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A F R I C A

# CANADA MINING

PROJECTS IN PROGRESS  
FEBRUARY **2019**

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#### UNITS OF MEASUREMENT

The distinction between tonne (1 000 kg) and ton (1 016.047 kg) is maintained in this report according to the information that is reported in the public domain by each company.

The material contained in this report was compiled by Sheila Barradas and the Research Unit of Creamer Media (Pty) Ltd, based in Johannesburg, South Africa.

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Picture by Bloomberg

# MINING IN CANADA

Canada is one of the leading mining countries and one of the largest producers of minerals and metals in the world.

It produces about 60 different minerals and metals, and ranked in the top five countries in the global production of 13 major minerals and metals in 2017. Metals mines – such as those mining gold, copper, nickel and zinc – account for two-thirds of the value of major mining-related projects.

Nonmetal mines – such as those mining potash, diamonds and coal – account for most of the rest.

Natural Resources Canada's 'Natural Resources: Major Projects Planned or Under Construction – 2018 to 2028' report, released in August 2018, shows that there were 108 major mining-related projects – including mine constructions, redevelopments, expansions and processing facilities – in the project inventory, representing \$72-billion in potential investment.

There was strong support for new mining investment, with 31 new mining-related projects, and a combined capital cost of \$13-billion being added to the inventory. However, the total



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value of mining-related projects in the inventory declined, owing to a combination of project completions amounting to \$11-billion and project cancellations and suspensions of about \$4-billion.

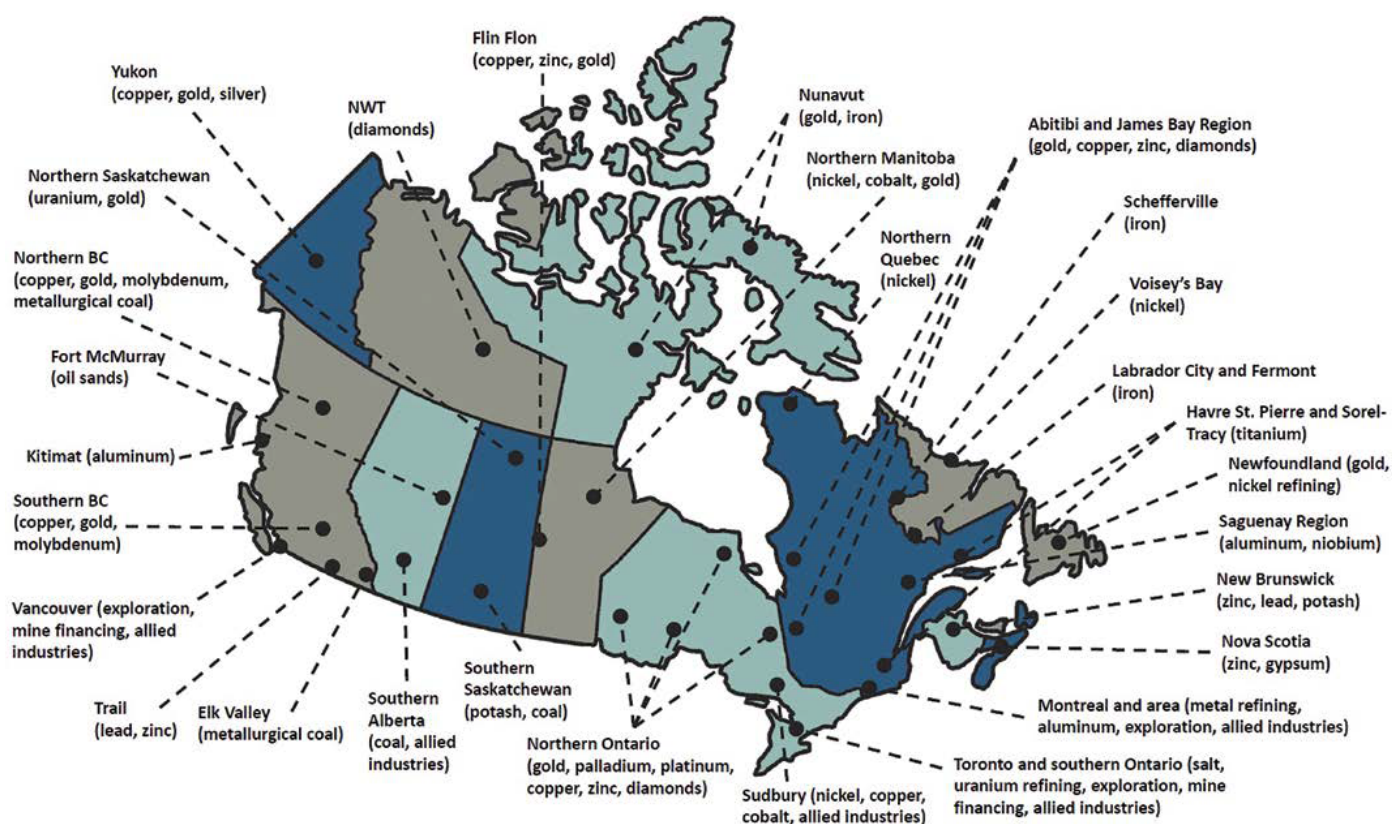
Of the mining-related projects, Saskatchewan accounts for 24% of the total value, British Columbia for 21%, Quebec for 16% and Ontario for 14%.

