoires existants utilisés par les provinces, les territoires et les organismes fédéraux. Des liens Internet permettraient aux utilisateurs de faire des recherches dans la base de données nationale et les bases affiliées. Une base de données exhaustive globale présenterait de façon uniforme les sites miniers inactifs de toutes les juridictions, quelle que soit la structure de la base de données. De tels systèmes se sont révélés compatibles avec les logiciels commerciaux existants. L'examen des systèmes de répertoires existants a montré l'importance d'une interface cartographique, en particulier pour les utilisateurs sans connaissance approfondie du système de désignation des terres locales et des métadonnées du répertoire.

Les définitions globales proposées :

- *site minier*
- *site minier actif*
- *site minier inactif*
- *site minier fermé*
- *site minier délaissé*
- *ancien site minier*
- *site minier orphelin ou abandonné*

visent à éliminer la plupart des contradictions entre les définitions existantes. Elles permettent également d'inclure tous les sites aux surfaces significativement perturbées qui ne sont pas exploités ou maintenus activement. Des définitions plus détaillées deviennent pertinentes pour des bases de données en particulier et des différences de signification peuvent survenir.

L'examen a permis de déterminer qu'au plan opérationnel, la plupart des juridictions ne sont pas très en faveur d'un répertoire national, non pas parce qu'ils n'aiment pas le concept, mais parce qu'ils craignent qu'un tel plan aura un impact sur leurs efforts actuels. Les bases de données normalisées regroupant plusieurs juridictions qui ont connu du succès offraient des incitatifs importants aux participants. À l'heure actuelle, il est peu probable qu'un important programme incitatif sera disponible pour encourager la participation à un effort national. Un effort non intrusif est donc nécessaire. Cependant, le public reconnaît le besoin de créer un tel répertoire.

La proposition d'un système (index) général branché aux répertoires existants des diverses juridictions sur Internet respecte ces contraintes.



## **2.0 Acknowledgements**

Cal Data Ltd. would like to thank all those who provided input to this report in the form of verbal interviews, general comments and draft reviews.

Representatives from all jurisdictions contacted provided frank comments and discussion on the merits of a national orphaned/abandoned mines database. Input from the following individuals is gratefully acknowledged; J.D. Bamburak, H. Copeland, J. Dionne, B. Hamilton, R. Holmes, D.S. Jones, R. McCandless, C. Powter, J. Robertson, G. Sankey, P. Schwann and G. Stewart.

Members of the NOAMI Advisory Committee provided knowledgeable feedback during a preliminary presentation of the report results during a steering committee meeting in Vancouver on November 29, 2004.

Finally, the report was significantly improved by a thorough review provided by Gregg Stewart, Gilles Trembley, John Robertson and Fred Privett.

### 3.0 Background

The legacy of orphaned/abandoned mines, with their associated environmental liability, human health concerns and the financial costs of clean-up, is a serious issue facing Canada. The National Orphaned/Abandoned Mines Initiative (NOAMI) is a co-operative Canadian program that is guided by an Advisory Committee consisting of the mining industry, federal/provincial/ territorial governments, environmental non-government organizations and First Nations.

In June 2001, a multi-stakeholder workshop was held in Winnipeg to review the issue of orphaned/abandoned mine sites in Canada and identify approaches for cleaning up these sites. Recommendations and guiding principles from that workshop presented at the September 2001 Mines Ministers Conference resulted in an Action Plan that received the support of the Mines Ministers. A national multi-stakeholder Advisory Committee on Orphaned/Abandoned Mines was subsequently established in 2002 and charged with undertaking the Action Plan. The Information Gathering Task Group was formed by the NOAMI Advisory Committee to address inventories and characterization of orphaned/abandoned mine sites. The principal objective of the Task Group is to *“develop capacity for a national inventory of active, closed and orphaned/abandoned mine sites based on compatible inventories in each province and territory, including an acceptable system for categorization and priority ranking. To include agreed upon definitions and terminology as applied to O/A minesites.”* A database is essential for comprehensive classification and analyses. Definitions and terminology as applied to orphaned and abandoned mine sites are key elements.

Orphaned and abandoned mines exist within all mining jurisdictions in Canada. These sites, however, are not well documented with respect to either their numbers or their associated physical/environmental impacts and liabilities. Further research and compilation of information on abandoned mines is desirable to enable effective, sustainable, cost-efficient planning and rehabilitation. Such information is also desirable to ensure transparency of decision-making and access to information by governments, civil society, industry and other stakeholders. To efficiently address both public health and safety, and environmental concerns associated with abandoned mines, a number of issues must be accounted for in an information gathering process. This information is critical to enable sound decision-making.

In 2002 the Information Gathering Task Group received information on abandoned and orphaned mines from eight provinces, one territory and one federal agency on key parameters such as terminology and definitions, types of information available, systems used to store the information, how sites are prioritized, financial assurance, etc. This information and the key contact names were made available to the contractor. In the past year the Task Group concentrated their efforts on developing the definitions. Orphaned and abandoned sites definitions vary between jurisdictions and the Task Group realized that a “national” definition for NOAMI’s use would be essential for the successful creation of a national inventory.

To avoid complex and lengthy definitions, the Task Group proposed a two-tier structure for defining abandoned mines and related mineral sites, namely, a general or generic all-inclusive definition for abandoned and/or orphaned mineral sites and a series of definitions for more specific mineral sites. These proposed definitions may not fully encompass all types of mineral activity in Canada but should account for the vast majority of them. The definitions as proposed would permit proper classification of mineral sites and comprehensive analyses to correct misunderstandings and misconceptions in the industry and the general public and to help address concerns about these sites. Proper definitions, to be accompanied by practical parameters and parameter modifiers will, for example, prevent lumping of all abandoned sites as abandoned mines. The Task Group debated on the definitions but could not reach consensus. This information was made available to the contractor who was expected to make recommendation(s) for a national definition(s) based on his discussions with the various jurisdictions.

It should be noted that a set of “common parameters” and qualifiers would be needed for designing and constructing a suitable database on abandoned and orphaned mineral sites. General parameters could include basic information such as type of mine, location, etc. More specific parameters would qualify the sites (risks associated, etc). Database development is expected to be an ongoing iterative process requiring more time and funding and is not part of this requirement.

The information received in 2002, the proposed definitions and any new information that exists needs to be reviewed and summarized. The results will be used by the contractor to recommend a national definition, develop a list of parameters (as key fields in a data base for characterizing various types of orphaned and abandoned mines and related mineral sites) and qualifiers for a national inventory of these mines and sites.

## 4.0 Scope and Methodology

The objective of this capacity building project is to summarize the existing information on orphaned and abandoned mine inventory efforts in Canada and internationally followed by recommendations concerning a National Inventory of Orphaned/Abandoned Mines in Canada. The recommendations include basic definitions, possible inventory configurations and capabilities, implementation scenarios and value of a national inventory.

The methodology utilized during the project was defined in the project description, proposal and subsequent contract. The major tasks of this project were to;

- Review, summarize and discuss the results of NOAMI's 2002 survey.
- Review, summarize and discuss documents and web-sites on similar inventory initiatives nationally and internationally.
- Interview representatives of Canadian agencies responsible for abandoned mines to obtain current knowledge of their initiatives and opinion on the value of a national inventory.
- Review and summarize the state of relevant databases across Canada.
- Review existing definitions and recommend options for national scale definitions.
- Propose a methodology to develop a national inventory based on the existing provincial, territorial and national databases.
- Discuss the value and viability of a national inventory.

## 5.0 Review of Canadian Inventories

### British Columbia

#### Definitions:

*Mine Site:* “all infrastructure related to a mine, including, but not limited to tailings facilities, waste rock dumps, buildings and mills.”

*Abandoned Mine:* “a mine for which all permit obligations under the *Mines Act* [Amended 1990] have been satisfied and in respect of which the mineral claims have reverted to the government.”

*Historic Mine:* “a place where mechanical disturbance of the ground or any excavation has been made to produce coal, mineral bearing substances, placer minerals, rock, sand or gravel, or other mined materials, including sites used for processing, concentrating, and waste disposal, and where a Mines Act permit does not exist for the mine site.”

*Closed Mine:* “a mine at which all mining activities have ceased but in respect of which the owner, agent or manager remains responsible for its compliance with the Mines Act and the Health, Safety and Reclamation Code.”

#### Information Sources:

In British Columbia a ‘Historic Mines’ inventory is maintained by the BC Ministry of Energy and Mines (BCMÉM). The Historic Mine Sites Database (HMSDB) contains approximately 1887 sites at which some production occurred and no current mine permit is present. The database was built using Microsoft Access as the platform and was designed to incorporate geological, geochemical, geotechnical and administrative information for each site. The strength of the database is the ability of the user to input a wide range of data sources and the ease at which detailed queries can be performed. The primary purpose of the database is to house an inventory of historic mine sites containing technical information, which characterizes sites. A secondary purpose of the database is to collect technical data on operating mines, which have been permitted by the ministry to assist in regulatory functions. The database is currently a ‘project in works’ as it is still being tested, amended and updated. The identification of these sites was through analysis of the province’s mineral deposit database, MINFILE. Of the 1887 sites identified about 62 have been inspected and documented (Barazzuol and Stewart, 2003). An on-line information page based on this document can be found at [www.em.gov.bc.ca/DL/GSBPubs/OF/2003-3/historicTOC.htm](http://www.em.gov.bc.ca/DL/GSBPubs/OF/2003-3/historicTOC.htm). An MS Excel table containing a summary listing all the past producers, their position, tonnage mined and commodities contained can be obtained from this site. The entire MINFILE database may also be downloaded or accessed online. Another site, ‘BC Historic Mines Atlas’, [www.shim.bc.ca/mines/mines\\_entry.htm](http://www.shim.bc.ca/mines/mines_entry.htm) displays the same ‘Historic Mines’ in a web-mapping system integrated with a variety of relevant mining and environmental information. This site is operated as a joint project between BCMÉM and Environment Canada and is designed as a working tool to allow information such as photographs and

water quality data to be uploaded to the system by qualified users (Robert McCandless, pers. comm., 2004).

An earlier study (Steffen Robertson and Kirsten (B.C.) Inc. and Norcol Environmental Consultants Ltd., 1992) examined 'Historic Mines' in the Fraser River watershed for their Acid Mine Drainage (AMD) potential. Site visitations were made to the major sites and a method for prioritizing the sites was tested.

**Comments:**

Historic Mine sites in BC are derived from the MINFILE mineral deposit database. In reality a single large mine may contain several of the MINFILE deposits. In addition a single MINFILE deposit may have a large number of mine openings and related mining features such as tailings ponds, waste dumps and abandoned buildings. The vast majority of potential problem sites have not been inspected in a standardized method in recent times. Sites are dealt with as the necessity arises and as resources are available.

An effort is underway to generate a short list of potential problem sites by means of database and GIS analysis for on-site inspections. The current effort is to create a short list of sites for follow-up field investigation should resources become available. Field investigation will provide the information required to determine the sites which require the most immediate attention. At the moment mine sites are dealt with when there are dangers related to public safety or environmental impacts to land and watercourses are recognized (Gregg Stewart, pers. comm., 2004).

## ALBERTA

### Definitions:

No definitions related to abandoned mines are included in the legislation or have been defined formally. Although not formally defined the term ‘*Abandoned*’ is used informally in the title of the Coal Mine Atlas and the term ‘*Permitted Mine*’ refers to any mine site for which a current mine permit exists.

### Information Sources:

In Alberta there has historically been very little metal mining, virtually all the mining has been for coal. It is believed that there is one old metal mine, produced some copper, but there were no problems associated with it (Chris Powter, pers. comm., 2004). The Alberta Mineral Deposits and Occurrences Database (AMDO) can be purchased from the Alberta Geological Survey ([www.ags.gov.ab.ca/MDA/AGS-1.HTML](http://www.ags.gov.ab.ca/MDA/AGS-1.HTML)). As this data source contains only metal and industrial mineral showings and prospects it was not investigated further.

There are by contrast more than 2000 large-scale coal mines in Alberta dating back to 1882. The Alberta Energy and Utilities Board (EUB) maintains a Coal Mine Atlas which contains the operating and abandoned coal mines in Alberta ([www.eub.gov.ab.ca/BBS/products/publications/statseries/st45-index.htm](http://www.eub.gov.ab.ca/BBS/products/publications/statseries/st45-index.htm)). The Atlas provides access to a listing of all coal mines by operator, location, mine number, type of mine and mining method. Each entry in these listings is linked to the appropriate PDF map. The maps are continually updated. In addition to the location maps, microfiche of the mine plans for many of the abandoned mines are available from the EUB (Gregg Sankey, pers. comm., 2004)

### Comments:

There is one recently abandoned coal mine currently being dealt with in the province. The abandonment was through bankruptcy and there are some resources in place to deal with the closure. Issues related to abandoned mines are dealt with as they become apparent. These are usually safety issues around mine openings and subsidence. One recurring problem with the old coal mines is fires originating from lightning strikes or spontaneous combustion.

## SASKATCHEWAN

### **Definitions:**

*abandoned mine:* a mine or area where mining operations have occurred in the past and: (1) The applicable reclamation bond or financial assurance has been released or forfeited or (2) if no reclamation bond or other financial assurance has been posted, no mining operations have occurred for five years or more. Also refers to a site for which there is no lease holder or current operator.

*orphaned site:* any location at which mining and/or milling activities have occurred in the past, and for which no former owner or operator can be identified.

### **Information Sources:**

The final report from a three-year survey of abandoned mines in northern Saskatchewan was released in October 2004. This report (Clifton Associates Ltd., 2003), documents 75 abandoned mines, all the known abandoned mines in northern Saskatchewan (B. Hamilton, pers. comm., 2004). The report is available through the following link [www.se.gov.sk.ca/environment/protection/land/land.asp](http://www.se.gov.sk.ca/environment/protection/land/land.asp). This report documents the survey methodology and the results and methodology used to rank the abandoned mines with respect to their human safety and environmental hazard potential.

In addition the Saskatchewan Northern Geological Survey maintains the Saskatchewan Mineral Deposit Index (SMDI) which is a searchable online database containing all the known mineral deposits in northern Saskatchewan. This database may be purchased in its entirety or searched online ([www.ir.gov.sk.ca/Default.aspx?DN=3374,3715,2965,2936,Documents](http://www.ir.gov.sk.ca/Default.aspx?DN=3374,3715,2965,2936,Documents)). There are 96 past producers in the SMDI but there does not seem to be a direct linkage between all the abandoned mines and past producers.

