FINAL REPORT

20 April 2012

CULTURAL HERITAGE EVALUATION REPORT

Deloro Mine Site
Township of Marmora and Lake
County of Hastings, Ontario

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Executive Summary

Study Purpose

The Deloro Mine Site has been under the care and control of the Ontario Ministry of the Environment (MOE) since 1979. The property escheated to the Crown in 1987. The 202 ha Mine Site is located adjacent to Highway 7 where it crosses the Moira River about 65 km east of Peterborough. The nearest population centres are Marmora, approximately five kilometres to the west and Madoc, approximately ten kilometres to the east.

The Deloro Mine Site is grossly contaminated with arsenic and arsenical compounds, refining slag, mine tailings, laboratory wastes, lead, cobalt, nickel, copper, mercury and other metals and low-level radioactive wastes as a result of the mining and refining activities that took place at the site. For over 30 years MOE has been responsible for the cleanup of this mining and industrial complex. The objective of the final cleanup is to isolate and contain the waste to make the site safe for people and the environment for hundreds of years. The final remediation engineering is scheduled to be completed in 2012.

MOE retained Golder Associates Ltd, in the spring of 2011, to conduct a Cultural Heritage Assessment of the Deloro Mine Site. The Assessment was required to help the MOE meet its requirements under the Ontario Heritage Act, *Standards and Guidelines for Conservation of Provincial Heritage Properties*. The Cultural Heritage Assessment was to research the history of the property and evaluate its cultural heritage value in sufficient depth to determine a preferred approach to protecting its heritage significance. The Heritage Assessment was to provide a rational for the government's long-term plans for heritage aspects of the site.

The MOE Request for Proposals required the following work:

- Update the Commonwealth Historic Resource Management Limited *An Historical Analysis of the Deloro Site* (January 1988).
- Prepare a thematic history of the property and research the history of individual resources identified during field work.
- Create a built heritage inventory of structures and ruins.
- Identify, describe and evaluate the significance of the cultural heritage landscape of the Deloro property.
- Evaluate the cultural significance of Deloro using *Ontario Regulations* 9/06 and 10/06.
- Prepare a *Statement of Cultural Heritage Value*.

Golder's proposal also allowed for the following work::

- Provide conservation strategies for key on-site structures.
- Provide guidelines for future management of the property.
- Identify historic themes that are appropriate for future site interpretation.

During the course of preparing the CHER, MOE advised that in accordance with the RFP and the *Standards and Guidelines* that as part of the 2012 remediation planning, the initial six bullet points up to, and including the preparation of a *Statement of Cultural Heritage Value* were of primary importance.

This Statement of Cultural Heritage Value will be reviewed by MOE to determine if the Deloro Mine Site is a property of provincial heritage significance. If the Site is deemed by the Ministry to have provincial heritage significance, the Site will have to meet the Ministry of Tourism, Culture and Sport *Standards and Guidelines for Conservation of Provincial Heritage Properties.* If the property is determined to be a provincial heritage property, MOE will have to prepare a Strategic Conservation Plan to provide guidance on conserving, maintaining, using and disposing of features and landscapes. If the property is determined to be a provincial heritage property of provincial significance, MOE will have to prepare a Strategic Conservation Plan that is approved by MTCS.

Study Method

The study approach for this assignment follows accepted practices for identifying and evaluating heritage structures and cultural landscapes as described in the Ontario Ministry of Tourism Culture and Sport, *Ontario Heritage Toolkit* (2005). Section 4 of this CHER is a thematic history of mining and refining processes and was written to provide a context for the evaluation of the property. A site specific history of the property was undertaken of the technology and economics that were specific to the property. The research, inventory, and evaluation of cultural heritage of the Deloro Mine Site are given in Sections 5-11 and constitute the bulk of the study. Research was based on documentation supplied by MOE and on government reports, technical literature, maps, photographs, secondary literature and archival sources. This material is listed in the source section of this report.

The inventory of the Deloro Mine Site was undertaken on three separate occasions in 2011 on May 16/17, July 11-14 and August 5. The inventory consisted of those sites of potential historic significance as well as those features that contribute to the cultural landscape of the property.

History and Inventory

From the late 1860s until 1903, Deloro was a gold mining area. Between 1907 and 1960 the site was the location of a major smelter and refining plant for silver/cobalt ores brought by rail from mines in northern Ontario and later overseas. From 1885 until 1901 it was the only producer of arsenic, a by-product of ore refining, in North America and remained a major Canadian producer until the 1950s.

Since 1979, when the Deloro Mine Site came under the care and control of MOE, it has been remediated as one of the most contaminated industrial sites in Ontario.

Golder identified a total of 22 historic features that are described and evaluated in Sections 5-10 of this report. All were determined to have local or regional cultural heritage value according to O.Reg 9/06. Individually, none were identified as having provincial significance according to O.Reg 10/06. However, collectively these 22 features constitute a mining and refining landscape of provincial heritage significance under the Statement of Cultural Heritage Value or Interest.

Statement of Cultural Heritage Value or Interest

This *Statement of Cultural Heritage Value or Interest* is intended to be read as a standalone document and therefore repeats some of the wording already used in this Executive Summary.

Description of Historic Place

The Deloro Mine Site has been under the care and control of the Ontario Ministry of the Environment (MOE) since 1979. The 202 ha Mine Site is located adjacent to Highway 7 where it crosses the Moira River about 65 km east of Peterborough. The village of Deloro developed adjacent to the Mine Site. The nearest population centres are Marmora, approximately five kilometres to the west and Madoc, approximately ten kilometres to the east.

The Deloro Mine Site is grossly contaminated with arsenic and arsenical compounds, refining slag, mine tailings, laboratory wastes, lead, cobalt, nickel, copper, mercury and other metals and low-level radioactive wastes as a result of the mining and refining activities that took place at the site. For over 30 years MOE has been responsible for the cleanup of this mining and industrial complex. The objective of the final cleanup is to isolate and contain the waste to make the site safe for people and the environment for hundreds of years.

The study area of this Cultural Heritage Evaluation Report (CHER) consists of 48 ha containing a wide range of heritage resources including two intact buildings, numerous ruins of buildings and structures, and earthworks (road, rail, pits, dumps). In addition, the ecology of the property has been modified by human activities. The property contains numerous debris scatters of mining ruins and artifacts. The following resources are the primary cultural features on the property:

- Two powder magazine ruins.
- Hundreds of mine prospecting earthworks of which the “Powder House Vein” has been specifically documented.
- Three ore stamp mill archaeological sites.
- A large hydraulic power complex of channels and dykes.
- Transportation routes consisting of a mine tramway, four confirmed mining roads, and remnant railway earthworks.
- Two intact buildings, the Research Lab and Transformer Building.
- Identifiable ruins of a primary treatment building and casting building in association with the slag field and debris fields of other building ruins associated with refining operations.
- The historic pattern of mine shafts that are preserved as concrete caps and vent pipes of remediated mines along with steel survey posts that identify the location of 109 known mine shafts and pits. The Hawkeye Mine is the least remediated of the former sites.

Statement of Provincial Significance

The Deloro Mine Site has cultural heritage value of provincial significance according to O.Reg 10/06 Category (1):

- The property represents or demonstrates a theme or pattern in Ontario's history.

The cultural value of the Deloro Mine Site falls into three eras of historic land use; mining, processing and remediation. Each era of human intervention in the land constructed features which created distinctive patterns of land use associated with natural resource extraction.

Mining Era

The first 36 years of operation consisted of *the mining era* from the 1866 "Gold Rush" to the flooding of the Gatling Mine in 1902. The Deloro Mines were among the first hard-rock mines in Ontario. Gold attracted a variety of interests ranging from the "heroic" individual miner, to the America speculators of Canada Consolidated, and finally the scientific mining undertaken by British investors in the Canadian Goldfields. Removing the arsenic found in the gold ore initially defeated the early miners. Yet the arsenic was also a valuable by-product and Deloro produced arsenic commercially on an intermittent basis from approximately 1880 until 1904. Until 1901 it was the only arsenic producing plant in North America. By 1900 collaboration between the mine engineer and Queens University geologists developed a refining process that could separate arsenic from the gold ore, thereby opening a wide range of Canadian arsenical ores to commercial exploitation. It was a fascinating era of mining development in Ontario. But, if natural resources were the only value of the property, Deloro would have remained a small story in a much bigger economic history of Ontario's industrial development.

Silver/cobalt Refining Era

During the 54 years from 1907 to 1961 Deloro Smelting became a world player in refining cobalt ore and marketing cobalt metal. The refining technology developed at the end of the mining era enabled the company to pioneer metallurgical techniques in refining arsenical cobalt ore. Deloro was no longer a mining property and silver/cobalt ore was imported by rail from the newly opened mining district around Cobalt, Ontario. The company acquired the Canadian/British rights to Stellite; a cobalt alloy especially useful in high speed machining. During the two World Wars, cobalt was a strategic metal and the company was especially profitable. Between the Wars the company engaged in a cartel with Belgium, German and French companies to try to control the global prices for cobalt. Until the mid-20th century arsenic continued to be a valuable by-product but as its markets shrank after the Second World War, the element became a waste material. As a mining site, the operation never employed much more than 100 people who lived in accommodations scattered around the mine site and the surrounding farms.

The new refining operation required a few hundred people and as a result a company town grew up beside the industrial complex. Changing world markets after the Second World War lead to the ultimate closure of the operation. The huge scale of operations, spanning 50 years, created considerable toxic waste particularly arsenic. refinery tailings and low-level radioactive waste.

Site Remediation Era

The *site remediation era* began in 1979 and is still underway. However, the origins of this era are in the 1950s with the increasing public awareness in North America of environmental degradation caused by industry. That site remediation has taken more than thirty years to complete – the same length of time as the mining era – is indicative of the difficulty in shifting public opinion, understanding the nature of the problems and finding suitable remediation technologies. When this third era of restoration is finished in a few years, one of Ontario's most contaminated sites will be as environmentally safe as modern technology can make it. A new fourth era of land use activity will then commence with three long-term hazardous waste storage area on the site. The material survival is closely linked to the societal attitude to industrialization that existed prior to the environmental awareness of the 1960s and later. Until then, owners could walk away from their property and leave the property derelict. Deloro Stellite still exists today as a component of an international concern but without any connection to the property.

Heritage Value

Historic and Associative Value

- Several well know people were associated with the different historic eras at Deloro. The more prominent included E.J. Chapman, professor of Mineralogy University of Toronto, Stafford Kirkpatrick, School of Mining, Queens University, and Henry Vennor, Geological Survey of Canada who conducted geological work on the property and worked to solve the refining problems of arsenical ores. Ontario industrialist M.J. O'Brien was a major mine speculator at Cobalt and financed the expansion of the refining capacity at Deloro.
- The Deloro Mine Site was of the most successful properties of the 1866 Gold Rush; likely due to financially sound investors. Along with iron mining that began at the time, Deloro helped to identify Eastern Ontario as a hard-rock mining area.
- As was common with so much 19th century industrial development in Ontario, financing in the Mining Era came from foreign sources. The first unsuccessful attempt in 1880 was American financed. The successful operation of the 1890s was a British investment.
- When mines opened at Cobalt, Ontario, Deloro became the main refining site for the silver/cobalt ore.
- The company continued metallurgical improvements of Stellite; a steel/cobalt/tungsten and chromium alloy that had been developed in the United States in 1907; between the two World Wars, the company engaged in a marketing cartel with Belgium, German and French companies to try to control the global prices for cobalt.
- Deloro had one advantage over its competitors in that it also sold a cobalt product called Stellite, as well as cobalt oxide. In the early 20th century, an entrepreneur in Kokomo, Indiana, Elwood Haynes, began experiments to develop a stainless metal. In 1907 he patented an alloy of cobalt, tungsten and chromium that he called Stellite. Since Haynes required cobalt, the only place he could get it in large quantity was from Deloro.

- Arsenic compounds were widely used in the 19th and early 20th centuries. Most of Canada's supply was imported from Europe but the Deloro production was seen as having great potential. Deloro was the only commercial producer of arsenic in North America until 1901.
- The demand to clean up the environmental degradation at Deloro was part of the broader North American concern that had started after World War Two.

Design and Architectural/Engineering Value

- The mining technology of shafts and stamp mills used at Deloro was in keeping with technology of the era. Several miners erected experimental furnaces during the 19th century to attempt to separate arsenic from the gold ore.
- Energy was an important consideration in 19th century mining and refining. The site relied on steam power until the 20th century when it was replaced with electricity. An extensive waterpower system was partially constructed and then abandoned in the 1880s in favour of steam power.

Contextual Value

- The Deloro Mine Site is at the southern boundary of the Canadian Shield and the property is characterized by rock outcrops, thin soils and wetlands in low lying poorly drained areas. The Moira River flows through the property and most of the historic mining and subsequent cobalt refining took place on the west side of the river. Combined with the rolling topography these land characteristics dictated that all large industrial facilities hugged the limited amount of flat land along the west river bank.
- The sharp relief was utilized for gravity feed of the various stamp mills that cascaded down the slopes. Conversely, mine roads had to follow circuitous routes to obtain the lowest grades for heavy, horse hauled wagons.
- The vegetation displays a sequence of deforestation due to mining and a subsequent re-establishment of forest cover starting in the 1930s. Waste dumps of slag and calcium arsenate create stark industrial nodes in an otherwise vegetated property.
- Ore prospecting in the 19th century relied heavily on test pits and shallow exploration shafts. The forest understory is pockmarked with these remnant features.
- The former village of Deloro is adjacent to the Mine Site. At the beginning of the 20th century it evolved from a collection of houses into a company town. The street layout and location of the main buildings was directed by the company's labour requirements.

Description of the Heritage Features

Prior to undertaking the present report, previous historic and archaeological studies had identified the following significant heritage features:

- A *Powder Magazine* consisting of stone, partially collapsed walls.
- *Bunkhouse ruins* consisting of the concrete footings of two buildings.
- The *Five Acres Stamp Mill* consisting of a stone wheel-pit, timber stamp frame beam; shelves excavated into valley wall to support equipment.
- An *Incinerator/Powder Magazine* poorly constructed of low stone foundation; originally identified in 1988 as an incinerator and now considered to be a powder magazine.
- A *Transformer Building* constructed of rusticated concrete blocks with a flat roof. It is one of only two intact buildings on the property.
- A former *Research Lab* constructed of brick and concrete and the second intact building on the property. It is currently used as an arsenic treatment facility and will continue in that use for the foreseeable future.
- The *Primary Treatment Building Trestle* consists of a series of concrete piers that once supported a railway track.
- The *Casting Building* is a partially ruined brick building with a very low pitch gable roof. The blast furnace slag field extends close to two sides of the building.

During the 2011 built heritage investigation of the property the following additional features were also identified as having cultural value:

A *Tramway Embankment* at the edge of the Moira River consists of c.1880 rubble-stone retaining walls on which a mine tramway was constructed. Along with the Powder Magazine, this is oldest surviving mining structure on the Deloro Mine Site.

A *Hydraulic Raceway*, covering several hectares, consists of man-made improvements to a natural valley extending from the Moira River above the falls and back to the river below. The raceway was partially completed but never used for water power. The main cultural features include: an *Intake Cutting* from the River defined by vertical rock walls, an *Earth Causeway* across the cutting to carry a road on top, and a long *Raceway Dyke* consisting of a low stone wall backed with an earth berm in order to raise the height of the headpond. The size of this raceway contributes to the mining landscape of the property.

There are several key *Mine Workings* sites. The oldest is the "*Powder House Vein*" and consists of a long, narrow vein in which ore has been removed from between the host rock. The walls of the vein dip at the angle of the ore body. Although one of numerous prospecting pits, this one has been specifically documented. The *Twenty-Stamp Mill* was much larger than the Gatling Mill mentioned above and consequently the shelves excavated into the hillside are prominent features.

Other associated components are timber posts from one of the stamp mill batteries, line shafting and an engine base for power house. This mill is the largest surviving feature outside of the ruins of the industrial area. The *Twenty-Stamp Mill Road* is a landscape feature but also an engineered structure. The road was built with a surveyed grade and made level with rubble stone retaining walls.

Cultural Landscapes

Mining Roads provided connections between the mining and refining areas and have existed since mining began in c.1870. These roads were opportunistically built, relocated, and abandoned as dictated by mining needs. These roads typically were quite narrow, generally two metres (seven to eight feet) or less, and contained steep grades and sharp curves. Four surviving historic alignments have been identified as the *Twenty-Stamp Mill Road, Hawkeye Mine Road, Lower Hawkeye Road,* and the *"Deloro" Road*

The only evidence of the former *Railway Line* is visible as the Primary Treatment Building Trestle and the access road from the Industrial Area to the main Mine Area. This vehicular road is characterized by the gentle curvature and low gradients typical of rail lines.

Some of the *Mine Workings* sites that are landscape features have been identified in previous sections above. Other sites include the *Hawkeye Mine Tip* which is today the last visible mine site. Although the property was partially remediated along with the other mines in the 1990s, it still retains the steep rock slopes with projecting fingers of rock dumps. As well the historic *Pattern of Mine Shafts* is visible in the concrete caps and vent pipes of remediated mines along with steel survey posts that identify the location of 109 known mine shafts and test pits located through the forested mining areas.

Although much of the industrial area is in ruins, the landscape associated with the Cobalt Refining era is seen in the ruins of the industrial buildings. Three buildings – the *Casting House, Primary Treatment Building,* and the *Research Lab (Arsenic Treatment building)* described above – help to define how this area once looked. The *Casting House* had a particularly dramatic setting because of its proximity to the slag field.

Description of the Cultural Heritage Landscape

Today the area of the Deloro Mine Site evaluated in this report can be described as an evolved cultural landscape, or more specifically as a derelict industrial landscape. The ground is covered in earthworks of embankments, mounds, pits and meadows produced from 150 years of mining and refining activities. Ruins of buildings litter the site. The vegetation displays a sequence of deforestation due to mining and a subsequent re-establishment of forest cover starting in the 1930s. Waste dumps of slag and calcium arsenate create stark industrial nodes in an otherwise vegetated property.

Such a landscape conveys many impressions. The pattern of historic features create a *Mining and Refining Landscape* that reflects some of the 19th century values of economic and social growth of Ontario and views of how land could be treated. The feeling that preoccupies the property today is one of failure. A century and a half of misuse has created a landscape disfigured with stark, man-made alterations to landforms and vegetation and poisoned with industrial contamination.

The goal of MOE is to isolate and contain the waste to make the site safe for people and the environment for hundreds of years. Since the 1990s, the Deloro Mine Site has slowly been changing from a *Landscape of Failure* into a *Landscape of Remediation*. This new landscape shows how much our attitudes to the environment have changed.

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1.0 STUDY PURPOSE

The Deloro Mine Site has been under the care and control of the Ontario Ministry of the Environment (MOE) since 1979. The property escheated to the Crown in 1987.[1] The 202 ha Mine Site is located adjacent to Highway 7 where it crosses the Moira River about 65 km east of Peterborough. The nearest population centres are Marmora, approximately five kilometres to the west and Madoc, approximately ten kilometres to the east (Figure 1).

The Deloro Mine Site is grossly contaminated with arsenic and arsenical compounds, refining slag, mine tailings, laboratory wastes, lead, cobalt, nickel, copper, mercury and other metals and low-level radioactive wastes as a result of the mining and refining activities that took place at the site. For over 30 years MOE has been responsible for the cleanup of this mining and industrial complex. The objective of the final cleanup is to isolate and contain the waste to make the site safe for people and the environment for hundreds of years. The final remediation engineering is scheduled to be completed in 2012.

From the late 1860s until 1903, Deloro was a gold mining area. Between 1907 and 1960 the site was the location of a major smelter and refining plant for cobalt ores brought by rail from mines in northern Ontario and later overseas. From 1979 until the present time it has been remediated as one of the most contaminated industrial sites in Ontario. These three eras left a profound mark on the landscape.

