# VALE'S VISION

## Reviving Totten Mine from its flooded past

### Vale set to open first new mine in Ontario in more than 40 years

**By Russell Noble**

Eight years ago when Vale acquired the Totten Mine from Inco, the words "cut and dry" were as far from reality as the remaining nickel at the bottom of their new, but flooded mine.

In fact, with more than 123 million gallons of water separating them from the bottom of the mine's 4,130-foot main shaft and the nickel, it's no wonder that Vale started thinking it had just bought the deepest 'fishing hole' in Ontario.

Under care and maintenance since 1972, and allowed to flood since 1976, the timbered shaft and drifts at the 47-year-old mine contained enough water to fill more than 250 average 16' x 32' backyard swimming pools.

In other words, the Totten Mine was literally a bottomless puddle more suited as a municipal reservoir than a nickel mine, but for Vale that obviously wasn't going to be the case.

With almost $760 million earmarked for the Totten Mine project, Vale was serious about opening its first mine in Ontario in nearly 40 years and a little water, albeit a lot in this case, wasn't going to get in its way.

As all companies know, water is both a friend and enemy to miners because next to electrical power, it's one of the two key ingredients required to make a mine work.

Too much of it, however, and it becomes a problem and getting rid of it was one of first challenges Vale's project team faced when putting its mine plan in action.

Dewatering the mine and getting rid of the 123 million gallons of water wasn't necessarily a monumental problem for Vale because it had extensive wastewater pumping and treatment plans well in order from the start of the project in 2006.

The biggest challenge, however, and question in the minds of Vale's project team involved the structural integrity of the mine once the water was removed.

As mentioned earlier, the Totten Mine was an old timbered structure that's been submerged under water for more than 38 years. And again, one of the bigger challenges Vale had was rehabilitating the shaft after the mine was dewatered in conjunction with underground activities. If extensive timber work was going to be required, this would significantly impact project delivery.

A 24-year veteran with engineering and management experience on projects in Manitoba and Ontario, Bob Booth, Senior Project Manager for Vale's Totten Mine, said he admits to being concerned about the unknown condition of the wooden timbers after being under water for so long.

Totten Mine's Lance Howland, Chief Mine Geologist (far left), David Landry, Ground Control Engineer (middle), and Erick Jarvi, Chief Mine Engineer (right), inspect the brow area of the mine's first blasthole stope.

Photo Credit: Mining Industrial Photographer courtesy of Vale.

Control room.

"It's rare to see new timbered shafts in this day and age. Understandably, we were all anxious to see what condition the beams were in once the water was lowered and they were exposed for the first time in so long."

Much to Booth's and the entire project-team's surprise and relief, the timbers weren't in bad shape.

"Being immersed in water was actually a good thing because the wood didn't get a chance to dry out and therefore it remained relatively strong and structurally intact," said Booth.

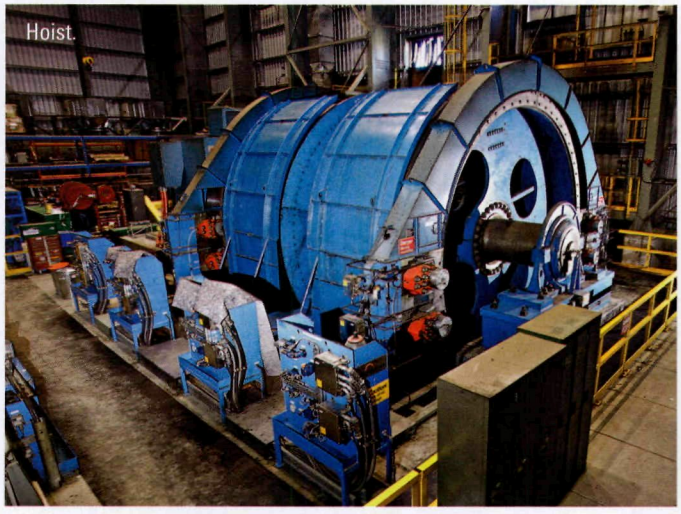
Once the team had a better understanding of the structural integrity of the shaft, it was able to focus on designing surface facilities. From the very beginning, Totten Mine was designed with the environment in mind. From a small surface footprint to enclosed material handling operations to integrated water management systems, Totten has been designed to operate with minimal potential impacts on the environment.

"Respect for the environment and the community in which we operate has always been an important element in the design of Totten Mine," said Booth. "The environmental management of this site is something we can all be very proud of."

It was also important to the Totten Mine project team that they respected that Totten Mine was located within the traditional territory of Sagamok Anishnawbek First Nation. Vale was able to successfully negotiate an Impact Benefits Agreement in June of 2012.

"Vale's relationship with the Sagamok First Nations influences how Totten is structured and operates," said Booth. "The mine features three onsite water treatment plants and we have direct liaison with local aboriginal groups and vendors."

On a project as complex and sensitive as the Totten Mine, Booth stressed that in-house project management and plain old team work with the more than 600 workers representing the various contractors and Vale personnel on the job combined to make the project a success.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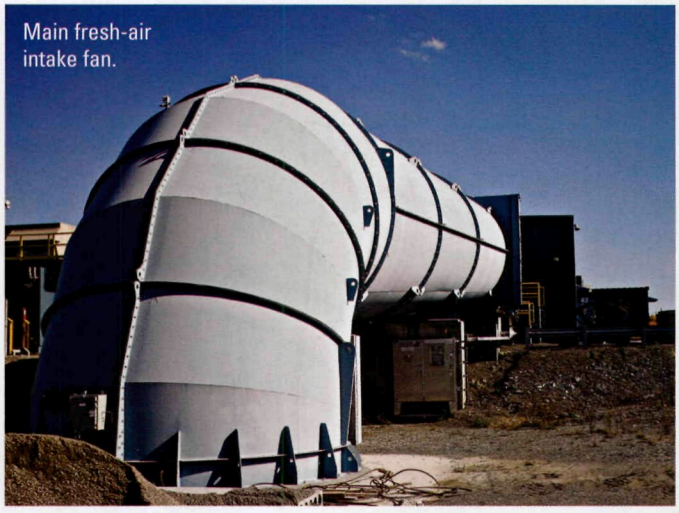
Main fresh-air intake fan.