The remaining projects are spread across all provinces and territories, with the exception of Prince Edward Island.

In this inaugural edition of Creamer Media's Canada Mining Projects in Progress, we present a selection of these mining projects announced over the past few months, including those in the preliminary economic assessment/scoping study phase, prefeasibility and bankable/definitive feasibility study phase.

## Canadian mining industry clusters

Canada's rich mineral endowment has led to the development of major mining regions such as the Labrador Trough on the Quebec-Newfoundland and Labrador border for iron-ore; the Abitibi goldbelt (Quebec and Ontario); the nickel/copper/platinum group elements mines of the Sudbury region (Ontario); the potash and uranium mines of Saskatchewan; the metallurgical coal, copper/gold and molybdenum mines of British Columbia; and the diamond mines of the Northwest Territories. Mineral exploration also includes emerging commodities – such as rare-earth elements, graphite and lithium – used in highly valued applications in the clean technology and information technology sectors.



Source: Facts & Figures 2017: Facts and Figures of the Canadian Mining Industry





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# COAL

## GORDON CREEK COAL PROJECT

### Name of the Project

Gordon Creek coal project.

### Location

The project is located about 27 km south-south-east of Tumbler Ridge in north-east British Columbia, Canada.

### Client

Colonial Coal.

### Project Description

The results of a preliminary economic assessment (PEA) have shown Gordon Creek to have positive economics worthy of further exploration and development.

The PEA is based on a conceptual underground mine plan that targets 111.60-million run-of-mine tonnes of resource, with a yield of 51% producing 57.40-million tonnes of clean coal over a mine life of 30 years. Coal will be mined from seams B to G, and premium pulverised coal injection coal from seams J and K that will be mined last. Seams J and K are the two deepest seams and represent about 28.60% of the reported resources and about 31.50% of the reported saleable tonnes.

In full mine operation, projected clean coal production ranges from 1.60-million tonnes a year to 2.60-million tonnes a year averaging about 1.90-million tonnes a year.

### Potential Job Creation

Not stated.

### Net Present Value/Internal Rate of Return

The project has an indicative after-tax (and royalty) net present value, at a 7.50% discount rate, of \$690.50-million and an internal rate of return of 24.40%, based on a weighted average coking coal price of \$164.80/t and a premium pulverised coal injection, or PCI, coal price of \$140.50/t. The project's proposed payback of initial capital is estimated to be within three years from the start of coal production.

### Value

The project will cost about \$300-million to implement.

### Duration

Not stated.