It has been a remarkable story. Hastings County, of which Deloro is a part, was the location of the beginning of hard-rock mining in Ontario and precipitated a brief, but speculative mining boom in the 1860s and 1870s. Some of the leading Canadian men of science and industry were involved in the site. Innovative metallurgical techniques were perfected at the property – notably the refining of arsenical ores and the commercial use of cobalt metal. These and other events have made the Deloro Mine Site of considerable historic interest. From 1885 until 1901 it was the only producer of arsenic – a by-product of ore refining – in North America and remained a major Canadian producer until the 1950s. The history of mining and refining also left a legacy of environmental contamination. The identification of Deloro as an environmental problem coincided with the general rise of the North American environmental movement of the 1960s and 1970s.

The environmental hazards of Deloro are twofold. Physical hazards consist primarily of 19th century mine shafts and tunnels and to a lesser extent, the ruins of collapsing industrial buildings. The second are chemical hazards, mainly associated with arsenic production. Some of it was deposited on the property during the refining process and some was dumped following a drop in the demand for arsenic following the Second World War. More insidiously arsenic entered the Moira River from run-off through the industrial area and from mine drainage passing through arsenical ores. The former tailings pond presented a combined physical and chemical hazard. The dyke and capping of the pond with limestone in the 1980s was not considered to be a final remediation strategy.

Since the 1980s, considerable historic research has been undertaken under the auspicious of MOE with the very specific aim of identifying historic environmental hazards. This work was done in parallel with research being undertaken by groups and individuals interested in the history of the property.

[1] *Escheat* is a common law doctrine which in this situation pertains to the re-assigning the legal title of unclaimed or abandoned land to the province.

A *Stage 1 Archaeological Assessment Report for the Deloro Mine Site Cleanup Project Environmental Assessment* was completed for MOE in 2006. This was followed by Stage 2 archaeological assessments undertaken for MOE in 2006 and 2007 by Archaeological Services Inc (ASI) and by Past Recovery in 2008. This was followed in 2010 by a Stage 3 Assessment conducted by Golder Associates Ltd.

In 2011 MOE contracted Golder Associates to conduct the last two cultural heritage studies to be undertaken prior to the property's final remediation. MOE required a Cultural Heritage Evaluation Report (CHER) that included both a Built Heritage Assessment and Cultural Heritage Landscape Assessment of the Deloro Mine Site. A Stage 4 Archaeological Assessment, completed in 2011, is a companion volume to this study.

The MOE Request for Proposals required the following work:

- Update the Commonwealth Historic Resource Management Limited *An Historical Analysis of the Deloro Site* (January 1988).
- Prepare a thematic history of the property and research the history of individual resources identified during field work.
- Create a built heritage inventory of potentially historic structures and ruins.
- Identify, describe and evaluate the significance of the cultural heritage landscape of the Deloro property.
- Evaluate the cultural significance of Deloro using *Ontario Regulations* 9/06 and 10/06.
- Prepare a *Statement of Cultural Heritage Value*.

Golder's proposal also allowed for the following work:

- Provide conservation strategies for key on-site structures.
- Provide guidelines for future management of the property.
- Identify historic themes that are appropriate for future site interpretation.

The Statement of Cultural Heritage Value will be reviewed by the Ministry of the Environment to determine if the Deloro Mine Site is a property of provincial heritage significance. If the Ministry deems the site to have provincial heritage significance, the Site will have to meet the Ministry of Tourism, Culture and Sport (MTCS) *Standards and Guidelines for Conservation of Provincial Heritage Properties.* If the property is determined to be a provincial heritage property, MOE will have to prepare a Strategic Conservation Plan to provide guidance on conserving, maintaining, using and disposing of features and landscapes. If the property is determined to be a provincial heritage property of provincial significance, MOE will have to prepare a Strategic Conservation Plan that is approved by MTCS.

The Deloro Mine Site is a property grossly contaminated with hazardous and low-level radioactive waste. Cultural heritage, although identified as a significant resource of the site, has to be carefully considered in the context of the primary requirement to minimize the hazardous character of the property and to reduce the amount of contamination going into the Moira River.

2.0 STUDY METHOD

2.1 Study Area

The entire 202 ha area under the care and control of MOE is referred to as the Deloro Mine Site. For descriptive purposes, this property has been divided into eight areas known as:

- Industrial Area
- Main Mine Area
- Red Mud Tailings Area
- Northwest Remote Mine Area
- Northeast Remote Mine Area
- South Remote Mine Area
- East Remote Mine Area

The area assessed in this CHER covered the Industrial Area (25 ha.), Main Mine Area (6 ha.), and Northwest Remote Mine Area (17 ha). These areas constituted the primary location of historic mining and refining activity. The Red Mud Tailings Area, South Remote Mining Area, East Remote Mine Area, and the Northeast Remote Mine Area had been remediated by the end of 2011. The Young's Creek Onsite Area was not a historic mining area.

The Study Area contained a wide range of cultural heritage resources including two buildings, numerous ruins of buildings and structures, and earthworks (road, rail, pits, dumps). In addition, the ecology of the property has been modified by human activities. Most of the mine shafts were remediated in the 1990s and surface elements removed. Their historic pattern has been preserved in the steel survey posts that identify the location of 109 known mine shafts and pits.

2.2 General Study Approach

This report follows accepted practices for identifying and evaluating heritage structures cultural landscapes of property, as described in the Ontario Ministry of Tourism Culture and Sport, *Ontario Heritage Toolkit*. Overall, the following tasks were undertaken:

- Documentary research and analysis of the evolution of the beginning of 19th century mining to MOE acquiring care and control of the property in 1979.
- Inventory of material evidence of historic activities such as, structures, earthworks, circulation patterns, ecological evidence of human activity.
- Evaluation of heritage attributes according to O.Reg 9/06 and 10/06 of the *Ontario Heritage Act*.
- Identification of character defining elements on the property.
- Draft a Statement of Cultural Heritage Value.

The research, inventory, and evaluation of cultural features are given in Sections 4 through 11 constitute the bulk of the study. The O.Reg 10/06 evaluation, identification of character defining elements and the Statement of Cultural Heritage Value are given in Section 12.

The historical analysis and inventory covers all features more than 40 years old, or 1971 in the case of this study. In Ontario a structure or feature must be more than 40 years old in order to be considered to have potential historical value. This date guideline had been adopted by Federal and Provincial organizations such as the Federal Heritage Building Review Office, the Ontario Ministry of Tourism Culture and Sport, the Ontario Ministry of Transportation and Infrastructure Ontario.

2.3 Documentary Research and Analysis

A thematic history of mining and refining was prepared to provide a context for the evaluation of cultural resources found on the property. A site specific technological and business history of the property was based on documentation supplied by MOE and on government reports, technical literature, maps, photographs, secondary literature and archival sources. This material is listed in Section 13 of this report. In addition MOE gathered a considerable, and very useful, collection of historic documentation to assist in identifying former mining and manufacturing hazards on the Mine Site.

In 1988 Commonwealth Historic Resource Management Limited prepared “An Historical Analysis of the Deloro Site,” as part of MOE’s early site planning. The Commonwealth Report was a landmark study for its research and analysis and provided a framework for all subsequent understanding of the evolution of the property. In the 25 years since the report was completed, new information has become available. The Commonwealth study was re-researched and its findings combined with new information to provide a more in-depth site analysis.

If future historical analysis is contemplated by MOE, several areas of research could not be examined in this report due to lack of time and could be researched. The literature review for this study suggests that the newspaper *Marmora Herald* contains much information on the site operation and people. Similarly, based on the published reports of the Canadian Geological Survey/Mines Division and of the Ontario Bureau of Mines, archival research of these government departments may turn up further documentation. Appendix E provides brief biographies of people that were associated with mining and refining at Deloro. Time did not permit the preparation of detailed histories and further biographical research may reveal further historic information about the property.

2.4 Inventory

The inventory of the Deloro Mine Site was undertaken on May 16-17, July 11-14 and August 5, 2011. The inventory consisted of sites of potential historic significance as well as those features that contribute to the property’s cultural landscape including circulation networks (roads, rail, tramways), boundary demarcations (fence lines, Moira River), and vegetation related to the impacts of mining and refining.

The inventory overlaps in some situations with resources identified in the archaeological studies. Some features that were visible on the surface were considered to be both built structures and archaeological sites. The largest example of this was the Twenty-Stamp mill.

The inventory undertaken by Commonwealth Historic Resource Management was updated and included as Appendix C in this report. The Commonwealth inventory was the first formal identification of historic resources on the property.

2.5 Supporting Reports

Due to the specialized nature of the Deloro Mine Site, two firms were sub-contracted by Golder to provide professional assistance.

ERA Architects Inc was retained to provide a Building Assessment and Conservation Strategy. This study was undertaken to provide a long-term strategy to protect and interpret the heritage value and attributes of the gold mine site and its industrial history. This report provides a conservation strategy to best preserve the surviving built heritage resources. These strategies are based on the current condition of the structures and the cultural heritage value of what remained in 2011. The ERA report is contained in Appendix A. If the Deloro Mine Site is determined to be a provincially significant property, the ERA report could form the basis of the Conservation Plan that would be required.

Ecoplans Limited was retained to provide an ecologist evaluation of the Deloro property to identify the physiographic, topographic and biological existing conditions and to document the extent to which they informed the development and function of the mining and industrial activities on site. In particular the study was to characterise the response of the vegetation to mining, industrial and remediation activities that have taken place as it relates to cultural heritage landscape. This type of connection to built cultural heritage is rarely undertaken and believed to be an innovative approach to this study.

2.6 Evaluation of Cultural Heritage Value

2.6.1 Provincial Heritage Property of Provincial Significance

Properties owned by the Province cannot be designated under the *Ontario Heritage Act*. However, under the provisions of the Ministry of Tourism Culture and Sport *Standards and Guidelines for Conservation of Provincial Heritage Properties* that came into effect in July, 2010 properties determined to have cultural heritage value on interest and owned or occupied by a ministry or a prescribed public body must be managed according to these *Standards and Guidelines*.

If a property meets the criteria for for cultural heritage value on interest defined in O.Reg 9/06, it is a "*provincial heritage property.*" If the property meets the criteria in O. Reg. 10/06, it is a "*provincial heritage property of provincial significance.*"

If the property is determined to be a *provincial heritage property* under O.Reg 9/06, a *Strategic Conservation Plan* must be prepared to provide guidance on conserving, maintaining, using and disposing of the property. If the property is determined to be a *provincial heritage property of provincial significance* under O.Reg 10/06, a *Strategic Conservation Plan* must be prepared and submitted to the Ministry of Tourism Culture and Sport for approval.

If the Ministry of the Environment accepts the O. Reg. 10/06 evaluation of the Deloro Mine Site, a Strategic Conservation Plan must be prepared for the property. Since the Statement of Cultural Heritage Value is the primary document for ministry review, this Statement has been prepared as a standalone document in Section 12.

2.6.2 Regulations 9/06 and 10/06

Regulation 9/06 requires that a property meet one or more of the following criteria:

1) The property has design value or physical value because it is:
   - i) rare, unique, representative or early example of a style, type or construction method; or,
   - ii) displays a high degree of craftsmanship or artistic merit; or,
   - iii) demonstrates a high degree of technical of scientific achievement.
2) The property has historical value or associative value because it
   - i) has direct associations with a theme, event, belief, person, activity, organization or institution that is significant to a community;
   - ii) yields, or has the potential to yield, information that contributes to an understanding of a community or culture, or
   - iii) demonstrates or reflects the work or ideas of an architect, artist, builder, designer or theorist who is significant to a community.
3) The property has contextual value because it:
   - i) is important in defining, maintaining, or supporting the character of an area;
   - ii) is physically, functionally, visually or historically linked to its surroundings; or,
   - iii) is a landmark.

Regulation 10/06 requires that a property meet one or more of the following criteria:

1) The property represents or demonstrates a theme or pattern in Ontario's history.
2) The property yields, or has the potential to yield, information that contributes to an understanding of Ontario's history.
3) The property demonstrates an uncommon, rare or unique aspect of Ontario's cultural heritage.
4) The property is of aesthetic, visual or contextual importance to the province.
5) The property demonstrates a high degree of excellence or creative, technical or scientific achievement at a provincial level in a given period.

6) The property has a strong or special association with the entire province or with a community that is found in more than one part of the province. The association exists for historic, social, or cultural reasons or because of traditional use.

7) The property has a strong or special association with the life or work of a person, group or organization of importance to the province or with an event of importance to the province.

8) The property is located in unorganized territory and the Minister determines that there is a provincial interest in the protection of the property.

2.7 Notes

2.7.1 Metrification

In 1971 Canada adopted the metric system, however all structural dimensions in this text are given in Imperial units. In general the use of Imperial rather than metric is preferred for describing historic structures. Engineered structures were built to standard Imperial dimensions and distinctive patterns within such structures can be obscured by converting the original Imperial into metric units.

2.7.2 Mispickel

Mispickel was the term used in the 19th century to describe the arsenical ores found at Deloro. The modern terminology is arsenopyrite (See Section 3.2.2). Mispickel is used in this report as it is historically correct for most of the time period covered.

2.7.3 Deloro/ Deloro Mine Site

A post office with the name Deloro was opened in 1881. In 1919 the community was incorporated as the Village of Deloro. The village status was dissolved in 1998 and the community incorporated into the Township of Marmora and Lake. The term Deloro is used as both the geographic and incorporated name of the community.

The term Deloro Mine Site, as used by MOE, and used in this report, pertains to the 202 ha property that is under the care and control of the Ministry.

2.7.4 Remediation

MOE uses the term “Remediation” in a specialized way to mean the “completion of an activity that improves the contaminant concentrations is soil, groundwater and/or air.” This document uses the term “Remediation” in the more general sense of “the act or process of correcting a fault or deficiency” in the broad environment.

2.7.5 Abbreviations

CHER Cultural Heritage Evaluation Report

MOE Ontario Ministry of the Environment

O.Reg. Ontario Regulation

3.0 THE LAND

3.1 Setting

The Deloro Mine Site is located in the municipal Township of Marmora and Lake in Hastings County (Figures 1 and 2). The Township of Marmora was surveyed in 1820. In 1850 Marmora and the adjacent surveyed Township of Lake were incorporated as the Township of Marmora and Lake. There was insufficient population in either township for separate incorporation. With better land to the south, Marmora Township was too swampy and rocky to attract settlement. In 1850 the township contained only 592 people. The Township of Madoc and Elzevir, just to the east of Deloro, was better suited to agriculture. In 1850 it contained 2,021 inhabitants.

The Village of Deloro was incorporated as a separate municipality within the Township in 1919. In 1998 the village was amalgamated back into the Township of Marmora and Lake.

The Village of Marmora predates the development of mining at Deloro. It is seven kilometres west of Deloro and the closest village to the mine site. In 2001 the village was also amalgamated back into the Township of Marmora and Lake. Madoc Village, which also predated Deloro, is 15 km east of the village.

In spite of the slow grow of Marmora Township its mineral wealth did attract some early industrial activity. In 1820 a group of English capitalists financed the construction of the Blairton Iron Mine near Marmora to mine and smelt iron ore. It was a failure but iron mining in north Hastings County was re-established in the 1860s. Commercial interest in the mineral wealth of Hastings County continued until the end of the century.

3.2 Geology

3.2.1 Bedrock Geology

The Deloro Mine Site is located on the southern margin of the Canadian Shield at the junction of the pre-Cambrian Hastings Series rocks and the sedimentary rocks of the Ordovician era (Figure 3). The most prominent geological feature is a generally oval body, about seven kilometres by 12 km known variously as the Deloro Granite, Deloro Pluton, and the Deloro Intrusive Complex.[2] This pluton forms an area of high ground called the Huckleberry Hills. The newer sedimentary rocks surrounding the Deloro Pluton are arranged more or less in concentric circles around it.[3] Gabbro intrudes into the Hastings strata in long narrow formation that contained the gold-bearing deposits associated with the Deloro mines (Figure 3a). It was this rock that contained the gold-bearing ores.

The geology of this area is quite complex. Thus, for example the Belmont gold mine, located about 20 km north of Deloro, consisted of an entirely different gold ore. Incidentally, this ore was much easier to refine than that found at Deloro.[4]

[2] A pluton is a column shaped body of granitic magma that cools deep underground.

[3] Park, Ian G., “Report on Gatling and Gawley Properties”, June 3, 1983

[4] OBM 1901

3.2.2 Economic Geology

Gold, cobalt, silver, and nickel are the four metals associated with the history of the Deloro Mine Site. Arsenic was a by-product of refining these metals. Only gold, and by association arsenic, were mined on the property and are therefore part of the economic geology of the area. Various silver/cobalt/nickel ores were imported to the property for refining. Of these ores, cobalt was the most important to the history of the property. Cobalt is described in Section 4.7.3 of this report.

Gold

The gold ore found at Deloro consists as arsenopyrite-quartz veins in the gabbro. Arsenopyrites are an important source of arsenic. Until into the 20th century arsenopyrite was normally referred to as mispickel, as defined in section 2.6.2 of this report. Mispickel was an old name of German origin and the term "*Mistpuckel"* was used by the Middle-Age mining engineer Georgius Agricola in 1546. The silver/cobalt/nickel ores brought to the property were also arsenopyrite or mispickel ores.[5]

At Deloro the mispickel consisted of about 55 percent iron, 25 percent arsenic and about 20 percent sulphur. In addition to the mispickel, small amounts of free gold were also found scattered throughout the quartz and occasionally in the mispickel. Unfortunately no practical method of separating the gold from the mispickel existed until the 1890s.[6]

Arsenic

Elemental arsenic is a shiny, steel-grey, non-poisonous substance. The main commercial product was the extremely poisonous arsenic trioxide, or white arsenic, and frequently known in the past as arsenious acid. Another commercial product was calcium arsenate. Although the popular perception of this element is as the poison of choice in detective fiction, it is, however, a surprisingly useful industrial product.

In the 19th century arsenic was commonly used in domestic products such as food colouring, dyes and medicine, as well as for industrial purposes. There is a social history of arsenic use in Canada which does not seem to have been studied.[7]

By the 20th century it was widely used in a variety of products, such as:

- Insecticides;
- Preservatives for wood, furs and leather;
- A mordant for aniline dyes;
- A pigment for various colours;

[5] Agricola wrote the first European textbook on mining, *De re metallica* in 1556. "Mispickel, *Encyclopaedia Britannica* 11th Edition, 1910 Volume 18

[6] Canada Consolidated , 1881; CDM *Mining and Metallurgical Industries 1907-8*

[7] By comparison the theme has been studied for Britain; see James Whorton, *The Arsenic Century* (2010).

- Manufacture of glass and enamel;
- Medicines and arsenic soap;
- White light used in pyrotechnics;
- Lead hardener; and
- Manufacturer of shot.[8]

In 1922 the Canada market consumed 384 tons of arsenic in the manufacture of insecticides and 138 tons in glass manufacturing.[9]

Britain, particularly the counties of Devon and Cornwall, were the principle 19th century world source of arsenic as a result of refining mispickel tin and copper ores. Belgium, Germany, Portugal, Spain, Italy, Hungary and Canada were other arsenic producers. Canada started to refine arsenic in 1885 at Deloro. Until the end of the century, Deloro was the only commercial arsenic producing plant in North America.[10]

The absence of arsenic production in 19th century United States seems unusual. Arsenical ores were being refined but the arsenic was not captured until 1901 when a plant opened in Everett, Washington. Production then increased rapidly with five plants in operation by 1916.[11]

The discovery of cobalt-nickel-silver veins at Cobalt in 1903 provided a new source of arsenic. After 1905, ore from this district was refined by the Deloro Smelting and Refining Company Limited. Smaller production came from Nova Scotia and British Columbia. In 1927, about 80 percent of the arsenic production of Canada was obtained from ores mined in the Cobalt district and refined at Deloro.[12]

Table 1: Arsenic Production, Deloro, 1899-1903[13]

Year	Tons Produced	Value
1899	57	$4,842.00
1900	303	$22,725.00
1901	695	$41,677.00
1902	800	$48,000.00
1903	225	$13,500.00

[8] *OBM 1913;* see also Canada. Arsenic Bearing Deposits 1927

[9] Canada. Arsenic Bearing Deposits 1927 p.4-5

[10] "Mispickel, *Encyclopaedia Britannica* 11th Edition, 1910 Vol 18; "Bounty wanted for Arsenic Refining," CMR 20:1901 274–75

[11] United States.. Mineral Resources of the United States, 1916p.501-2

[12] Canada. *Arsenic Bearing Deposits* 1927 p.4-5

[13] CDM *Mining and Metallurgical Industries 1907-8*

The demand for arsenic expanded dramatically during the first two decades of the 20th century. The cotton boll weevil entered Texas from Mexico in 1892. Infestation began to spread and by 1922 it had reached 87 percent of the cotton producing areas of the United States. Research soon determined that dusting cotton plants with calcium arsenate was the cheapest and most effective method yet devised for controlling the weevil.[14]

For the gold mines of Deloro, arsenic production did more than provide an additional source of revenue. Given the high cost of separating gold and arsenic in the mispickel ore, the added value of arsenic often made the difference between a loss and profit in the overall operation of the mine.

