

The Art of Mining: Shaping the Mine of the Future

As described on PwC Canada's website: 'The art of mining is a photography competition that aims to highlight the positive impact the mining community is delivering across the world'. In 2017, the second year of this annual contest, the theme was 'How is your organization transforming the face of mining through diversity and innovation?' Prior to the annual Prospectors & Developers Association of Canada (PDAC) convention, Canadian mining companies, were invited to submit a photo based on this theme.

Prizes are awarded to the top three winners: a financial donation to a charity or community program as determined by the winning company. In a reception held at the Art Gallery of Ontario, 700 attendees enjoyed an exclusive art exhibition of the 22 finalists' photo entries.

In December 2016 Denison Mines requested pictures from all of their operations across Canada for an internal contest and the photo chosen to represent Denison at the art exhibition was a view of Dam 10 at the former Denison Mine site in Elliot Lake. Denison's Dam 10 is

part of a decommissioned site that contains the tailings from 35 years of active uranium mining in the region, and is an example of how Denison's Environmental Services ("DES") division takes pride in achieving engineering in balance with nature. Faced with historically low uranium prices, Denison has taken an innovative view of turning its historic mining liabilities in Elliot Lake into an asset - relying on the "resourcefulness" of its staff at DES to care for its own decommissioned sites and serve others in the Canadian mining industry as a

means to help fund the company's next generation of uranium mining in the Athabasca Basin region in northern Saskatchewan.

Although our photo was not the grand prize winner, it was an honour to have been selected as a finalist along with a number of mining giants - Goldcorp Inc., BHP, IAMGOLD Corporation, Kinross Gold Corporation, Lundin Mining Corporation as well as Agnico Eagle Mines Limited, the grand prize winner who received a \$10,000 donation to their community program or charity of their choice.



Denison Dam 10

New Faces at Denison Environmental Services

2016 and 2017 saw multiple changes for the workforce of Denison Environmental Services (DES) Elliot Lake. DES continues to provide a diverse team of professionals with a dynamic vision for the future. We are proud to introduce the following additions to our Elliot Lake team.

Janet Lowe B.Sc. - General Manager. Janet has functioned as an Operations Executive and/or as a technical expert in Environmental Permitting and First Nations Consultation. Janet has strong technical and business qualifications with over 25 years of hands-on experience in business development and management.

Adam Cecchetto B.Sc. (EV) EP - Environmental Scientist. Adam brings 14 years of experience working in the environmental field. Adam's diverse experience in mine permitting, closure planning, mine site environmental operations and permitting along with Governmental and First Nations consultation provides new possibilities for the future of DES.

Eric Drouin - Operations. Eric joined our Electrical Division in February 2017. He is a 3rd Year Electrical Apprentice and is a valuable asset to the DES team. Eric has also achieved his Computer Engineering Technology Diploma and provides IT services to the DES division of Denison Mines.

Sandy Ibbitson - Occupational Health and Safety Coordinator. Sandy returned to the DES team in the summer of 2017 to provide health and safety expertise for DES workers at our sites across Canada. Sandy is also available to provide training for employees of businesses and organizations in communities both near and far from Elliot Lake. The training opportunities include First Aid/AED/CPR A&C, Fit testing and Basic training for Joint Health & Safety Parts 1 and 2.

Hélène McLean - Finance Manager. Hélène brings 16 years of financial and administrative experience in Project Administration, Project Management, budgeting and Financial Control.

Stephane Desjardins ET - Environmental Technician. Steph joined our team in the spring of 2017. Steph's training in Environmental Management and as an Environmental Technician make him a valuable asset to the Environmental group, providing Care & Maintenance 24/7 of the closed mines sites in Elliot Lake.

Simon Xian P.Eng. - Sr. Project Engineer. Simon brings 21 years of strength as a professional Environmental and Chemical engineer with experience and skills in performance analysis for environmental and operational excellence, strategic planning, project and process development as well as regulatory auditing, quality control and scope of work design.

Christopher Massicotte ET - Environmental Technician. Chris joined our team mid-2016 as a post graduate with honors in Environmental Technician, Protection and Compliance. Chris is a welcome addition to the Environmental team, providing Care & Maintenance 24/7 of the closed mines sites in Elliot Lake.

Jason Charette - Operations. Jason started with our Denison Operations division in January 2017. Initially hired to provide support as an A-Z truck driver, Jason has achieved his license as a Pesticide Exterminator for Industrial Vegetation - 2009 and now leads our Operations group in controlling site vegetation on dams and roadways.