### Latest Developments

None stated.

### Key Contracts and Suppliers

Stantec Consulting Service (PEA).

### On Budget and on Time?

Not stated.

### Contact Details for Project Information

Colonial Coal, tel +1 604 568 4962.





# COPPER

## NEW INGERBELLE COPPER/GOLD PROJECT

### Name of the Project

New Ingerbelle copper/gold project.

### Location

Southern British Columbia, Canada.

### Client

Copper Mountain Mining Corporation.

### Project Description

A preliminary economic assessment (PEA) has shown New Ingerbelle to be a low-capital, low-risk, high-quality development project. The project is expected to have total production of 768-million pounds of copper and 550 300 oz of gold over its expected 12-year mine life, based on measured and indicated resources only.

The PEA envisages New Ingerbelle mill feed being trucked to the Copper Mountain operation using Copper Mountain's existing mine equipment fleet, the 40 000 t/d mill and tailings facility.

Total mill feed mined is estimated at 175-million tonnes and total waste is expected to be 250-million tonnes for a low strip ratio of 1.43:1.

### Potential Job Creation

Not stated.

### Net Present Value/Internal Rate of Return

The project has an after-tax net present value, at an 8% discount rate, of \$394-million and an internal rate of return of 65%.

### Value

The total initial capital cost required to start operations at New Ingerbelle is estimated to be about \$130-million.

### Duration

Not stated.

### Latest Developments

Copper Mountain plans to evaluate various operational alternatives to test against this base case, which proposes to replace Copper Mountain mine production. The company plans to incorporate New Ingerbelle into the Copper Mountain mine plan using the existing mill, and study expanding the mill at Copper Mountain to increase the combined yearly production.

### Key Contracts and Suppliers

None stated.

### On Budget and on Time?

Not stated.

### Contact Details for Project Information

Copper Mountain, tel +1604 682 2992 or email Dan@CuMtn.com.





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# DIAMONDS

## RENARD DIAMOND MINE EXPANSION

### Name of the Project

Renard diamond mine expansion.

### Location

Quebec, Canada.

### Client

Stornoway Diamonds.

### Project Description

Renard diamond mine transitioned to underground mining in 2018.

Stornoway is investigating the potential for openpit mining at the Renard 4 and nearby Renard 9 kimberlites to supply additional ore feed earlier in the Renard diamond mine's life. Such a pit would allow the extraction of a portion, or all, of the estimated two-million carats of diamonds in the top 140 m of Renard 4.

These diamonds are contained within the project's indicated mineral resources, but are outside the current mineral reserve as they occur in the area of the proposed crown pillar for the Renard 4 underground mine. An openpit would require a water retention structure within the Lagopède Lake. If successful the openpit will enable Stornoway to take advantage of the expanded plant processing capacity offered by the new ore-sorting circuit.

### Potential Job Creation

Not stated.

### Net Present Value/Internal Rate of Return

Not stated.

### Value

Not stated.

### Duration

Not stated.

### Latest Developments

The results of the current sampling programme at the mine will be used to support an economic assessment for the development of a Renard 4-Renard 9 openpit.

### Key Contracts and Suppliers

None stated.

### On Budget and on Time?

Not stated.

### Contact Details for Project Information

Stornoway Diamonds manager – investor relations and business development Alexandre Burelle, tel +1 450 616 5555 or email [aburelle@stornowaydiamonds.com](mailto:aburelle@stornowaydiamonds.com).





## STAR-ORION SOUTH DIAMOND PROJECT

### Name of the Project

Star-Orion South diamond project.

### Location

The project is situated in the Fort à la Corne diamond district of central Saskatchewan, Canada.

### Client

Star Diamond Corp.

### Project Description

A preliminary economic assessment (PEA) has determined that an estimated 66-million carats of diamonds could be recovered from a surface mine over a 34-year life-of-mine. The PEA envisages the development of two openpits, initially Orion South, followed by Star, using conventional openpit methods.