When large scale gold mining was first advocated at Deloro in 1880, the promoters optimistically viewed the arsenic as a profitable by-product valued at $1.50 per ton. One of the chief promoters of the company, Richard Rothwell, visited Europe to assess the arsenic markets and determined that Europe could take all the arsenic the company produced. In the end, an economical refining method eluded the operators and the mine closed without shipping any arsenic, or much gold. Fifteen years later, the second large scale mining operation at Deloro, by Canadian Goldfields Limited, admitted that the rising cost of arsenic would make its mining operation profitable.[15]

Arsenic production expanded significantly with the refining of Cobalt arsenical ores. It seems that the demand for arsenic more or less matched production until after the Second World War. Then, as markets declined, arsenic was stockpiled at Deloro as an unwanted by-product of cobalt refining.

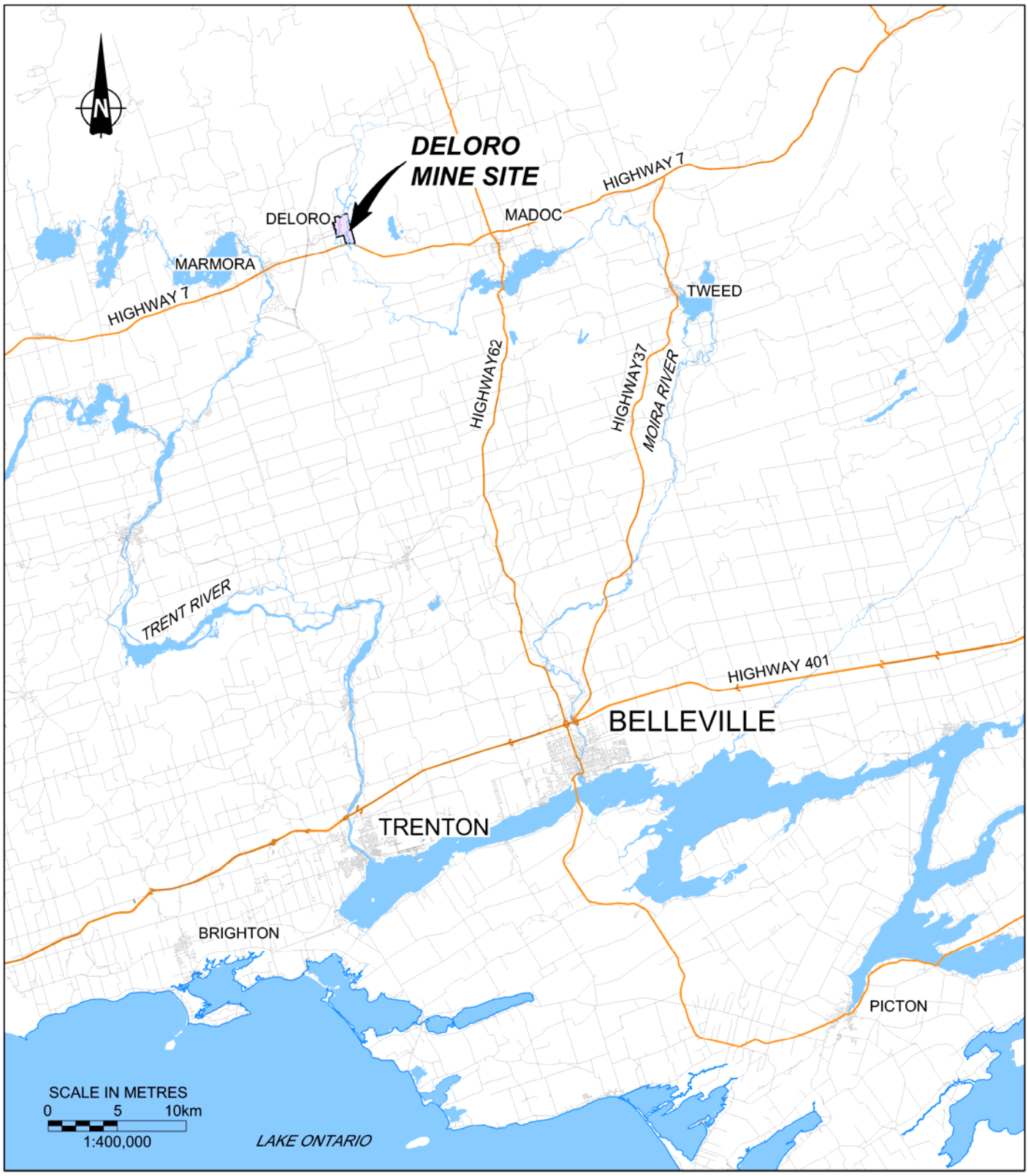
3.3 Physiography

The topography of the Deloro Mine Site is formed from an irregular bedrock surface that often protrudes through the overburden to form bedrock knobs. The overburden is generally less than three metres thick but is found up to six metres in depth in some areas. The Ecoplans Study prepared for this report provides a detailed description of the physiography (see Appendix B).

The Moira River defines the eastern boundary of the Mining and Industrial Areas. In this section the river is relatively narrow and shallow and flows through a well defined rock channel. Roughly half way along this section, it tumbles over a waterfall of about eight metres. The flood plain is also relatively narrow with a steep valley wall along the west side. There are several wetlands along the banks of the flood plain and historic mapping indicates that there were others. The most important, with regards to this study, is the area known in 2011 as the equalization pond. Historically this was a wet land that has been progressively filled over time with waste material. Today the equalization pond is used as part of the water treatment plant on the Deloro Mine Site.

[14] Canada. *Arsenic Bearing Deposits* 1927 p.2

[15] Canada Consolidated, *Report of Progress*, 1881; *Report Canada Consolidated Gold Mining Company* 1880; “Bounty wanted for Arsenic Refining,” *CMR* 20:1901 274–75; “Gold Mining in Ontario,” OBM 1899, 1900; *CMR* 15: 1896, p. 29; Kierkgaard, *CMR* 20:1901 p. 50-3



REFERENCE

DRAWING BASED ON CANMAP STREETFILES V2008.4; AND ONTARIO BASIC MAPPING (OBM) DATA, 2011, BY THE GEOGRAPHY NETORK.

NOTES

THIS DRAWING IS SCHEMATIC ONLY AND IS TO BE READ IN CONJUNCTION WITH ACCOMPANYING TEXT.

ALL LOCATIONS ARE APPROXIMATE.

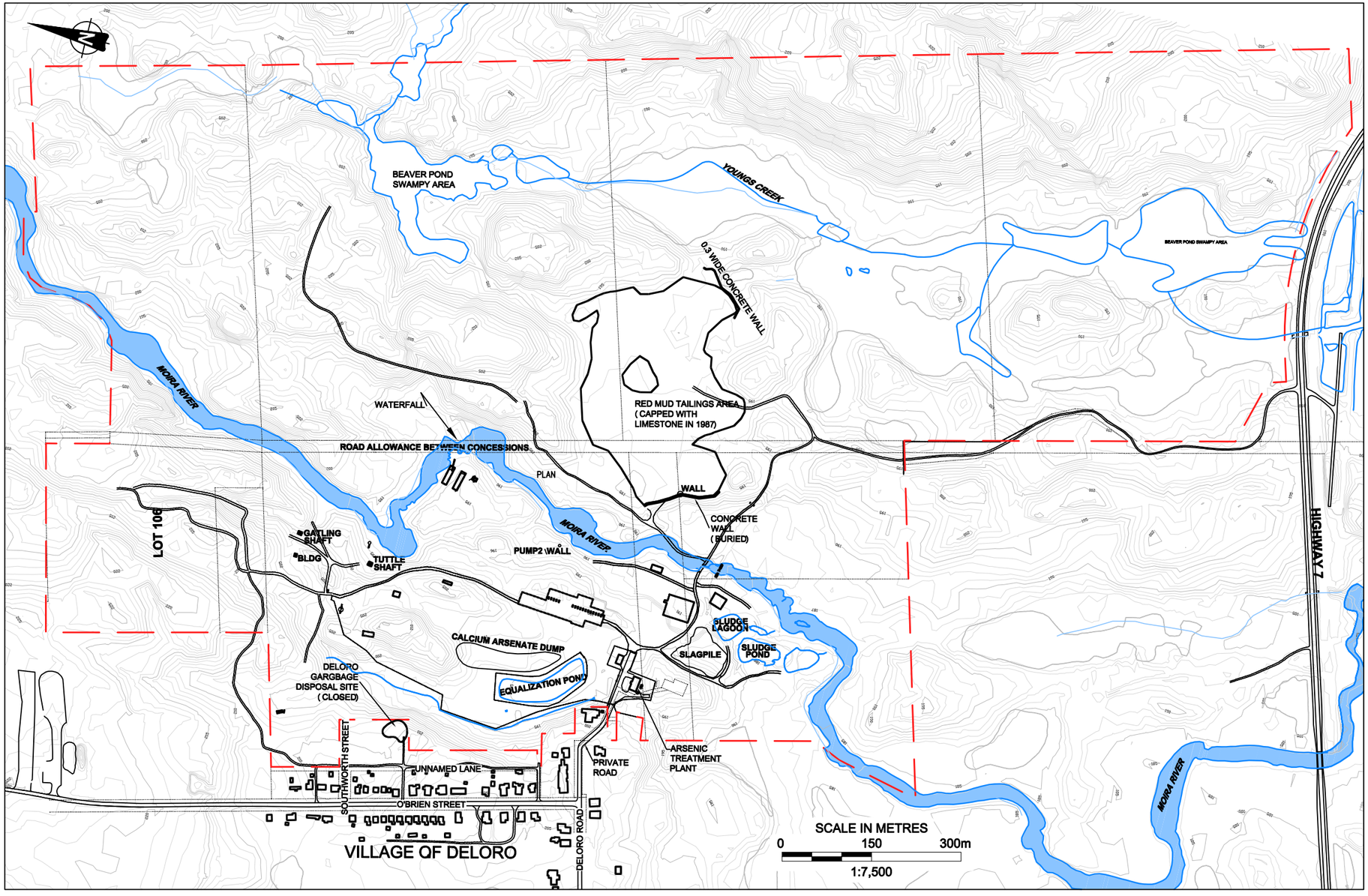
PROJECT: CULTURAL HERITAGE EVALUATION REPORT
DELORO MINE SITE
TOWNSHIP OF MARMORA AND LAKE
HASTING COUNTY, ONTARIO

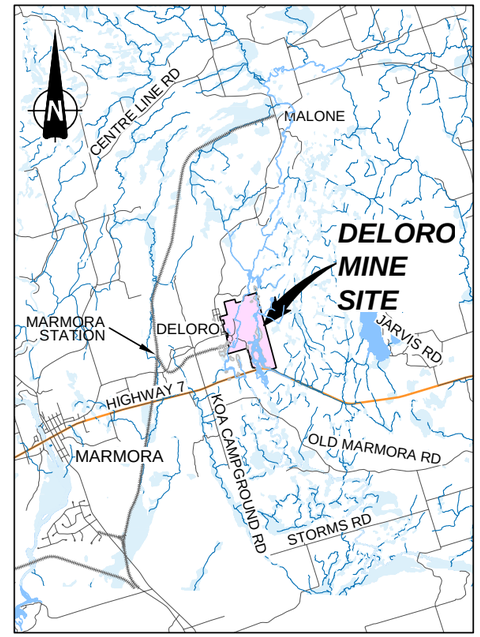
TITLE: **REGIONAL MAP**

Golder Associates
LONDON, ONTARIO

PROJECT No. 11-1126-0037			FILE No. 1111260037-4000-R06001
			SCALE AS SHOWN REV.
CADD	DCH	Apr. 20/12	**FIGURE 1**
CHECK			

Drawing file: 1111260037-4000-R06001.dwg Apr 20, 2012 - 9:41am





KEY PLAN (Note: All rail lines are abandoned)

LEGEND

PROPERTY/BOUNDARY

REFERENCE

DRAWING BASED ON J.D. BARNES LTD., TOPOGRAPHICAL SKETCH No. 08-25-075-00, JULY 8 2008; AND CANMAP STREETFILES V2008.4.

NOTES

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ALL LOCATIONS ARE APPROXIMATE.

PROJECT

CULTURAL HERITAGE EVALUATION REPORT
DELORO MINE SITE
TOWNSHIP OF MARMORA AND LAKE
HASTING COUNTY, ONTARIO

TITLE

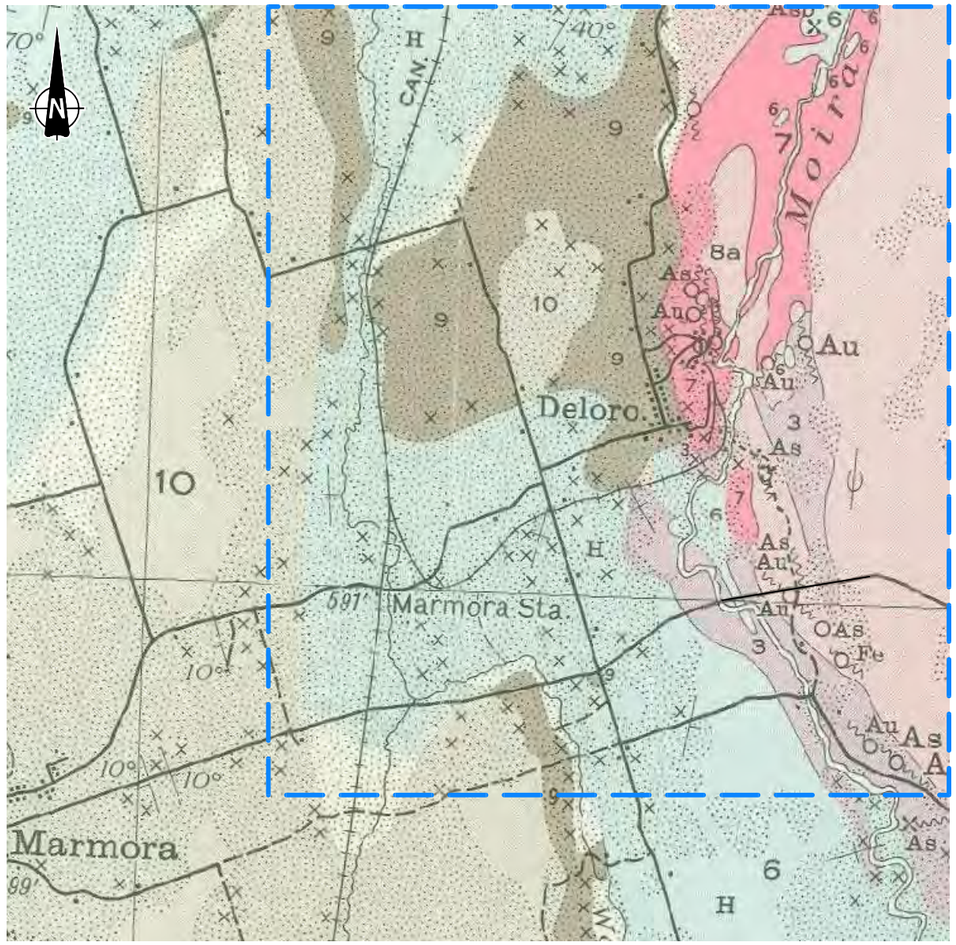
STUDY AREA MAP (DELORO MINE SITE)

Golder Associates
LONDON, ONTARIO

PROJECT No. 11-1126-0037			FILE No. 1111260037-4000-R06001
			SCALE NTS REV.
CADD	DCH	Apr. 20/12	**FIGURE 2**
CHECK			

Drawing file: 1111260037-4000-R06001.dwg Apr 20, 2012 - 9:51am

PORTION OF GEOLOGICAL SURVEY OF CANADA. MAP 560A, MARMORA, 1940



ORDOVICIAN

10 — LERAY AND LOWVILLE FORMATIONS: limestone

9 — PAMELIA FORMATION; limestone, dolomitic limestone, sandy limestone, shale

BLACK RIVER GROUP

POST-HASTINGS

8 — Granite-gneiss; 8a, Deloro granite and syenite

7 — Diorite, gabbro, basalt

HASTINGS SERIES AND GRENVILLE SERIES

6 — Crystalline limestone, some dolomitic limestone

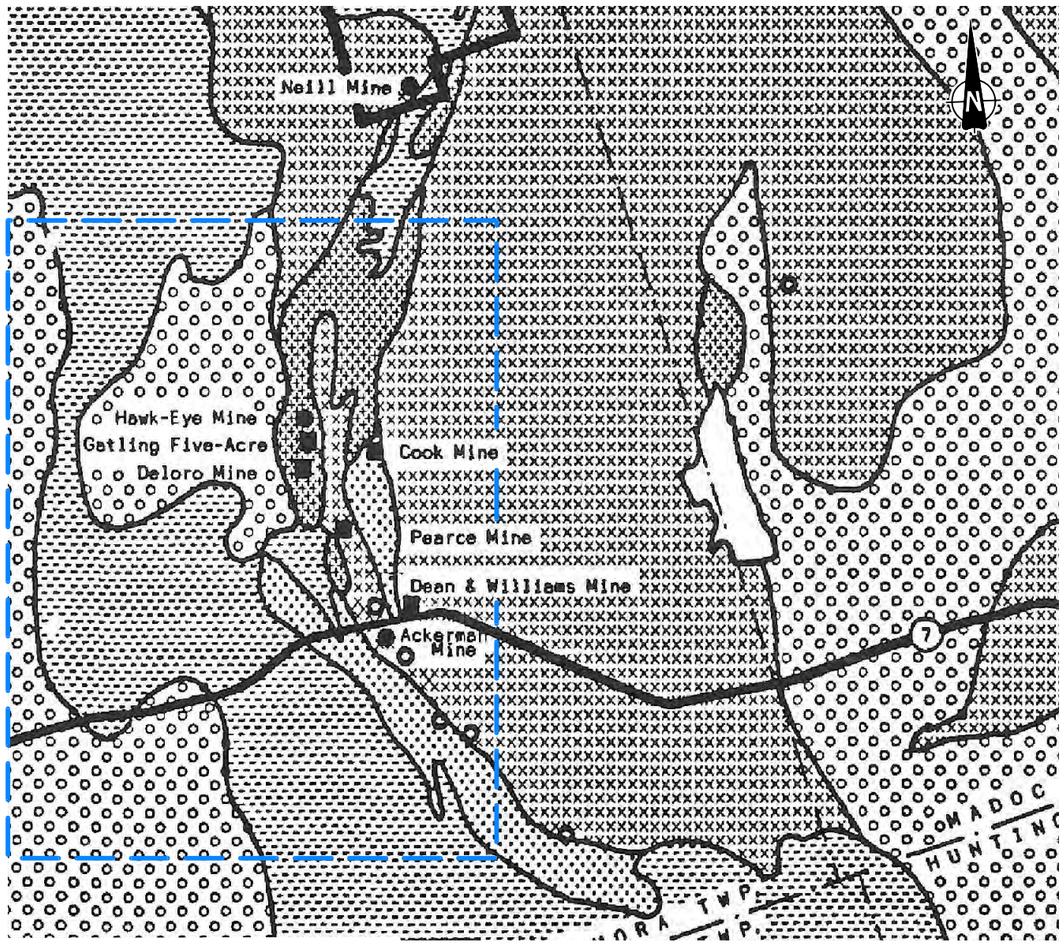
3 / 3a — Argillite; mica schist, garnet schist, staurolite schist; 3a, mica schist and garnet schist interbanded with amphibole schist 3b, mica schist and garnet schist injected and silicified by granite

APPROXIMATE SCALE IN METRES

0 0.5 1km

1:40,000

INTERPRETATION OF MAP 560A SHOWING GEOLOGY AND GOLD MINES OF THE DELORO AREA. SOURCE BOWDIDGE CONSULTING, 1987



Paleozoic

Granite and syenite

Gabbro and amphibolite

Clastic metasediments

Calcareous metasediments

Former gold producer

Gold prospect with shaft

Gold prospect

NOT TO SCALE

REFERENCE

DRAWING BASED ON:

1) CANMAP STREETFILES V2008.4;
2) CANADA. GEOLOGICAL SURVEY OF CANADA. MAP 560A, MARMORA BY M.E. WILSON, 1940, 1:63,360
3) BOWDIDGE CONSULTING GEOLOGISTS. "MALONE GOLD PROSPECT; MARMORA TOWNSHIP EASTERN ONTARIO. REWPORT ON GEOLOGICAL MAPPING, VLF-ELECTROMAGNETIC SURVEY AND MAGNETIC SURVEY," BY C.R. BOWDIDGE, FEBRUARY 1987.

