

Deloro Mine Site Cleanup Project



Protecting our environment.



Ontario

What is the Deloro Mine Site Cleanup Project?



The Deloro Mine Site Cleanup Project is a multimillion dollar initiative of the Ontario Ministry of the Environment to clean up the abandoned mining, refining, and manufacturing site at Deloro, Ontario.

The ministry assumed responsibility for this site in 1979 as remediator of last resort when the site owner failed to comply with ministry orders to stop pollution. The ministry has made significant progress in dealing with the complex and multifaceted environmental issues at the site, and is now consulting on the draft plan to finish the cleanup.

The Deloro Mine Site is in eastern Ontario about 200 km southwest of Ottawa and 65 km east of Peterborough. The site sits along the banks of the Moira River, beside the eastern boundary of the Village of Deloro (pop. 180).

Environmental legacy

The Deloro Mine Site has an industrial history that dates to about 1867. Major industry included gold mining and refining, production of arsenical pesticides, production of cobalt metal, silver, nickel, and stellite. When the refining and manufacturing operations were shut down in 1961, nearly a century's worth of hazardous by-products and residues (a complex blend of toxic compounds; metals like cobalt, copper, nickel; and low-level radioactive wastes) remained on the property.

Arsenic is the main contaminant of concern. Low-level radioactive slag and tailings were produced as a result of the re-refining of by-products from uranium refining. All these materials caused significant environmental impact at the site, including contamination of the site's soil, sediment, surface water and groundwater. In addition to chemical concerns the site was scattered with abandoned mine workings.



◀ Deloro Mine Site early 1900s



▲ Industrial Area



◀ Abandoned mine shaft before it was sealed

What has been done at the site so far?

The Ontario Ministry of the Environment has made significant progress since taking over this abandoned site, and has spent more than \$20.5 million on this project on actions that include:

- Construction and ongoing operation of an Arsenic Treatment Plant to treat contaminated groundwater (the plant removes about 99.5 per cent of the arsenic from the contaminated groundwater it treats);
- Establishment of an extensive ground and surface water monitoring network;
- Construction of an on-site laboratory to analyze ground and surface water samples;
- Locating and sealing all major abandoned mine shafts, and remediating all other mining related hazards;
- Demolishing derelict buildings;
- Capping eight hectares of tailings with a half metre of crushed limestone to eliminate wind and surface water erosion and to address chemistry related issues;
- Fencing the entire site to discourage trespassing; and
- Conducting two off-site assessments: *Deloro Village Environmental Health Risk Study*; and the *Moirra River Study* to assess potential off-site impacts to people and the environment.

As a result of the work the ministry has already done, there has been an 80 per cent reduction of the amount of arsenic going into the Moira River, which runs through the middle of the site.

The province estimates it will spend an additional \$30 - 40 million more of capital investment to finish the job.



What is the objective of the cleanup?

The overall objective of the Deloro Mine Site Cleanup Project is to finish the cleanup of this abandoned mining and industrial complex, by isolating and containing wastes, and engineering the site to be safe for people and the environment for hundreds of years.

Public consultation on a new milestone

As part of its commitment to finish the cleanup of the Deloro Mine Site, the Ministry of the Environment has released its draft cleanup plan for a 60-day public consultation period. During this time, the ministry will look to residents of Deloro and downstream of the mine site, local municipalities, environmental groups and anyone with an interest in the project for comment. All comments will be reviewed and considered by the project team, and if appropriate, will be included in the draft cleanup plan.

This multimillion dollar draft cleanup plan was developed by CH2M HILL Canada Limited's team of technicians, scientists and engineers. It has been carefully reviewed by ministry scientists and engineers, and by the ministry's three project liaison committees. The draft cleanup plan is designed to isolate and contain the remaining complex blend of contamination at the site.

Since taking over this abandoned mining and industrial site, the ministry has reduced the amount of contamination coming from the site by 80 per cent. The draft cleanup plan addresses the remaining 20 per cent of the problem. This is an exciting milestone in this project that will ultimately result in cleaner land for the people of Deloro and cleaner water for the people downstream of the mine site.

How can I get involved?