In southern Saskatchewan there was a report produced in 1989 titled “Abandoned Mines in Saskatchewan” that dealt with abandoned coal mines. There are 405 coal mines documented in this publication (Pam Schwann, pers. comm., 2004). Unfortunately, attempts to locate this document have not yet been successful.

### **Comments:**

The abandoned mines of northern Saskatchewan are well documented as a result of the recently completed 3 year survey. All abandoned mines are believed to have been identified and surveyed. The local population assisted in locating all the sites. Part of the survey was a thorough legal search for owners of all the sites to ascertain that they were indeed abandoned. This search did turn up one owner for what was thought to be an abandoned uranium mill site and that owner is now actively involved in the cleanup. The 1989 survey of coal mines in southern Saskatchewan was initiated as the result of a death involving an abandoned mine opening.



## MANITOBA

### **Definitions:**

*abandoned mine*: a mine in respect of which the right to mine has been forfeited, cancelled, revoked or otherwise terminated.

Also

“Where ownership of the mine has been reverted back to the crown, as the former mining company no longer exists or does not have the financial capacity to carryout rehabilitation work.”

### **Information Sources:**

Manitoba hosts an online searchable database of mineral occurrences at the following link [www2.gov.mb.ca/Itm-cat/minsearch.htm](http://www2.gov.mb.ca/Itm-cat/minsearch.htm) was last updated about 10 years ago but nonetheless provides an excellent historic documentation of the known mineral deposits and production records (James Bamburak, pers. comm., 2004). Two publications documenting the mineral inventory and mines of Manitoba are available (Bamburak, 1980 and Bamburak, 1990). Any deposit of interest with respect to NOAMI would certainly be contained in this database of at least 763 deposits.

A “comprehensive database of mine sites” (Shaft List (Att-3).xls provided to NOAMI survey) contains 31 fields in a spreadsheet format. It is still a work in progress and needs editing and refining. Over 237 mine sites have been identified in the province; ~120 have been closed and rehabilitated (according to rules in place in 2002).

### **Comments:**

Abandoned / inactive mines in Manitoba drew a great deal of attention when the federal government used an inactive mine working near Flin Flon to grow medicinal marijuana. The attention drawn to the environmental conditions surrounding the site and the public use of terms surrounding old mine workings is highlighted on the following site [www.medicalmarihuana.ca/toxic.html](http://www.medicalmarihuana.ca/toxic.html). This site contains a collection of information and terminology that clouds the difference between the definitions for inactive and abandoned mines, increases the potential for significant public confusion on the subject.

## ONTARIO

### **Definitions:**

*The following are “working” definitions not defined by Statute or Regulation.*

*Abandoned mines:* those which had ceased production and closed prior to Part VII of Ontario’s *Mining Act* coming into effect. They are described as where mining or milling has ceased, but where the site has not been rehabilitated.

*Abandoned:* is a site where a proponent has ceased or suspended indefinitely advanced exploration, mining, or mine production on the site, without rehabilitating the site.

*Orphaned mine:* has been used by some to describe sites without an owner. They use the term orphaned on an informal basis if the owner can not be found or the site has reverted to the crown

### **Information Sources:**

The Abandoned Mines Information System (AMIS) contains approximately 5600 abandoned and inactive mine sites and mine hazards within Ontario, which includes 18,500 mine hazards and individual features such as shafts and trenches. A compressed version of the database is available in ESRI shape and ASCII format at [www.mndm.gov.on.ca/MNDM/MINES/data/amis/amisdb.zip](http://www.mndm.gov.on.ca/MNDM/MINES/data/amis/amisdb.zip). Hardcopy mine plans and sections for many of the abandoned mines are available at the relevant district office.

The Mineral Deposit Inventory Version 2 contains some 19,000 deposit descriptions and may be purchased in a MS Access format. An online search of the database at [www.mndm.gov.on.ca/mndm/mines/ims/pub/digcat/mdi\\_e.asp](http://www.mndm.gov.on.ca/mndm/mines/ims/pub/digcat/mdi_e.asp) using deposit status values such as producer and past producer should include all the abandoned mines in AMIS plus those potential problem mines which still have an owner.

### **Comments:**

An earlier effort to prioritize all the abandoned mines in the province using an expert system technique based on site survey parameters and evaluations known as the AMHAZ program proved unreliable due to sampling biases. It is hoped that through more rigid standardized procedures that the program may prove successful in the future (John Robertson, pers. comm., 2004).

Work is in progress to provide AMIS information to the public through Land Information Ontario (LIO).

## QUEBEC

### **Definitions:**

*Abandoned Mine Site:* site having no owner or the owner is unable to pay for decommissioning and cleanup.

*Active Mine Site:* the owner is already working the property.

*Inactive Mine Site:* the owner is not working the property (Tremblay, R., 2001).

It is believed that due to Quebec legislation inclusion of any Quebec information in a database referred to as 'abandoned' could have undesirable legal ramifications. They have not done a full legal ownership search of all their sites of interest so cannot call them 'abandoned' (Jean Dionne, pers. comm., 2004).

### **Information Sources:**

An MS Excel database containing all the mines in Quebec of all categories is maintained but is not publicly available at this time.

Mineral occurrences number more than 5800. Two thousand two hundred mine openings have been identified of which 1129 had been secured by the end of 2001.

The province's mineral occurrence database can be searched online at [sigeom.mrnfp.gouv.qc.ca/signet/classes/I1102\\_index](http://sigeom.mrnfp.gouv.qc.ca/signet/classes/I1102_index). The database contains some 5645 occurrences, of which 292 are closed mines.

### **Comments:**

Quebec has inspected nearly all the potential problem sites and using a modified CCME ranking system has classified 16 sites as priority #1. About 95% of the sites require some remediation. The ranking system is somewhat flexible to meet the demands of public input.

Any involvement with a national database must have formal approval but they think it would be a positive step if a standardized system of ranking sites could be established.

There are about 70 sites with no traceable owner or the owner has become insolvent. Of these about 15 sites are considered to have a major environmental impact and must be prioritized for future work.

## YUKON

### **Definitions:**

*Type II Mines:* refer to major mine sites with the potential of unfunded environmental liabilities at the time of closure which became the shared responsibility of the Federal and Territorial governments upon devolution. *Type I Mines:* refer to active sites where companies are responsible for reclamation of sites under modern territorial guidelines. *Abandoned or orphaned sites:* A site is abandoned or orphaned “where the person or corporation .....is unknown or out of business and the site is on federal crown land or reserve land (Canada Lands).

### **Information Sources:**

Yukon utilizes Indian and Northern Affairs Canada’s ‘Federal Contaminated Sites and Solid Waste Landfills Inventory’ for abandoned or orphaned mine sites. The database contains 28 contaminated sites of all types for the Yukon (Robert Holmes, pers. comm., 2004). The Assessment and Abandoned Mines Branch manages the remediation of these major sites and deals with minor sites as the need arises. Additional information on Type II site management can be found at [www.emr.gov.yk.ca/Mining/TypeII/contact.htm](http://www.emr.gov.yk.ca/Mining/TypeII/contact.htm). In preparation for devolution all known sites were identified and classified. If new abandoned mine sites become known, which is highly unlikely, they will be added to this database rather than creating a new Yukon specific database (Hugh Copland, pers. comm., 2004). A complete listing of all Type I, Type II and other sites (which include mines) identified throughout the Yukon is provided in Appendix H of the Devolution document [www.emr.gov.yk.ca/mining/aam.html](http://www.emr.gov.yk.ca/mining/aam.html).

The Yukon MINFILE is maintained by the Yukon Geological Survey and contains 2603 separate mineral occurrences. The database may be downloaded or searched online at [www.geology.gov.yk.ca/minfile/index.html](http://www.geology.gov.yk.ca/minfile/index.html)

### **Comments:**

It is felt that all the significant abandoned mine sites have been identified and are being addressed through the previous work of INAC and are contained in its database. There are other Type II mines in the Yukon but they are under the care of private owner/operators.

## NORTHWEST TERRITORIES

### **Definitions:**

*abandoned or orphaned sites:* A site is abandoned or orphaned “where the person or corporation .....is unknown or out of business and the site is on federal crown land or reserve land (Canada Lands).”

### **Information Sources:**

The Northwest Territories utilizes INAC’s ‘Federal Contaminated Sites and Solid Waste Landfills Inventory’ for abandoned or orphaned mine sites. The NWT has 66 sites contained in this database of which 17 are abandoned sites associated with mining or exploration activities. Treasury Board (Government of Canada) maintains this site at [www.tbs-sct.gc.ca/dfrp-rbif/cs-sc/home-accueil.asp?Language=EN](http://www.tbs-sct.gc.ca/dfrp-rbif/cs-sc/home-accueil.asp?Language=EN).

INAC maintains a mineral occurrence database, NORMIN, which provides online access to the mineral deposits of the NWT and NUNAVUT. This database may also be downloaded for use offline. The INAC contaminated sites database contains only the major identified contaminated sites whereas the NORMIN database contains a listing of sites with the potential to have mine openings or workings that could present a public safety or environmental hazard ([www.nwtgeoscience.ca/normin/](http://www.nwtgeoscience.ca/normin/)). NORMIN identifies about 22 ‘Past Producer Abandoned’ and 25 ‘Minor Past Producer Abandoned’ sites in the NWT.

## NUNAVUT

### **Definitions:**

*abandoned or orphaned sites:* A site is abandoned or orphaned “where the person or corporation .....is unknown or out of business and the site is on federal crown land or reserve land (Canada Lands).”

### **Information Sources:**

Nunavut utilizes INAC’s ‘Federal Contaminated Sites and Solid Waste Landfills Inventory’ for abandoned or orphaned mine sites. Nunavut has 77 sites contained in this database of which two are believed associated with mining or exploration activities. Treasury Board (Government of Canada) maintains this site at [www.tbs-sct.gc.ca/dfrp-rbif/cs-sc/home-accueil.asp?Language=EN](http://www.tbs-sct.gc.ca/dfrp-rbif/cs-sc/home-accueil.asp?Language=EN).

INAC maintains a mineral occurrence database, NORMIN, which provides online access to the mineral deposits of the NWT and NUNAVUT. This database may also be downloaded for use offline. As INAC’s contaminated sites database contains only the major sites that have been identified, the NORMIN database contains a listing of sites with the potential to have mine openings or workings that could present a public safety or environmental hazard ([www.nwtgeoscience.ca/normin/](http://www.nwtgeoscience.ca/normin/)). NORMIN identifies about three ‘Past Producer Abandoned’ sites in Nunavut.

## **NEW BRUNSWICK**

### **Definitions:**

The New Brunswick Department of Natural Resources and Energy (NBDNRE) “does not currently have a position or policy concerning abandoned mines”. Their current definitions are: operating, temporary closure, closed, and reclaimed.

### **Information Sources:**

New Brunswick maintains a “New Brunswick Mine Shaft” database housed in an MS Excel format containing some 142 sites. The sites are both operational and non-operational and may or may not have current owners.

The New Brunswick Mineral Occurrence Database contains information about 1419 mineral occurrences in an on-line searchable database ([www1.gnb.ca/0078/GeoscienceDatabase/Minerals/Search.asp](http://www1.gnb.ca/0078/GeoscienceDatabase/Minerals/Search.asp)).

### **Comments:**

They have not progressed to the stage of prioritizing sites for work. Their Crown Lands Branch is developing a risk management system for crown lands in general and this may be applied to abandoned mines.

## NOVA SCOTIA

### **Definitions:**

*abandoned mine*: no formal definition but the term is used to indicate mine openings that are no longer active. Ownership is not part of this definition as about 75% of the abandoned mines are on private land

[www.gov.ns.ca/natr/publications/naturesresources/pdf/6.1/abandonedMineOpenings.pdf](http://www.gov.ns.ca/natr/publications/naturesresources/pdf/6.1/abandonedMineOpenings.pdf).

### **Information Sources:**

The Nova Scotia Abandoned Mine Openings Database contains an inventory of some 6582 mine openings located on public and private land in Nova Scotia. The database may be downloaded from [www.gov.ns.ca/natr/meb/download/dp010.htm](http://www.gov.ns.ca/natr/meb/download/dp010.htm).

In addition the Nova Scotia Mineral Occurrence Database contains an inventory of some 2790 coal, metallic and industrial mineral occurrences in the province and these can be obtained at [www.gov.ns.ca/natr/meb/pubs/pubs3db.htm#mo](http://www.gov.ns.ca/natr/meb/pubs/pubs3db.htm#mo).

### **Comments:**

“The NS Abandoned Mines database is comprised of two components:

- Abandoned Mine Openings (AMO) information (size, shape, condition, ease of access ... etc. and a general assessment (rating) of the hazard)
- Environmental Characteristics of the mine site (tailings, tailings dams, ARD, waste rock, structures & foundations, fuel oil storage, mine plans, current ground & aerial photos of the site, ... etc.)

We have made significant progress on the AMO database, especially for sites located on Crown Lands. Very limited progress has been made on the Environmental Characteristics database.” (Donald Jones, pers. comm., 2004).

All Abandoned Mines information is freely available to the public and would also be available to a National Database.

As of 2002 all mine openings on Crown land have been evaluated and assigned a hazard potential. Owners of lands containing abandoned mine openings have been advised of their legal responsibilities with respect to public safety. It is believed that virtually all the abandoned mines have been located and documented.



## NEWFOUNDLAND & LABRADOR

### **Definitions:**

*abandoned:* “a condition in which a project has ceased or has been suspended indefinitely without being rehabilitated”.

*closed out:* “means a project in which all the requirements of an approved rehabilitation and closure plan have been fulfilled”.

*closure:* “means the final termination of a project”.

### **Information Sources:**

The Mineral Development Division maintains an “Abandoned Mine Database” that contains over 100 abandoned properties. The properties may be past producers or advanced prospects. The database is contained in an active MS Access file structure. More properties will be added as they are located.

The Mineral Occurrence Data System (MODS) contains information on approximately 6000 mineral occurrences in the province. The database is freely available to the public at [www.gov.nf.ca/mines&en/geosurvey/mods](http://www.gov.nf.ca/mines&en/geosurvey/mods).

### **Comments:**

Elimination of public safety hazards is the initial phase of the abandoned mine effort in Newfoundland & Labrador with the assessment of environmental impact to follow.

## 6.0 Review of International Inventories

### 6.1 United States

The mining histories of the United States and Canada are comparable in many respects. The scale of the issue in the United States is captured in the following excerpt from UNEP (2001) by George Stone of the Bureau of Land Management (BLM).