NOTES

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ALL LOCATIONS ARE APPROXIMATE.

PROJECT

CULTURAL HERITAGE EVALUATION REPORT
DELORO MINE SITE
TOWNSHIP OF MARMORA AND LAKE
HASTING COUNTY, ONTARIO

TITLE

MARMORA TOWNSHIP GEOLOGY & GOLD DEPOSITS

Golder Associates
LONDON, ONTARIO

PROJECT No. 11-1126-0037			FILE No. 1111260037-4000-R06001
			SCALE AS SHOWN / REV.
CADD	DCH	Apr. 20/12	
CHECK			FIGURE 3

Drawing file: 1111260037-4000-R06001.dwg Apr 20, 2012 - 9:53am

4.0 MINING TECHNOLOGY

The purpose of this section is to provide a brief summary of some of the key issues associated with developing a mining operation at Deloro.

4.1 Transportation

Gold mining was not as dependant on good transportation as some other forms of mining – notably iron. Gold was refined at the mine and the high value, low volume product then shipped from the mine. Iron, by contrast, was shipped in considerable tonnage as an unrefined ore from the mine for refining at a distant furnace. Roads were adequate for gold mining; iron mines required rail transport. But even gold mines would have benefited from lower freight costs if mining equipment could have been brought by rail rather than road.

Good communications – then as now – were important. A telegraph line was apparently under construction, probably in association with railway building, in the early 1880s. The mining company had only to supply the poles between the telegraph company line and Deloro.[16] The date of actual construction was not determined.

Road and rail connections were such that by 1880 the Deloro mines were reasonably accessible to travellers. The well known Canadian engineer, Walter Shanly, commenting in January, 1881, said that the travel time from Marmora to Toronto was 10 hours, to Montreal 14 hours, and to New York or Boston about 30 hours.[17]

4.1.1 Roads

The economic mining of gold at Deloro required two types of roads. Public roads provided for long distance travel from mine to market. Mining roads were private roads which linked the various on site operations and typically were not as well built as public roads.

Deloro is about 55 km north of Belleville and Trenton, both located on Lake Ontario. By the 1860s a road extended from these communities to Marmora. Indeed the road from Trenton was gravelled to Marmora. When W.J. Gatling started mining at Deloro in the 1860s, he undertook improvements to the road between the mine and Marmora.[18]

The condition of the roads seems to have been suspiciously good. The Secretary of the Canada Consolidated Mines, writing in 1881, commented that the mines could be reached from Belleville by taking a train to Madoc where a carriage could be rented. However, he considered a more pleasant way was to stop the night at Belleville and proceed the next morning by carriage for the full 58km.[19]

All of the mines were connected by roads to the mill in order to transport the ore for processing. The development of this road network is depicted in historical mapping and can be traced on the landscape today. No textual historical records pertaining to mine roads have been identified thus far.

[16] *Report Canada Consolidated Gold Mining Company* 1880

[17] *Report Canada Consolidated Gold Mining Company* 1880

[18] Vennor, 1871-72, p.138

[19] Canada Consolidated, *Report of Progress* June, 1881

Typically these roads took advantage of the natural landscape to avoid the need for upgrading the routes. In general the travelled surface appear to have been about two metres in width. They contained sharp bends and steep grades. The “Twenty-Stamp Mill Road” was the only route that seems to have been deliberately engineered; it would also have been one of the last mining roads completed. The “Deloro Road” appears to have been in use for the longest time and is marginally wider and with improved earthworks than the other mining roads.

A network of roads also surrounded the industrial area. These have been largely disturbed by site remediation and building demolition. There is a well defined road that comes from approximately the existing main gate to the property beside the research lab and works its way down the slope to the former slag pile. From this point a north south road extended at the T intersection. The section to the south has more or less disappeared. The section leading back to the main industrial site is in existence today and runs adjacent to the slag pile.

4.1.2 Railways

The Grand Trunk Railway between Montreal and Toronto was completed through Belleville and Trenton in 1856. The first line to come close to Deloro was not finished until 1878 when the Grand Junction Railway (later the Midland Railway) was opened from Belleville to Madoc and Eldorado. The Madoc Station was about 15 km from the Deloro Mine Site. The cost of haulage to the mine from Madoc could be contracted out from $1.25 to $1.50 per ton.[20]

In 1884 the Central Ontario Railway finished a line from Trenton, through Marmora, to Eldorado. The line passed halfway between Marmora and Deloro. The Marmora Station was only about two kilometres from the Deloro Mine Site (Plate 1).

Also in 1884, the Canadian Pacific Railway mainline from Toronto to Montreal passed about 10 km south of Deloro. However, the road pattern was such that wagon traffic had to pass by either the Marmora or Madoc railway stations before reaching the Canadian Pacific station. Unless Canadian Pacific freight rates were very competitive, it may have been more profitable to ship through the closer stations of the competing railway serving Marmora and Madoc.

In the early 20th century both the Midland Railway and Central Ontario Railway became part of the Canadian National. The Madoc line was closed in 1984 after the Marmora line closed in 1982.

Although the Central Ontario Railway was of great value to the Deloro Mines, the line was promoted and constructed largely to serve the iron mining in North Hastings County. By the early 1880s there were at least 33 iron mines operating in Eastern Ontario with one of the most productive new deposits was located north of Deloro at Coe Hill.

[20] Canada Consolidated 1880

The railway was promoted by Samuel J. Ritchie who was a carriage maker in Akron, Ohio. The ore turned out to be the wrong kind of iron (it contained too much sulphur) and traffic never grew. However, as a result of the line's construction, Deloro did get rail access. Ritchie went on to become a successful operator of a nickel mine in Sudbury.[21]

A rail spur from the mainline directly into Deloro was not economically viable until large quantities of silver-cobalt ore began to arrive at the smelter. The branch line to Deloro was completed in September 1913 (Plate 2). The line was operated by the Deloro Mining and Reduction Company using its own locomotives. All ore, fuel and supplies were delivered in railway cars to the works.[22]

Remarkably, one locomotive survives in 2011. A small 0-4-0 tank engine built in 1920 was acquired by the Deloro Mining and Smelting Company and used until the plant closed in 1960. It was then purchased by a private collector before being transferred to the Niagara Railway Museum in Fort Erie.[23]

4.2 Energy

4.2.1 Thermal

Heat was required in several sectors of the mining industry. It produced steam to operate the engines, crushers, steam drills, and other mine equipment. Furnaces were used to roast ores to drive off the arsenic and sulphites to facilitate the extraction of gold. Stationary steam engines were used to power machinery in the 19th century. In the early 20th century they were gradually replaced with electric motors. Steam drills were used until 1900.

Heat was also required to keep the concentration works functioning. In December 1882 the refining mill had to stop when the temperature fell to -22°F. By then the Canada Consolidated Gold Mines was in poor financial condition. The company actually owned heating pipes for the concentrator works but they were being held by the railway company until the company could pay the freight charges.[24]

Wood

Until the arrival of the railway enabled the import of coal, wood was the fuel. It is difficult to calculate how much wood was consumed for power and heat. However, in 1880 Canada Consolidated estimated it took one cord a day to roast 10 tons of ore. At that time cord wood was delivered to the mill at $1.25 per cord. By 1883, probably due to the demand created by the mines, the price had doubled to $2.50 per cord.[25]

[21] Gibson, W. *Mining in Ontario*, 1937 p.118, 120; Smith,. Harvest from the Rock; p.27-28, 61-66

[22] T&NO Ry. *Mining Industry served*, 1914

[23] Niagara Railway Museum website www.nfrm.ca/news.php

[24] *Reports on Present Condition Canada Consolidated* 1883

[25] *Report Canada Consolidated Gold Mining Company* 1880; *Reports on Present Condition Canada Consolidated* 1883

Coal

Coal, which came from Pennsylvania and Ohio, began to be used by the 1890s. It had far more energy per unit than the wood equivalent and was much easier to handle. The Canada Goldfields Company required $35,000 to $38,000 a year for fuel. The Atlas Arsenic Company working the Gawley Shaft with a 10 stamp mill required $20,000 per year for fuel.[26]

4.2.2 Water

When only mechanical power was necessary, water power was far cheaper than thermal energy. The seven metre head that was concentrated at the falls on the Moira River was more than sufficient to run turbines. However, it was unavailable for two-three months a year because of freezing. During the winter, steam power would have been required. Furthermore, heat for processing the ore would still have to be produced throughout the year.[27]

Despite the availability of water power, there were only two documented cases of water power being used. In 1870 a mill of five stamps was worked by water power on Lot 6, Con VIII. Shortly after construction the dam on the Moira River broke and the work was suspended.[28]

A far more ambitious plan to use water power was developed by Canada Consolidated. The company's mining engineer, R.H. Stretch, indicated that the Moira River could provide power for all the necessary machinery for eight months of the year. He recommended construction of a low dam and a short, shallow earth cutting that lead into a natural valley. The intention was to build a flume 400 to 500 feet long (120 – 150m) with a fall of 21 feet (6.4m) to drive the machinery at the concentrating and arsenic works. Critically, the 1881 *Report of Progress* stated "water will be carried to the new mill by a flume . . ." Subsequent maps depict the earth cutting and a stream leading to a reservoir. This reservoir was too low to provide a useful head of water and probably was not used for power.[29]

The cutting is visible in 2011 as is a long dyke along the east side of the valley. It is speculated that a control dam was to have been built across the valley and the flume built at this point. There is no evidence of a dam in the valley. There is also no evidence of a dam on the Moira River although this is not surprising due to the winter ice scour of more than a century.

The most intriguing aspect of water power is that it may explain why the concentrator/arsenic works was so far away from the mines. Based on modern observations of the land, it should have been possible to build the concentrator in the area occupied by the later transformer building. This was several metres above the Moira River. The actual site of the mill was below the waterfall where an adequate head of water power would have been available. The trade-off was that a tramway had to be built to haul the ore from the mines to the concentrator.

[26] CMR 28:1907, 60-1

[27] Report Canada Consolidated Gold Mining Company 1880

[28] Vennor, 1871-72, p.136

[29] Canada Consolidated, *Report Canada Consolidated* 1880, *Report of Progress* June, 1881

4.2.3 Horses

Horses were necessary from the beginning to move ore in wagons and bring in firewood and supplies. However, there are no specific references to horses. The earliest indication of horses on site was the construction of a stable and carriage house about 1870. Another source stated that there were two barns on the property by 1895.[30]

4.2.4 Compressed Air

Although steam drills were used until the end of the 19th century, compressed air started to replace steam by the 1880s. About 1880, Canada Consolidated installed air compressors in the mill to power drills. At the turn of the century, the Atlas Arsenic Company ran a compressor to operate ten drills. Canada Goldfields also used compressed air to work water pumps in its mine.[31] The company built a very large, brick compressor building.

4.2.5 Electricity

Electricity was introduced at Deloro in 1900 to provide lighting in the plant. The power plant was located in the compressed air building and consisted of a 250 horsepower steam engine driving a 100 kilowatt AC generator. Later, power was transmitted 550m (1,800 feet) to the new Cobalt plant where all of the machinery was electrically driven. The Twenty-Stamp mill was separately driven by a 75 horsepower steam engine.

A more economical source of electricity occurred in 1909 when the company was connected to the Seymour Power Company's hydroelectric plant located 35 km away at Campbellford. The mine purchased 300 to 400 horsepower of power.[32] A new substation was constructed and survives in 2011.

4.3 Building Materials

With a few exceptions, timber was the primary building material during the mining era at Deloro. By the 1880s there was a water powered sawmill on the Crowe River at Marmora, about six kilometres away. Pine lumber cost $8.00 per thousand board feet.[33] In addition to boards, mining required large quantities of heavy timbers to prevent shafts and tunnels from being crushed.

Stone was used when fireproof construction was important. The Gatling Mine powder house was stone, as was a c.1880 mine hoist-engine shed. Stone was used to build vertical retaining walls along roads as well as terraces for industrial buildings.

[30] Vennor, 1871-72, p.138; OBM 1896, 1897

[31] Canada Consolidated, *Report of Progress* 1881;OBM 1898,1901; "Deloro Mining" *CMJ* 1:17, 1907 517-22

[32] OBM 1900, 1918; Kierkgaard, *CMR* 20:1901 p. 50-3; "Deloro Mining" *CMJ* 1:17, 1907 517-22; Canada, Dept, *Mining and Metallurgical Industries*, 1908, p.380-81; T&NO Ry. *Mining Industry*, 1912

[33] Canada Consolidated 1880

Brick provided fireproof construction but would have been a luxury at Deloro in the mid-19th century. Nonetheless, the Canada Consolidated Gold Mines constructed two large brick buildings about 1881 for an office building and superintendent's house. Brick would have had to be made on-site and its use would have been an extravagance at the time.[34] About 1898 a powerhouse, laboratory and concentrating building were constructed of brick. By then, rail transportation was available and factory made brick could be imported. But wood was still the most common material. An immense stamp mill was constructed entirely of timber.

Concrete began to be used apparently sometime after 1910 when the material started to become widely available. Virtually all concrete work was associated with the refining , rather than the mining, era of Deloro. The earliest datable concrete structure is the transformer building c.1909. The boarding house ruins are another example and were constructed in 1919. The most prominent example remaining in 2011 were the piers of the former concrete trestle in the primary treatment building dating from c.1950. By then, concrete had long passed out of its role as a novel, new material.

Steel does not seem to have been used as a structural material at Deloro in the 19th century. The material was used for pipes for water, compressed air and steam. Steel rails were laid in c1883 for a tramway between the mines and refinery. Steel construction is associated primarily with the mill buildings built during the 20th century refining era of Deloro.

Although not mentioned in the documentary record, fire brick would have been required for furnace and ladle linings. The earliest furnaces built in the 1870s could have been lined with common clay brick but by 1900 fire brick would have been used. Fire brick was not manufactured in Ontario until c.1900. Prior to this brick was imported from the United States or Great Britain.

4.4 Proving Ore Deposits

Gold was discovered in Madoc Township in 1866. The initial gold strike was found accidentally by a prospector who thought he had found copper. This subsequent Gold Rush quickly identified all of the principal deposits that were to be the focus of the next 30 years of mining. As soon as the discovery was made, the Geological Survey of Canada sent one of their geologists, Henry Vernnor. As a result of the publication of his two reports in 1869 and 1872, the geology of the gold bearing areas was generally well understood.[35]

Mining properties in the Deloro area were determined to consist of four or five parallel veins in a belt about 150-180m wide. These veins extended for about a kilometre across the property of the Canada Consolidated Gold Mine and continue across adjacent properties for a further five kilometres. The strike of the veins had a dip that varied from 45 to 60 degrees. The lode was irregular varying from about 1.5 m (the average) to occasionally 7.5 m.[36]

Information about the outcropping and dip of the veins could not give an accurate estimate of how much ore was in the ground. At the time the only way to understand a potential deposit was to look for as many possible outcrops of the mineral over a wide area and then sink trenches and pits into the veins.

[34] Canada Consolidated 1880

[35] CGS 1866-69; 1871-72

[36] Rothwell, 1881; Kierkgaard, CMR 20:1901 p. 50-3

One such trench survives in 2011 as part of the Powder House vein. At promising locations shafts were excavated to raise the status of an "occurrence" of ore into a "prospect." The quality of information about the ore potential improved as mining was undertaken.[37] By 1900 the deepest shaft at Deloro had reached 122 m (400 feet).

One problem with relying on trenches was that chemical decomposition of ore could occur on the surface and give a false impression of the actual ore deposit. This was noted in a report prepared by a mining engineer, Thomas Couch, in February, 1880. He noted that partly free gold in the quartz (which was easy to refine) was found principally near the surface. At this point there had been atmospheric decomposition of the mispickel (which at the time was impossible to economically refine).[38]

A faster, more reliable, way of establishing the scale of an ore body was to take core samples by drilling. Apparently the first use of a diamond prospecting drill in Ontario occurred in 1873 at the Silver Islet Mine. However, core drills were expensive and were as a consequence not generally used in the province until the Ontario Bureau of Mines acquired one in the 1890s to loan out to prospectors. The first cores at Deloro were not drilled until 1900 when the Canadian Goldfields Limited used the provincial drill to do exploration work on their property.[39]

4.5 Mining

4.5.1 Shafts and Levels

The Deloro mines were developed in the normal manner for hard rock mines. Shafts were sunk through the ore bearing veins. Because of the slope of the veins, the shafts were on inclines of 40-50° instead of vertical. At specified depths, levels or drifts were driven from the shaft to follow the vein. At appropriate locations the level was excavated upwards through the vein to remove the ore and leave an underground void known as a stope. After the ore was removed, the stopes were backfilled with waste rock. By 1881 Canada Consolidated was working seven shafts to depths of roughly 40 to 110 feet (12 to 33.5m). In addition two 40 foot (12.2m) levels were driven from the shafts. Three of the shafts were named as the Tuttle, the A Shaft, and the Deep Shaft.[40]

Effectively all of the mining was done through shafts. The main operation was at the Deep (Gatling) and Tuttle Shafts. A hoist house was built between these shafts and rope drives to the shafts to hoist ore to the surface. Since the shafts were driven on an angle to follow the dip of the vein, the ore appears to have been hauled up in skip cars that ran on rails in the shaft. Separate man ways and pump ways were constructed that where independent of the hoist shafts.[41]

Apparently the only mining tunnel on the property driven horizontally into a hillside, was a 50 foot adit northeast of the Cook Mine main shaft (Plate 3).[42]

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[37] *Canada Consolidated* 1880; 1881; Morris Zaslow, *Reading the Rocks* p.36; p.27

[38] *Canada Consolidated* 1880

[39] OBM 1900; Newell, Dianne, "Technological Change," UWO, 1981 p.29

[40] Rothwell, 1881OBM 1899, 1901 Kierkgaard, CMR 20:1901 p. 50-3

[41] *Canada Consolidated* 1881, 1883

[42] MOE, Deloro Mine Workings Closure Plan by J.D.C. Dupont, 1994

The shafts and levels were lined with heavy timbers to prevent rock falls. However, as previously discussed, there were almost no historic references to timbering. The Ontario Bureau of Mines noted in 1898/99 that the timbers throughout the mine were in good condition. In some cases the character of the walls were such that little timbering was necessary. In the older upper portions of the mine, the rock had been weakened by weathering. At these locations the stopes were filled with rock waste and the timber removed.[43]

The mines had to be ventilated to prevent gas build-ups and reduce dust. Air movement could be achieved by natural circulation or mechanical fans, but again, there are virtually no historic references. The Ontario Bureau of Mines noted in 1898/99 that the ventilation was considered unusually good, although the method was not mentioned. In the 1890s Canadian Goldfields was using Shaft A to handle materials (timbers, mining equipment, etc.) and for mine ventilation. The Pearce Mine was the only mine identified to have a mechanical fan for ventilation.[44]

4.5.2 Drilling

Until the development of the steam powered drill, all mining was done with hand drills. By 1851 a steam powered machine drill had been developed in the United States. Initially steam drills were only used on the surface as it was considered too difficult and potentially dangerous to use underground. But the benefit of such drills was such that they were soon employed underground. The next development was to use compressed air which was first used on a rock drill in Switzerland in 1861. Early machine drills tended to be too bulky for small operations and they were often too complex to be used by unskilled labour. This too quickly changed.[45]

Apparently until Canada Consolidated became active, mining was done with hand drills. A mining engineer working for the company in 1880, Thomas Couch, recommended that rock drills be used due to the hard stone associated with sinking shafts. He believed it would be possible to sink a 10 x 5 foot shaft at one foot a day with drilling machines.[46]

Canada Consolidated was an early adopter of compressed air drills when it installed its plant in the early 1880s. Pipes for carrying air to the different shafts were laid on the ground between the compressor and mines. The compressor had sufficient capacity to operate 12 drills. Similarly the Atlas Arsenic Company used an extensive compressed air system that operated drills at both its Pearce Mine and Five Acres Mine – about 500m apart – using a compressor plant at the Five Acres property.[47]

Conversely Canadian Goldfields used steam drills at the end of the century and switched to compressed air only about 1902. The Cook Mine of the Cook Land Company also used steam drills.[48]

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[43] OBM 1898, 1899; Kirkegaard, “Auriferous Mispickel Ores,” 1901

[44] *Canada Consolidated 1881;* OBM 1897 1898, 1899, 1908

[45] Newell, Dianne, “Technological Change,” UWO, 1981 p.30-32

[46] Rothwell *Report Canada Consolidated Gold Mining Company* 1880

[47] Canada Consolidated, *Report of Progress* 1881; OBM 1902

[48] OBM 1896, 1897, 1902

4.5.3 Blasting

Rock blasting was initially undertaken with black powder. By the 1870s nitro-glycerine had been perfected as a safe explosive for mining. An explosive plant had been built at Kingston about 1876.[49]

A powder magazine had been built on the Gatling property in the 1870s. Its design is similar to that of other surviving magazines in Ontario of the era.