Conventional hydraulic excavators and haul trucks create a starting "key" for three bucket wheel excavators (BWEs) to remove the sand and clay overburden from the kimberlite. Conveyor belts will transfer the sand and clay from the BWEs to the nearby overburden waste area. The exposed kimberlite will be lightly blasted and conventional hydraulic shovels will load the rock into trucks. These trucks will transfer the rock to an in-pit feeder and the kimberlite will be delivered to the processing plant using a conveyor belt.

The processing facility will have the capacity to process 45 000 t/d of kimberlite using autogenous milling, followed by screening, X-ray transmission diamond recovery and dense-media separation of heavy mineral concentrate.

The recovery section will use X-ray technology, with grease as the scavenging technology to recover the low-luminescence diamonds. The diamonds will be sorted into parcels in the on-site sorting facility.

### Potential Job Creation

Not stated.

### Net Present Value/Internal Rate of Return

The project has an after-tax net present value, at a 7% discount rate, of \$2-billion and an internal rate of return of 19%, with a payback of 3.5 years after the start of construction.



Star-Orion South diamond project high-value stones

### Value

Preproduction capital expenditure is estimated at \$1.41-billion.

### Duration

Not stated.

### Latest Developments

The Saskatchewan Ministry of Environment approved the Star-Orion South project in October 2018.

### Key Contracts and Suppliers

SGS Canada; DRA Americas and ENGCOMP Engineering and Computing Professionals (PEA).

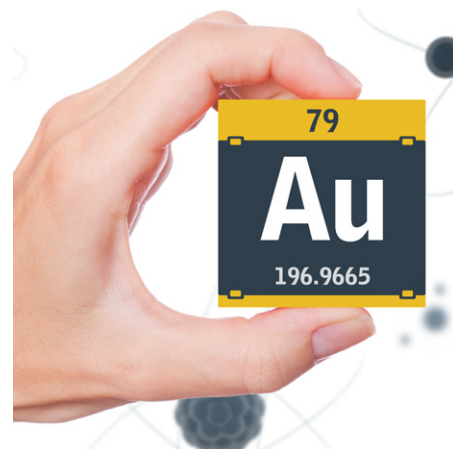
### On Budget and on Time?

Too early to state.

### Contact Details for Project Information

Star Diamond Corp, tel +1 306 664 2202 or email stardiamondcorp@stardiamondcorp.com.





# GOLD

## BRUCEJACK GOLD MINE EXPANSION

### Name of the Project

Brucejack gold mine expansion.

### Location

The project is located in north-western British Columbia, Canada.

### Client

Pretium Resources.

### Project Description

The project aims to increase the Brucejack mine's production from 2 700 t/d to 3 800 t/d, which will result in an average production rate of 1.39-million tonnes a year, up from 990 000 t/y.

### Potential Job Creation

Not stated.

### Net Present Value/Internal Rate of Return

Not stated.

### Value

Based on preliminary engineering, the capital cost to increase the mill capacity is estimated to be less than \$25-million, which is expected to be incurred in 2019.

### Duration

Not stated.



Picture by Pretium Resources

Brucejack mine

### Latest Developments

None stated.

### Key Contracts and Suppliers

None stated.

### On Budget and on Time?

Not stated.

### Contact Details for Project Information

Pretium Resources, tel +1 604 558 1784 or email [invest@pretium.com](mailto:invest@pretium.com).





## EAU CLAIRE GOLD PROJECT

### Name of the Project

Eau Claire gold project.

### Location

The project is located in James Bay, Quebec, Canada.

### Client

Eastmain Resources.

### Project Description

A preliminary economic assessment (PEA) has shown the robust economics for a combined openpit and underground mining operation, with a mine life of 12 years.



Picture by Eastmain Resources

Gold mineralisation at the Eau Claire gold project

The project has total mineral resources of 4.29-million tonnes grading 6.18 g/t gold.