*“The Bureau has estimated that there are between 100,000 and 500,000+ small and mid-size abandoned hard rock mines in the west. Most sites are not posing problems. Of those that are, 25 per cent relate to health and safety matters and 5 per cent to environment, primarily issues of water pollution. There are some 13,000 abandoned coal mines, mostly small and mid-sized in the east. These are causing mainly health and safety problems.”*

This summary of the US situation provides some useful insight into the relative percentage risk types. It is likely that a similar ratio would be present in Canada.

There has been significant effort directed to establishing comprehensive inventories of historic mine sites and evaluating their risk with respect to public safety and environmental damage in the US. Activities on a national and state scale were reviewed for this study and are summarized below.

#### *National Scale Inventories*

##### **BLM’s Abandoned Mine Lands (AML) Cleanup Program**

([www.blm.gov/aml/](http://www.blm.gov/aml/))

- a. The Bureau of Land Management administers over 250 million acres of American public lands, located primarily in 12 Western States. Their website addresses the various programs they are pursuing.
- b. The BLM and participating States share a common database structure with the Office of Surface Mining (OSM), discussed later in this section. “On-the-ground AML inventories were conducted under a 1993 BLM directive that put into place common data elements to ensure that AML is characterized consistently. To date, only a small percent of all public lands have been inventoried on-the-ground with these strategy guidelines. Given the magnitude of the task and the fiscal resources that would be required, it is impractical to achieve a 100% field-verified inventory of all lands managed by the BLM. However, the AML data collected during that 1993-1995 inventory period has been compiled into an Abandoned Mine Lands Inventory System (AMLIS). It should be noted that the original inventory efforts were directed toward physical safety hazards sites and not those posing problems for watersheds, which is where we are placing increased emphasis today.”

- c. One page on this site describes the status of AML inventory sites in AMLIS for each of the twelve states [www.blm.gov/aml/amlis.htm#states](http://www.blm.gov/aml/amlis.htm#states) . Elsewhere in the website the links to each of the twelve states' AML page are given.
- d. The inventory field sheets for a site assessment (8 pages), directions for filling out the site assessment (23 pages) and attachments can be found at this link on the website: [www.blm.gov/aml/amlis.htm#states](http://www.blm.gov/aml/amlis.htm#states).
- e. For the BLM abandoned mine lands is defined as: "... a generic term used by federal land management agencies (e.g., BLM, United States Forest Service) to describe and characterize sites that have undergone historic mining and have not been properly cleaned up. These abandoned sites may include disturbances or features ranging from exploration holes and trenches to full blown, large-scale mine openings, pits, waste dumps, and processing facilities. One AML site can encompass many acres as well as many mine features."

### USGS Abandoned Mine Lands Initiative

([amli.usgs.gov/](http://amli.usgs.gov/) )

- a. [amli.usgs.gov/reports/ofr98\\_297/church.html](http://amli.usgs.gov/reports/ofr98_297/church.html)

**The Role of Geoenvironmental Maps and Statewide Assessments in Prioritizing Watersheds for Remediation of Abandoned Mine Lands, (1998)**

S.E. Church, T.C. Sole, D.B. Yager, and A.E. McCafferty. Prioritizing AML for reclamation across the U.S. is a problem they are trying to address. This short report discusses problems with the present water quality sampling across the country to detect the affect of AML in watersheds. They discuss application of the GeoEnvironmental Map (GEM) which was developed to integrate geologic information, environmental characteristics of different mineral-deposit types, and available water-quality data to evaluate the effect of mining on surface waters.

Federal law requires that sites be addressed in a priority order:

**Priority one.** The protection of public health, safety, general welfare and property from the extreme danger of adverse effects of mineral mining and processing practices.

**Priority two.** The protection of public health, safety, and general welfare from the adverse effects of mineral mining and processing practices; and

**Priority three.** The restoration of land and water resources and the environment previously degraded by the adverse effects of mineral mining and processing practices.

## **National Association of Abandoned Mine Land Programs**

([www.onenet.net/~naamlp/](http://www.onenet.net/~naamlp/))

- a. This association of some 30 states / Indian tribes was established in 1995 to “provide a forum to address current issues, discuss common problems, and share new technologies regarding the reclamation of abandoned mine lands”. It also serves to produce better relationships between states and tribes and the federal government and enhance coordination and communication.
- b. “The Surface Mining Control and Reclamation Act of 1977 (SMCRA) established the national Abandoned Mine Land (AML) Reclamation Program under the Office of Surface Mining Reclamation and Enforcement (OSMRE), U.S. Department of the Interior.” Fees were levied on active coal mining and deposited in the AML fund. “Congress authorized states and Indian tribes to implement their own programs. The programs are funded through grants from OSMRE, which receives funding from the AML Fund through the regular congressional budget and appropriations process.” This National Association monitors OSMRE administration of state and federal reclamation programs.

## **The Office of Surface Mining, U.S. Department of the Interior** ([www.osmre.gov/](http://www.osmre.gov/))

- a. This bureau has the responsibility, in cooperation with the states and Indian tribes, to protect citizens and the environment during mining and reclamation, and to reclaim mines abandoned before 1977. This relates principally to coal mining.

- b. [www.osmre.gov/pdf/99reportcolor.pdf](http://www.osmre.gov/pdf/99reportcolor.pdf)

This PDF is for the 1999 report for the Office of Surface Mining and Reclamation. On pages 15 to 16 they discuss the creation and ongoing enlargement of their digital inventory, Abandoned Mine Land Inventory System (AMLIS). It is a GIS and is online (see below). In 1999 the Bureau of Land Management decided to store its abandoned mine inventory in a specially modified version of the OSM inventory system. Users can query both databases. There is a plan to include access to the U.S. Forest Service abandoned mine inventory.

- c. [www.osmre.gov/aml/inven/zintroin.htm](http://www.osmre.gov/aml/inven/zintroin.htm)

Abandoned Mine Inventory System (AMLIS): A computerized database containing the AML Inventory information. The information is developed and entered by the State and Indian tribes managing their own AML programs and by OSM for non-program states and Indian tribes. AMLIS can query the database and then create reports, maps, or download the data.

**The US Forest Service**, U.S. Department of Agriculture  
([www.fs.fed.us/geology/fs\\_AML\\_program.pdf](http://www.fs.fed.us/geology/fs_AML_program.pdf))

- a. The USFS has responsibility for abandoned mineral lands on all NFS lands. The remediation component of this program is funded an average rate of about \$20 million dollars per year. Runoff from NFS lands impact about 66 million people in the United States.

## ***State Scale Inventories***

The following states have a webpage or a website to explain their AML programs and progress:

### **Alabama**

1. [dir.alabama.gov/mr/reclamation.aspx](http://dir.alabama.gov/mr/reclamation.aspx)
  - a. The webpage for Alabama's *Abandoned Mine Land Reclamation*, in the Department of Industrial Relations. Contains a link to the OSM site which hosts their information.

### **Alaska**

1. [www.dnr.state.ak.us/mlw/mining/aml/index.htm](http://www.dnr.state.ak.us/mlw/mining/aml/index.htm)
  - a. This is the *Abandoned Mines Land Program* link for Alaska. The state has a partially completed inventory of all coal and non-coal historic mines. Tables show the result of their inventory so far. The site discusses the funding sources for AML reclamation work.

### **Arizona**

1. [www.asmi.state.az.us/abandoned.html](http://www.asmi.state.az.us/abandoned.html)
  - a. This site is by the *Abandoned Mines Supervisor* for the state of Arizona. The web page discusses the work on abandoned mine reclamation as well as mine safety programs which have been undertaken. "In ...1992, the Arizona State Mine Inspector entered into an agreement with the Bureau of Land Management to survey federally-managed lands and inventory abandoned and inactive mines." The site includes statistics for the inventory to 1999...when "the focus of the cooperation with the Bureau of Land Management changed from inventory to mine remediation". Numerous links to associated sites are included.
  - b. The inventorying of abandoned mines in Arizona continues at present. Over 9000 mines were inventoried by 1999. No online database /inventory is mentioned anywhere.

## Arkansas

1. [www.adeq.state.ar.us/mining/default.htm](http://www.adeq.state.ar.us/mining/default.htm)
  - a. The site of the *Surface Mining and Reclamation Division*, Department of Environmental Quality, for the state of Arkansas. Information is focused on current mining oversight. They have an online searchable database for all types of mining permits and their current status. This can also be wholly down-loaded.

## Colorado

1. [mining.state.co.us/dmginactive.html](http://mining.state.co.us/dmginactive.html)
  - a. The *Colorado Division of Minerals & Geology, Abandoned Mines* site has links to a number of programs addressing: Inactive Mine Reclamation, Mine Subsidence Protection Program, Non-Point Source Program, Forfeited Bond Reclamation, Danger, etc. One link is to Tourist Mines – where an extensive list of mines opened to tourists is listed with their links. They encourage people to visit these tourist attractions to learn about mining history in Colorado. There is no link to a public database from this site. Links to BLM site are provided to view work on AML in Colorado.

## Idaho

1. [www2.state.id.us/lands/Bureau/Minerals/abandoned\\_mine/abl\\_index.htm](http://www2.state.id.us/lands/Bureau/Minerals/abandoned_mine/abl_index.htm)
  - a. The Idaho Department of Lands' *Abandoned Mine Land Program* webpage gives general information about the program and a table which lists reclamation accomplishments. A link to the BLM site is provided to view work on AML in Idaho.

## Illinois

1. [dnr.state.il.us/mines/aml/recpgm.htm](http://dnr.state.il.us/mines/aml/recpgm.htm)
  - a. The Illinois Department of Natural Resources' *Illinois Abandoned Mine Land (AML) Reclamation Program's* website has an online searchable database, *Abandoned Mines Site Locator* for abandoned mine sites in the state. One enters either the county or nearest town, and a table is presented with seven fields including “problem type” and “units” (physical size). There is also a glossary with pictures for AML terms. In addition the site discusses work which has been accomplished in the state.

## Indiana

1. [www.in.gov/dnr/reclamation/downloads/AML\\_guide.pdf](http://www.in.gov/dnr/reclamation/downloads/AML_guide.pdf)
  - a. This links to the PDF *Citizen's Guide to Indiana's Abandoned Mine Land Program*. The six page brochure describes the work of Indiana Department of

Natural Resources, Division of Reclamation. It also discusses AML funding and the role of the OSM.

## **Iowa**

1. [www.agriculture.state.ia.us/abandonedmine.htm](http://www.agriculture.state.ia.us/abandonedmine.htm)
  - a. The Iowa Department of Agriculture and Land Stewardship – Mines & Minerals Bureau, *Abandoned Mined Land Reclamation* webpage describes their program and links to OSM.

## **Kansas**

1. [www.kdhe.state.ks.us/mining/abandoned\\_mineland.html](http://www.kdhe.state.ks.us/mining/abandoned_mineland.html)
  - a. This website is for the Kansas Department of Health and Environment, Surface Mining Section, *Abandoned Mine Land (AML) Program*. Under the Remediation section there is an online database of all contaminated sites managed by the Bureau of Remediation – which includes abandoned mine sites. A search is made by location and can be chosen by a number of criteria which will then display a list of sites. Each contaminated site is linked to its fact sheet *Identified Sites List Information* which contains over 30 fields. These include “Actions Completed”, “Actions Underway” and “Actions Proposed”, with dates for start and completion, activity type, etc.

## **Kentucky**

1. [www.surfacemining.ky.gov/aml/](http://www.surfacemining.ky.gov/aml/)
  - a. Kentucky’s Department for Natural Resources has this link to the *Division of Abandoned Mine Lands (AML)*. This site has a link to AMLIS (see above), however, the site notes: “Not all Kentucky AML problems have been entered into the federal database, primarily because of the large volume of AML problems in the Commonwealth. However, Kentucky does maintain an in-house inventory that contains all reported AML problems in the state”. This in-house inventory does not appear to be online. The DNR has an exhaustive online GIS which includes digitized surveys of underground workings as layers.

## **Louisiana**

1. [www.dnr.state.la.us/CONS/CONSERIN/SURFMINE/Abandprog.ssi](http://www.dnr.state.la.us/CONS/CONSERIN/SURFMINE/Abandprog.ssi)
  - a. The *Abandoned Mine Lands Program* of the Louisiana Office of Conservation (Department of Natural Resources) site only has a general statement. The DNR has an online web mapping service, but it does not show AML.

## **Maryland**

1. [www.mde.state.md.us/Programs/WaterPrograms/MiningInMaryland/MineReclamationProgram/index.asp](http://www.mde.state.md.us/Programs/WaterPrograms/MiningInMaryland/MineReclamationProgram/index.asp)

Natural Resources, Division of Reclamation. It also discusses AML funding and the role of the OSM.

## **Iowa**

1. [www.agriculture.state.ia.us/abandonedmine.htm](http://www.agriculture.state.ia.us/abandonedmine.htm)
  - a. The Iowa Department of Agriculture and Land Stewardship – Mines & Minerals Bureau, *Abandoned Mined Land Reclamation* webpage describes their program and links to OSM.

## **Kansas**

1. [www.kdhe.state.ks.us/mining/abandoned\\_mineland.html](http://www.kdhe.state.ks.us/mining/abandoned_mineland.html)
  - a. This website is for the Kansas Department of Health and Environment, Surface Mining Section, *Abandoned Mine Land (AML) Program*. Under the Remediation section there is an online database of all contaminated sites managed by the Bureau of Remediation – which includes abandoned mine sites. A search is made by location and can be chosen by a number of criteria which will then display a list of sites. Each contaminated site is linked to its fact sheet *Identified Sites List Information* which contains over 30 fields. These include “Actions Completed”, “Actions Underway” and “Actions Proposed”, with dates for start and completion, activity type, etc.

## **Kentucky**

1. [www.surfacemining.ky.gov/aml/](http://www.surfacemining.ky.gov/aml/)
  - a. Kentucky’s Department for Natural Resources has this link to the *Division of Abandoned Mine Lands (AML)*. This site has a link to AMLIS (see above), however, the site notes: “Not all Kentucky AML problems have been entered into the federal database, primarily because of the large volume of AML problems in the Commonwealth. However, Kentucky does maintain an in-house inventory that contains all reported AML problems in the state”. This in-house inventory does not appear to be online. The DNR has an exhaustive online GIS which includes digitized surveys of underground workings as layers.

## **Louisiana**

1. [www.dnr.louisiana.gov/cons/conserin/SURFMINE/Abandprog.ssi](http://www.dnr.louisiana.gov/cons/conserin/SURFMINE/Abandprog.ssi)
  - a. The *Abandoned Mine Lands Program* of the Louisiana Office of Conservation (Department of Natural Resources) site only has a general statement. The DNR has an online web mapping service, but it does not show AML.

