

Ministry of the Environment programs and initiatives

The Deloro Mine Site Cleanup Project

Through its cleanup actions the Ministry of the Environment has reduced the loadings of arsenic to the Moira River by more than 80 percent.

For 100 years private mining and refining operations at the Deloro Mine Site contributed to the prosperity of Ontario. But that prosperity came with a price — serious and extensive environmental degradation. The last owners abandoned the site in 1979, leaving behind a complex blend of contamination. The Ministry of the Environment made every effort to force the company to clean up the site, but when efforts failed, the ministry stepped in to address the problem.

Over the last 22 years, the ministry has made significant progress at the site. As a result of cleanup work the ministry has reduced the amount of arsenic coming off the site by more than 80 per cent. The final phase of the cleanup will control and securely contain all types of contamination at the site — from arsenic to radioactivity.

A century of contamination

Situated where the Canadian Shield intersects the Great Lakes lowlands, some 200 kilometres southwest of Ottawa and 65 kilometres east of Peterborough, the Deloro area is rich in mineral deposits. In 1866, gold was discovered — the name Deloro is based on the Spanish word for gold — and within five years, numerous shafts had been sunk and refining facilities had been constructed. The extraction of gold was no easy task. The gold-bearing ore was bound up with arsenic, a potentially dangerous byproduct.

The gold mines closed in the early 1900s and the site was used to process silver and cobalt ores from mines in northern Ontario. In the 1930s, 1940s and 1950s, smelted ore was brought from Eldorado Nuclear Limited in Port Hope for further refinement to extract the cobalt. Deloro was the first plant in the world to produce cobalt commercially and was also a leading producer of stellite, a cobalt-chromium-tungsten alloy highly valued during the war years. Ores from all over the world were processed in Deloro's smelter.

Pesticides were produced from the arsenic byproducts of the smelting operations and continued as a major activity at the site until those products were replaced by organic pesticides in the late 1950s.

By the time the mining and refining operations were shut down, nearly a century's worth of hazardous byproducts and residues — a complex blend of toxic compounds, heavy metals and low level radioactive wastes — remained on the property. Early cleanup efforts also uncovered serious contamination of the site's soil, surface water and groundwater.



Deloro Mine Site early 1900s.



Staff photo at the Silver plant – Deloro, circa 1920s.

The ministry takes control

The Ministry of the Environment, formed in 1973, turned its attention to the Deloro Mine Site in the late 1970s. In 1978, the ministry issued an order under the Environmental Protection Act to force the property's owner, Erickson Construction Company Limited, to take steps to control the discharge of arsenic to the nearby Moira River. The company was operating a treatment plant that cut the acidity of wastewaters discharged off-site, but there was little action being taken to reduce the amount of arsenic going into the river. Erickson Construction failed to comply with the terms of the ministry order and, in 1979, declared a lack of operating funds. An order was issued against the company to cease operations that affected the environment. The company abandoned the site and the ministry took control of the property as remediator of last resort.

Addressing immediate concerns

When the ministry took control of the site, the most pressing concern was the arsenic leaching into the Moira River and the potential threat it posed to the environment and to communities downstream. The goal was to address the immediate sources of contamination and to reduce runoff to the Moira River. The ministry focused its initial efforts on upgrading the existing wastewater plant. Plans were developed for the creation of a new arsenic treatment plant, and by 1983 the collection, storage and treatment facility was in operation. Additional pumping stations were installed in 1984 and 1985 to collect groundwater from other contaminated areas. Containment and leachate collection facilities established by the ministry are now operated on contract by the Ontario Clean Water Agency.

The ministry also tackled other major sources of arsenic on the site. A number of contaminated industrial buildings, used for collecting and processing arsenic in the smelting days were demolished. The areas where these structures stood were regraded and seeded. Eight hectares of red mud tailings, the arsenic contaminated byproduct from the smelting process, were covered to a depth of 0.5 metres with approximately 76,000 tonnes of crushed limestone in order to eliminate wind and surface water erosion, elevate the pH of the tailings and stabilize the containment dams.

An extensive sampling network is in place to monitor surface and groundwater quality at the Deloro site. A series of collection stations on the Moira River and Young's Creek provide information on surface water, while monitoring wells on the



Ferric arsenate sludge: the byproduct of the arsenic treatment plant.



The Deloro Mine Site about 1983, before the red mud tailings were covered.