Allison Armstrong, BA Honours - Junior Environmental Scientist. Allison accepted a full time position at DES in September 2017. Previously Allison was one of our summer students, from 2014-2016, acting in the role of Environmental Assistant while she worked toward her BA Honours in Geography and Environmental Studies at the University of Ottawa. Allison has considerable field experience and will be working in Elliot Lake as support for our Projects division.



2017 Mine Tours: Photo by Ann Paton, BHP

Mine Tours

As part of the annual "Uranium Heritage Days", Rio Algom Limited (RAL) and Denison Mines Inc. (DMI) partner to sponsor and host public bus tours of the decommissioned mines sites and tailings management areas. Tours are hosted by representatives of both RAL and DMI.

In 2017, each day the tour bus was full of engaged and interested guests from a wide variety of age groups.

A special thanks to Darla Hennessey and her crew at the Elliot Lake Nuclear and Mining Museum for efficiently coordinating these tours on our behalf!

Small Projects in Elliot Lake

Although it may not be as evident to Elliot Lake residents, it has been a busy two years for Denison Environmental Services (DES) in Elliot Lake. In addition to our Care & Maintenance contract with BHP, DES completed and participated in various other projects on the closed mine sites. These projects included improvements to aging facilities and equipment, tests of water treatment alternatives and improvements to enhance the safety of our workers.

The largest project was the complete retrofit of the Quirke effluent treatment plant (ETP). Details are highlighted in the following article, Quirke ETP Renovation, on page 7. Other projects included provision of ice auger operators and snowmobiles for a winter water sampling program, repairs to the Quirke transformer station switchgear, dye testing of the Quirke effluent water as it enters the Serpent River and application of a



Quirke ETP Before

membrane roof coating at the Panel treatment plant.

DES performed flocculant testing and resin testing at the Stanleigh treatment plant in an effort to optimize treatment. Additionally, we provided data for a radiation public dose survey by sampling City drinking water and measuring the radiation dose that would be received from walking on the closed mine sites in the area.

Another larger project that DES completed was the fabrication of a working platform at the top of the Nordic plant lime slurry tank. The platform was engineered locally, parts fabricated at our shop and then welded in place at the Nordic plant. The platform allows for workers to safely access the top of the lime slurry tank for inspection and regular washing of the tank contents.

A final project that was started in 2016 was the provision of workers and a boat for a bathymetric survey of the tailings and treated water settling ponds at the BHP closed mine sites. This project was completed in 2017.



Quirke ETP After

Nordic History

The Nordic tailings management area (TMA) is located approximately 7 km east of the City of Elliot Lake. The Nordic mine operated from 1957 to 1968 and the Nordic mill produced approximately 12 million tonnes of tailings. Tailings were deposited to the Nordic TMA which is composed of two areas (Nordic Main and Nordic West Arm) with a total area of approxi-

mately 107 hectares. Nordic Main is approximately 1,500 m long by 600 m wide and was constructed using mine waste embankments. Nordic West Arm is approximately 1,000 m long by 100 m wide.

The Nordic TMA was successfully revegetated in the late 1970's. In 1998-1999 tailings containment structures and precipitation management facilities were upgraded.



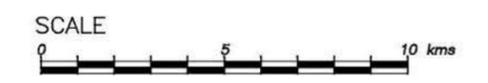
Nordic Buckles Tailings Management Area

This included placing layers of rock and till in areas of the West Arm to improve vegetation growth.

Current activities at the site include seasonal water treatment through a lime treatment plant, removal of vegetation from site dams, inspections of the cover and facility conditions, and environmental monitoring. The site complies with all environmental regulations and licences and has been an excellent example of mine closure done right in Ontario.