By the end of the 19th century, the general practice in Ontario was to keep a one day supply of explosives underground in a locked room and away from the active mining areas. Due to the tentative character of the mining in the past, the Ontario Bureau of Mines had not objected to the location of above ground explosives magazines. However, the Canadian Goldfields operation had grown to the point that the stone magazine was considered dangerously close to the mine and surface plant.

The company was ordered to build a new magazine of lighter construction than the old stone one and to be located at least 400 feet (roughly 120m) away from any works or road. The new magazine was built of wood, was well ventilated, and had sand filling the hollow wall space. It was erected 200m from the arsenic works and about 300m south of the mill.[50] This would place it roughly in the position of the feature identified today as an incinerator.

The only other reference to a magazine was the Atlas Arsenic Company dynamite magazine located 400 feet (roughly 120m) southeast of the mill.[51]

4.5.4 Drainage

Flooding of the Deloro Mines was an ongoing problem. In 1884 the Canada Consolidated Gold Mine flooded causing the work to shut down. In 1896 Canadian Goldfields spent a considerable amount of time pumping out the mine. The company maintained four pumps of which two were in operation and two kept for emergencies. By 1900, the Tuttle Shaft was used for pumping water out of the mine and was not for active mining.[52]

The normal method of pumping by direct acting steam pumps was considered too slow and costly for the in-flow at Deloro. Thus in about 1900, the Canadian Goldfields installed a compressed air operated pumping system known as the Harris Air Lift. The mine manager, Kierkgaard, decided to use the Harris system because no machinery was required in the mine. The risk of using the system was that it was much more expensive than other pumping systems and it was unproven in a high lift mining installation. The minimum capacity had been 300,000 gallons per day and a maximum of 650,000 gallons.[53]

[49] Newell, Dianne, “Technological Change,” UWO, 1981 p.34

[50] OBM 1898, 1899, 1900

[51] OBM 1899

[52] *Canada Consolidated 1881*OBM 1896, 1897, 1898, 1900; Deloro Mining” CMJ 1:17, 1907 517-22

[53] Kierkgaard, “Harris System,” ***JCMI?*** p. 265–73

A heavy flow of water through the foot wall of the fifth level was apparently a major problem. It was kept under control by two pumps located on the fifth level and a third one on the fourth. They raised the water to a well in the Tuttle Shaft where the air lift moved it to the surface.[54] The heavy flow of 1902 was apparently too great even for this system and the mine flooded, shutting down all future mining onsite.

4.6 Crushing and Milling

Most ores must be milled to a fine dust or powder prior to any subsequent processing. Throughout the 19th century this fine crushing was done with stamp mills. This type of mill was in use by 1700 in Europe. The first such mills were first used in North America during the California Gold Rush.

The stamps consisted of cast iron shoes attached to rods or "lifters" and typically weighed between 600 and 900 pounds. The lift of the shoe could vary from 10 to 45 cm and the number of blows from 30 to over 100 per minute. The shoe dropped into a mortar in which the ore was pulverized. In cross section, mortars resembled a trough. Ore was fed into a slot at the back and the crushed ore exited through a screen in the front of the mortar.[55]

Generally the ore, as it came from the mine, had to be crushed to a size that would fit into the mortar. This could be done by hand, or more commonly by a jaw crusher. The preferred design after the 1850s was the Blake Crusher.[56] Another type of mill was known as a grizzly.

Due to their simplicity of construction and operation, stamp mills were well adapted to operations that were remote from railway facilities. Their comparative cheapness made them attractive where the operation was temporary or capital limited. Stamps were usually arranged in batteries of five each that worked on a common, heavy, cast iron mortar. Few permanent stamp mills were comprised of less than ten stamps. The number of stamps at mills was typically increased in multiples of ten. The batteries were set up in pairs with the middle battery post common to the frames of both stamps.[57] Ten stamp mills were the normal size in north Hastings County. Only the Canadian Goldfields and the Belmont mines had larger stamp batteries.[58]

Although stamp mills were being used in the gold fields of Hastings County, Canada Consolidated chose to use Cornish rollers. As the name implies, these mills consisted of pairs of rollers through which the rock was crushed. Depending on the size of the rolls and their spacing, Cornish rollers could carry out all of the functions from coarse crushing from the mine through to the fine crushing needed for subsequent processing.[59]

[54] OBM 1902

[55] Gold." *Encyclopaedia Britannica* 11th Edition, 1910 Volume 12; International Correspondence School. *Textbook on Metal Mining* 1899

[56] Newell, Dianne, "Technological Change," UWO, 1981 p.36

[57] International Correspondence School. *Textbook on Metal Mining* 1899 p.18, 24

[58] *CMR* 28:1907, 60-1

[59] International Correspondence School. *Textbook on Metal Mining* 1899 Section 43, p.8-9) (Rothwell, 1883

When Canadian Goldfields reopened the Deloro mine in 1898 it constructed a ten stamp mill about 250m from the Gatling Mine. Primary crushing was done at the mine head and the crushed ore was hauled in small cars over a tramway to the stamp mill. The mill was doubled in size to 20 stamps in 1901. At the same time, the Atlas Arsenic Company had a ten stamp mill on the Five Acre Property.[60]

Later, after mining ceased and ore was brought in from Cobalt, the Deloro Mining and Reduction Company used a combination of a Blake crusher, high-speed rollers and a ball mill.[61]

4.7 Ore Refining

4.7.1 Gold

The time honoured method of refining gold was by means of mercury amalgamation, sometimes called raw amalgamation. The method worked for free gold but not on the mispickel ores of Deloro. The earliest efforts were successful because free gold was found in the shallow, weathered surface deposits. However, miners noticed that the ore became “refractory” when the water table was reached.[62] Mercury amalgamation would recover some gold from mispickel ore, but not in economic quantities. Thus from 1872 until 1896, when the first practical technology was developed, miners and metallurgists looked for ways of separating the gold from the arsenic.

Dean/ Williams (1872)

The mine operator Williams quickly discovered that the quartz mispickel ore needed to be roasted before it could be milled. The concept of ore roasting had only been recently introduced to the United States from Europe. It was being applied to ores used in the American west. Williams calcined his ore in an open kiln with a capacity of 40 tons. This probably was very similar to the ordinary lime kilns in use at the time. The ore took four days to calcine properly. Prior to the construction of the kiln, ore had been taken to the mill directly. The refining produced about $10 of gold per ton.[63]

During the winter of 1871-72 Williams replaced the open kiln with a revolving cylinder furnace that had been built and patented by the Mine Manager J.H. Dunstan. Basically the ore came from the stamps as a wet slurry. It was spread out in a drying pan and raked slowly forwards to a hopper in which it then passed into the cylinder. The cylinder rotated at five revolutions per minute and took about 20 revolutions to descend through the chamber. Apparently the innovative part of this design was a trough at the end of the cylinder which collected the roasted ore and carried it to the amalgamating pans. Vennor commented that the furnace had been in operation for far too short a time to determine if it was successful.

[60] Kierkgaard, *CMR* 20:1901 p. 50-3; Miller, *JCMI* 1902, Vol 5 p. 333; OBM 1901

[61] CDM *Mining and Metallurgical Industries 1907-8*

[62] Wells, JCMI 1897, Vol 2, p. 127–33; Canada Consolidated, 1881

[63] Newell, Dianne, “Technological Change,” UWO, 1981 p.148-149 ; “Vennor “Progress report” GSC, *Report of Progress for 1871-1872*

He did note that it had some defects and would require some very important alterations. Nevertheless he thought the concept was a trial that was leading in the right direction. Up to that time Williams had been getting $9 to $11 per ton of gold. After the furnace was in operation he was extracting $18 per ton.[64]

Chapman (1873)

E.J. Chapman was a Professor at the University of Toronto who studied the mispickel ores over a number of years and provided consulting services to a number of mine operations. In 1873 he obtained a patent for the refining of the ore. Apparently his work encouraged much of the mining work in the 1870s; however, the process was never a commercial success.[65]

Mears (Chlorination) Process (c.1880)

The Canada Consolidated Company attempted to treat the ores with a barrel chlorination process. The process is described in detail by Rothwell (1883) and consisted of the following steps:

- Crushing
- Concentrating
- Roasting
- Condensing and collecting arsenic fumes
- Chlorination of roasted concentrates
- Precipitation and melting of gold

The chlorination stage was the distinct part of the process. The roasted concentrates were chlorinated in one ton charges in a revolving lead-lined iron cylinder. The chlorine was produced at the mine from lime chloride and sulphuric acid. The operation lasted about two hours. The gold chloride was precipitated through charcoal. Apparently the charcoal was then shipped to North Carolina to be burned and extract the gold. Rothwell stated that the Mears Process could extract 93 to 98 percent of the gold.[66]

Rothwell down-played the experimental nature of the work he was doing. His description of the process indicated that he had to add a second roasting cylinder and that high grade ore was essential. Apparently the best was achieved by using handpicked ore. He also made the comment that after 47 tons of ore had been processed, the concentrating machinery froze up. After that un-concentrated ore had to be roasted.[67] The method was an utter failure.

[64] "Vennor "Progress report" GSC, *Report of Progress for 1871-1872;* Newell, Dianne, "Technological Change," UWO, 1981 p.151

[65] See patents #s 2015 (January 29, 1873) and #2026 (February 3, 1873) in the Newell thesis p. 66

[66] Canada Consolidated, 1883

[67] Canada Consolidated, 1883

Walker-Carter (Chlorination) Process (1892-94)

From 1892 until 1894 the Hastings Mining and Reduction Company experimented in a new chlorination process called the Walker-Carter process developed by an American named Bancroft. The company treated pulverized and roasted ore with mercury vapour which was then condensed and passed over copper and silver plates to catch the amalgam. The process was experimentally successful but had too many working parts and the plant closed.[68]

Sulman and Teed (Bromo-Cyanide) Process (1896)

This system finally provided an economic means of separating the gold from the arsenic. The process was invented and patented by Sulman and Teed and Canadian Goldfields acquired the sole right to the patents for Ontario in 1896.

In the first step ore was crushed with gravity stamps and most gold was extracted by mercury amalgamation. The residual "pulp" then flowed into concentrators and was treated by the Bromo-Cyanide process. Between amalgamation and this process 85 to 90 percent of the gold value was retrieved.[69] The mine manager, Kirkegaard described the Sulman-Teed process as a "double concentrating process" that was essential for the mispickel ores as no single process would work to produce clean tails.[70]

4.7.2 Arsenic

Arsenic was recovered by roasting the ore after the mercury amalgamation process. In the case of the Sulman and Teed process, roasting was done after the gold had been extracted by amalgamation and the Bromo-Cyanide treatment.[71] The process later used by Deloro Smelting for the cobalt ores roasted the ore first to drive off the arsenic and then extract the silver, cobalt and nickel. In either case, arsenic was vapourized by heating and then condensed as crude arsenic in special chambers. The material was then vapourized again in an excess of air to produce white arsenic.[72]

Arsenic was packed in kegs for shipment. Given the toxicity of the product the keg exteriors were cleaned after filling and clearly labelled.[73]

[68] OBM 1893, 1894; Wells, "Mispickel Gold Ores,", *JCMI* 1897, Vol 2, p. 127–33

[69] "Gold and Arsenic," Canadian Mining Review, 1901; Wright, "Auriferous Mispickel Ores," 1901

[70] Kierkgaard, *CMR* 20:1901 p. 50-3; Kirkegaard, "Auriferous Mispickel Ores," 1901

[71] "Gold and Arsenic," *Canadian Mining Review*, 1901

[72] Canada. *Arsenic Bearing Deposits* 1927 p.2

[73] "Bounty wanted for Arsenic Refining," *CMR* 20:1901 274–75; "Gold Mining in Ontario," OBM 1899, 1900; *CMR* 15: 1896, p. 29; Kierkgaard, *CMR* 20:1901 p. 50-3

4.7.3 Cobalt

The cobalt ore refined at Deloro actually contained a variety of important metals including silver, cobalt, nickel, and arsenic. When the Deloro Mining and Reduction Company plant was first erected the products were limited to silver, refined arsenic and mixed oxides. By 1918 the company was producing refined silver, cobalt oxide and metal, nickel oxide and metal, and arsenic. Over time the company also manufactured a variety of arsenic compounds and a high-strength, cobalt-chromium-tungsten alloy known as Stellite.[74]

The arsenical ores from Cobalt had an arsenic concentration of about 16 percent which required smelting in a blast furnace (Plate 4). The ore received by rail was crushed in a ball mill and mixed with fluxes and charged into the blast furnace. Coke was used as a fuel and local limestone was the flux. Occasionally a little scrap iron was added. The blast furnace process produced metallic silver, a speiss cobalt, nickel, copper and some iron, a slag containing lime, magnesia and iron, and flue dust which contained particles of ore, arsenious oxide and coke dust. The speiss was re-crushed and roasted in a coal or oil fired furnace and then conveyed to chlorinating furnaces. The resulting chlorinated speiss was charged into agitating tanks where the silver was extracted by sodium cyanide. The residue from the cyanide treatment was given further treatment to separate by precipitation the cobalt and nickel.[75]

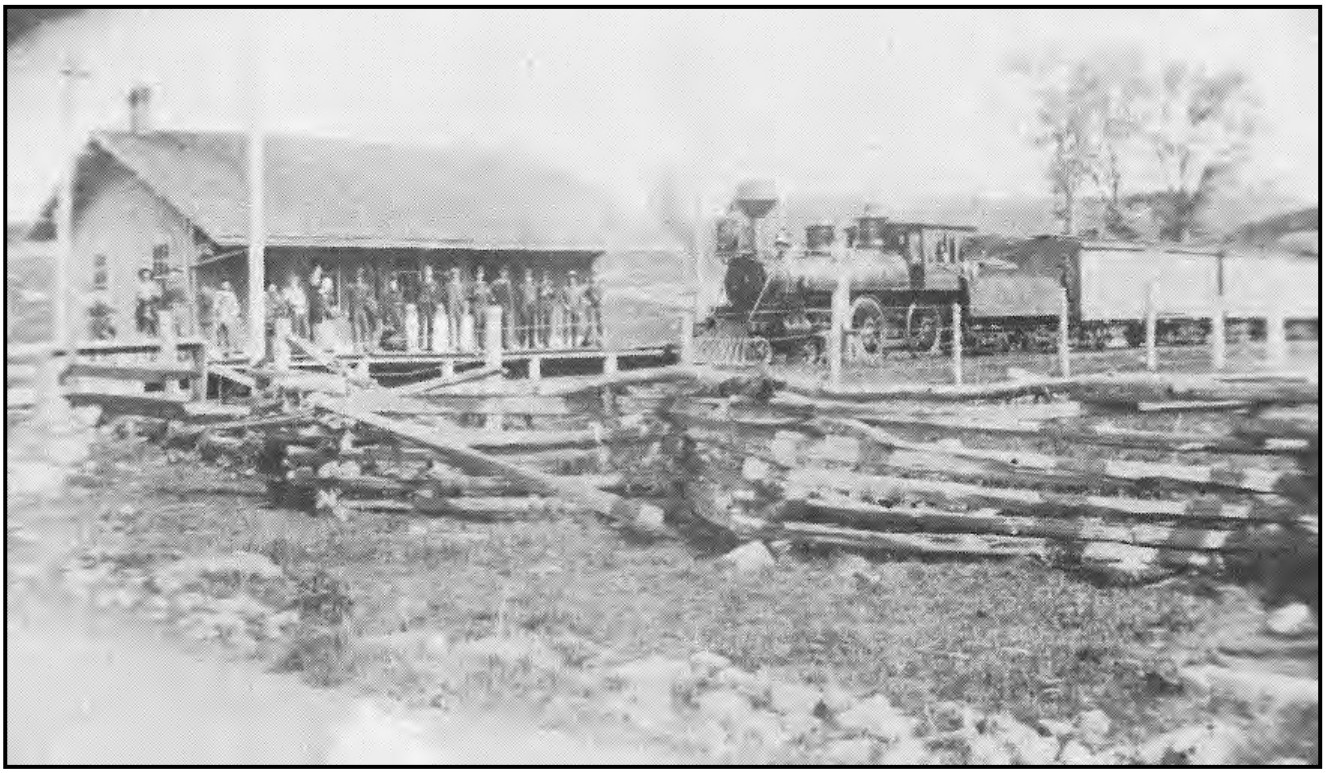

Plate 1: Marmora Station, 1880s. Plomer, Desperate Venture.