## **Maryland**

1. [www.mde.state.md.us/Programs/WaterPrograms/MiningInMaryland/MineReclamationProgram/index.asp](http://www.mde.state.md.us/Programs/WaterPrograms/MiningInMaryland/MineReclamationProgram/index.asp)



- a. The *Abandoned Mine Land Reclamation Program* of the Maryland Department of the Environment discusses the benefits of reclamation and has links to examples of reclaimed mines sites. No inventory is mentioned.

## Michigan

1. [www.michigan.gov/deq/0,1607,7-135-3311\\_4111---,00.html](http://www.michigan.gov/deq/0,1607,7-135-3311_4111---,00.html)

- a. It is difficult with the state of Michigan to find out who administers the AML funds from the OSM. The *Department of Environmental Quality* site describes their other reclamation responsibilities. On the other hand the *Office of the Geological Survey*, [www.michigan.gov/deq/0,1607,%207-135-3306\\_28607---,00.html](http://www.michigan.gov/deq/0,1607,%207-135-3306_28607---,00.html), looks as though it may also be involved. AML is not mentioned anywhere. However, see below.

2. [www.mg.mtu.edu/mining/ab.htm](http://www.mg.mtu.edu/mining/ab.htm)

- a. The *Michigan Abandoned Mine Lands Inventory* was created by the Department of Mining Engineering at Michigan Technical University (MTU). The Mineral Technology Research Group at MTU began this inventory in 1995 when they received a contract from Michigan's Department of Natural Resources (DNR). The contract was to inventory, document and map abandoned underground mines in the state and identify and rank unsafe conditions. This database does not appear to be publicly available.

## Missouri

1. [www.dnr.mo.gov/alpd/lrp/amlinfo.htm](http://www.dnr.mo.gov/alpd/lrp/amlinfo.htm)

- a. Missouri's *Abandoned Mine Lands (AML)* webpage by the Department of Natural Resources, Air and Land Protection Division has links to further information and a large table of completed reclamation sites. DNR's web mapping service does not address abandoned mines.

## Montana

1. [www.deq.state.mt.us/abandonedmines/index.asp](http://www.deq.state.mt.us/abandonedmines/index.asp)

- a. The Montana Department of Environmental Quality's (DEQ) *Abandoned Mine Section* webpage describes the abandoned mines effort in the state. The *Mine Waste Cleanup Bureau* is responsible for work on abandoned mine sites. The state has a complete inventory which has prioritized sites for clean-up. "Montana has completed reclamation of its abandoned coal mines, but if any new problems occur, DEQ will address them right away. DEQ is now addressing abandoned non-coal mines. These have been ranked in priority order based on an abandoned and inactive mine scoring system and a safety score. The non-coal abandoned mines are being addressed on a roughly worst-first basis."

- b. Montana Inactive Mines – statewide databases pertaining to Montana inactive mines can be downloaded in four different file formats. The *Montana Mines Priority Cleanup Sites* database contains the location of the 380 priority cleanup sites for inactive hardrock mines in the state. The *Montana Inactive Mine Sites* database lists the locations and features of all 3,834 investigated inactive hardrock mines in Montana. The *Water Sampling Sites for Montana Inactive Mines* database contains water sampling data from 621 sites near the priority cleanup mine sites. The *Sediment Sampling Sites for Montana Inactive Mines* database contains sediment sampling data from 484 sites near the priority cleanup mine sites.

2. [maps2.nris.state.mt.us/mapper/index.html](http://maps2.nris.state.mt.us/mapper/index.html)

- a. The *Montana Natural Resource Information System Digital Atlas of Montana* contains layers for Abandoned Mines. The Shape files (SHP) for this layer are available for download from this site.

### Navajo Nation

1. [www.navajoaml.osmre.gov/NAML\\_PFP/PFP\\_page.htm](http://www.navajoaml.osmre.gov/NAML_PFP/PFP_page.htm)

- a. This is the link to the *Navajo AML Reclamation / UMTRA Department* website. This is part of the Navajo Nation Division of Natural Resources. They are responsible for the AML Database Development. This does not appear to be online.

### Nevada

1. [minerals.state.nv.us/programs/aml.htm](http://minerals.state.nv.us/programs/aml.htm)

- a. The Nevada Division of Minerals maintains this public information website to promote awareness and understanding of the issues surrounding abandoned mines in the state. The site provides information ranging from how to obtain a warning sign to the excellent achievement of Eagle Scouts in securing abandoned mines as community service projects. Nevada has identified some 10,056 sites to date with some 8,023 of these sites being secured for a secured percentage rate of 79.8%.

### New Mexico

1. [www.emnrd.state.nm.us/Mining/aml/default.htm](http://www.emnrd.state.nm.us/Mining/aml/default.htm)

- a. New Mexico Energy, Minerals and Natural Resources Department’s Mining and Minerals Division website for their *Abandoned Mine Land Program*.

## Ohio

1. [www.fhwa.dot.gov/mine/01trblrr.htm](http://www.fhwa.dot.gov/mine/01trblrr.htm)

- a. The Ohio Department of Transportation maintains an inventory of abandoned coal mines to facilitate planning of highways and the repair of roadways that have suffered from subsidence due to old mine workings. This is an example of a segment of a state government maintaining its own inventory for a specific purpose.

## Washington

1. [www.dnr.wa.gov/geology/abanmine.htm](http://www.dnr.wa.gov/geology/abanmine.htm)

- a. Washington's "Department of Natural Resources (DNR), Division of Geology and Earth Resources (DGER) has created a database (in Microsoft Access format) and a series of written Open File Reports (OFRs) documenting present-day characteristics of selected *Inactive and Abandoned Mine Lands (IAML)* in the state. The documents focus on physical characteristics and hazards (openings, structures, materials, and waste) and water-related issues (acidic drainage and metals transport). Accurate location, current ownership, and land status information is included. This website also has an online map of all abandoned sites.
- b. 3800 mineral properties have been located in the state during the last 100 years. However, they have identified only approximately 60 sites that meet one of the following criteria: (a) more than 2000 feet of underground development, (b) more than 10,000 tons of production, (c) location of a known mill site or smelter. This subset of sites includes only metal mines no longer in operation. The database is considered critical to the systematic survey and prioritization of environmental hazards, site remediation, and reclamation of wildlife habitat at these mines. To date the EPA, USFS, and DNR have contributed funding for the project. A copy of the *Inactive and Abandoned Mine Lands* database may be viewed with assistance from DGER personnel. Open File Reports on IAML may be obtained online at [www.dnr.wa.gov/geology/pubs/pubs\\_ol.htm#minerecl](http://www.dnr.wa.gov/geology/pubs/pubs_ol.htm#minerecl).
- c. SURFMINES is a GIS coverage containing the locations of mines with current (1162 points) or terminated (1645 points) Washington Department of Natural Resources Reclamation Permits. It is available from this site ([www.dnr.wa.gov/geology/smgis.htm](http://www.dnr.wa.gov/geology/smgis.htm)) for download as ArcInfo coverage or ArcView shapefiles.

- d. The article “Washington’s Inactive and Abandoned Metal Mine Inventory and Database” by D.K. Norman in *Washington Geology* discusses the need for an AML database / inventory and discusses the types of information which it should contain. This article is in the September 2000 edition which may be found online at [www.dnr.wa.gov/geology/pubs/pubs\\_ol.htm#minerecl](http://www.dnr.wa.gov/geology/pubs/pubs_ol.htm#minerecl), and is contained in Appendix 3 of this report.

## 6.2 Iran

The Abandoned Mines Database of Iran is described at the following web address, [www.ngdir.ir/GeoportalInfo/SubjectInfoDetail.asp?PID=5](http://www.ngdir.ir/GeoportalInfo/SubjectInfoDetail.asp?PID=5). This site is included in the survey to show an alternative perspective on abandoned mines. In reality this perspective is no different than in any other jurisdiction but it is interesting to see abandoned mines being promoted as an asset while simultaneously undergoing remediation (Figure 1).

In the Iranian database scheme inactive mines are divided into two sub-groups; Stagnant mines and Abandoned mines.

*Stagnant mines:* mines that do not have any exploitation and preparation permission (exploration or development permits) in a particular year.

*Abandoned mines:* mines that do not have any exploitation and preparation permission (exploration or development permits) in a particular year and have not had such permissions for more than 5 years.

The goal of the Abandoned Mines Database of Iran is the compilation of data concerning abandoned mines and the utilization of this information to promote the re-examination of these deposits. As a result, activities at abandoned mine sites have been stopped and any licenses have been cancelled. Both abandoned mines and stagnant mines are included in this database of potentially economically viable deposits.

This example offers an alternative purpose for the development of an inventory of orphaned/abandoned mines, that of economic development. It is difficult from the site to determine if any remediation has been accomplished as the photographic examples showing remediation are from the Gawley Mine and the MacMillan Mine in Ontario and have been taken from the Ontario Government website ([www.mndm.gov.on.ca/mndm/mines/mg/abanmin/default\\_e.asp](http://www.mndm.gov.on.ca/mndm/mines/mg/abanmin/default_e.asp)).

**NATIONAL GEOSCIENCE DATABASE OF IRAN**

Access to information by: Subject Region Scale Search Newest Specific Info

## Abandoned Mines DB of Iran

### Inactive mines database of Iran

[Page 1 to 8] 1 2 3 4 5 6 7 8 Next

Page 1

Abandoned Mines Database of Iran: Introduction.

One of the fundamentals in sustainable development of each country is the optimum usage of available and unused capitals. Parallel to this case, the review of abandoned mines in Iran is very significant. It is necessary to re-assess these mines to increase the exploitation and proper usage of them.

For this purpose, the National Geosciences Database of Iran has decided to compile all available data about these mines, and the arrangement of them under appropriate and executable structure will prepare a suitable condition to review and re-open these mines. These mines will be a suitable environment for domestic and foreign investors via presentation data under appropriate structures and three-dimensionally geometrical modelling. This situation is a positive step toward economically sustainable development. It is evident that the returns of capitals to the mining industry cycle produce economic development and employment.

On the other hand, if these mines ran out of their resources must not be abandoned because they have many hazards for inhabitants, environment and ecosystem of the region. Hope the re-examination of these mines and their safeties prevent from the damages of their being abandoned.

In each country, optimal utilization of available & unused capital is one of the basics for sustainable development. In this direction, revision of abandoned mines in Iran is of special importance & it is necessary to reevaluate the mines & unused capital for proper utilization & increasing profit

```

    graph TD
      A[Mine operation] --> B[Post closure]
      B --> C[Exploration]
      C --> D[Development / Feasibility]
      D --> E[Mine operation]
      E --> F[Closure / rehabilitation]
      F --> B
  
```

Abandoned mines- Description.

Figure 1. Iranian Abandoned Mines Database. Note cycle of closure and exploration.

## 6.3 Non-Government Organization

In addition to government related organizations that monitor and inventory active and inactive mining activities a number of non-government organizations (NGOs) with special interests perform similar functions on various scales. The World Information Service on Energy (WISE) organization maintains a number of inventories. Their inventory of uranium activities contains a comprehensive database of active and inactive uranium mines and facilities around the world. The database for Canada can be viewed at [www.antenna.nl/wise/uranium/uddcdn.html](http://www.antenna.nl/wise/uranium/uddcdn.html). Figure 2 below illustrates the layout and information included on this site (as of update for August 28, 2004). The links associated with each documented site provide an excellent source of background information.

### Decommissioning Data - Canada

(last updated 28 Aug 2004)

Contents:

- [Mines](#)
- [Waste Rock](#)
- [Mill Tailings](#)

#### Mines

Uranium mines - Canada

Location	Type	No. of Shafts	Total Production [t U]	Status
<b>Northwest Territories</b>				
Port Radium				abandoned <a href="#">[ISSUES]</a>
Rayrock				abandoned <a href="#">[ISSUES]</a>
<b>Saskatchewan</b>				
Beaverlodge				abandoned <a href="#">[ISSUES]</a>
Gunnar				abandoned <a href="#">[ISSUES]</a>
Lorado				abandoned <a href="#">[ISSUES]</a>
Nisto				abandoned <a href="#">[ISSUES]</a>
<a href="#">Rabbit Lake</a>	OP			closed <a href="#">[ISSUES]</a>
<a href="#">Cluff Lake</a>				closed <a href="#">[ISSUES]</a>
<a href="#">Key Lake</a>	OP			mine closed, Deilmann pit to receive <a href="#">McArthur River</a> tailings
<a href="#">McArthur River</a>	UG			operating <a href="#">[ISSUES]</a>
<a href="#">McClellan Lake</a>	OP, UG			idle; JEB pit receives tailings
<b>Ontario</b>				
Pronto ( <a href="#">Rio Algom</a> )	UG			
Quirke ( <a href="#">Rio Algom</a> )	UG			remediation complete
Denison ( <a href="#">Denison</a> )	UG			
Panel ( <a href="#">Rio Algom</a> )	UG			remediation complete
Can-Met ( <a href="#">Denison</a> )				
Stanrock ( <a href="#">Denison</a> )	UG			remediation complete
Stanleigh ( <a href="#">Rio Algom</a> )				remediation in action
Buckles	UG			remediated

Spanish American ( <a href="#">Rio Algom</a> )	UG		
Milliken	UG		<input type="checkbox"/>
Lacnor ( <a href="#">Rio Algom</a> )	UG		<input checked="" type="checkbox"/> remediated
Nordic ( <a href="#">Rio Algom</a> )	UG		<input checked="" type="checkbox"/> remediated
Agnew Lake (ALM-Kerr Addison)	UG		<input checked="" type="checkbox"/> remediation complete
Bancroft			<input type="checkbox"/>
TOTAL		321,626*	

Type: UG = underground, OP = open pit

\* as of end 1998

Sources: Uranium 1999, OECD 2000

## Waste Rock

### Uranium waste rock deposits - Canada

Location	No. of Heaps	Area ha	Volume 10 <sup>6</sup> m <sup>3</sup>	Status
?	?	?	?	?
TOTAL				

Sources:

## Mill Tailings

### Uranium Mill Tailings Deposits - Canada

Location	Area ha	Contents 10 <sup>6</sup> t	Status
<b>Northwest Territories</b>			
Port Radium		1	<input checked="" type="checkbox"/> soil, rock cover <a href="#">[ISSUES]</a>
Rayrock		0.07	<input checked="" type="checkbox"/> soil cover <a href="#">[ISSUES]</a>
<b>Saskatchewan</b>			
Beaverlodge		5.7	<input type="checkbox"/> lake disposal <a href="#">[ISSUES]</a>
Gunnar	74	4.1	<input type="checkbox"/> lake disposal, no reclamation <a href="#">[ISSUES]</a>
Lorado	10	0.36	<input type="checkbox"/> no reclamation <a href="#">[ISSUES]</a>
<a href="#">Rabbit Lake</a>	54	6	<input checked="" type="checkbox"/> operating <a href="#">[ISSUES]</a> <a href="#">[DECOMM. ISSUES]</a>
<a href="#">Chuff Lake</a>	36	2.5	<input type="checkbox"/> closed <a href="#">[ISSUES]</a>
<a href="#">Key Lake</a>	45	9.2	<input type="checkbox"/> original tailings deposit closed <input checked="" type="checkbox"/> Deilmann pit to receive <a href="#">McArthur River</a> tailings <a href="#">[ISSUES]</a>
<a href="#">McClellan Lake</a>			<input checked="" type="checkbox"/> disposal in JEB pit operating, also to receive tailings from <a href="#">Midwest</a> and <a href="#">Cigar Lake</a> <a href="#">[ISSUES]</a>
<b>Ontario</b>			
Pronto ( <a href="#">Rio Algom</a> )		2	<input type="checkbox"/> no reclamation <a href="#">[ISSUES]</a>
Quirke ( <a href="#">Rio Algom</a> )	192	46	<input type="checkbox"/> flooded <a href="#">[ISSUES]</a>
Denison ( <a href="#">Denison</a> )	280	63.3	<input type="checkbox"/> [DETAILS: <a href="#">Denison</a> ] <a href="#">[ISSUES]</a>
Panel ( <a href="#">Rio Algom</a> )	123	16	<input type="checkbox"/> flooded <a href="#">[ISSUES]</a>
Stanrock ( <a href="#">Denison</a> )	52	5.7	<input type="checkbox"/> [DETAILS: <a href="#">Denison</a> ] <a href="#">[ISSUES]</a>
Stanleigh ( <a href="#">Rio Algom</a> )		20	<input type="checkbox"/> ? <a href="#">[ISSUES]</a>
Spanish American ( <a href="#">Rio Algom</a> )		0.4	<input type="checkbox"/> lake disposal <a href="#">[ISSUES]</a>
Lacnor ( <a href="#">Rio Algom</a> )		3	<input checked="" type="checkbox"/> revegetated <a href="#">[ISSUES]</a>
Nordic ( <a href="#">Rio Algom</a> )	10	12	<input checked="" type="checkbox"/> revegetated <a href="#">[ISSUES]</a>
Agnew Lake		0.4	<input checked="" type="checkbox"/> soil cover <a href="#">[ISSUES]</a>
Bancroft		4.4	<input checked="" type="checkbox"/> soil cover <a href="#">[ISSUES]</a>
TOTAL		> 202.13	

Sources: TMW'97 p.763; Sudbury'95 V.3 p.1199; IAEA-TECDOC-865 V.1 p.65; IAEA-TECDOC-982 p.35 (1997); Panel (1996)



## 6.4 Other Countries

A summary of abandoned mine inventory initiatives for other countries is contained in Mining for the Future (Appendix C) of the Mining, Minerals and Sustainable Development (MMSD) Project final report “Breaking New Ground”. This document was commissioned by International Institute for Environment and Development (IIED) and the World Council for Sustainable Development. Appendix C: The Abandoned Mines Working Paper (van Zyl *et al.* 2002) is available at [www.iied.org/mmsd/mmsd\\_pdfs/draft\\_paper\\_am.pdf](http://www.iied.org/mmsd/mmsd_pdfs/draft_paper_am.pdf).

Portions of this document that deal with jurisdictions not already addressed above are reproduced below (please see original document for listing of references). The information contained in this document for Canada is sketchy and misleading. Their information was summarized from older information (W.O. Mackasey, 2000) and is a good indication of the need for some form of standardized inventory.

This document also reinforces the findings of the current study, that the United States has by far the most advanced inventories dealing with the abandoned mine issue.

### 6.4.1 Australia (from van Zyl *et al.*, 2002)

There is no nation-wide inventory of abandoned mines in Australia. It is the responsibility of the states and territorial governments. The different states are in the process of developing their own data collection and review systems for abandoned mines (pers. comm. B. Gray, Land Access and Environment Section, Coal and Mineral Industries Division, Department of Industry, Science and Resources, Australia, 2001). The New South Wales (NSW) Department of Mineral Resources has a database of about 500 abandoned mines but it is not a comprehensive list of all the sites.

As a result of the general lack of mining development between the 1940s and 1980s the state of Victoria has few abandoned mine sites. However, there are good records of many older sites as a result of a long-term project to document historic mine sites. These records provide descriptions, interpretations and an assessment of the heritage status of around 2,000 sites. There is currently no coordinated program to prioritize or address rehabilitation of these sites (pers. comm. B. Gray, 2001).

In Western Australia (WA), the Department of Minerals and Energy is just developing its database of abandoned mines (pers. comm. B. Gray, 2001). This is the first part of a process in identifying the outstanding risks and then prioritizing each site as far as safety and environmental issues are concerned. This Abandoned Mine Sites program commenced in July 1999, with the objectives of accurately locating and describing abandoned mine sites in WA (pers. comm. D. Flint, Manager of Resource Assessment and Advice, Geological Survey of Western Australia, 2001). Priority in the inventory

compilation is being given to high-risk sites, such as those close to population centres (within 10 km), main roads (within 1 km), areas of tourism activity, where the department has received complaints, and where accidents are known to have occurred. In the first one and a half years of the survey, a total of 23,000 hazards or potential hazards were inspected. This corresponds to about 40% of all high priority sites requiring inspection (pers. comm. D. Flint, 2001). On average, each site of historic mineral production (of which there are about 2,000) converts to about 10 hazards or potential hazards in the database.

The Northern Territory has not yet undertaken an abandoned mines survey, but should commence in the next year, i.e. 2002 (pers. comm. D. Flint, 2001).

### **6.4.2 United Kingdom** (from van Zyl *et al.*, 2002)

The recording of abandoned mines became a statutory requirement for England and Wales in 1870 (National Rivers Authority, 1994). Even with this statutory requirement in place, there is no total figure of abandoned mines available. One reason that prevents an accurate inventory in the UK is the change of mine names as old leases are combined and worked from one or several shafts. This is a major factor in Cornwall (Dines, 1956). There were no records of abandoned mines prior to 1872 (National Rivers Authority, 1994). The Mines and Quarries Inspectorate held only non-coal records and the data was not in a form easily accessible to the public. The British Coal Authority has a database of approximately 10,000 abandoned mine workings, i.e. Government owned mines, though this figure is believed to be an estimate as some of the mines may have been re-opened for commercial, recreational and educational purposes. It was also estimated that there were 1,700 abandoned metalliferous mine workings in the south-western region, whereas the British Geological Survey of abandoned mine data from the Metallogenic Map of Britain 1996 listed 155 abandoned mines.

### **6.4.3 South Africa** (from van Zyl *et al.*, 2002)

Due to a long history of mining, South Africa has many abandoned mines. These include 134 abandoned asbestos mines and 400 asbestos dumps that are still contributing to the constant flow of asbestos dust to the surrounding areas creating a health hazard.

Abandoned mines in South Africa are controlled under the Water Amendment Act 58 of 1997. The Water Act came into effect in 1956. It protects water and limits effluent discharge by the industry. Before promulgation of the Water Act in 1956, many mines were abandoned without implementation of adequate pollution control measures. The provision of pollution control measures at abandoned collieries and the responsibility for costs to institute these measures, were established in an agreement called "The Fanie

Botha Accord” reached between the mining industry and the South African Government in 1976. The Fanie Botha Accord in summary states that:

- Pollution control measures, the maintenance of such measures and all costs pertaining to mines and works abandoned before 1956, would be the responsibility of the State.
- In respect of mines or works abandoned subsequent to July 1956, where measures have been instituted to the satisfaction of the State, the State will take responsibility for the maintenance and betterment of the pollution control measures taken.
- Should mining or works at any stage be resumed at a previously abandoned mine, the company resuming the operations will be responsible for any existing pollution control measures on the portion which is to be reworked, and for any additional pollution control measures required in respect to the resumed operations (Dalton *et al.*, 1998).

#### **6.4.4 Others – brief notes** (from van Zyl *et al.*, 2002)

##### **Ireland**

In Ireland the Environmental Protection Agency (EPA) has a list of 128 abandoned mines and most of these are very small or old and do not present any environmental problem. The Department of Natural Resources in Ireland identified five sites that are or have the potential to cause environmental problems.

##### **Sweden, Japan, Chile**

In Sweden, the EPA has a list of over 1,000 abandoned mines, of which only 70 are environmentally significant. In Japan, the national survey found 5,500 abandoned mines (UNEP, 2000). In Chile, a survey by the National Geology and Mining Service in 1989/1990 found that in northern and central Chile over 50% of the 665 tailings storage facilities studied had been abandoned without any cleanup or rehabilitation (Clark *et al.*, 2000).

##### **Comment** (from van Zyl *et al.*, 2002)

From all the information above, it is clear that no country has a definitive abandoned mines list although globally the number may run into millions i.e. depending on the definition of an abandoned ‘mine’. It is also clear that abandoned mines databases are a higher priority in developed countries. In most areas there is little or no coordinated information available to gauge the extent of the problem. In general abandoned mines may present physical hazards and /or create environmental impacts. This distinction has not been made in many of the inventories.



## 7.0 Definitions

Definitions that are concise and unambiguous are essential to a national database effort that will incorporate a large number of existing databases from a number of jurisdictions each with their own pre-existing definitions. Reasonable definitions must also be relatively consistent with the common usage of the term by the target audience. The following definition taken from UNEP (2001) is a good description of the public's perception of an abandoned or orphaned mine. "...*abandoned sites and orphan sites refer to mine sites and mineral operations that are: no longer operational; are not actively managed; not rehabilitated; are causing significant environmental or social problems; and for which no one is currently accountable for the site's remediation or rehabilitation.*" The proposed NOAMI national inventory effort is typical of a database that is required to accommodate definitions from multiple sources in a single unambiguous definition for its target audience.

A review of the current definitions in use by the different jurisdictions in Canada was undertaken as the initial step in rationalizing a set of analogous definitions for the proposed national database. Cal Data Ltd. was provided with the results of the NOAMI Information Gathering Task Group's survey which received information from eight Canadian jurisdictions. In addition, telephone interviews were conducted with a number of representatives from Canadian jurisdictions and these provided additional input on the subject of definitions. A large number of international websites dealing with the subject of orphaned and abandoned mine sites were investigated to obtain an international component to the usage of the definitions.

The NOAMI web site's opening statement defines orphaned and abandoned mines as "Orphaned or abandoned mines are those mines for which the owner cannot be found or for which the owner is financially unable or unwilling to carry out clean-up." However these terms have significantly different meanings in a number of Canadian jurisdictions. Orphaned and/or abandoned mine are common terms that have come to signify inactive mines that may present a threat to humans or the environment around the world. Yet the precise definition for each of these terms varies across the country and between stakeholders. At first glance these words seem quite obvious in their meaning but as one examines them in more detail and from different perspectives a large number of differences arise.

A news article that appeared during the writing of this section highlights the potential misuse of poorly defined definitions associated with mines. The article that is presented in Appendix 1 discusses the merits of a proposed gravel pit and its potential impact on a local fishery. In the article a proposed gravel pit is referred to variously as a gravel pit, quarry and mine all depending on the desired spin of the person being quoted. It is an excellent example of the connotations that can be invoked through the use of a term. Poor definition of terms in a database can lead to comparable problems when it is utilized by a wide range of clients.

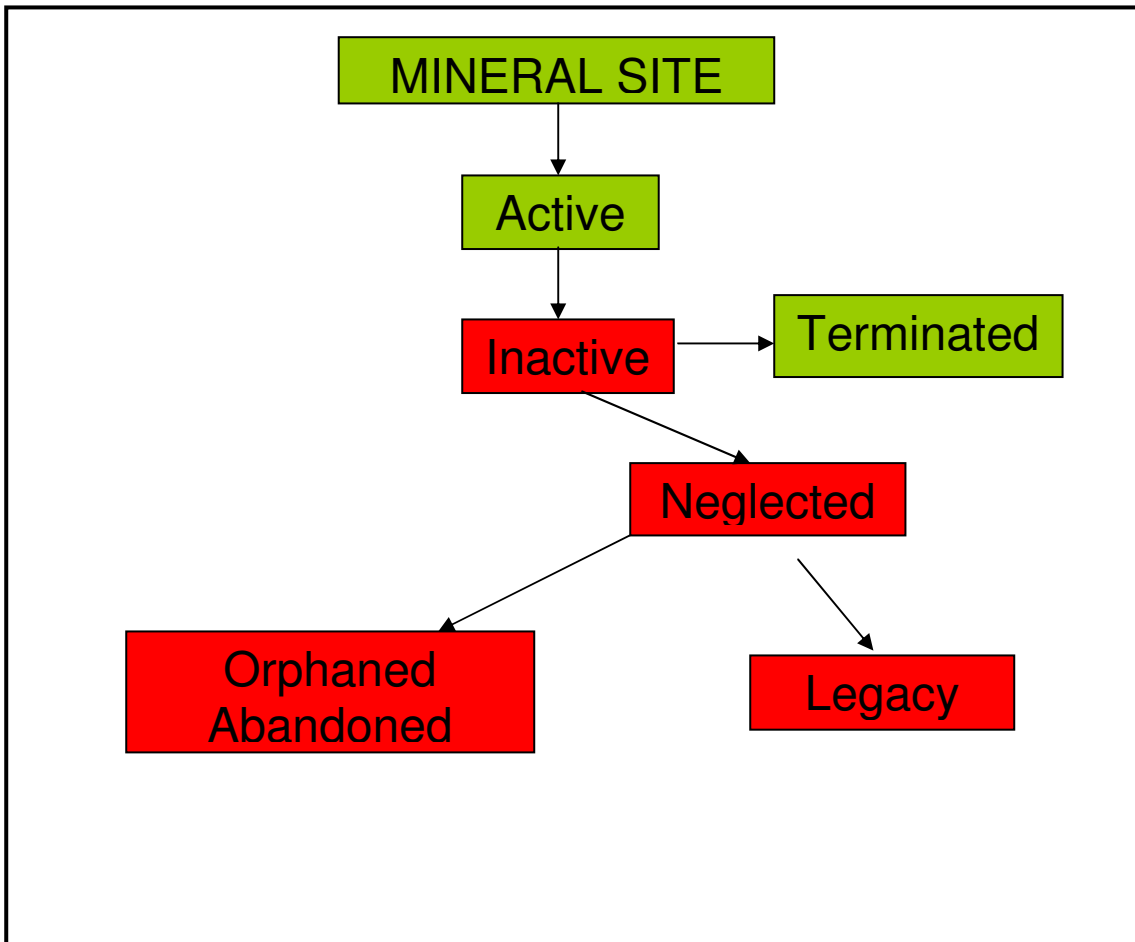
In addition to differences in common usage these terms may be defined within legislation or formally defined through publication. The following examples represent the subtle diverse meanings which may be associated with the term “abandoned”. In British Columbia the term is defined in the Mining Act as “a mine for which all permit obligations under this Act have been satisfied and in respect of which the mineral claims have reverted to the government”. In Ontario the definition is “a site where a proponent has ceased or suspended indefinitely advanced exploration, mining, or mine production on the site, without rehabilitating the site.” The US EPA Abandoned Mine Lands Program’s definition is “Abandoned mine lands include areas where mining or processing activity is temporarily inactive.”