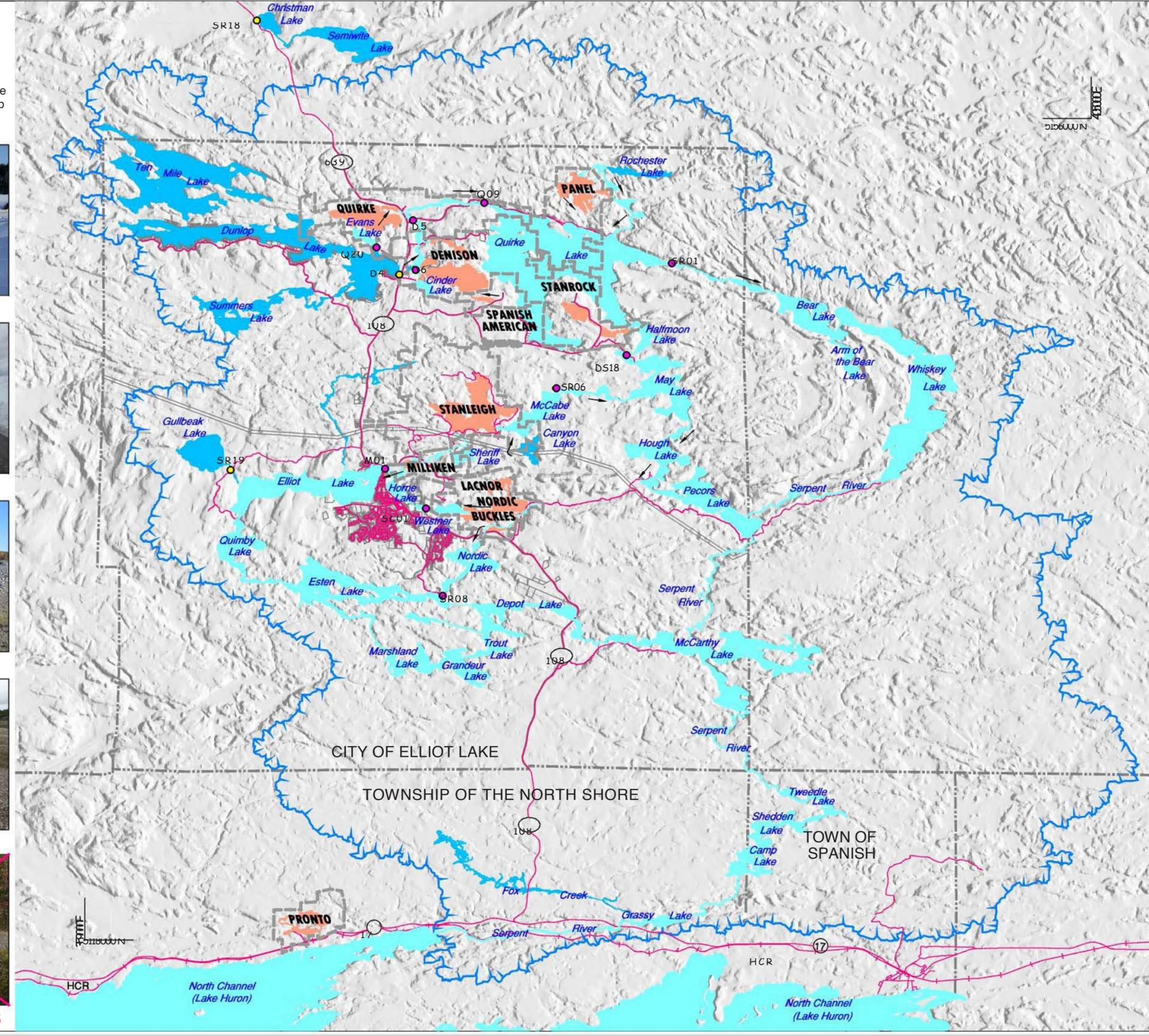
Serpent River Watershed Monitoring Program Cycle 4

October 2015



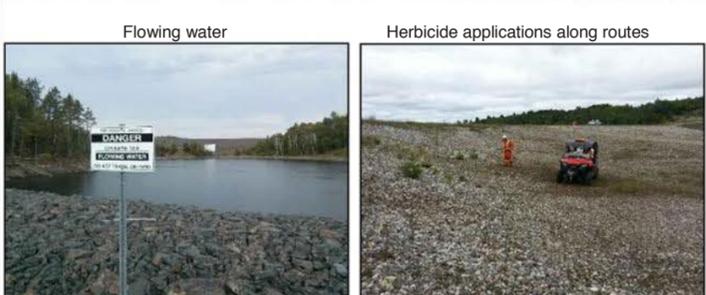
- Legend**
- Public Roads.
 - Railway.
 - Limit of Mine Properties.
 - Tailings Management Areas (TMA).
 - Exposure Lakes (Included in SRWMP).
 - Reference Lakes (included in SRWMP).
 - Water Sample Location (Exposure).
 - Water Sample Location (Reference).
 - Direction of flow.
 - Exterior limit of the Serpent River Watershed.

- Produced under Licence with the Ministry of Natural Resources (MNR) © Queens Printer for Ontario, 2015.
 - The watershed as shown is courtesy of the MNR.
 - No endorsement by this Ministry or the Ontario Government is implied by the use of their mapping products.
 - Additional mapping was provided by The City of Elliot Lake Engineering Department.