Safety, naturally, was everyone's concern (and responsibility) and the team's motto: "One team, one-way to zero harm" was successful because the Totten Team recently celebrated one million man hours without a lost-time injury."

That's a huge achievement and one of those "Team Totten" members that was at the forefront of the project when the challenges often seemed almost insurmountable was Cementation Canada Inc. of North Bay.

Being a company that specializes in just about every aspect of mine engineering and development, Cementation was one of the first contractors on site when it set up camp at the Totten Mine in April 2007 to start with the initial scope of dewatering and rehabilitating the shaft.

The company was also responsible for managing the construction of the mine's new head frame and hoist plant. It also carried out some of the initial large diameter raise boring for the new mine ventilation system.

Eric Kohtakangas, Cementation's Vice-president, Operations, Totten Mine Reactivation Team, said that "After mobilization to the site, Cementation installed a temporary dewatering set-up in the escape raise from the 1250 level to the surface. While pumping (using ITT Flyght Canada Model B-2400, 144 hp submersible pumps) started in this raise, a temporary hoist was installed with pump winches to dewater through the existing timber shaft."

"Initial pumping through the escape raise towards the 650 level allowed for dewatering to commence while the main pumping station was being set up for main pumping and rehabilitation in the shaft concurrent with new headframe construction. Accessing the 1250 level allowed for initial early ventilation, plus it allowed for the development required to establish a raise bore nest on 1250 and drilling of an eight-foot diameter hole from level 1250 to 4000 level."

Kohtakangas explained that all shaft timber or shaft equipping was rehabbed as the water level in the shaft was lowered

Aerial view of Totten Mine.

Bolting
Photo by Cementation

Inspection of the mine's first blasthole stope.

through pumping. Initial inspections revealed, like Bob Booth mentioned earlier, that most shaft timber and guide strings were in good condition and that the concrete rings appeared solid.

"Hanging rods, guide brackets and bolts showed some evidence of surface rust. A decision was made later in the project to carry out additional extensive refurbishment and support to help ensure safety for the planned increased payloads for skipping at higher speeds," said Kohtakangas.

With the completion of the shaft dewatering and shaft rehabilitation, Cementation removed the old existing shaft manway and installed guides in the manway compartment to allow for an auxiliary conveyance.

Almost two years to the day after Cementation arrived at the site in 2007, all 123 million gallons of water had been removed from the mine and shaft rehab work was completed to the shaft bottom elevation just below the 4000 foot level.

Concurrent to the shaft dewatering and shaft rehab, the existing head frame and hoist house was demolished and a new head frame and hoist plant was built.

Cementation started the raise boring of the ventilation circuit for the Totten Mine in 2008. This three-raise project included one raise at a diameter of 18 feet, one raise at a diameter of 16 feet, and the longest raise of 2,725 feet at a diameter of 8 feet for a total of more than 6,400 feet.

All completed without incident or in-hole hardware failure.

Additional raise boring for the mine

ventilation system was completed by J.S. Redpath which consisted of 10 and 12-foot diameter raises from the 1850 level down to the 3150 and 3850 levels as well as an 8-foot diameter raise form surface down to the 1250 level.

Fully vented and on its way to producing up to 2,200 tonnes per day, miners will reach that mark by 2015-16 but in the meantime, the mine's 43,200 feet of recent lateral development will help it produce the ore required over the first 23 months of production.

Accessing the ore is being done through a network of 14 x 14-foot drifts with 14 x 16-foot ramps to accommodate a fleet of 30-tonne trucks and six-yard scoops. Additional features include a Davey-Markham hoist in a 9 x 18-foot service shaft and two conveyances with FLSmidth and Stainless Steel Technology equipment.

There are two conveyances featuring a 15 and 18-tonne skip and an underslung cage for 17 miners and a double-deck auxiliary cage for eight.

All mining is currently being done on the 3150 and 3850 levels.

At the mining levels, production involves a fleet of Redbore 40 raise drills and two fully automatic Atlas Copco Simba 4.5-inch in-the-hole drills, equipped with electronic detonators, for blasting on the faces.

In keeping with innovations, at full production, Totten Mine will also include an automated backfill system with 5,000 tonnes of sand stockpiled on the surface and fed automatically to underground locations through a series of diverter valves.

Golder Associates designed the system whereby bulk cement is stored in a tower and transferred by screw conveyor into a three-impeller mixer to make a water/cement slurry.

As needed, the slurry is initially sent to the 1250 level, then horizontally 300 feet to another valve where it descends to the 3615 level.

Underground development work and surface activities at the Totten Mine involved as many as 500 people at one time. In order to maintain communications and most of all safety, one of the things that Bob Booth says sets the Totten Mine apart from many of the others is the number of sophisticated electronic devices that are used to keep in touch with what's going on in and around the mine.

"Everything from the top of the head frame, down the shaft, to the ore faces, to the equipment and the operators working at them, are being monitored to help ensure safety at all levels," says Booth.

"There's not an inch of this mine, nor a person or piece of equipment in it, that's not under the watchful eye of our central control team and that's a good thing because we're determined to make the Totten Mine the safest and most productive place to work.

"What's more, we have a motto to live up to: "One team, one-way to zero harm" and we are continuing this culture into the operations phase of the Totten Mine." CMJ