The NOAMI Information Gathering Task Group has spent a considerable amount of effort developing a set of definitions to cover what have been referred to as abandoned and orphaned mineral sites. Many of the definitions and terms generated by the Task Group are incorporated in the set of definitions proposed here. The proposed set of definitions cover a broader range of conditions than those recommended by the Task Group in March 2004. It is hoped that this broader set of definitions will provide a more inclusive framework in which all Canadian jurisdictions can participate comfortably.

Generic definitions are required for the potential national database that will include a number of databases from different jurisdictions each with their own set of definitions. If considered in a hierarchical fashion the most generic terms will be at the top of the definition tree and the more specific definitions will form sub-branches of the tree. The mineral site status definition tree is displayed in Figure 3. A mineral site (and any related features) is either active or inactive. An active mine is of no immediate interest to this inventory and is documented in a national mine inventory ([mmsdl.mms.nrcan.gc.ca/maps/](http://mmsdl.mms.nrcan.gc.ca/maps/)). Inactive mineral sites may be reclaimed and closed (terminated) or may yet require closing. A terminated mineral site is of no safety or environmental concern but may still hold historic, educational or tourism value. Of the inactive mines requiring remediation and closing some will have a mine operator/owner present and responsible but others will have no responsible mine operator present. Those mines with no responsible mine operator/owner present fall to the state for remediation while those with a responsible mine operator/owner present usually are reclaimed and closed in an orderly and thorough manner. Many inactive mines are held in a safe and environmentally responsible condition until economic conditions improve before production is resumed.

The suggested NOAMI database definitions presented below are designed to accommodate as many of the definitions used by the Canadian jurisdictions as possible or at least avoid any direct conflict. An attempt to avoid terms already in use in these jurisdictions and yet provide terms that may be directly correlated has been made. The inclusion of all mineral sites that are not active and not just those considered orphaned/abandoned allows all jurisdictions to place their mineral sites within the definitions without drawing any unwarranted conclusions about the site ownership. In most jurisdictions an exhaustive legal search has not been performed to determine if all

their inactive mineral sites have a current owner. In some jurisdictions there is concern that by the government categorizing a mineral site as abandoned they are implicitly saying it is the case. With this definition system a mineral site may be categorized and included in the database simply by stating the obvious and not requiring any additional investigation. There have been cases such as the Lorado mineral site in Saskatchewan that as the result of a legal search of a “neglected mineral site” an owner was found. This owner was unaware of their “legacy mineral site” and has since joined the federal government in the orderly “termination” process for the mineral site.



**Figure 3.** Mineral site status diagram. Descriptions of these terms are discussed below (in text).

**Mineral Site Status Definitions**

The following definitions describe the range of activity status’ which may occur at a site where minerals are explored for or mined. The relationship of these terms are illustrated in Fig. 3.

***Mineral Site: “A site on which some physical disturbance has occurred due to mineral exploration, mining or processing.”***

- 1) The word “mineral” is used to limit the definition to metallic, coal and industrial mineral commodities. Aggregate resources are not included in this definition as in most jurisdictions their ownership and utilization is handled in a significantly different manner than metallic, coal and industrial mineral commodities.
- 2) The word “site” is used as being more specific than terms such as project and property which are not necessarily spatially limited to the area of disturbance. A site may contain many features or hazards.

***Active Mineral Site: “A site on which mineral exploration, mining or processing is ongoing with the proper regulatory approvals in place.”***

- 1) Active mineral exploration sites are those sites included in the approved work program of the current mineral tenure holder.
- 2) Active mineral mining sites are those sites covered by the appropriate mining permissions.
- 3) Active mineral processing sites are those sites involved in the ongoing process of beneficiating mine commodities.

***Inactive Mineral Site: “All mineral sites which are not considered active mineral sites.”***

- 1) Inactive sites may be inactive for many reasons including but not limited to:
  - a. completion of the exploration, mining or processing project
  - b. standby status of exploration, mining or processing project awaiting better market conditions
  - c. loss of owner/operator capability for any number of reasons

***Terminated Mineral Site: “A former active mineral site at which mineral exploration, mining or processing has concluded and all current appropriate regulatory obligations have been satisfied.”***

- 1) The implication being that the site was reclaimed to the level required at the time of termination by the responsible jurisdiction authority.

***Neglected Mineral Site: “An inactive site that has not been terminated and that has no obvious owner.”***

- 1) Many neglected mineral sites are in existence due to changes in regulations that have imposed defined termination parameters after the mineral site became inactive.
- 2) No ownership or site responsibility is implied in this definition.

***Abandoned Mineral Site: “A neglected mineral site that has not been terminated and that has no responsible owner.”***

- 1) Responsibility for the site reverts to the Crown either provincially or federally depending on the jurisdiction.



- 2) Orphaned mineral site is synonymous with abandoned mineral site.
- 3) This definition only applies to those sites which have been proven to have no responsible party other than the crown.
- 4) Abandoned (Orphaned) mineral sites may be adopted by a responsible party other than the crown and become active mineral sites.

***Legacy Mineral Site: “A neglected mineral site that has not been terminated and that has an owner.”***

- 1) The responsible owner may or may not be aware of their ownership of the mineral site.
- 2) A neglected mineral site usually becomes a legacy mineral site through detailed ownership investigation. It is possible that the owner was not aware of their ownership and on becoming aware of their ownership moves the mineral site into the care and maintenance or active category awaiting termination.

A Mineral Site could be considered to fall within one of three broad categories: exploration, mining or processing. But all three of these activities could occur within one Mineral Site or they could be the sole activity within a Mineral Site. The definition of what is considered exploration or mining within a jurisdiction may have nothing to do with the type of work that was performed but rather the type of tenure on which the activity was performed. Similarly the definition between what is mineral processing and what is part of a mining activity may vary between jurisdictions. For this reason there seems little benefit to implementing definitions for this type of Mineral Site. The primary activity at a particular site can be implied by the type of features present at the site. If a classification of Mineral Sites is desired at some point this structure would allow a user to define their own categories and assign sites to them depending on the type of site features present. The basic premise of this approach is to not over classify the information but retain as much of its basic data as possible to meet varied and changing definition schemes in the future.

The Mineral Site will be the basic unit of a national inventory. A Mineral Site will contain one or more physical features associated with mineral exploration, mining or mineral processing activities. The physical features will define the type and characteristic of the Mineral Site. How the physical features will be used to categorize the Mineral Site will remain the prerogative of the end user.

## 8.0 Databases

Databases housing inventories of Inactive Mineral Sites that may require remediation vary in sophistication and complexity from jurisdiction to jurisdiction. Of the databases surveyed during this investigation a number contain information from multiple jurisdictions. All Canadian jurisdictions maintain a database of their own even if they are involved in a multi-jurisdiction database. In the United States some jurisdictions rely completely on a multi-jurisdiction database but in the vast majority of the cases individual jurisdictions maintain their own database even if involved in a multi-jurisdiction program.

### 8.1 Proposal

Virtually all jurisdictions have a database system of their own housing data about Inactive Mineral Sites that they use for their own ongoing operations. In nearly all cases these databases only contain the sites and information directly related to their responsibilities. In some cases the database only houses the Mineral Sites that are known to be a problem, are on crown land and have no known owner. In other cases the equivalent database includes all known Mineral Sites without regard to ownership or risk hazard. In some jurisdictions the sites of interest may be housed in more than one mutually exclusive database. The objective of a national database should be to include all Inactive Mineral Sites as the common basic database entity. The subtleties of ownership, hazard risk, and responsibility can be qualifiers within the database and are likely to change with time. But no Mineral Site should go unrepresented in the database. In this way all known Mineral Sites are documented and it will be obvious when an undocumented site is discovered. Also each Canadian jurisdiction can presently meet this level of documentation.

Most Canadian jurisdictions maintain at least two relevant databases. The first type is directly related to the issue of Inactive Mineral Sites and tends to be quite restrictive about what site is admitted. The other type of database is often referred to as a mineral deposit or occurrence database. Within these mineral occurrence databases there are common occurrence classifications such as 'Past Producer' and 'Developed Prospect' which identify Mineral Sites that are relevant to an inventory of Inactive Mineral Sites. These databases tend to be inclusive of all sites within a jurisdiction, disregarding the ownership issue. The section reviewing Canadian efforts documents both types of relevant database.

During the review of Canadian and international inventory efforts on a national or at least multi-jurisdictional level several excellent examples were identified. Several agencies within the United States maintain multi-jurisdictional databases which are comprehensive and well accepted. Some of these efforts have in fact merged and some jurisdictions rely on them totally for their operational requirements. However, all the multi-jurisdictional databases are either directly funded by their parent agency or there is some form of

significant financial reward beyond the cost of participating for the individual jurisdiction's participation.

The proposed NOAMI inventory is not likely to provide a significant financial incentive to Canadian jurisdictions to encourage their participation. No Canadian jurisdiction was identified that was enthusiastic about participating in a national inventory at the operational level. There are a variety of reasons for this general lack of enthusiasm which will be discussed in a later section but the primary concern was that such an effort would further dilute the very scarce resources being directed at the problem.

Therefore, a NOAMI database effort must be as non-intrusive as possible and be designed to incorporate existing inventories, require no modification to these fundamental databases and take advantage of all existing database tools already in-place within the individual participating jurisdictions. It is essential that the NOAMI database be WEB-Centric and a map-based front end has become the standard method of interaction with such an inventory. There are several models for such a national WEB-Centric, multi-participant database employing a map-based access system in Canada.

## 8.2 National Examples

The “Mapping Federal-Provincial-Territorial Mining Knowledge” maintained by the Minerals and Metals sector of NRCan provides an interactive database over the Internet of all active mines in Canada (Figure 4). This is an example where a single agency built and maintains the database with input from all the Canadian jurisdictions ([mmsdl.mms.nrcan.gc.ca/maps/intro\\_e.asp](http://mmsdl.mms.nrcan.gc.ca/maps/intro_e.asp)).

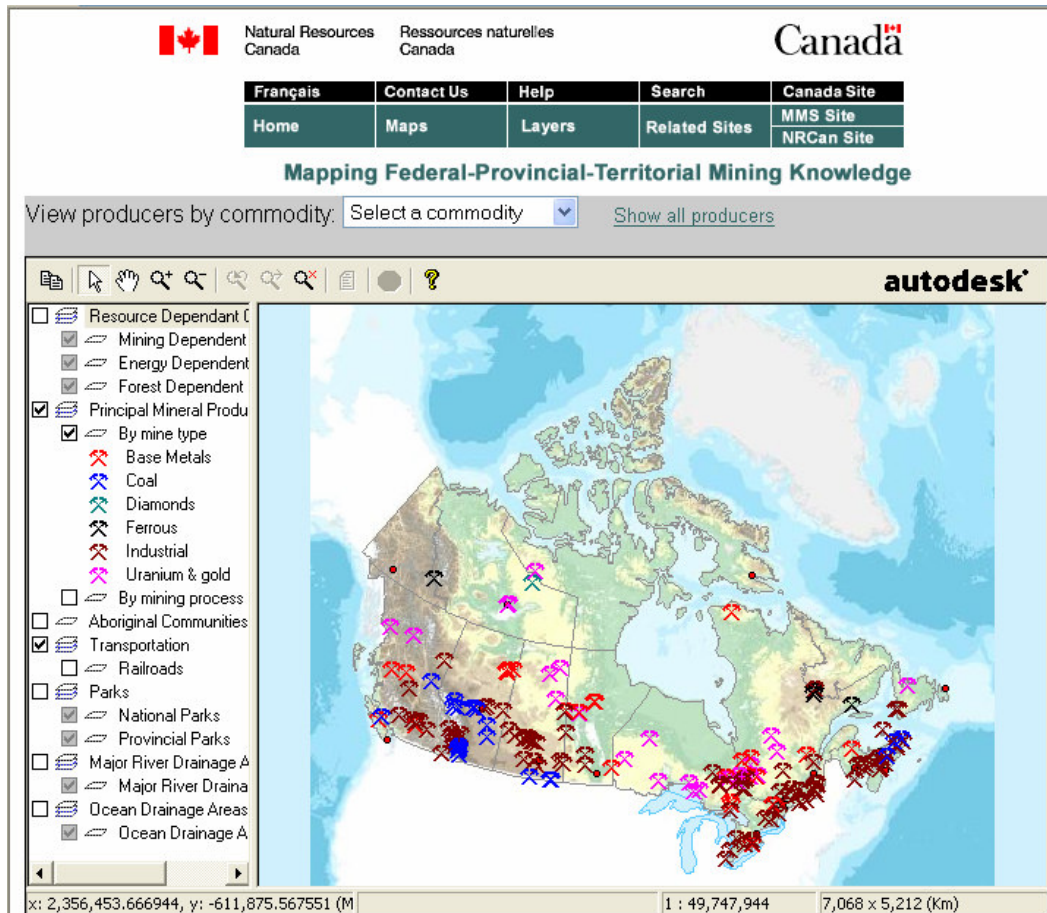


Figure 4. Display of the web mapping interface used on the Active Mines site.

The Canadian Geoscience Knowledge Network’s (CGKN) Geoscience Publications directory is another example. This one is hosted by the Geological Survey of Canada, NRCan ([cgpdcgkn.net/cgpdc/default\\_e.htm](http://cgpdcgkn.net/cgpdc/default_e.htm)). This database includes federal, provincial and territorial publication databases (Figure 5). In some cases there is a direct link from the map interface to the relevant participant web presence and in other cases the required information is loaded and distributed from the CGKN server with out linkage back to the originating jurisdiction.