Know the Hazards Access at Your Own Risk

Sites are rugged with boulders, protruding objects, covered mine openings and uneven ground conditions. Removal of any materials from these sites is strictly prohibited. Exercise caution and restrict your travel to marked trails and routes. Consider your own level of fitness and the limitations of the equipment that you are using. Visitors should be aware of wildlife including bears and should always keep their dogs on leash while visiting the sites.



IN CASE OF EMERGENCY CALL: 705-461-0466



Emergency Response

Denison Environmental Services (DES) plans for emergencies so we can respond appropriately and effectively to emergencies or situations which have the potential to occur with local dams. DES is responsible to plan, prepare and respond to a safety emergency involving a dam that we own or maintain.

Most dam safety activities fall within the normal day-to-day responsibility of DES, as part of our routine monitoring and dam surveillance program. Minor defects in appearance are observed and recorded. Since the consequences of a dam failure could be significant, all efforts are made to prevent minor events from developing into catastrophic failure. If there is any doubt as to whether a particular change in appearance or minor defect could become dangerous, they are acted upon immediately.

DES has developed Emergency Action Plans (EAPs) for all of our closed mine sites in Elliot Lake. An EAP is a formal but simple plan that identifies potential emergen-

cy conditions that could occur at a dam, and prescribes procedures to follow to minimize the potential for property damage. Ideally, the design, construction, operation, maintenance, and inspection of dams are all intended to minimize the risk of dam failures. Despite the adequacy of these programs, rare and unique situations may develop that may result in dam failure.

It is prudent for dam 'owners' to develop and maintain an EAP so that emergency measures can be initiated that could prevent or minimize the consequences to life and property. Every year DES updates, discusses and plans EAPs. Table top exercises provide a practical check list of procedures to follow, in case of disaster. We discuss critical procedures and planning documents needed to ensure every disaster scenario has been covered, with key personnel discussing simulated scenarios in an informal setting.

For more information on DES's emergency response, contact our office at 705-848-9191.



Road Wash Out

Radiation Exposure for Hikers

All of the closed uranium mine sites in the Serpent River Watershed have undergone decommissioning and reclamation, and are currently in their post-closure phase. Denison Environmental Services (DES) has been overseeing their care and maintenance for environmental protection and public safety. A significant part of the post-closure phase is radiation monitoring for the safety of the public and the workers.

Uranium mine tailings and mineralized waste rocks have to be managed over a long period of time because they often contain radioactive material like thorium and radium along with their associated decay products. During reclamation of the Elliot Lake mine sites, the tailings were covered either by water or vegetation to minimize radiation exposure and the generation of acids. On some sites, the water in tailings management areas (TMAs) continues to be treated with barium chloride to minimize radium levels in the water. Radium decays into radon gas, and thus it is important to keep radium levels as low as possible. Water samples continue to be collected and tested regularly to ensure radium levels do not exceed regulatory limits set by the Canadian Nuclear Safety Commission (CNSC). Despite these control measures, it should be noted that radiation levels at the TMAs are a bit higher compared to most other areas in Elliot Lake.

To assess public radiation exposure following reclamation in late 1990s and early 2000s, data was collected from walking surveys with radia-

tion detectors, drinking water tests and fish tests. The results showed that the incremental dose from radiation for a member of the public, spending an assumed 200 hours on a TMA is about 0.016 mSv/year. In comparison, the effective radiation dose limit for the public is 1 mSv/year under Canadian regulation.

It had been over a decade since the last radiation survey was conducted. Therefore new data was collected to update the incremental public radiation dose. In 2016, several components of the radiation monitoring program were completed. This included quarterly site specific radiation surveys of public walking trails (radon and direct Gamma), analysis of radionuclides in drinking water and a community survey. The survey was conducted to determine the time a representative person spent hiking on the mining properties as well as information about their consumption of fish on local lakes. A report is currently underway to update the recent public dose estimation using the data collected in 2016.

The 2016 survey numbers thus far indicate that it is completely safe to hike at the closed mine sites including the TMA's. However, hikers (especially with dogs) and other recreational visitors also have a responsibility to minimize their exposure to radiation and other hazards by ensuring that they

Continued on page 7

Radiation Exposure

Continued from page 6

DO NOT:

- Approach water bodies in TMAs
- Allow their dogs to play in or near water bodies in TMAs
- Remove any vegetation, soil or rocks from the TMAs
- Damage any dams, dykes, tailings vegetation cover or other structures. ATVs, snowmobiles, etc. are prohibited on sites to prevent such damages.

Quirke ETP Renovation

The Quirke Effluent Treatment Plant ETP is located 15 km north of Elliot Lake. The 192 ha TMA is located within an east-west trending bedrock valley with a number of dams in topographic low areas providing containment for 46 million tonnes of tailings and waste rock.