[74] OBM, *Annual Report* 1918 Vol 27, Part 3, *Cobalt*, p.38-39)

[75] OBM, *Annual Report* 1918 Vol 27, Part 3, *Cobalt*, p.33, 38-39

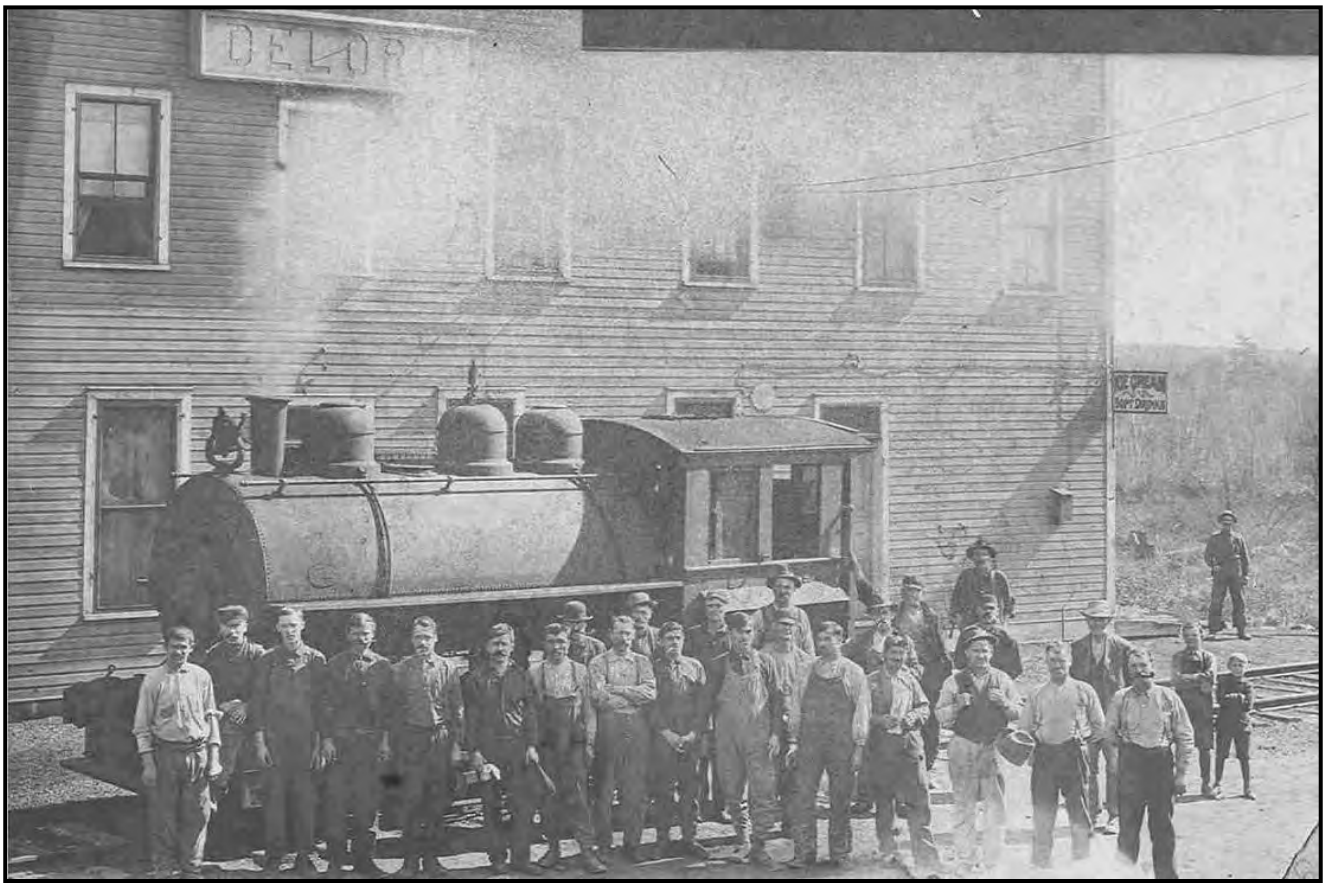

Plate 2: Locomotive at Deloro, c.1920. One of the two locomotives has been preserved.

Plate 3: Iron mining at Marmora c.1880 illustrating an adit. Steam engine hoist over mine shaft; two iron pipes on left for compressed air or steam for drills, tramway track on right with bucket for ore. Picturesque Canada

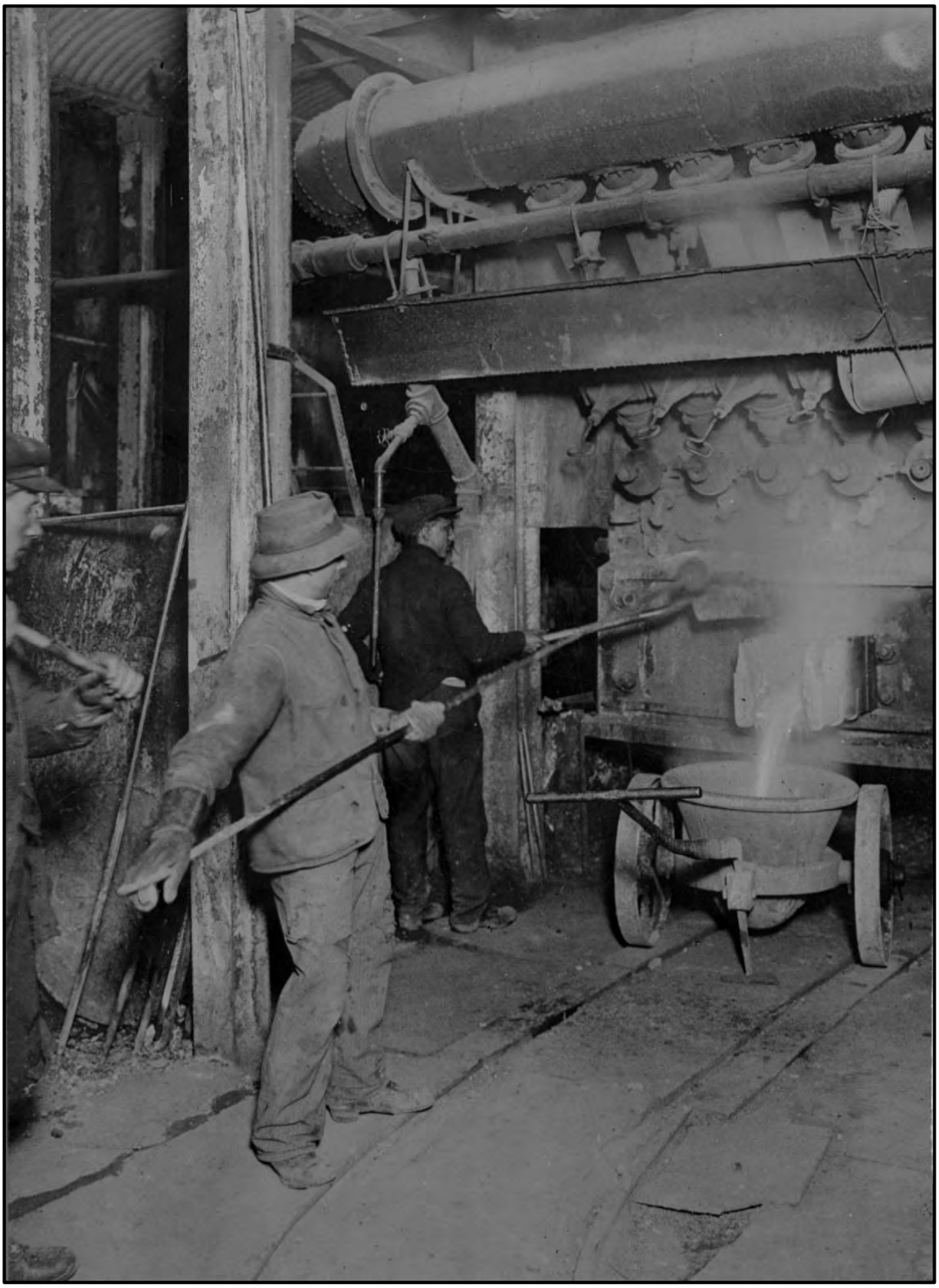

Plate 4: Tapping the blast furnace, Deloro 1908. Courtesy Deloro Stellite (C. R. Wittemore)/67. Negative by Lumbers.

5.0 DISCOVERY 1860s/1870s

5.1 The Gold Rush

When the Geological Survey of Canada published the *Geology of Canada* in 1863, the book became the authority on the geology of Canada. No further major reconnaissance surveys were made in the immediate years after its publication. Instead there was a shift to determine the location of economic minerals and ore deposits. During 1865, one of the Survey's geologists, Thomas MacFarlane, was sent to the Hastings District to investigate iron and other metallic minerals in the area. The field work was triggered by a petition to the government to offer a large land grant for the construction of a railway into the District.[76]

In August 1866 gold was discovered by "a man named Powell, and an old Dutch miner" on the eastern part of the J. Richardson farm on Lot 18, Concession 5, Madoc Township, near Bannockburn. The Richardson discovery was quickly followed by other prospectors in the surrounding townships. Later that year, another Survey geologist, Henry Vennor was sent to report on the gold fields. He continued to work in the area for two more years. The gold rush was short. As Vennor noted in 1871 "the feverish excitement which pervaded this district in 1868, has entirely subsided, and is now replaced by steady working in some three or four localities."[77] By 1871 seven gold sites from the rush, all of them in the Moira River Valley in Marmora Township, were being steadily worked.

5.2 The Mines

Seven mine sites were opened along the Moira River in and around the future Deloro Mine Site (Figure 4).

5.2.1 Dean (Cooke) and Williams

In the early 1870s the Cooke Mine was the most developed operation in the gold field. It was more popularly known as the Dean and Williams mine. The Cooke or Williams mine was located in the southwest corner of Lot 7 Concession 9. This was near the modern intersection of Highway 7 and Young's Creek at the south end of the Deloro Mine Site. The mine was owned by the Cooke brothers of Toronto and superintended by J.D.R. Williams, MD. It had come into operation in 1869. A shaft six feet by ten feet (1.8m by 3m) had been sunk to a depth of 70 feet (roughly 21m). Approximately 90 feet (roughly 25m) of levels had been driven off from either side of the shaft. A large quantity of ore had been raised but was lying on the ground awaiting treatment.

Up to the winter of 1872 the work being carried on had been chiefly experimental. A five stamp mill worked by a 15 horsepower engine had been acquired from another mine. The mill was erected a short distance from the shaft, close to the Moira River, on Lot 6 Concession 8 where the Gillen Mine was located. About 35 men were employed at the mill and shaft.[78]

[76] Zaslow, *Reading the Rocks* p.89-90

[77] "Vennor "Progress report" GSC, *Report of Progress for 1871-1872* p.132

[78] "Vennor "Progress report" GSC, *Report of Progress for 1871-1872* 133-6; RC, 1890 p. 28Newell, Dianne, "Technological Change," UWO, 1981 p.148-149

In February 1871 Williams made an arrangement to test a newly patented "Forbes Automatic Steam Quartz Crusher" as a replacement to his stamp mill. The inventor warranted that with two stamps and a five horsepower engine it could do the work of an ordinary mill of twenty stamps using 25 horsepower. After a very short trial it was abandoned as being quite unsuitable and Williams purchased 15 more stamps and a 50 horsepower engine. At the same time he made preparations for erecting a suitable reverberatory furnace for roasting the mispickel ore.[79] About 1901-05, the mine site was redeveloped by the Cook Land Company (See Section 7.3.2).

5.2.2 Gillen (Campbell-Bloomfield) Mine

The Gillen Mine was situated on the northeast corner of Lot 6 Concession 8. It was about 500m southwest of the Williams shaft (Figure 4). In 1870 a five stamp mill worked by water power was installed. The mine was apparently operated by William Gilbert. Initially he was able to get $5 to $9 per ton but the Dean and Williams mine manager, Dunstan, was able to obtain $20 per ton in some additional tests. Shortly afterwards the dam broke and the work was suspended at this location. [80]

In 1871 Andrew White raised 100 tons of ore from the mine and had it tested at the Dean and Williams mill. An opening was made in the vein about 50 feet long and 5 or 6 feet wide (roughly 15m long and 1.6m or 1.8m wide). It was of irregular depth and the lowest point reached was about 20 feet (roughly 6m).[81]

A.H. Campbell of Toronto and C.J. Bloomfield of Lakefield, Ontario, purchased the property in 1871 on the basis of a favourable report from Professor Chapman. By 1900 it was known as the Campbell-Bloomfield property. In 1901 the vein was rediscovered and two shafts sunk to 12 feet and 60 feet (3.6m and 18.3m, respectively). At some point six acres which included the mine site of the southeast corner were sold to the Toronto Mining Company (See Section 7.3.3).[82]

5.2.3 Severn Mine

The Severn Mine was located between the 8th and 9th Concession at about Lot 8. At the time of Vennor's visit a shaft had been sunk to a depth of about 15 feet (roughly 4.5m). During the winter of 1870 about 300 tons of ore had been put through a small stamp mill. [83] The property later became part of the Atlas Arsenic Company (See Section 7.3.1).

[79] Vennor "Progress report" GSC, *Report of Progress for 1871-1872;* Newell, Dianne, "Technological Change," UWO, 1981 p.148-149

[80] Vennor "Progress report" GSC, *Report of Progress for 1871-1872.*

[81] Vennor "Progress report" GSC, *Report of Progress for 1871-1872.*

[82] Snell, , Mines and Mining; CDM, *Gold Occurrences*, 1936, 115

[83] Vennor "Progress report" GSC, *Report of Progress for 1871-1872.*

5.2.4 Gatling Mine

One of the most notable attempts at gold mining in the township of Marmora was at the Gatling Mine. Assays of different samples of this ore gave the mine a value of $39.47 of gold per ton of ore. Despite this value the gold was difficult to separate from the mispickel.[84]

The Gatling Mine was located in the northeast corner of Lot 9 Concession 8. The #1 shaft had been sunk to a depth of 68 feet (20.7m) while the #2 shaft (25m away) had reached a depth of 64 feet (19.5m). The #3 shaft, about 90m west, had been sunk to a depth of 20 feet (roughly 6m). About 2,000 tons of ore had been raised from these three shafts. Most of the ore lay on the ground awaiting treatment. Two barrels of samples (1,700 lbs) had been sent to an assay firm in Newark, New Jersey. The tests produced gold at $28 to $30 per ton.[85]

By the 1870s over six acres of land had been cleared on the Gatling property. A number of substantial and neat frame buildings were built in proximity to the shafts. These included a dwelling house, a boarding house for 30 workmen, a workshop, stable, carriage house and a smith's forge. A good road was also constructed connecting the main travelled road between Madoc and Marmora. Plans were underway for the construction of a twenty stamp mill and roasting furnace (Figure 5, Plate 5). [86] The property included four principal mine shafts.

Deep Shaft

The Deep Shaft was the most productive mine on the property. It was sunk to about 70 feet (roughly 20m).[87]

Neill's Mine

Neill's Mine was situated on the west half of Lot 14 Concession 10. In 1870-71 an opening was made on the property by Mr. Neill, or O'Neil, who was a partner of Gatling.[88]

Tuttle Shaft

At the time of the investigation of the Gatling Mine by Canada Consolidated in 1880, the Tuttle Shaft was 38 feet deep (roughly 11.5m). The first 30 feet were sunk vertically and constructed about nine feet square (roughly 9m and 2.5m square, respectively). This part of the shaft was all within the ore. At that depth the probable foot wall was struck with a westerly dip of about 60°. The shaft angle was then changed to follow the dip of the vein. At the bottom of the shaft, water was struck and it rose to within five feet (1.5m) of the surface. This was about seven feet (2.1m) above the water in the river.[89]

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[84] GSC, Vennor, 1869, p.165; Royal Commission, 1890 p. 27-28

[85] "Vennor "Progress report" GSC, *Report of Progress for 1871-1872*

[86] "Vennor "Progress report" GSC, *Report of Progress for 1871-1872*

[87] *Canada Consolidated* 1880

[88] "Vennor "Progress report" GSC, *Report of Progress for 1871-1872*

[89] *Canada Consolidated* 1880

5.2.5 Other Mines

Also associated with the principal mining operations outlined above were three other mines.

Hawkeye Mine

The Hawkeye Mine was located on the east quarter of Lot 10 Concession 8. It was about 500m north of the Gatling Mine. Two shafts were sunk by Mr. Jones of Iowa. One shaft was 46 feet and the other 30 feet (roughly 14m and 9.1m, respectively). By 1871 a considerable amount of ore has been raised but not yet milled.[90]

South Hawkeye Shaft

By 1880 the South Hawkeye Shaft was about 25 feet deep (roughly 7.6m). It contained very large dumps which seemed to suggest that ore had been raised to the surface but not hauled away.[91]

Powell Mine

The Powell Mine was located about 800m northeast of the Neill mine. It was located in the west half of Lot 17 Concession 11. Some work has continued on this property over the years since 1867. A shaft 50 feet deep (roughly 15m) was sunk on the property. Mr. Jenkins was the Superintendent of the work. A temporary five stamp mill, powered by a 20 horsepower engine was constructed. The ore was roasted in a small furnace. About seven or eight men were employed at the mine.[92]

5.3 Inventory 2011

Extant features and/or buildings associated with this era identified in the study are outlined below.

5.3.1 Magazine

The former powder magazine ruin is on top of a low ridge just to the west of the former Gatling Mine (Plates 5 and 6). On the north side of the building are remnants of a light, timber frame of unknown function.

The Commonwealth report describes the powder magazine as in “fair to good condition”. The change between 1987 and 2011 illustrates the continual deterioration of the structure.

The ERA Conservation Report concluded that the masonry structure is in poor condition. It has deteriorated largely as a result of the removal of the lead roof more than 20 years earlier.

[90] “Vennor “Progress report” GSC, *Report of Progress for 1871-1872*

[91] *Canada Consolidated* 1880

[92] “Vennor “Progress report” GSC, *Report of Progress for 1871-1872*

Nonetheless, ERA recommended that the structure be retained, repaired, and protected as it contributes substantially to the narrative of Deloro and represents 19th century construction on the site. See Appendix A for further details.

Table 2: Magazine Cultural Heritage Evaluation

Evaluation of Cultural Heritage Value or Interest According to Ontario Regulation 10/06:	
Not determined to have 10/06 provincial cultural heritage value or interest	
Evaluation of Cultural Heritage Value or Interest According to Ontario Regulation 9/06:	
Design or Physical Value:	Rare survivor of industrial powder magazine
Historical or Associative Value:	Oldest surviving structure of mining at Deloro
Contextual Value:	Contributes to the mining landscape of property
Character Defining Elements: Heavy stone walls, location on top of ridge	

5.3.2 Powder House Vein

Figure 5 identifies a double line of small outcrops, about 100m long, known as the Powder House vein extending from the stone powder house, on top of the ridge, to the office building. By 1880, a few small holes had been sunk in the outcrops but not enough to determine their potential. They did not seem to have commercial value.[93] The area is illustrated in Plate 5.

Plate 7 identifies the character of the most prominent of the test trenches. The trench dips in a westerly direction. The walls are defined by the host rock and the mined out gold ore forms the void between the walls. Although adjacent to the remediated Gatling Shaft area, there is no evidence that this site has been impacted. Part of the trench is up to two metres deep. Of particular interest is that the dip of the ore vein is quite evident.

Table 3: Powder House Vein Cultural Heritage Evaluation

Evaluation of Cultural Heritage Value or Interest According to Ontario Regulation 10/06:	
Not determined to have 10/06 provincial cultural heritage value or interest	
Evaluation of Cultural Heritage Value or Interest According to Ontario Regulation 9/06:	
Design or Physical Value:	Dip and size of ore body evident in trench
Historical or Associative Value:	trench is associated with mine development in the 1870s and is oldest surviving feature of mining at Deloro
Contextual Value:	Contributes to mining landscape of property
Character Defining Elements: Void between trench walls; dip of walls	

[93] *Canada Consolidated* 1880

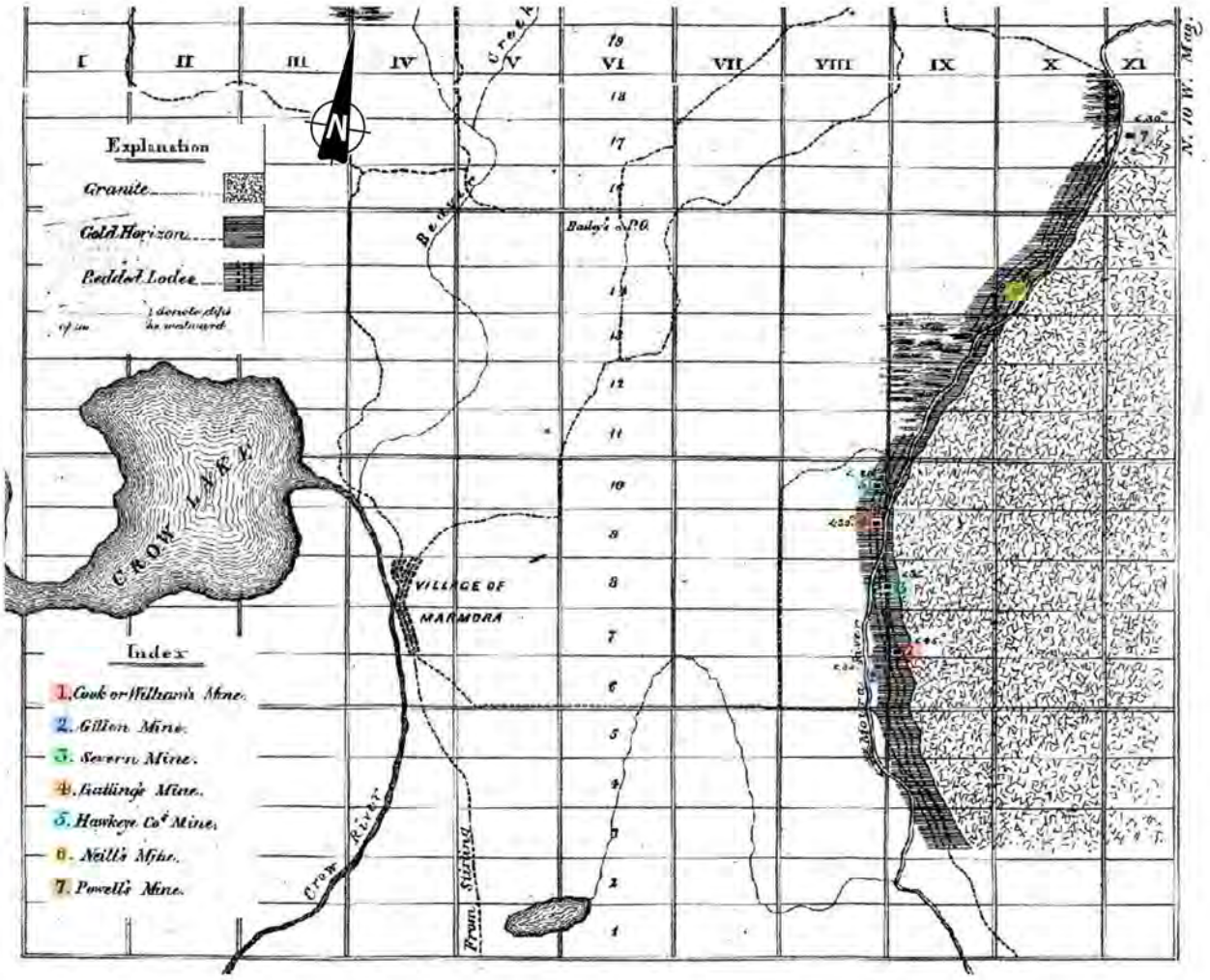
5.3.3 Gatling Mill Complex

Plate 5 and Figure 5 identify the mill building constructed by Gatling in the early 1870s. The Golder Archaeological Assessment (September 2011) investigated the condition of the site and identified three terraces. The site was visited as part of the cultural heritage resources assessment in July 2011 but the area was too obscured by vegetation to clearly define the extent of the feature.