Figure 5. Initial page of the CGKN Publications Directory.

An essential requirement of a truly national database is that it accommodates all jurisdictions with an apparently equal level of service. A highly evolved system such as the Abandoned Mine Inventory System in the US would be inappropriate as its level of required detail could only be met by a very few provinces or territories. A more appropriate system would be one that acted as an index to provincial, territorial and federal systems by housing a consistent but necessarily general level of information. Such a system would provide access to all the available relevant information through a single portal and allow whatever level of investigation that can be supported by the information maintained by the individual jurisdictions.

NOAMI's national database objectives would be met by a system that provided spatial and high level information about each Mineral Site in the country through a map-based interface. The system could be queried and integrated with a variety of pertinent spatial data and linked to existing jurisdiction specific WEB-based systems providing detailed information about each Mineral Site. This style of system can be delivered with commercial off the shelf software and has been well tested in the exploration and mining

communities and can be achieved without significant disruption to the participating jurisdiction's regular line of business.

### **8.3 Information Sources**

If as recommended the database contains all Inactive Mineral Sites the information used will generally come from two sources in each jurisdiction. One source will be the existing database of known Inactive Mineral Sites that are considered a risk to human safety or the environment. The second source will be the inventory of known past producing mines and advanced exploration projects that would have resulted in some surface disturbance. In some jurisdictions additional sources of information may exist such as a listing of mine openings, processing sites or mine plans. Most of these data sources are already maintained in digital form and could be included into a national system in a straight forward manner. A few data sources may require some unique approaches for their inclusion.

The basic parameters required for such a data base would include but not be limited to:

- the mineral site location, typically this would be a single central point
- the characteristics of the mineral site (underground workings, open pit, mill, exploration trenching, etc.).
- the commodities extracted or processed
- the operation size, including parameters such as area disturbed, tonnes mined and on-site facilities
- age of workings

### **8.4 Acceptance Level**

This investigation concentrated on input from individuals and agencies involved in producing inventories of Mineral Sites and not on the users of such inventories. As a result their perspective is different than potential users of such a site.

#### *National Inventory Positive Aspects*

- 1) The existence of a national inventory would promote the exchange of ideas on how to deal with specific remedial situations.
- 2) The inventory would be a positive step if the most offensive sites in the country could be identified and their remediation funded.

#### *National Inventory Negatives or Areas of Concern*

- 1) A national inventory would drain off scarce resources in the participating jurisdictions that would be better directed to reclaiming sites.
- 2) A national inventory may invite 'fishing expeditions' where a potentially hazardous site is located and then a wide range of negative impacts are attributed to it by special interests. As a result a high profile special interest sites may receive unwarranted attention to the detriment of a uniformed approach to all sites.

- 3) Site locations tend to attract visitors and increase the risk of accident, disturbance of wildlife habitat and historic sites.
- 4) The obvious disparity in how different jurisdictions have dealt with the issue will be highlighted with negative results. Each jurisdiction's approach has resulted from their requirements and available resources and they should not necessarily be compared.

These operational concerns must be weighed against the need for the public to have access to this information. The formation of NOAMI is an expression of this requirement. In addition, a failure to provide a national inventory will only result in other organizations concentrating on narrow aspects of the abandoned mine issue generating their own inventories which may or may not be in the best interest of the country, provinces and territories (i.e. the WISE Uranium site inventory).

## 9.0 Site Risk Ranking

An objective of this study was to examine the methods used to rank the risks associated with Mineral Sites in various jurisdictions and comment on their applicability to a national inventory. Risk ranking methodologies range from on-demand remediation to elaborate well calibrated systems that result in the awarding of 100s of millions of dollars for remediation between numerous jurisdictions (US AMIS).

In most, if not all jurisdictions two types of risk are associated with each mineral site. The human safety risk aspect of a site typically receives the most immediate attention, is relatively obvious and can be addressed in relatively short order with an appropriate solution. The environmental risk associated with a mineral site typically requires relatively more planning, resources and time to obtain a satisfactory solution. The combination of immediate danger to people and well developed solutions results in safety issues being ranked as the most important in all jurisdictions reviewed. Ranking schemes employed often take the available remediation resources into account either formally or informally. Several provinces have detailed inventories of mine openings and some have addressed all known problem sites. On the other hand environmental remediation efforts have been limited to a very small portion of the sites requiring attention in most jurisdictions. This is due to the often very large resource requirements for these sites rather than an identification and ranking of the sites' hazard.

Each province, territory or federal agency has its own method of prioritizing Mineral Sites. Each system is based on that jurisdiction's priorities and resources. An attempt to mix these prioritization schemes in a single inventory would show where each jurisdiction placed its concern but they would not be comparable. An attempt to generate a national prioritization of sites would also run into significant problems due to the huge disparity in detailed knowledge of Mineral Sites between jurisdictions. Without a standardized investigation of sites across the country a national ranking scheme would be invalid.

There is little value in prioritizing Mineral Site Risk on a national scale unless there is a national effort to address the remediation of these sites.



## 10.0 Recommendations

### The Inventory:

On the basis of the reviews conducted and input received during this study it is recommended that a national inventory of Inactive Mineral Sites be developed. The Mineral Sites inventory would include Abandoned Mineral Sites, the strict objective of NOAMI but also include all the potential Abandoned Mineral Sites. The restrictive definition of Abandoned Mineral Sites excludes a significant number of the Mineral Sites in the country that may pose a risk to human health and safety and a negative impact on the environment. An all inclusive inventory that takes advantage of the diversity of approaches developed in each jurisdiction and acts as an index to these inventories is an accomplishable significant step to a standardized national inventory. An operational national inventory will:

- provide a single public access point to the country's Inactive Mineral Sites,
- encourage synergies between jurisdictions,
- provide a working platform from which to develop and refine the evolution of the NOAMI database.

A WEB-based system that incorporates a map interface is strongly recommended. A WEB-based system is essential to provide public access to the database and map interfaces have proven very popular relative to a simple form query display. A map system is capable of providing the user access to information without requiring *a priori* knowledge of a local mapping convention, site name or number. It also provides the opportunity to include a vast array of relevant information such as spatially related features and satellite imagery of the sites that will increase the users understanding of the overall situation and spark their investigative spirit.

It is recommended that the national database act as an index into the existing provincial, territorial and federal inventories. In this way all the richness of the existing systems are maintained and there is no requirement to convert existing databases into a new structure with the inevitable loss of detail and expenditure of resources. All web-based inventories can be linked with little or no impact on the existing systems. Those inventories that are currently not accessible through the Internet can be loaded on the national inventory site but with content control maintained by the owning jurisdiction.

### Site Definitions:

A set of high level site definitions have been recommended. These definitions build on the work previously performed by the NOAMI Information Gathering Task Group but expand the coverage of the definitions and do not go into detail regarding site type. The proposed definitions are inline with the broadened scope and reduced detail contained in the proposed national inventory. The primary object was to provide a set of definitions under which information from all jurisdictions can be defined. The seven definitions (*Mineral Site, Active Mineral Site, Inactive Mineral Site, Terminated Mineral Site, Neglected Mineral Site, Legacy Mineral Site and Orphaned/Abandoned Mineral Site*)

describe a Mineral Site and its status. An attempt was made to avoid using definitions already in use in Canadian jurisdictions that could be in conflict or confused with their use in a national inventory. The only direct conflict present in the proposed definitions is with the term 'abandoned' and its use in British Columbia and in Quebec. If this is a major issue this definition could be reduced to Orphaned Mineral Site as little or no distinction has been made between the terms orphaned and abandoned in Canadian inventories and they are generally considered synonymous.

Jurisdiction specific definitions should be made available to inventory users as they migrate from the national scale dataset to the individual provincial, territorial or federal datasets. Any attempt to rationalize all the possible terms will require significant effort. As a bridging system between the end-user and numerous jurisdiction specific inventories the national inventory should provide the capacity to display these lower level definitions in an appropriate and user friendly manner.

**Prioritization:**

It is recommended that no attempt be made to generate a national prioritization scheme at this time. The individual databases are vastly different in their ability to define hazards making it impossible to build a priority list based on anything but the broadest site characterizations. Priorities and categorizations determined by the participating jurisdictions should be available through the inventory initiative but inter-jurisdictional comparisons should be discouraged. Mineral Sites in the remediation process or earmarked for remediation within each jurisdiction form the best list of high priority sites across the country. Any effort at ranking the hazards posed by sites from across the country will require a standardized and well calibrated site evaluation methodology before ranking (note Ontario's efforts).

**Implementation:**

The implementation of a national database of the type described is straight forward and an obtainable goal utilizing existing provincial, territorial and federal databases and commercial off the shelf software. Such a system could be operational in fairly short order and continue to evolve in response to added information and requirements. While it is technically feasible to build such a system and meet all expressed goals there must be a commitment to maintain the system or it will suffer the fate of many similar database efforts. It is expected that at least one full-time person must be dedicated to the systems maintenance and advancement for it to succeed. To maintain the momentum achieved by its creation the system must continually advance with added information and capabilities or it will simply become irrelevant. Care must be taken that the effort does not become just another information technology project and passed off to some service group for operational maintenance. It must have a champion.

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## **Personal Communications Details**

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# Appendix 1.

## Pit, Quarry or Mine?

### british columbia news

Saturday, Oct 16, 2004

#### Proposed mine near Abbotsford hatchery a concern

ABBOTSFORD (BC Newspaper Group) — Fish industry experts across the province say they are "gravely concerned" the City of Abbotsford approved a new gravel mine that will gut a 10- acre hillside above the largest trout hatchery in B.C.

Fraser Valley Aggregates Ltd. is planning to mine 352,000 square metres of sand and gravel out of the hillside at the corner of McKenzie and Vye roads for the next five to seven years. The elevation of the land will drop by about 60 feet.

Don Peterson, president of the Freshwater Fisheries Society of B.C., said the gravel mine threatens to contaminate the groundwater that is critical to the survival of millions of young fish raised annually at the Fraser Valley Trout Hatchery on Vye Road.

"That hatchery in Abbotsford is the lifeblood of the freshwater fisheries of B.C., which is a \$400 million annual industry - and the groundwater that feeds into that hatchery is the lifeblood of the hatchery," said Peterson.

Dave Vernon, spokesman for Fraser Valley Aggregates, said the company fully intends to prevent contamination of the groundwater with engineering expertise and is committed to using environmentally clean fill at the site. He believes the mine proposal is environmentally sound and will provide economic benefits to the community.

"We don't want to affect any of the groundwater," Vernon, said, adding that the company doesn't handle contaminated material.

The B.C. Federation of Drift Fishers, however, is also troubled by the location of the new gravel mine.

"Why would anyone allow a new gravel mine to go beside the number one trout hatchery in B.C.? The contamination danger is far too great," said Rod Clapton, president of the B.C. Federation of Drift Fishers.

"That mine could kill everything in the hatchery," Clapton warned, adding that it "should be a non-starter, a no-go."

The quarry application now requires approval by the Agriculture Land Commission, because the property is in the Agriculture Land Reserve (ALR).

The Freshwater Fisheries Society is asking the land commission, which is set to meet again in November, to deny the gravel mine, because the hatchery is extremely important to the public fisheries resource.

Vernon, on the other hand, said the application should be approved because of its importance to the construction industry. Gravel mines are an allowable activity in the ALR.

The fishing industry is united in their opposition. Peterson is asking John van Dongen, B.C. Agriculture, Fisheries and Foods Minister, for help.

"The mandate of the Agriculture Land Commission is to protect farmland and raising fish is a bona-fide aquaculture business," Peterson said. "Raising fish is a recognized farming operation."

He is appealing to van Dongen to protect the hatchery, because this potential disaster is right in the minister's own backyard.

"There's a great deal at stake here," Peterson said. "This development threatens our long-standing farm operation."

He is also appealing to the Ministry of Water, Land and Air Protection (MWLAP).

Van Dongen said he believes that protection of the habitat around the hatchery falls under the mandate of the MWLAP -not his ministry.

The groundwater concerns should be addressed between the land commission and the city, van Dongen said. He believes a groundwater report by a qualified professional, which would likely be paid by the proponent, may be in order.

"I would have thought the city would have referred this to WLAP," van Dongen said, adding that he will make sure the hatchery's concerns about groundwater quality are covered in the approval process with the provincial government.

Meanwhile, Abbotsford Mayor Mary Reeves was unavailable for comment, as of deadline, to explain the city's rationale for approving the project. The new quarry would be located west of the current City of Abbotsford gravel pit which is also on a higher elevation than the hatchery.

Opponents say there are two problems with the proposed mine.

The company shouldn't remove all that sand and gravel from the hillside which serves as a natural filter of the water that moves down into the aquifer, Clapton said.

"The second and more serious problem," Clapton said, "is that truckloads of fill may contain contaminated soil."

There isn't enough manpower within the various provincial ministries to properly monitor the activities of the mine, Clapton said.

"Who's going to monitor it?"

Vernon, however, said those risks can be mitigated. He said he doesn't understand why the concerns are being raised, since the City of Abbotsford already operates a gravel pit beside the hatchery and the water quality has not been affected. And there are also two important economic benefits of this new gravel operation, Vernon said.

Not only will Fraser Valley Aggregates provide sand and gravel which is much required for the construction industry, but there is also a desperate need for a place to dump the excess excavated material from all the new roads and subdivisions being built in the area, Vernon said.

However, Clapton said it doesn't make any sense to him to dump material beside the largest hatchery in the province.

Patrick Brisbin, Golder Associates engineer and agrologist, said the sources of the fill will be thoroughly investigated and undergo an environmental assessment prior to being accepted at the mine. He also noted

that each truckload of fill - which may include clay, till or soil - would be inspected on-site with a paper trail to identify what is being dumped.

A groundwater monitoring program is also under consideration to be set up in consultation with the Freshwater Fisheries Society.

Clapton said the mine shouldn't be approved because there's no shortage of gravel since the federal government recently allowed 500,000 cubic metres to be removed from the Fraser River.

Vernon, however, argued that the gravel from the river is a drop in the bucket, compared to the needs of the construction industry.

## Appendix 2.

### ORPHANED/ABANDONED MINES PROGRAM

#### INFORMATION GATHERING REQUEST

##### **To Federal and Provincial/Territorial Mining Representatives:**

The minerals and metals industry in Canada is striving to meet the challenges of sustainable development by improving its efforts toward social, environmental and economic responsibility. A critical issue confronting industry, government and civil society, however, is the legacy of abandoned mines and their associated environmental, human health problems and financial costs of clean up. In fact, in its 2000 *Towards Sustainable Mining* initiative, the Mining Association of Canada (MAC) revealed that the need to address abandoned mines continues to be a priority for the industry and other stakeholders.