Surface water from the facility is treated with lime and barium chloride at the outlet of the eastern basin and released to a series of settling ponds for removal of solids prior to final discharge to the Serpent River.

Rio Algom Limited (RAL) constructed the existing Quirke Effluent Treatment Plant during the time of mine expansion in the early 1980s. While the plant operates reliably and consistently achieves discharge criteria, the facility was aging and in need of a renovation.

RAL retained the services of an engineering firm in 2014 to re-

view the structural integrity of the plant and support operational review. This review's intent was to improve ease of maintenance as well as secondary containment and to allow for an upgrade of the electrical system to current code compliance. This renovation work does not alter the basic treatment process (e.g. treatment rate, lime or barium chloride addition) nor treatment performance, but will improve safety of operations.

Renovations included a new automated programmable logic controller (PLC), interior secondary containment, replacement of the roof, siding and insulation, exterior concentrated lime tank steel cladding, barium chloride tank replacement, electrical upgrades and the addition of a propane backup heater.

Site Safety

At the entrance to every site owned by Denison Mines (DM) there are warning signs. Please read the signs posted on or at all gates to the sites. We want you to know what you may encounter if you choose to park and/or walk at the sites. Remember, these are not just big open spaces. These are closed mine sites, with Tailings Management Areas (TMAs) covered by vegetation or water, and licensed under the Canadian Nuclear Safety Commission (CNSC).

TMAs use geographical features and man-made barriers such as dams to contain the tailings. They are designed to ensure that groundwater and surface water is diverted from

the tailings to prevent any contamination. Tailings are a type of waste from the mining industry. When a mineral product was mined, the valuable portion was embedded in ore. Once the ore was stripped of its valuable minerals, tailings remained. Tailings can reach immense proportions, appearing in the form of large hills or deposited within ponds on the landscape. Water is collected and processed through a water treatment plant to remove contaminants and the resulting effluent must meet regulated quality requirements before it is permitted to be discharged into the environment.

Hunters and those who have breached the gates on snow machines or ATVs will be escorted from site. It is prohibited to hunt or to drive motorized recreational vehicles on the sites because once you leave the roads on the site, you will never know if you are traveling on trails or over tailings covered with vegetation. The vegetation acts as a protective cover over the tailings and if disturbed by recreational vehicles, the tailings become exposed to the environment and to people who pass over that area. That waterbody you see isn't a lake you can fish in, it is likely a tailings area with a water cover.

Remember, what is behind those gates are work sites. You may encounter beaver traps, transports full of lime, barium being moved from one plant to another and/or trucks with environmental technicians ensuring water treatment. Please think twice before stepping onto the Denison sites.

For more information on site safety, contact our office at 705-848-9191.

Take Time to Read the Signs



Be Aware of Dangers



Mine Sites are Private Properties



Construction at sites: Site closed



No Parking Areas

Keeping in Touch

You are invited to keep in touch and stay informed about Denison Mines (DMI) and Rio Algom's (RAL) activities in the Serpent River Watershed. Each summer the Nuclear and Mining Museum organizes tours of the mine sites as part of the Uranium Heritage Days festivities (Thank You Darla Hennessey!). Annually, both DMI and RAL provide a public presentation to Elliot Lake Council. If you prefer written material, our newsletter is published annually in the Standard and our technical reports on the Serpent River Watershed are available at the Elliot Lake library or by contacting either Janet Lowe at Denison Environmental Services or the Site Superintendent at Rio Algom Limited. If your group or organization is interested in a presentation on our activities or would like to arrange a group tour of our sites, please complete the response form on the right.



Marsh Boardwalk at Sherriff Creek
Photo by Brenda Clark

Response Form



We'd like to hear your thoughts about our performance in the operation, care and maintenance of our closed mine sites. Please call us or send us a note. We'll respond as quickly as possible.

Elliot Lake Closed Mine Site
Operation, Care and Maintenance

Question(s):

Cut out this form and use it to mail your comments to:

I'd like to know more about:

Rio Algom Limited
Attn: Site Superintendent
P.O. Box 38
Elliot Lake, Ontario
P5A 2J6
ClosedSiteEnquiry@bhpbilliton.com

or

Janet Lowe
General Manager
Denison Mines Inc.
1 Horne Walk, Suite 200
Elliot Lake, Ontario
P5A 2A5
JLowe@denisonenvironmental.com

Your name and address (please print):

Telephone:

Fax:

E-mail:

Date:

**Thank You,
 Merci and Miigwetch!**