The Ministry of the Environment welcomes your input on the draft cleanup plan for the Deloro Mine Site. All materials including the full technical report for the draft cleanup plan are located on the Deloro Web page on the ministry's Web site: www.ene.gov.on.ca. For more information, contact Heather Hawthorne 613-549-4000 extension 6927.

Please provide your comments in writing no later than January 12, 2005 to:

Deloro Mine Site Cleanup Project
Ministry of the Environment
133 Dalton Avenue
Kingston, Ontario
K7L 4X6





Quick facts about the Deloro Mine Site

Size:

About 202 hectares (ha)

Contaminants of Concern:

- Arsenic, the main contaminant of concern
- Cobalt, copper, nickel
- Low-level radioactive material (represents two to six per cent of waste at the site)

Other Materials to be Managed:

- Refining slag
- Mine tailings
- Laboratory wastes
- Demolished materials

Division of Areas:

Site divided into four conceptual areas based on historical use: Industrial Area, Mine Area, Tailings Area, Young's Creek Area. A cleanup strategy has been developed for each area of the site, to deal with each area's unique environmental issues.

Volume of Waste:

About 650,000 cubic metres (m³)

How was the draft cleanup plan developed?

Cleanup strategies for the Deloro Mine Site Cleanup Project were selected using a very detailed and rigorous review process. A thorough review of scientific literature was used to develop a long list of possible cleanup methods for each area of the site. A four step process was used to develop and review cleanup alternatives. To be considered further each potential method had to meet all project cleanup objectives. Experimental methods were not considered.

Cleanup methods were evaluated using 16 different measures of effectiveness that considered technical, social, environmental, and cost considerations. All evaluation criteria carried equal weight in the process.

For each area of the site, each comprehensive cleanup alternative was compared to others. For the Industrial Area, 16 cleanup alternatives were considered, for the Mine Area three, for the Tailings Area six, and for the Young's Creek Area four.

A cleanup strategy for each area of the site was recommended at the end of the evaluation process. That recommendation was further developed in a Closure Plan for each area of the mine site. Each recommended alternative satisfied the greatest number of criteria.



KEY ELEMENTS OF THE CLEANUP PLAN

The Industrial Area

Concentrated industrial activity took place in this area from about 1867 to 1961. Activities included smelting, refining, and manufacturing of materials including arsenical-based pesticides, refined gold, refined silver, cobalt metal, stellite, and machine parts. This is the most heavily contaminated part of the site. Most of the ongoing arsenic loading to the Moira River comes from this area, and the Mine Area.

CLEANUP STRATEGY FOR INDUSTRIAL AREA

Consolidate and cover wastes with an engineered cover combined with groundwater and surface water flow diversion to enhance the existing collection/treatment system.

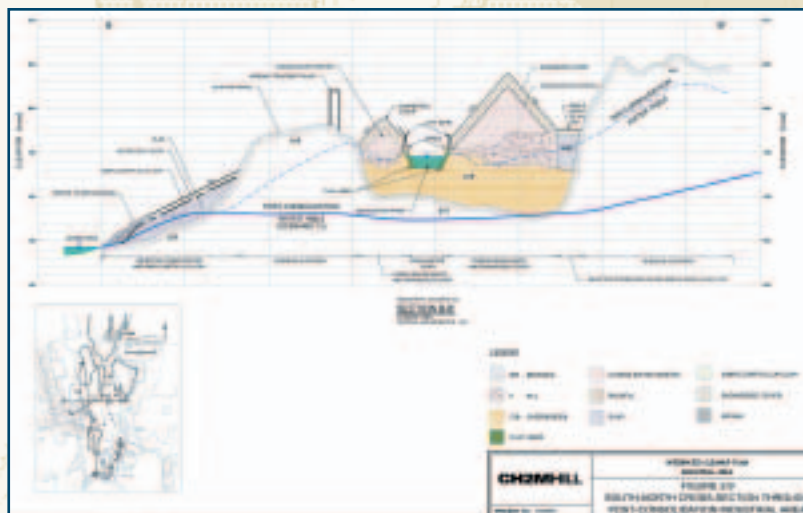
Consolidation of waste and capping

The most highly contaminated wastes will be placed in a waste consolidation area and capped with an engineered cover that is 1.5 metres thick. This will reduce the footprint of the wastes, and will isolate them from the environment.