Covering the red mud tailings with crushed limestone.

property are used to assess groundwater contamination. Depending on the location of the sampling station, samples are taken hourly, daily, weekly, monthly or quarterly. Water is also carefully monitored as it enters and leaves the treatment plant.

Ongoing monitoring shows that arsenic concentrations in the Moira River have been substantially reduced since the ministry took control of the site. In 1979, the annual average of arsenic escaping into the river was 52.1 kilograms a day. Since the arsenic treatment plant was put in operation in 1983, the arsenic going into the river has been reduced by more than 80 per cent, to an average amount of less than 10 kilograms a day.

Creating the strategy for cleanup

The cleanup at the Deloro Mine Site was a work in progress — while there was success at the arsenic treatment plant there was more work to be done on the site. By 1992 a multi-phase rehabilitation strategy was developed. It provided a strategy for the work needed to achieve final site remediation.

The strategy divided the site into the Mine, Tailings, and Industrial areas and recommended that strategies be developed to address problems unique to each area. It also identified information gaps that had to be addressed in order to develop detailed cleanup plans for each area of the site. Young's Creek was added as another area for remediation based on the investigation work which followed.

Before work could continue, two problems had to be addressed right away. First, the existing ferric arsenate sludge, a hazardous waste from the arsenic treatment plant, had to be dealt with. On-site storage was not an option because there were no secure hazardous waste containment systems in place. The material was transported to secure hazardous waste landfills in Quebec and Ontario.

The other major concern was worker safety. Abandoned mine shafts and other mine hazards were scattered over the site's 242 hectares, with little information on their number or precise location. Further environmental cleanup work over much of the property could not proceed until the mine workings were located and sealed.

In 1992, in consultation with the Ministry of Northern Development and Mines, the ministry undertook an in-depth review of local mining claims and historical data to locate and identify the collapsing mine shafts. Land surveys were conducted and ground-penetrating radar was used to pinpoint underground workings. By 1995, all mine shafts had been located, secured, and either fitted with reinforced concrete shaft caps, or backfilled according to the specifications of the Ministry of Northern Development and Mines. The project took three years to complete, with funding assistance from Environment Canada and the Ministry of Northern Development and Mines.

Finishing the cleanup

With the site safe for workers, the ministry could proceed with the necessary field work to fill in information gaps, and determine the best options for the final cleanup, containment and management of on-site contaminants. An engineering consulting firm was hired in April 1997 and in-depth field investigations began in June of that



Surveying the mine site.

During the sealing of the abandoned mine shafts, an air track drill was used to verify the location and extent of any underground stopes.



Seven major mine shafts were fitted with reinforced concrete shaft caps according to the Ministry of Northern Development and Mines' standard shaft cap design.



A diamond bit drill took core samples that were used to assess the stability of the crown pillars (i.e. ground above the old mining stopes).

year. Problems that had been identified earlier were now studied in greater detail. This phase of the work was completed in June 1998.

The ministry's consultants are now working on finalizing the technical reports to be used in the development of a final cleanup plan. Consultation on the final cleanup plan will begin in 2001. Major cleanup work will get underway in 2002 subject to the outcome of public consultation.

In the final phase of the cleanup, upgrades will be made to the arsenic treatment plant and work will proceed to stabilize and secure the red mud tailings area. On the west side of the river, the infrastructure associated with the smelting and refining plant will be demolished. On-site hazardous waste disposal facilities will be established to securely contain contaminated materials currently on the property. The process will take approximately two to three years to complete at an estimated cost of \$18 million.

Dealing with off-site concerns

As part of the overall cleanup project, the ministry committed to defining the extent of any off-site environmental problems associated with the Deloro Mine Site, including the potential for contamination in the former village of Deloro and in the Moira River watershed. Soil samples taken beyond the boundaries of the mine site in late 1997 showed the presence of arsenic, cobalt, nickel, silver and other heavy metals. Airborne pollutants released during nearly 100 years of mining and refining are the most likely cause of this contamination.

These preliminary findings were reviewed with the local Medical Officer of Health and, after consultation, the ministry concluded there was a need for further investigation. In 1998, the ministry, in cooperation with the Hastings and Prince Edward Counties Health Unit and the Ministry of Health, launched the Deloro Village Environmental Health Risk Study. The study examined total exposure to contaminants through air, soil, drinking water and food to determine if elevated levels of contaminants were present. It also examined the potential for health risks in the community. The final report, released in July 1999, found the village is a safe community— there is no significant link between contamination and health risk for the people living in Deloro.