About 1899 the Atlas Arsenic Company built a ten-stamp mill, known as the Five Acre Mill, in a similar location, and possibly somewhat further to the left of the Gatling Mill in Plate 5. It is possible that the Gatling Mill described here is actually the Five Acre Mill. Insufficient evidence was found to confirm or disprove the 1870s age of the mill ruin.

Table 4: Gatling Mill Complex Cultural Heritage Evaluation

Evaluation of Cultural Heritage Value or Interest According to Ontario Regulation 10/06:	
Not determined to have 10/06 provincial cultural heritage value or interest	
Evaluation of Cultural Heritage Value or Interest According to Ontario Regulation 9/06:	
Design or Physical Value:	Terraces are indicative of stamp mill floors; stone wall evidence of engine room
Historical or Associative Value:	Oldest surviving structure of mining at Deloro
Contextual Value:	Contributes to mining landscape of property
Character Defining Elements: Terraces cut into hillside, stone wall of engine room	



REFERENCE

DRAWING BASED ON CANADIAN GEOLOGICAL SURVEY OF CANADA. REPORT OF PROGRESS 1866-1869. "REPORT TO SIR WILLIAM LOGAN, 1869" BY HENRY VERNNOR.

NOTES

THIS DRAWING IS SCHEMATIC ONLY AND IS TO BE READ IN CONJUNCTION WITH ACCOMPANYING TEXT.

ALL LOCATIONS ARE APPROXIMATE.

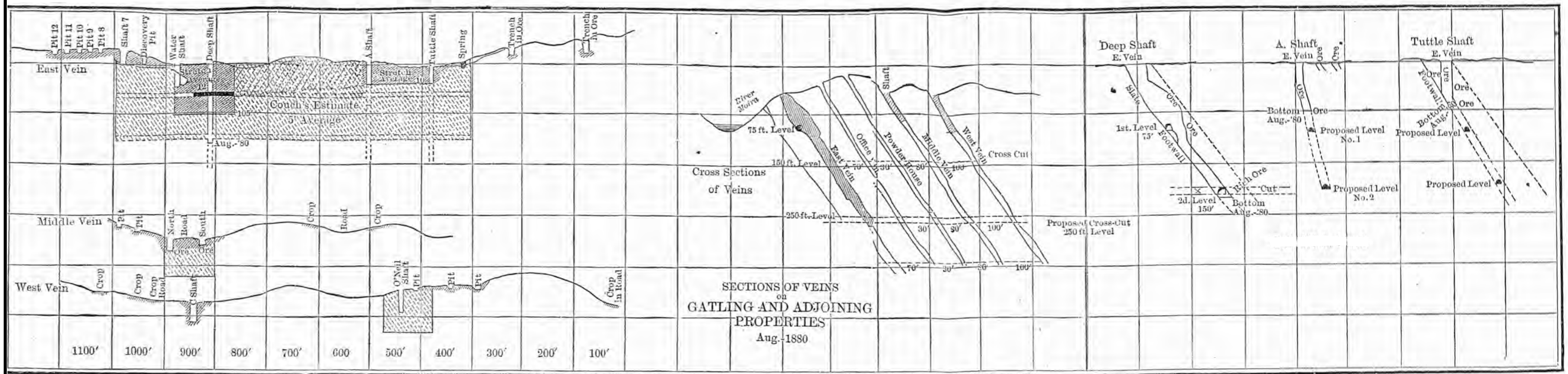
PROJECT: CULTURAL HERITAGE EVALUATION REPORT
DELORO MINE SITE
TOWNSHIP OF MARMORA AND LAKE
HASTING COUNTY, ONTARIO

TITLE: **MINES LOCATED IN THE TOWNSHIP OF MARMORA, 1871**

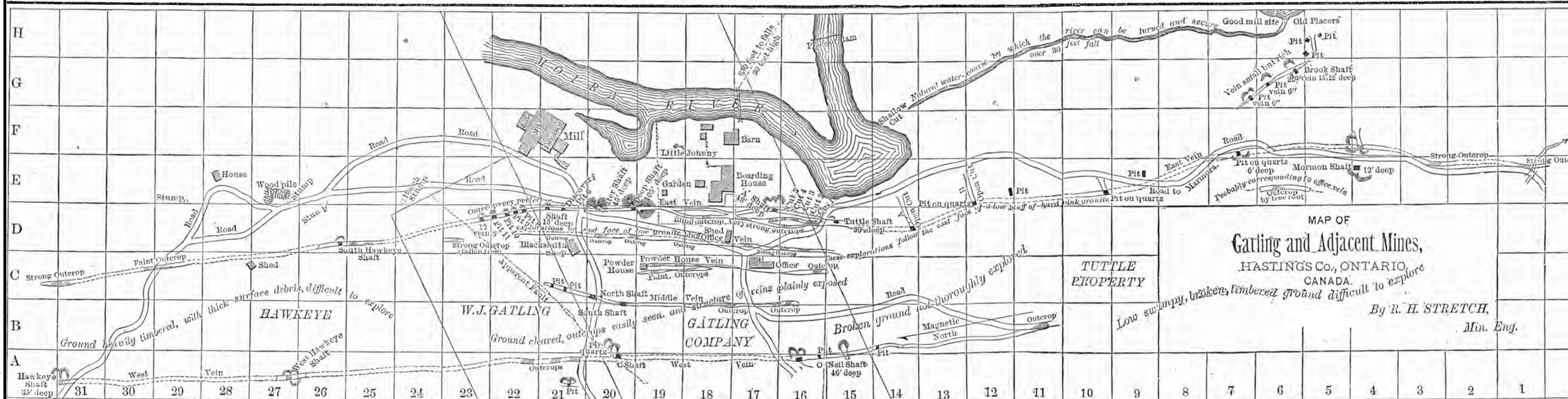
Golder Associates
LONDON, ONTARIO

PROJECT No. 11-1126-0037			FILE No. 1111260037-4000-R06001
			SCALE NTS REV.
CADD	DCH	Apr. 20/12	
CHECK			**FIGURE 4**

Drawing file: 1111260037-4000-R06001.dwg Apr 20, 2012 - 9:53am



11A : MINING VEINS OF THE GATLING AND ADJOINING PROPERTIES



11B : GATLING MINE SITE AND ADJACENT MINES

APPROXIMATE SCALE IN METRES
0 50 100m
1:2,500

REFERENCE

DRAWING BASED ON ROTHWELL, RICHARD P. 'THE GOLD-BEARING MISPICKEL VEINS OF MARMORA, ONTARIO, CANADA, TRANSACTIONS OF THE AMERICAN INSTITUTE OF MINING ENGINEERS, VOL. IX, 1881.

NOTES

THIS DRAWING IS SCHEMATIC ONLY AND IS TO BE READ IN CONJUNCTION WITH ACCOMPANYING TEXT.

NOTED UNITS ON PLAN ARE IMPERIAL.

ALL LOCATIONS ARE APPROXIMATE.

PROJECT

CULTURAL HERITAGE EVALUATION REPORT
DELORO MINE SITE
TOWNSHIP OF MARMORA AND LAKE
HASTING COUNTY, ONTARIO

TITLE

PLAN AND SECTION OF CANADA CONSOLIDATED GOLD MINE OPERATIONS 1880

Golder Associates
LONDON, ONTARIO

PROJECT No. 11-1126-0037		FILE No. 1111260037-4000-R06001	
		SCALE AS SHOWN	REV.
CADD	DCH	Apr. 20/12	
CHECK			FIGURE 5

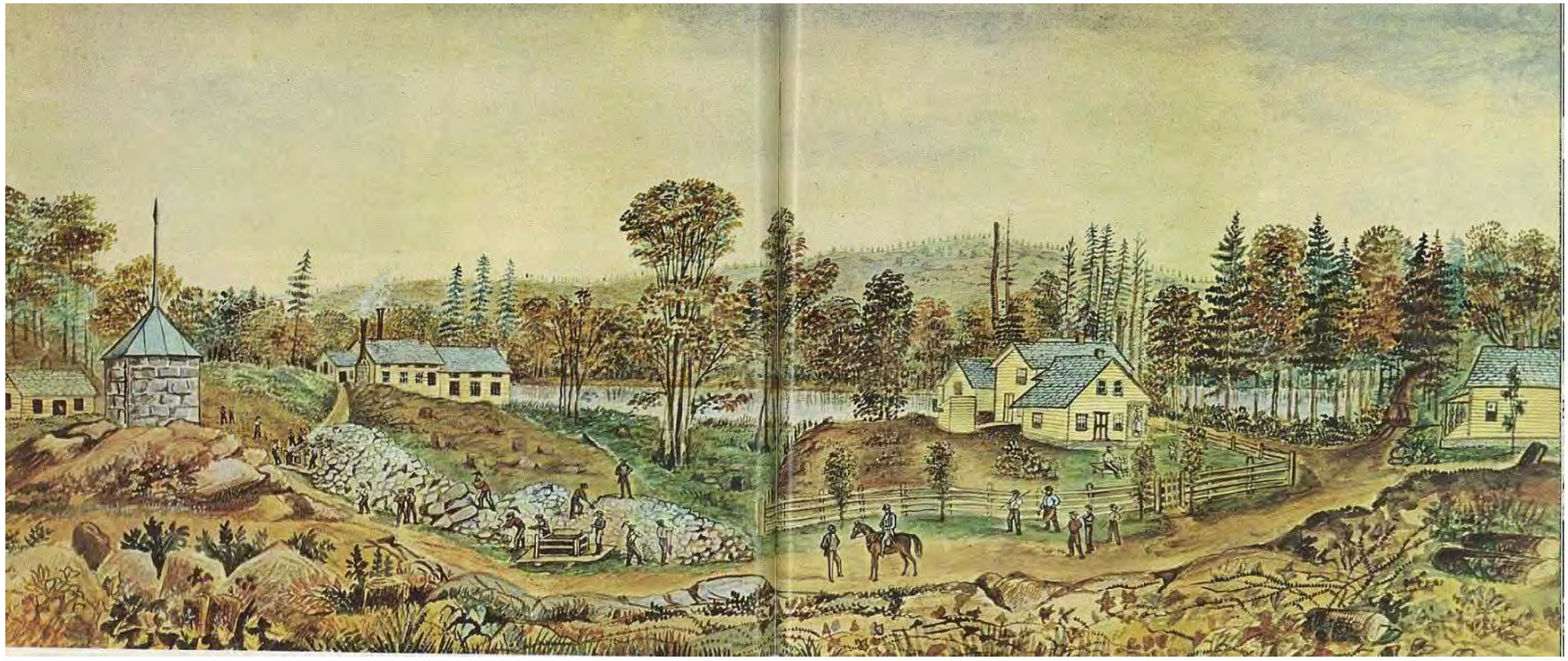


Plate 5: Gatling Mine c. From right to left: office, boarding house (barn behind), Deep Shaft (manual hoist), Water Shaft (manual hoist), Mill behind the Water Shaft, Powder house, blacksmith shop. In the foreground is the "Road to Marmora" and in the background is the Moira River with the pool at the bend in the river on the right. Source: Toronto Public Library; John Ross Robertson Collection

Plate 6: Powder House with entrance door facing former Gatling Mine

Plate 7: Powder House Vein located by the two trees in the vein in the foreground

6.0 CANADA CONSOLIDATED GOLD MINING COMPANY

6.1 The Company

Sometime around 1878/79, an American mining engineer named Richard Rothwell acquired options on the Gatling properties. In c.1880 he arranged for a group of New York capitalists to purchase the mining properties of J .M. Tuttle, R.P. Rothwell, Devine, Auger, and Christie, and the Gatling Gold and Silver Mining Company. The Canada Consolidated Gold Mining Company was incorporated in New York State with a capital stock of $300,000 and its head office in New York City.[94]

It is difficult to tell more than a century later if the prospectus for the Canada Consolidated Gold Mining Company was normal promotional hyperbola or something more. The 1880 *Report Canada Consolidated Gold Mining Company* is extremely glowing in the prospects. A major promoter of the company, Rothwell compared the Deloro finds to "the famous mines of Cornwall, Saxony, and other parts of the old world, where they have been worked with profit for 100 years." He also indicated that the potential yield of the property was more than double that of the Homestake Mine in the Black Hills of Dakota. This was followed with similar comments by the Canadian civil engineer, Walter Shanly, who also compared the Deloro operation to the Homestake Mine. He was honest enough to comment that the Homestake ore was free milling and readily amalgamated, while the Deloro ores had to be roasted at an additional cost. However he believed that the cost would be offset by the far greater value of the Deloro ore. Similar testimonials are found throughout the report.[95]

Rothwell noted that although sporadic attempts had been made to treat the ore since gold had been found in 1865, none of the operators had sufficient capital to put up suitable works to develop the mines. The proposal put forth by the Canada Consolidated was to acquire most of these smaller properties and thus make a commercially viable operation. The properties had been developed to such an extent that Rothwell placed their value beyond question.[96]

The land acquired by the company consisted of 850 acres that were described as containing some good farm land and being well timbered. The chief mineral wealth of the area consisted of the gold bearing quartz veins which ran through Lots 8, 9 and 10 of the 8th Concession. In addition to gold, Lot 27, Concession 3 contained a promising vein of galena. The lot also had a waterfall of 15 to 20 feet (4.5 to 6m) which could be used in concentrating the galena (lead) ore. The land was purchased from four different groups:[97]

- Gatling Gold and Silver Mining Company (six properties);
- General J.M. Tuttle (one 37½ acre lot);
- Devine, Auger and Christy properties; and
- Hawkeye Gold Mining Company (45 acres). This sale took longer; 1880 were under negotiation and the transfer occurred the following year.

[94] Report of Canada Consolidated, *Gold Mining Company*, 1881

[95] *Report Canada Consolidated Gold Mining Company* 1880

[96] *Report Canada Consolidated Gold Mining Company* 1880

[97] *Report Canada Consolidated Gold Mining Company* 1880, 1881

Those properties purchased covered all of the important mines. On Lot 5, Concession 9, just south of the Canada Consolidated properties, was a vein that had been worked only slightly. On Lots 4 and 5 of Concession 8 there were other small operations. The next significant mining district was at Malone, about six kilometres further up the river. This included the Feigle, the Gladstone and the Cameron mines.[98]

6.2 Assay

The value of the Canada Consolidated investment depended on the amount of mineable ore available and also on the value of gold in the ore. The value of the ore was determined by assays values expressed as the dollar value of gold per ton. Rothwell based his valuation on assays conducted over the previous eight years. In hindsight, the results were wildly optimistic. He noted that the Geological Survey of Canada conducted 20 assays with an average of $33.81 per ton of ore. Professor E.J. Chapman of University College, Toronto obtained two assays at $20.66 and $25.32, three between $60.26 and $73.50 and a remarkable $112.00 from a small sample of the Gatling mine. The most extensive tests were made under the direction of Rothwell over a four month period in 1880. He sampled 515 tons with an average assay of $18.65 per ton.[99]

Rothwell also used D.E.K. Stewart, who had leased the Feigle and Gladstone mines Malone in 1878, to provide an assay of the Gatling mine. Stewart tested 70 to 80 tons of ore and obtained a value of $14.00 of gold per ton ore.[100] With such a low value, it is perhaps not surprising that this information was not provided in the Canada Consolidated 1880 report.

Rothwell also does not seem to have accounted for the report by the mining engineer Thomas Couch, who noted that partly free gold in the quartz was found near the surface due to atmospheric decomposition of the mispickel.[101] Thus ore samples taken from shallow pits gave a higher assay value than those from deeper shafts.

On the basis of the assays, Rothwell determined an average assay value of $20.00. He then calculated the potential net value realizable from the ore reserves. He suggested that a prudently managed works, treating not less than 100 tons a day, could safely be estimated at having a net value of $500,000. If one included the improvements to the property through the mines, mills, houses, and development of water powers he gives the net value at more than $650,000. Finally he suggests that greater investigation of the reserves through one year of mining development would set the net value of at least one and one half million dollars.[102]

[98] Royal Commission on Mineral Resources 1890,p.110-111, 548

[99] *Canada Consolidated* 1880

[100] Royal Commission on Mineral Resources 1890,p.110-111, 548

[101] *Canada Consolidated 1880*

[102] *Canada Consolidated* 1880

In calculating the net profits, Rothwell stated that the assay value of the ore was $18.65 per ton. During treatment one would expect 9 to 20 percent of the gold to be lost. The cost of mining and milling was assumed as a conservative figure of $3.42 per ton (in 1883 the actual cost was $9.65 per ton). Therefore the net profit would be $11.50 per ton. On the assumption of 100 tons of ore a day, this would result in a net profit of $25,000 a month.[103]

6.3 Operations

In 1881 Canada Consolidated embarked on an ambitious mine development program that was as unrealistic as Rothwell's assay values and mining cost projections. Even as construction was underway, the signs of failure soon became apparent.

6.3.1 The Mines

The Gatling and Tuttle Mines were the most important mines on the property.