The soil along the western bank of the Moira River, once the site of the arsenic baghouse, will be removed and placed under the engineered cover. The riverbank will be reconstructed with “clean” fill.

Less contaminated materials will be covered with an engineered clay cap 1.5 metres thick to isolate them from people and the environment.

Cross-section of engineered cover



Area: 25 hectares (ha)

Contaminants of Concern:

Calcium arsenate/arsenite, low-level radioactive materials, slag and gold mine tailings contaminated with arsenic, cobalt, copper, lead, mercury, nickel; and ferric arsenate (sludge from the Arsenic Treatment Plant).

Volume of Waste: Approximately 305,000 cubic metres (m³)

Ground and surface water diversion

Groundwater and surface water flow will be diverted away from contaminated materials. Clean groundwater will be diverted away from the wastes and under the engineered cover by a passive groundwater interceptor well network located near the western boundary of the Industrial Area. Extensive grading and interceptor ditches will be built to drain or divert surface water from the engineered cover.

The existing groundwater collection/treatment system (the Arsenic Treatment Plant) will continue to operate.

Demolition of unsafe structures

Unsafe structures and tanks will be demolished and consolidated with existing ruins.

The Mine Area

Gold mining at the site took place over a period of about 35 years from about 1867 to 1902. Mine shafts were scattered throughout the site. The deepest mine shaft was the Gatling Shaft at a depth of approximately 152 metres. The ministry located and sealed all major mine shafts, and remediated all other mine features from 1993-1995. The proposed cleanup strategy for the Mine Area deals with remaining waste rock and contaminated soils.

CLEANUP STRATEGY FOR MINE AREA

Relocation/consolidation of highly contaminated wastes to the Industrial Area, placement of a soil cover in the remaining areas and treatment of groundwater from the Tuttle Shaft.

Consolidation of wastes

Highly contaminated materials (including radioactive slag) will be excavated and relocated to the Industrial Area, where they will be consolidated under an engineered cover that is 1.5 metres thick. "Clean" fill will replace the waste materials and the area will be vegetated.

Area: Main Mine Area - 3 ha
Remote Mine Area - 114 ha

Contaminants of Concern:
Arsenic, low-level radioactive slag

Volume of Wastes:
Approximately 32,000 m³

Capping

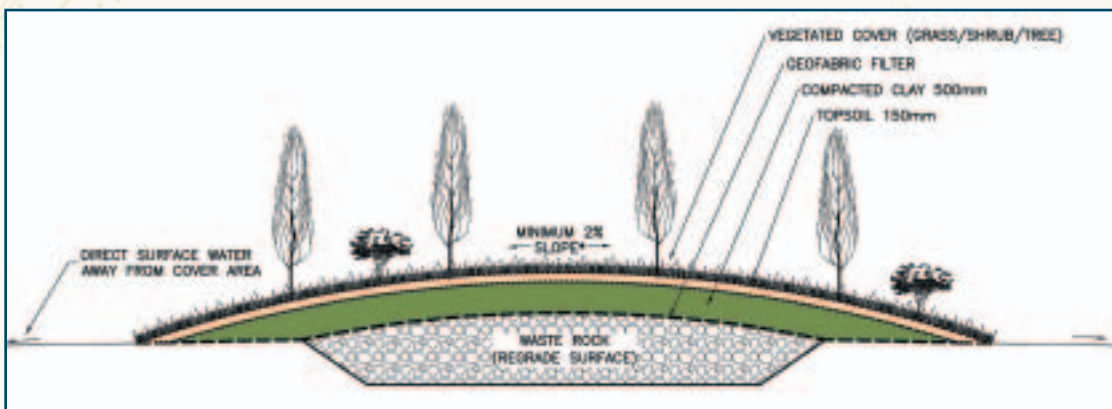
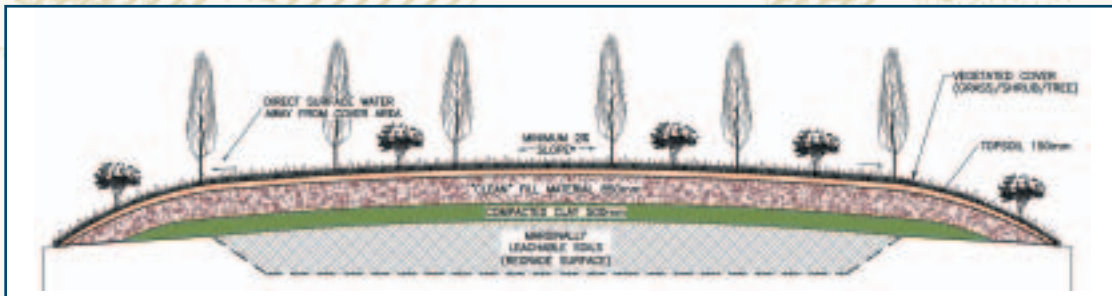
Less contaminated areas will be covered with an engineered clay cap 1.5 metres thick.