In December 1998, the ministry also launched a detailed study of the Moira River system to examine the environmental impact of historical contamination from the abandoned mine site on the Moira River. The draft report, released for public consultation August 2000, and the final



Deloro Mine Site, summer 1997.



The Moira River.

report, released in April 2001 found that despite the presence of historical contamination in the river system, there is no adverse effect on aquatic life and little or no health concern for residents.

The ministry is maintaining contact and consultation with those groups, agencies and people who are potentially affected by their proximity to the Deloro Mine Site. The ministry meets with three project liaison committees to keep them informed and to gather input and comments on the cleanup.

The ministry's efforts to this point have significantly decreased arsenic concentrations and loadings to the Moira River, but more work is needed. The final cleanup plan will be designed to result in the control and secure containment of all types of contamination at the site — from arsenic to radioactivity.

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Chronology – Deloro Mine Site Cleanup Project Ministry of the Environment activities and spending

Mine Site Cleanup

Ordering the company and taking control: 1978-1979

- Ministry of the Environment takes control of the mine site in 1979 when the private owners fail to comply with Environmental Protection Act cleanup orders and declare a lack of sufficient funds.

Controlling arsenic loadings to the Moira River: 1979-83

- Ministry takes action to deal with immediate issue of arsenic by engineering and constructing a collection, storage and treatment system that removes arsenic and other heavy metals that are leaching from the site.



Interior of the arsenic treatment plant.

Demolishing contaminated buildings: 1984-86

- Contaminated industrial buildings are demolished to remove other significant sources of arsenic.

Covering red mud tailings: 1986-87

- Eight hectares of red mud tailings (arsenic contaminated by-product from smelting process) are covered with 76,000 tonnes of crushed limestone to reduce dust, stabilize the material and reduce leaching of arsenic and heavy metals.

Creating the Strategy for Final Cleanup: 1989-1992

- Ministry finalizes a multi-phase rehabilitation strategy outlining steps necessary to complete the site cleanup.
- Rehabilitation Strategy identifies:
 - Areas to be remediated – Mine, Industrial, Tailings areas. (Note: Young’s Creek is added as another area for remediation in 1997).
 - Information gaps need to be addressed to develop detailed cleanup plans for each area.
 - Two critical problems to be addressed immediately – establish safe working conditions by eliminating mine hazards; remove treatment plant sludge.

Sealing Mine Shafts and Removing Sludge: 1992-95

- Ministry locates and secures collapsing mine workings in consultation with Ministry of Northern Development and Mines (MNDM).
- Mine openings are sealed with engineered rock plugs and concrete shaft caps or backfilled according to MNDM specifications.
- Sludge by-product from the arsenic treatment plant is removed to hazardous waste landfills.

Proceeding with Final Remediation

Stage 1 Field Work: 1996-2000

- Ministry hires Prime Consultant for project management and consulting engineering.
- In depth investigation of the Industrial, Tailings, Mine, and Young’s Creek areas done to answer outstanding questions and identify options for cleanup of all contaminants.

Stage 2 Construction: 2001 and ongoing

- Technical reports are being finalized. Next step is to draft detailed final cleanup plan.
- Consultation on draft plan is targeted for 2001.
- Tendering for construction work is targeted for 2002.
- Cleanup work anticipated to commence in 2002. Final cleanup is expected to take 2-3 years to complete.

Addressing Off-Site Issues

Deloro Village Environmental Health Risk Study: 1998-1999

- Ministry conducts a comprehensive environmental health risk study in the village of Deloro to assess potential health impact from any off-site contamination.
- Study is conducted in cooperation with the Medical Officer of Health, Ministry of Health, Ministry of Labour and community representatives.
- Final report is released July 1999. Comprehensive environmental sampling and urine testing results find the Village of Deloro is a safe community.

Moira River Study: 1999-2001

- Ministry begins detailed study of Moira River system from below Deloro
- Mine Site to Bay of Quinte to assess extent and significance of contamination on aquatic life and potential health risk for people living along the river system
- Final report, released April 2001 finds no adverse effect on aquatic life, and little or no health risk for people. Water quality has greatly improved over the last 35 years in response to the end of processing activities and the ministry's subsequent cleanup actions at the mine site.

Total Spending to Date: \$16 million

Estimated Future Spending: \$18 million