Abandoned (orphaned) mine sites are generally defined as closed mines for which ownership has reverted to the Crown, either because the owner has gone out of business, is unable to finance the costs of reclamation or where no owner can be found. Abandoned mines are also described as mine sites where the proponent has ceased or indefinitely suspended advanced exploration, mining or mine production, while failing to rehabilitate the site.

At the September 2000 Mines Ministers Conference, federal-provincial-territorial governments and other stakeholders made a number of recommendations to Ministers, including “the establishment of a joint industry-government working group, assisted by other stakeholders, to review the issue of abandoned mines”. This initiative was supported and a National Multi-Stakeholder Workshop on Abandoned Mines was held in June 2001.

Ministers endorsed the recommendations that resulted from the workshop at the 2001 Mines Ministers' Conference, including the creation of a Multi-Stakeholder Advisory Committee (Advisory Committee) to address the workshop's key issues and priorities. Recommendations include developing an agreed-upon definition of orphaned/abandoned mines, a common approach to ranking sites and building capacity for a national inventory



of active, closed, and orphaned/abandoned mine sites based on compatible inventories across Canada.

**A principle objective of the Advisory Committee is to develop capacity for a National Inventory of active, closed and orphaned/abandoned mine sites based on compatible inventories in each province and territory, and to include a nationally acceptable categorization and priority-ranking system. An Information Gathering Task Group was established to complete this objective.**

As a first step, the Advisory Committee is requesting that government departments provide information on their past, current and proposed efforts to track mines and mine sites in each of their respective jurisdictions.

The Advisory Committee is requesting that representatives for each jurisdiction forward a summary of the following to the Project Leader, Gilles Tremblay at the Abandoned Mines Secretariat (555 Booth Street, Ottawa, Ontario, K1A 0G1, [gtrembla@nrcan.gc.ca](mailto:gtrembla@nrcan.gc.ca)) by June 21, 2002. If possible, please provide your response electronically.

- Terminology and definitions currently applied to abandoned mines
- System used to store information
- Data structure of the system used
- Types of information available
- Current programs currently being undertaken
- The extent to which sites are prioritized and ranked according to various criteria
- The form of financial assurance used regarding mine site reclamation liability

The information you provide should include active, closed and orphaned mines, including advanced exploration sites.

The information received by the Project Leader will be reviewed, and compiled to document:

- What data is available?
- What data has been collected and how is it (or has it been) stored?
- What definitions are being used?

This information will form a preliminary analysis report prepared in early July, after which both the Information Gathering Task Group and the Orphaned/Abandoned Mines Advisory Committee will review and approve. The analysis report will determine the next steps in the process.

I would like to thank you for your participation in this initiative. Please do not hesitate to contact me if you have questions regarding this request for information.

Sincerely,

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# Washington's Inactive and Abandoned Metal Mine Inventory and Database

David K. Norman

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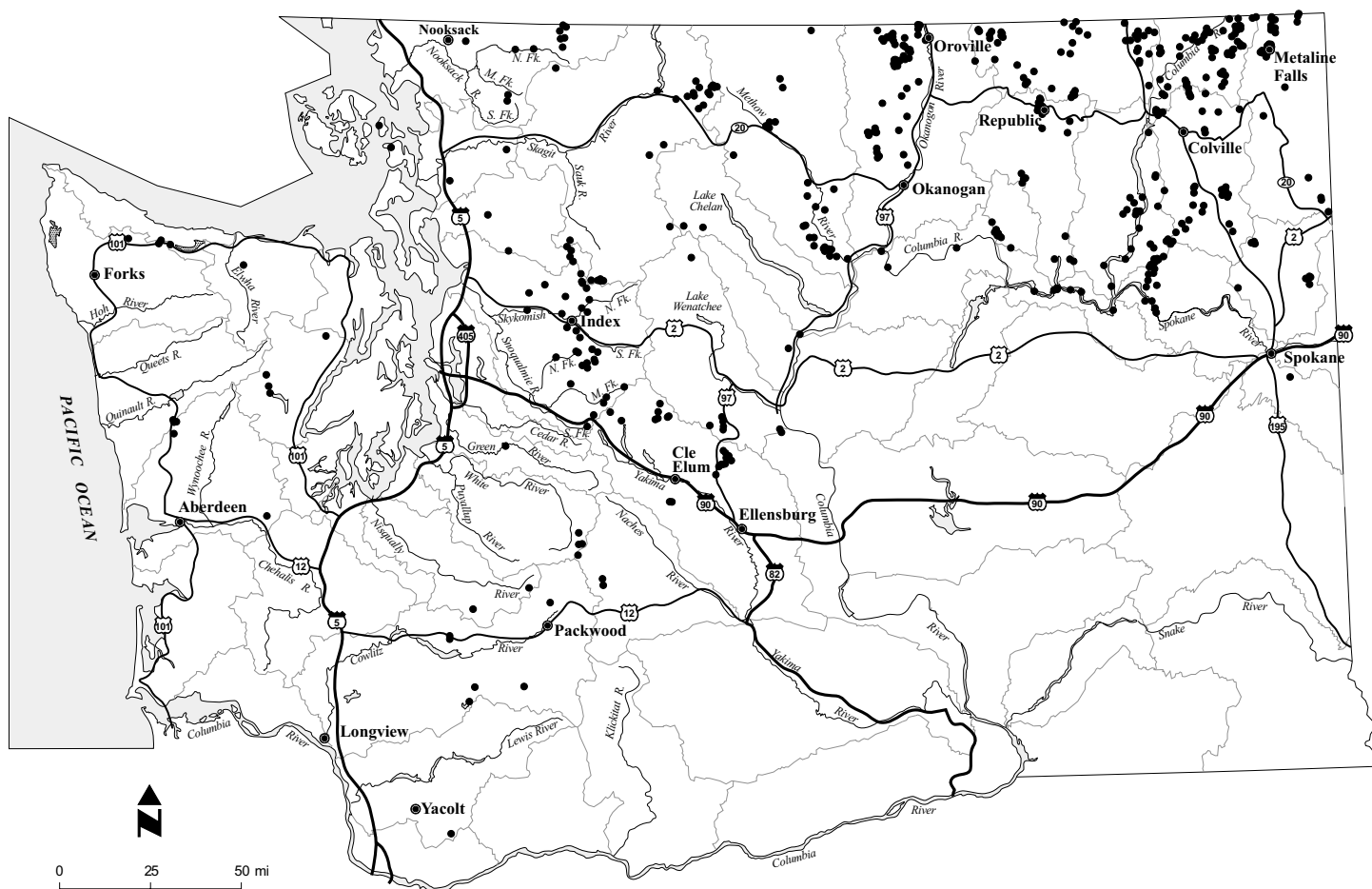
## INTRODUCTION

Presently in Washington State there is no systematic database of inactive and abandoned metal mines and their associated environmental problems. The Washington Department of Natural Resources (DNR) has the most complete historic information in archives, publications, and a database of economic attributes (Derkey and others, 1990). The U.S. Bureau of Mines/U.S. Geological Survey's Minerals Availability System/Mineral Industry Location System (MAS/MIL) database is considered inadequate because of errors in the data set and incomplete environmental information. The creation of a state-managed environmental database is a cooperative effort between DNR, the U.S. Forest Service (USFS), the U.S. Bureau of Land Management (BLM), the U.S. Environmental Protection Agency (EPA), and the Washington Department of Ecology (DOE), with DNR as the lead agency. A state-managed database has advantages because the state has access to many of the records

needed (for example, land ownership) and can easily update and maintain the database. The goal is to build a single database and geographic information system (GIS) coverage of mines in the state. This database is critical to a systematic survey and prioritization of environmental hazards, site remediation, and reclamation of wildlife habitat at these mines. To date the EPA, USFS, and DNR have contributed funding for the project.

## HISTORY OF MINING AND ITS EFFECT ON THE ENVIRONMENT IN WASHINGTON

Washington State had a very active metal mining industry in its early history. The dominant metals mined have been gold, silver, copper, lead, zinc, and magnesium. The earliest record of lode mining in the state was about 1871 when Hiram F. Smith, a future member of the Washington State legislature, discovered gold near the base of Chopaka Mountain in Okanogan County



**Figure 1.** Locations of some major abandoned metal mines and their watersheds in Washington, based on data from Derkey and others (1990). Most metal mining has occurred in the northern Cascades and northeastern Washington. Copper, lead, zinc, magnesium, gold, and silver have been the main elements sought.

(Moen, 1982). Since then, there have been thousands of mines and prospects. These mines are primarily in the Cascade Range and the Okanogan Highlands of northeastern Washington (Fig. 1). Most of the mines were small and completely unregulated. Virtually all of the pre-1971 mines (before the beginning of environmental regulation in the state) have become inactive or have been abandoned. Old mine sites typically contain unreclaimed tailings, waste-rock piles, and openings that do not meet present-day standards. They can pose local environmental hazards and impact water quality because of acid mine drainage (AMD). There are often open shafts and adits, which are dangerous “attractive nuisances” and may need closure (Fig. 2). On the other hand, some of the mines have become critical wildlife habitat and need preservation or enhancement.



**Figure 2.** Mine portals and adits such as this one at the Holden Mine can be dangerous physical hazards and sources of water pollution when acid mine drainage is generated and metals are transported to surface or ground water.

## CONSTRUCTING THE DATABASE

A literature and record search will be conducted for documented abandoned mines in Washington. Based on the results of the search, a subgroup of sites will be selected for on-site investigation. As information becomes available it will be incorporated into the database. The major categories of information to be entered into the database are listed below.

### General Information

General information will include the name of the mine, the owner/operator, dates of operation, landowner, location (latitude and longitude), type of mine, minerals mined, production information, ore processing, and access to the site. DNR, as well as most other agencies, uses mine names to track the history of a mine. Land ownership is important because it will allow for easier designation of responsibility for site cleanup. One of the most important tasks will be to assign an accurate location to the mines. To date, many mines locations in our records are inaccurate. Locations will be determined from USGS maps and site visits using the global positioning system (GPS). Whether the mine is underground or an open pit will be included. The production and processing history at the site can be an indicator of the extent of mining and potential water problems. For example, it can tell us whether or not cyanide or mercury was used in ore processing and may be contaminating the site or nearby streams.

### Physical Elements

Physical elements such as elevation and topography, geology of the area, and deposit type can have an effect on environmental risks at a mine site. High-elevation mines or mines on steep slopes can be more difficult to reclaim. The local geology can also influence water quality and mine hazards. For example, mines located in carbonate formations or rocks that have a high buffering capacity have a lower potential for AMD. Location of faults and other geologic structures is critical to understanding potential pathways to ground water.

### Physical Hazards and Components of the Mine

Mine shafts, old buildings, underground workings, waste rock, and tailings are present at many old mine sites and can be dangerous. Mine shafts are vertical mine openings that may be the most dangerous aspect of many mines (U.S. Bureau of Mines, 1994) (Fig. 3). All physical features such as adits, shafts, pits, ponds, tailings and waste rock dumps, open drill holes, structures, and hazardous materials will be noted on site visits and included in the database. Ease of public access will be noted, as this may bear on the priority for hazard abatement.

### Vegetation

Visual evaluation of the types of vegetation near a mine and their state of health can provide clues to the health of the area. Plants can be affected by a high metal content in soils and may be an indicator of the need for reclamation. Bare slopes with no vegetation are more likely to erode and fail and to deliver sediment to surface water. Evidence of healthy natural revegetation suggests that a site is on the road to recovery and a natural succession of species will follow.

### Wildlife

Some abandoned mines have become important resources for wildlife. Rattlesnakes, bats, bears, or mountain lions can den or escape the heat in the dark recesses of a mine. Underground mines can be critical habitat for such species. Perhaps most important is the use of abandoned mines by bats (Tuttle and Taylor, 1994). Mines are key sites for bats for rearing young in summer, for hibernating in winter, and for use as temporary havens. The microclimate of the mine, especially the temperature, determines whether or not bats can use a mine. Abandoned mines will not be closed without proper biological assessment by qualified personnel.

### Water Quality

Mineral deposits and (or) their development are potential sources of surface- and ground-water pollution that may re-



quire reclamation and remediation (Fig. 4). Few data exist to document the extent of this problem in Washington (Raforth and others, 2000). Acid generation is dependent upon mineralogy, surface- and ground-water hydrology, and oxygen availability. Metallic deposits, particularly those rich in base metal sulfides, may generate natural acid drainage, which may be accelerated by mine development. Discharges may occur from underground mines, open pits, waste-rock piles, tailings, haul roads, and mill sites. Reactions of sulfides often produce brilliantly colored metal precipitates and bacteria communities in surface waters down-gradient.

The low-pH conditions of AMD at metal mines may pose significant health risks to floral and faunal species, including humans. Heavy metals mobilized as a result of the acid generation pose the greatest threat, particularly to aquatic species. If there are multiple mines or natural sources of acid drainage in a watershed being considered for reclamation and remediation, it is important to know the location of the various sources and their relative contribution of metals. Environmental conditions leading to AMD and water and sediment sampling data collected during site visits will be critical information included in the database.

### Reclamation

Specific site observations regarding actions needed to abate hazards and reclaim the site will also be entered into the database. Examples of such observations include slope instability, shafts to be plugged, soil amendments needed, erosion control, and water quality. A digital photo log will be included for mines that receive visits.

### CONCLUSIONS

The proposed database will be used to gather information to aid reclamation and remediation at abandoned mines that are damaging the environment. A watershed approach using the information in the database will result in more efficient reclamation and remediation and wiser use of state dollars, as a watershed can be treated as a whole and sites can be ranked in priority of need.

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**Figure 3.** Unnamed open mine shaft approximately 50 feet deep on Palmer Mountain in Okanogan County. Open shafts such as this can be extremely hazardous because of loose material around the collar, rotting timbers, and vertical depths that could be fatal in a fall.



**Figure 4.** Tailings deposited along the banks of the Similkameen River from the Kaaba Texas mine were removed and the banks revegetated in 1999 and 2000. The revegetation was the result of an interagency cooperation between BLM, EPA, DOE, and DNR. The metal-bearing tailings were loaded onto trucks and hauled to an upland repository where metals would not be released to the environment. Approximately 80,000 cubic yards of tailings were removed. (Photo courtesy of EPA Region X.)

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