Waste rock will be covered with a geofabric filter, clay, topsoil, (minimum total thickness 0.65 metres) and then vegetated.

Groundwater treatment

Groundwater will continue to be pumped from the Main Mine Area, and treated at the Arsenic Treatment Plant.

▼ Engineered clay caps



The Tailings Area

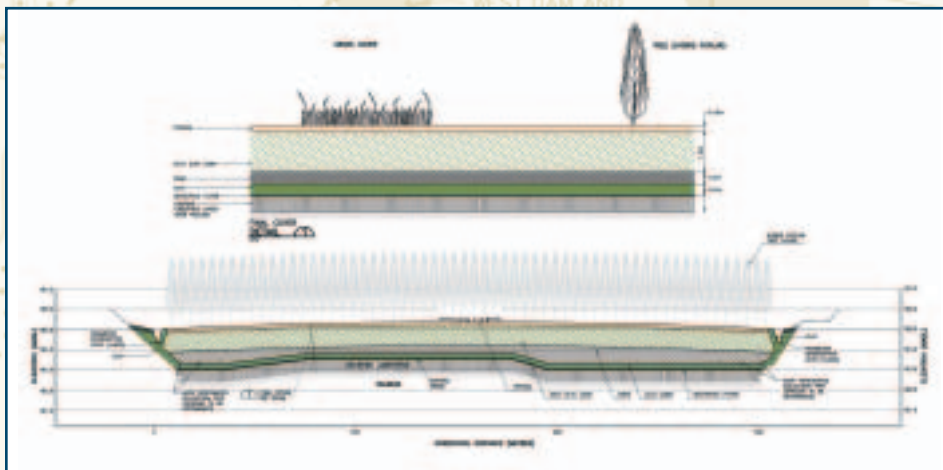
The Tailings Area, to the east of the Moira River, was once a natural lowland area. During the ore refining process, ferric hydroxide (red mud) was pumped as waste slurry from the hydrometallurgical plant that operated from 1914 to 1961. The Ministry of the Environment covered this area with a half a metre of crushed limestone in 1986/1987 to eliminate wind and surface water erosion and to address chemistry related issues. The cover also acts as a shield against low-level radioactivity, also present in the tailings.

CLEANUP STRATEGY FOR THE TAILINGS AREA

Cover tailings with an engineered soil cover combined with collection/treatment of groundwater and upstream surface water flow diversion.

Engineered cap

The existing limestone cap in this area will be covered with an engineered cap that is 1.75 metres thick, and vegetated with hybrid poplar trees and grass. These measures will prevent 90 per cent of precipitation from infiltrating the tailings.