Gatling Shaft (Number One Shaft - Deep Shaft)

What became known as the Gatling Shaft was also known at various times as the "Number One Shaft" (original name), "Deep Shaft" (Canada Consolidated name), and the **"**Main Shaft" (Plate 8). The first two shafts were sunk in c.18661870 when the Number One shaft was taken to 68 feet (roughly 20m).[104]

Canada Consolidated focused most of its development work at Deloro on the Deep Shaft. The shaft had been sunk on an incline of 55° to follow the vein. During the winter of 1879-1880, before the company acquired ownership, the shaft was extended to 105 feet (32m). At the 70 foot (roughly 20m) level, tunnels were extended 46 feet to the north and 41 feet to the south (14m and 12.5m respectively). By the end of 1881 a total of four levels had been driven from the shaft and a separate man-way and pump-way completed adjacent to the hoist shaft to improve the efficiency of operation. Possibly because the supply of ore was far greater than the ability of the mill to process it, the Deep Shaft was not worked after July 1882. By then it had been opened to a depth of 170 feet (52m) and about 1,100 feet (335m) of shafts and levels had been constructed. The average thickness of the ore vein was eight feet (roughly 2.5m) and the proven reserve was sufficient to supply the present works for several years.[105]

Hoisting for both the Deep Shaft and the Tuttle Shaft was undertaken from a single hoist house located between the two shafts. The large stone building contained two steam engines so that the shafts could be operated independently. (Figure 8, Plate 9).[106]

[103] *Canada Consolidated* 1880, 1883

[104] Vennor, 1871-72, p.138; *Canada Consolidated 1881*

[105] *Canada Consolidated 1880, 1881, 1883*

[106] *Canada Consolidated 1881, 1883*

Tuttle Shaft (Number Two Shaft)

The Tuttle Shaft was originally known as the "Number Two Shaft". It had also been opened in c.1866/1870 and reached a depth of 64 feet (19.5m). When Canada Consolidated acquired the mine, it was described as only 38 feet (11.5m) deep. The first 30 feet (9m) were sunk vertically within the ore. At that depth it changed to a 60° slope to follow the westerly dip of the vein. At the bottom of the shaft water was struck and it soon rose to within five feet (1.5m) of the top of the shaft, which was about seven feet (roughly 2m) above the Moira River. Water was always associated with this shaft. By 1900, Canadian Goldfields used the Tuttle Shaft only for pumping water out of the mine and not for active mining.[107] In 2011 the Ministry of the Environment still uses the shaft to collect arsenic contaminated groundwater.

A Shaft

The A Shaft was located about 300 feet (roughly 90m) south of the Deep Shaft and 125 feet (roughly 40m) north of the Tuttle Shaft. In 1880 it was 46 feet (14m) deep which suggests that it had been previously started by Gatling and his partners. In the 1890s, Canadian Goldfields used Shaft A to handle materials (timbers, mining equipment, etc.) and for mine ventilation.[108]

Neill's Mine

The mine was situated on the west half of Lot 14 Concession 10. In 1870-71 an opening was made on the property by Mr. Neill, or O'Neil, who was a partner of Gatling.[109]

By 1881 the Neill Mine was being called the "O'Neill Shaft" and ore was being taken from the mine. By 1900 it was being called the "Red Shaft". In 1902 the shaft was temporarily reopened but closed at a depth of 155 feet (47m).[110]

Hawkeye Mine

Two shafts known as the Hawkeye Mine had been sunk to depths of 30 and 46 feet (9m and 14m respectively). By 1880 there were apparently two shafts on the property, one at 50 feet and two at 25 feet (15m and 7.5m respectively). About 1899 Canadian Goldfields extended the shafts, by then called Hawkeye #1 and #2, to develop the deposit.[111]

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[107] Vennor, 1871-72, p.138; *Canada Consolidated 1880, 1881;* OBM 1900

[108] *Canada Consolidated 1880, 1881,* OBM 1897

[109] "Vennor "Progress report" GSC, *Report of Progress for 1871-1872*

[110] *Canada Consolidated 1881;* OBM 1902

[111] Vennor, 1871-72, p.139; *Canada Consolidated* 1880, 1881, CDM, *Gold Occurrences*, 1936, 118; OBM 1899

South Hawkeye Shaft

The South Hawkeye Shaft may have been part of the Hawkeye Mine group but was always identified separately. In 1880 it was about 25 feet (7.5m) deep. It contained very large dumps which suggest that ore had been raised to the surface but not hauled away.[112] Delays occurred in obtaining the necessary machinery as soon as it had been expected. [113]

A large storehouse, Mine Captain's office and other essential mining buildings were erected in 1881 and work has begun upon the foundation of five blocks to provide ten miner's houses. [114] Plans had been prepared for a brick office building, Superintendent's house and a store.

6.3.2 The Mills

In 1881 a mill capable of treating 125 tons of ore a day was under construction. Primary ore crushing seems to have been done at the Gatling Mine using a Blake crusher. By 1883 the concentrating mill had a proven a capacity of five tons per hour. Fine milling of the ore was done by Cornish rolls rather than stamp mills and they worked very successfully. Roasting furnaces had a capacity of ten tons per day. [115]

Roasting, chlorination, condensing and collecting arsenic fumes as well as gold smelting were all undertaken in one large plant, located some distance from mine (Figure 7, Plate 10). This necessitated the construction of a tramway in 1881/82 to transport ore from the mine shafts to the mill. [116] The location of the mill seems to have been determined by the use of water power. A dam was built in 1880 and water was carried to the new mill by a flume of 120-150m and with a fall of 6.4m. [117]

Despite the substantial investment in the mill operation, some equipment of poor quality was installed. One or two of the tanks had been lined with very thin lead and the refining chemicals ate holes through the tanks. Repairs were made as soon as losses occurred. In addition, rubber hoses used to convey the solution from the filter to the collecting tanks were of a poor quality. They would crack and holes appeared.[118]

The company's published *Reports of Progress* in 1880-1882 were very positive and never alluded to the experimental nature of the refining process. In 1880, Adolph Thies, General Mine Manager, noted that the ores had been successfully roasted in the revolving cylinder and he was obtaining 80 percent of the assay value.[119] At this time the property was still under option and the roasting would have been a pilot operation. Scaling it up to commercial use had not yet been demonstrated.

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[112] *Canada Consolidated 1880*

[113] *Canada Consolidated 1881*

[114] *Canada Consolidated 1881*

[115] *Canada Consolidated* 1881, 1883 Royal Commission on Mineral Resources 1890, p.106-108

[116] *Canada Consolidated 1881,* 1883

[117] *Canada Consolidated 1881*

[118] *Canada Consolidated 1883*

[119] *Canada Consolidated 1880*

Two years later when industrial scale production commenced, the inadequate furnace draft prevented it from getting hot enough to roast the ore. The operation was shut down until an exhaust fan could be ordered and installed. Then it was found that the draft was so strong that 40 percent of the ore was sucked out of the roasting chamber into a dust collecting chamber. Most of the arsenic, instead of being deposited in the arsenic chambers, was carried out the chimney. The furnaces again were again shut down to enlarge the size of the flues. All of these modifications took until the end of July. At the beginning of August the boiler house caught fire and repairs took an additional three weeks.[120] Finally, after a delay of five months, roasting could commence.

Roasting of the mispickel ore was undertaken as a continuous operation using two revolving cylinders with a combined capacity of ten tons per 24 hours. The chlorinating and filtering capacity matched that of the cylinders. This represented about one half of the ore milling capacity. Why the capacity of the concentrators was only half that of the mill was not stated. It was possibly a cost saving measure. Rothwell stated that it would cost $15,000 to $18,000 to double the furnace and concentrators to match that of the mill.[121]

By 1883 Rothwell admitted that the loss of gold during the concentrating process was enormous. However, he believed that this was due to avoidable conditions such as careless handling, leaks in the new tanks, imperfect precipitation, and losses in melting.[122]

The company chemist, Wilkins Greene, commented the real problem was extracting the gold during the precipitation stage. In 1880 Rothwell was championing the proven merits of the Mears Chlorination Process; at the end of 1882 Greene was still conducting experiments to make the process work. Meanwhile, the rest of the plant was continuing to produce the gold solution and all of the storage tanks had been filled. Since the company had ordered that the process could not stop, Greene continued the chlorination process but experimented on each batch. By January 1883 he believed that charcoal filters would work.[123]

In any case, production in the mill ended at the beginning of December when the temperature fell to -22°F. By this point, although they could roast ten tons of concentrate per day, it was found that the lime in the gold solution made the precipitation of gold so difficult that only a few tons per day could be chlorinated. Legal complications forced the company to suspend work for several weeks on the chlorination and roasting processes. It was thought that substituting charcoal filters for ordinary precipitation would solve the difficulty. This conclusion had been reached at the end of December and early January, 1883.[124]

When the concentrating plant had to shut down in December 1882 the mill had crushed only 800 tons of ore; it had been built to process 100 tons per day. Nevertheless, this tonnage should have supplied 80 days of feed to the concentrator but, in fact, only a small portion was processed.[125]

[120] *Canada Consolidated 1883*

[121] *Canada Consolidated 1883*

[122] *Canada Consolidated 1883*

[123] *Canada Consolidated 1883*

[124] *Canada Consolidated 1883*

[125] *Canada Consolidated 1883*

6.4 The Failure

Ultimately, the real failure of the Canada Consolidated operation was the inability to extract sufficient gold from the mispickel ore.

The 1881 *Report of Progress* was the result of an order made at the annual meeting in January to let the investors know the status of the developments. Some of the stock was sold through the Bank of Montreal and all of these shares have been fully paid for. A sale of working capital stock had been undertaken and it was being taken up as rapidly as the company requirements demanded.[126]

By 1883 it was different. The *Report of Progress* noted that if the stockholders had promptly responded to the urgent appeals of the trustees and subscribed to the bonds when they were issued, the work would have been much more efficiently done.[127]

The financial crisis became acute by 1883. In 1881 the company had paid wages of $1.00 - $1.25 per day. Two years later the company was months in arrears in paying wages.[128] Not surprisingly, many labourers went to work on the two railway lines then under construction around Marmora. This, in turn exacerbated the labour shortage at the mine. Rather than working the entire plant, workers had to perform one task, for example ore crushing, and then shut it down when sufficient material was on hand to move on to the next task of concentrating.[129]

The lack of funds delayed the arrival of essential mining components. Critical castings for the ore roaster were stuck at the Sterling railway station, near Belleville, until freight charges were paid to continue the shipment. Heating pipes, that would have enabled the mill to run in the critical winter of 1882/83, were held in Customs at Belleville because the company lacked funds to pay the duty.[130] Yet a year earlier, the company had built two prestigious brick office and mine manger buildings.

In 1880 the cost of milling, roasting and chlorinating the ore was estimated at $2.50 per ton. The actual cost at the end of 1882 was $9.65 per ton.[131] The date when operations ceased was not determined. It would seem unlikely that the plant would have re-opened in the spring of 1883 after such a disastrous year in 1882.

The only optimistic result that could be reported was that by 1883 the company had 45 tons of crude arsenic on hand with a value of $20.00 per ton. The refining of the crude arsenic into white arsenic would double the value of the product.[132]

[126] *Canada Consolidated 1881*

[127] *Canada Consolidated 1883*

[128] *Canada Consolidated* 1881, 1883

[129] *Canada Consolidated 1883*

[130] *Canada Consolidated 1883*

[131] *Canada Consolidated 1883*

[132] *Canada Consolidated* 1883

6.5 After Canada Consolidated

The story of Canada Consolidated runs cold after 1883. It is assumed that the corporate entity continued to exist and own the land. From then until 1896, the property was worked intermittently by two operations which exploited the heavy capital investment made by Canada Consolidated.

6.5.1 Charles Taylor

In June 1888 Charles Taylor, a local mining engineer, started extracting gold from the mill tailings. He used a simple amalgamation process and obtained about $4.50 of gold per ton of tailings. Working with two men he extracted about $100.00 to $150.00 per week. Taylor boasted that he used a building 40 feet (12m) square and could process twice as much ore as the original company could do with a mill that covered half an acre. However, he did admit that he was treating arsenical ore that had already been concentrated by the previous company.[133]

6.5.2 Hastings Mining and Reduction Company, (1892?-1896)

In 1892 the Hastings Mining and Reduction Company, backed by a group of Toronto and Philadelphia businessmen, was operating on the site. The company sank a shaft at the Pearce mine on the east side of the Moira River. In 1893 seven men had extracted 300 tons of ore. The company attempted to use the Walker-Carter process to extract the gold. Their reduction works was not built at Deloro but instead a water-powered plant was built on the Crow River in Marmora (Plate 11). The process was experimentally successful but had too many working parts to be a commercial success and the operation soon stopped.[134]

6.5.3 The Future of Gold Mining

By 1890 the prospects of further gold mining in the Hastings County gold field seemed dim. The only profitable activity had been to scavenge the waste dumps of previously failed operators. The first *Annual Report* of the Ontario Bureau of Mines in 1891 summed up the future prospects:

> *It is now more than a quarter of a century since gold was discovered in the County of Hastings. For several years mines were worked at various points in the Townships of Marmora and Madoc, and a number of mines gave good promise to their owners. Several mills for treating the ores were built, and excitement at times was raised to a fever heat as new discoveries were made. But in almost every case it was found that when a shaft had been sunk to the water-line the ore ceased to be free milling and no process then known made the economic treatment of it possible.*

[133] Royal Commission on Mineral Resources 1890, p.111

[134] OBM 1893, 1894; CDM, *Gold Occurrences*, 1936, 118; Wells, "Mispickel Gold Ores,"*, JCMI* 1897, Vol 2, p. 127–33 (

The mispickel, although still rich in gold as shown by assays, was too refractory to yield the precious metals in paying qualities; and notwithstanding that various methods were tried and large sums were wasted on new experiments, conviction slowly settled down in the minds of capitalists, miners and metallurgists alike that there was no money to be made in mining or milling the mispickel ores of Hastings.

6.6 Inventory 2011

It seems extraordinary that so much money and effort had been invested by Canada Consolidated in the property and so little remains today. The remains of the mine shafts were remediated in the 1990s. The gold mill lies under the ruin of the industrial area buildings. Nevertheless some remarkable features still survive.

6.6.1 Hydraulic Race and Reservoir

The former hydraulic race and reservoir are the largest and best preserved resources dating from the site occupation by Canada Consolidated. The historic resources combined man-made structures and natural resources.

Control Dam

A control dam on the Moira River is marked on several maps but no physical evidence of one was located in 2011 (Figures 6 & 11). An obvious location for the dam was just downstream of the intake to the raceway where the river valley is somewhat narrower than elsewhere (Plate 12). The bank is high on the south side and on the north side a rock outcrop rises above the floodplain. These outcrops could have provided adequate abutments for a dam of about two metres.

Intake Channel

An intake channel was cut through rock from the Moira River to the head of a natural ravine (Plate 13). An earth causeway containing a culvert was constructed over the channel.

Waterpower Dam and Dyke

The ravine widens out as it extends for a few hundred metres where it opens into a wide valley with low walls. The point at which the valley begins to widen substantially would have been the logical place to construct a waterpower dam (Plate 14). A well-built dyke of stone and clay extends along the crest of the east valley wall and terminates at the probable site of the dam (Plates 15, 16 and 17). The dyke filled-in low sections of the valley crest to maximize the height of the headpond.

Dam Reservoir

The area below the dam site was referred to as a reservoir on some maps (Figures 7 & 11). This appears to be a natural rock basin that has silted in. A narrow channel, probably modern, has been excavated through the silt presumably to dry out the area. The natural maximum elevation of the water surface in the reservoir would have been lower than the assumed waterpower dam and would not have been suitable for power production. Possibly it was used as a source of process water for the refining operations. The water drains through a natural depression back into the Moira River. This area was identified in Figure 5 as a place for a mill.

The highland between the Moira River and the reservoir is traversed by an undulating line of rock rubble. It is not a dyke because it is not waterproof and the crest of the rubble pile rises and falls with the topography. The purpose of this rubble could not be determined.

Table 5: Hydraulic Race and Reservoir Cultural Heritage Evaluation

Evaluation of Cultural Heritage Value or Interest According to Ontario Regulation 10/06:	
Not determined to have 10/06 provincial cultural heritage value or interest	
Evaluation of Cultural Heritage Value or Interest According to Ontario Regulation 9/06:	
Design or Physical Value:	Dyke wall unusually well built
Historical or Associative Value:	Built to supply waterpower to arsenic mill; dictated location of mill;
Contextual Value:	Built structures and natural features combine to produce a large historic feature; contributes to mining landscape
Character Defining Elements: Rock cut intake, causeway, dyke	

6.6.2 Tramway

Canada Consolidated built a tramway to haul ore from the mines to the mill. It appears that the mill was located so far away to take advantage of the water power potential of the river. The only remnant of this tram line is a stone embankment over a low area of land adjacent to the river near the Tuttle Mine pump house. The right-of-way at each end of the embankment has been obliterated by modern remediation work to the property. The embankment is a very finely built stone structure of two parallel walls with fill between them. The surface of the embankment rises on a slight grade from north to south (Figure 6, Plates 18, 19).

Table 6: Tramway Cultural Heritage Evaluation

Evaluation of Cultural Heritage Value or Interest According to Ontario Regulation 10/06:	
Not determined to have 10/06 provincial cultural heritage value or interest	
Evaluation of Cultural Heritage Value or Interest According to Ontario Regulation 9/06:	
Design or Physical Value:	Well built stone causeway
Historical or Associative Value:	Transport ore from mine to mill
Contextual Value:	contributes to mining landscape
Character Defining Elements: Two parallel stone walls with earth infill, slide grade to top of causeway	

6.6.3 Mining Roads

Hawkeye Mine Road

The Hawkeye Mine Road extends from the vicinity of the Red Shaft to north property boundary. The alignment appears to be unchanged from that shown on maps but the width was probably increased during remediation of Hawkeye Mine in the 1990s. The road runs along the base of the mine dump and is the least altered throughout this section. The road also passes the top of the Five Acres Stamp Mill (Figure 5, Plate 20). A second road runs along the toe of the valley wall but much of it has disappeared.

Deloro Village Road

The remains of the former Deloro Village Road extend from a junction with the Hawkeye Road to rise up the hillside to the Deloro village site. Today this road ends at the Deloro Mine Site boundary fence. This was the widest of the original roads identified in the 2011 field inventory and has relatively prominent earthworks. The road seems to have been used into the 20th century. A less visible road to a former quarry extends northwards from this main road (Figure 7, Plate 21).

Table 7: Mining Roads Cultural Heritage Evaluation

Evaluation of Cultural Heritage Value or Interest According to Ontario Regulation 10/06:	
Not determined to have 10/06 provincial cultural heritage value or interest	
Evaluation of Cultural Heritage Value or Interest According to Ontario Regulation 9/06:	
Design or Physical Value:	None noted
Historical or Associative Value:	Essential transportation routes for mining operations
Contextual Value:	Distinctive pattern associated with mining
Character Defining Elements: width of right-of-way, minimal earthworks, alignment follows topography	

6.6.4 Mine Shaft Markers/Mapping

Although all of the actual mine workings have been remediated out of existence, the spatial pattern of shaft locations has been preserved by the 1990s concrete caps and ventilation shafts (Plates 22, 23). In addition, the location of about 100 test pits and trenches throughout the Deloro Mine Site were accurately surveyed in the 1990s and marked with blue-painted steel posts (Appendix F). These pits presumably date from the entire mining era on the property. About 20 posts were visually observed in the 2011 inventory.

Table 8: Mine Shaft Markers/Mapping Cultural Heritage Evaluation

Evaluation of Cultural Heritage Value or Interest According to Ontario Regulation 10/06:	
Not determined to have 10/06 provincial cultural heritage value or interest	
Evaluation of Cultural Heritage Value or Interest According to Ontario Regulation 9/06:	
Design or Physical Value:	None noted
Historical or Associative Value:	Test pits main method of delineating ore deposits
Contextual Value:	Landscape pattern of mine exploration in 19th century
Character Defining Elements: Shallow pits, trenches, disturbed vegetation, blue metal marker posts	

6.6.5 Hawkeye Mine

The Hawkeye Mine was originally worked in the 1870s and then by Canada Consolidated in the 1880s and Canadian Goldfields in c.1900. The mine is the only property on the Deloro Mine Site to still contain a visible rock dump (Plate 24). As the amount of mining activity at any point of time is unknown, it is impossible to tell if the dump was produced primarily by Canada Consolidated or Canadian Goldfields.

Table 9: Hawkeye Mine Cultural Heritage Evaluation

Evaluation of Cultural Heritage Value or Interest According to Ontario Regulation 10/06:	
Not determined to have 10/06 provincial cultural heritage value or interest	
Evaluation of Cultural Heritage Value or Interest According to Ontario Regulation 9/06:	
Design or Physical Value:	Last remnants of mine west dump on Deloro Mine Site
Historical or Associative Value:	Mine operated throughout mining era at Deloro
Contextual Value:	Conveys a visual impression of an abandoned mine site
Character Defining Elements: Rock dump, pit markers	