◀ Engineered cover ▼

Area: 13 ha

Contaminants of Concern:
Arsenic, cobalt, copper, nickel, and low-level radioactive materials

Volume of Wastes:
Approximately 45,000 m³

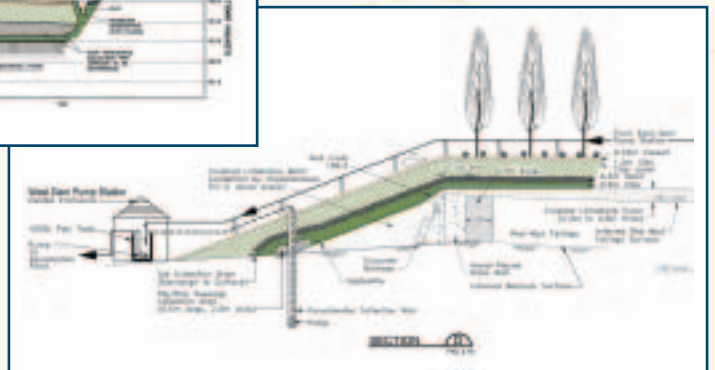
Ground and surface water management

An interceptor ditch will be built to divert clean, upstream surface water away from the engineered cover.

Water collection/treatment

Contaminated seepage will be pumped and collected for treatment at the Arsenic Treatment Plant.

EAST DAM AND SEEPAGE COLLECTION (CONCRETE WALL)
COMMON HEADER
WELL (TYPICAL)
COLLECTION AND PUMPING SYSTEM
SURFACE WATER DRAINAGE DITCHES



The Young's Creek Area

Young's Creek begins on the Deloro Mine Site at its northeast corner and flows south along the eastern side of the Tailings Area, connecting with the Moira River south of Highway #7. Over the last century, run-off from the Tailings Area has resulted in heavy sediment contamination in the creek. Water flow is very low in this area, which is typically wetland-like in nature.

Young's Creek currently contributes about three per cent of the arsenic loading to the Moira River watershed. Cleanup of this area is planned due to the high levels of metals in sediments, the presence of low-level radioactive material in the onsite portion, and due to the potential for occasional high river flows to re-suspend contamination, especially during a 100-year flood event. Biological diversity and abundance in this area are affected as a direct result of contaminated sediments.

The Young's Creek Area is part of a provincially significant wetland, known as the Deloro Wetland Complex. In light of that fact, a wetland restoration plan will be implemented following removal of contaminated sediments.

CLEANUP STRATEGY FOR THE YOUNG'S CREEK AREA

Full depth excavation of onsite sediment, shallow depth excavation of offsite sediment, and disposal in a new onsite engineered containment cell followed by creek rehabilitation.

The Young's Creek Area includes an onsite and an offsite portion. The onsite portion is much more contaminated, and to a greater depth than the offsite portion.

Excavation and containment

Contaminated sediments and soils will be excavated, dewatered, and placed in a secure engineered containment cell that will be built onsite to the south of the Tailings Area.

Area: Onsite – about 47 ha
Offsite (south of Highway # 7) – about 19 ha

Contaminants of Concern:

Onsite area - Arsenic, cobalt, copper, nickel, and low-level radioactive material
Offsite area - Arsenic, cobalt, copper, and nickel. There is no radioactivity in the offsite area.

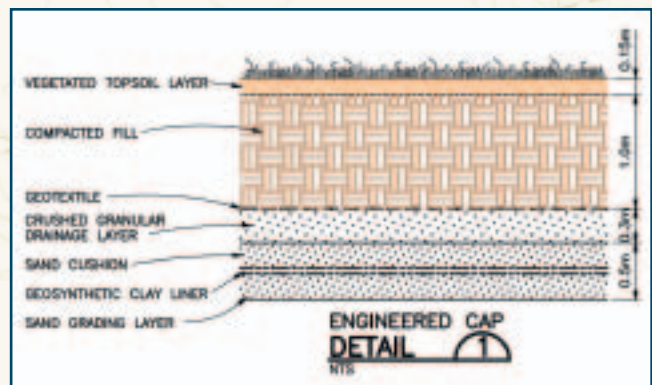
Volume of Wastes:

Onsite - 100,000 m³ of shallow contaminated sediments and an equal amount of contaminated deeper soils
Offsite - About 68,000 m³ of contaminated shallow sediments

The containment cell will have an engineered vegetated cap and liner system to isolate contamination from the environment. The cell will be substantial in size, covering an area of about 5 hectares (ha) to a height of approximately 17 metres.

Wetland reconstruction

Areas of the wetland removed by excavation will be reconstructed. This is especially important for rebuilding the ecosystem since this area is part of a provincially significant wetland.



Next Steps

Once the cleanup plan is finalized there are a number of steps that must be taken before major construction for the cleanup work can begin including:

► 2005

Finalize the cleanup plan: The ministry will finalize the cleanup plan following public consultation.

Detailed engineering design: Development of the 'blueprints' for engineered facilities, covers, caps, wells and pumping stations.

Licence applications and permits: Regulatory approvals that must be obtained in order to proceed with construction, including permits from: the Ministry of the Environment (MOE), Conservation Authority (CA), Ministry of Natural Resources (MNR), Department of Fisheries and Oceans (DFO), Canadian Nuclear Safety Commission (CNSC), and the Ministry of Northern Development and Mines (MNDM) among others.

Federal Environmental Assessment

Requirements: Required as part of the ministry's application to the Canadian Nuclear Safety Commission (CNSC) for a licence for the long-term storage of the existing low-level radioactive material at the site.

► 2006

Tendering: Offering construction contracts for cleanup work through a competitive bid process.

Site preparation construction: Preparation of the site for major cleanup construction activities will involve construction of access roads and wash-down facilities, clearing vegetation and trees, and installation of surface water controls.

► 2007 - 2012

Complete the cleanup: major cleanup construction begins. All materials will be secured to make the site safe for people and the environment for hundreds of years.

► Long-Term Commitment

The Ministry of the Environment will maintain its long-term commitment to this site. The site will require ongoing monitoring of surface water, groundwater, pumping systems, and the wastewater treatment plant to ensure the continued effectiveness of the site cleanup measures.



Stepping Back

The Site's Mining and Industrial History

Deloro mine was the site of nearly 100 years of mining, refining, and manufacturing. It has a rich past and an important place in the history of industry in Canada.

Mining at the site began around 1867, and was part of the Madoc Gold Rush, the first discovery of gold in Ontario. Operations at the site evolved over the next century to include not only mining and refining of gold, but also smelting and refining of a number of other elements including arsenic, silver, and cobalt.

The Deloro Mining and Reduction Company was the first plant in the world to produce cobalt commercially. The company was also a leading producer of stellite, a cobalt-chromium-tungsten alloy. Concentrates from uranium extraction were imported to the site and further processed to extract cobalt and arsenic.

Deloro was a pioneer producer of arsenic-based pesticides, which were produced from the by-products of smelting operations and continued as a main activity at the site until the market collapsed in the late 1950s.

Ownership of the property now known as the Deloro Mine Site was transferred through a succession of entrepreneurs including the Gatling Gold and Silver Mining Company, Canada Consolidated Mining Company, Canadian Goldfields Limited, and the Deloro Mining and Reduction Company which later changed its name to the Deloro Smelting and Refining Company.

In 1961 the Deloro Smelting and Refining Company closed its plant. In 1970 British Oxygen bought Deloro Stellite. (a division of the Deloro Smelting and Refining Company). The sale did not include the mine site property, which was transferred

to Erickson Construction Company Limited, a subsidiary of M.J. O'Brien. In 1979 Erickson Construction Company Limited abandoned the site. The Ontario Ministry of the Environment assumed responsibility for the environmental cleanup of the site as the remediator of last resort. The property escheated to the provincial Crown in 1987.

Heritage Matters

The Deloro Mine Site has a rich and important history. From its place in the Madoc Gold Rush, to its innovations in creating and producing metals and alloys, Deloro played a key role in the history of mining and industry in Canada. There are many stories to be told about the Deloro Mine Site, its geology, its industry, its innovation and its people. There are also important lessons to be learned about the consequences of reckless exploitation of the environment - a legacy of our uninformed past - and the extensive cleanup that must follow.

While the first priority is to complete the cleanup of the mine site, the ministry is working with the community, heritage organizations, and other provincial ministries to preserve and promote the important natural, industrial, social and environmental history of the Deloro Mine Site. A heritage plan will be developed for the site that will include preservation of several remaining structures on the site, and the possible creation of on-site walking trails and commemorative plaques once the cleanup is complete.