The PEA schedule assumes combined openpit and underground operations of 6.40-million tonnes of mineralised material at a blended grade of 4.87 g/t gold for one-million contained ounces of gold over 12 years.

Proposed mining will start with openpit mining followed by underground mining.

The PEA proposes a conventional truck-and-shovel openpit operation, followed by ramp access and captive long-hole open stoping in the underground portion of the mine.

The mine plan is to extract the upper portions of the mineral resources (top 100 m) using openpit mining methods. While the openpit is producing, an underground portal will be established outside of the pit and an underground ramp will be extended below the proposed crown pillar.

The PEA envisages mining of 1.64-million tonnes of mineralised material at 3.78 g/t gold for 199 000 oz of gold over three years from the two openpits. The openpit operations comprise production from the Main pit (650 m × 275 m × 100 m depth) and the smaller West pit (260 m × 120 m × 40 m depth), to be mined at a bench height of 5 m. The openpits have an average strip ratio of 9.4:1.

Underground mining will progress by captive long-hole methods in a top-down fashion, with major sublevels every 24 m. The underground operation proposes mining of 4.76-million tonnes of mineralised material grading 5.24 g/t gold for 801 500 oz over 11 years. The average planned dilution factor has been conservatively applied at 40% at zero dilution grade.

Gold mineralisation will be processed in a 1 500 t/d process plant, using conventional crushing, grinding, cyanidation and carbon-in-pulp processes. The conventional cyanidation circuit includes a gravity concentration within the grinding circuit followed by direct cyanidation of gravity tails. The PEA recovery factor relies on metallurgical testwork conducted by SGS Lakefield Research, which indicates that gold recovery of 95% is attainable with gravity and cyanidation processes. A bond ball mill index of 11 kWh/t indicates material will not require high energy to be processed.



Tailings will be dewatered in the process plant and transported by truck to a geomembrane-lined tailings management facility (TMF), reducing the risk for potential surface and groundwater contamination.

The TMF design will incorporate engineered features to manage the chemical and physical stability of the deposited tailings in accordance with current best-in-class practices. This mitigation strategy is similar to those at other operations in the region.

#### Potential Job Creation

Not stated.

#### Net Present Value/Internal Rate of Return

The project has a pretax net present value (NPV), at a 5% discount rate, of \$381-million and an internal rate of return (IRR) of 32%. After-tax, the NPV is estimated at \$260-million, at a 5% discount rate, and the IRR at 27%, with a payback of 3.1 years.

#### Value

The project has a preproduction capital cost, including contingency, of \$174.70-million.

#### Duration

Not stated.

#### Latest Developments

Eastmain continues to move forward with its predevelopment plans for the Eau Claire project.

The company is progressing studies pertaining to the advanced exploration of the Eau Claire deposit through underground exploration and bulk sampling.

#### Key Contracts and Suppliers

P&E Mining Consultants (PEA) and SGS Lakefield Research (metallurgical testwork).

#### On Budget and on Time?

Not stated.

#### Contact Details for Project Information

Eastmain Resources investor relations consultant Laurenn Russell, tel +1 647 347 3735 or email [Lrussell@eastmain.com](mailto:Lrussell@eastmain.com).

## GOLDBORO GOLD PROJECT

#### Name of the Project

Goldboro gold project.

#### Location

Nova Scotia, Canada.

#### Client

Anaconda Mining.

#### Project Description

Goldboro is an advanced exploration and development project.

A preliminary economic assessment completed on the project in January 2018 envisages an openpit and underground mining operation, on-site concentration through gravity and flotation circuits and leaching of the concentrate and gold recovery at Anaconda's Pine Cove mill, in Newfoundland.

The operation is expected to have an 8.8-year mine life, with 2.40-million tonnes of potential mill feed at an average grade of 5.13 g/t of gold and a recovery rate of 93.60%, resulting in gold production of 375 900 oz.

Mining is expected to be conducted at 600 t/d of mineralised material at an average openpit grade of 2.99 g/t and an underground grade of 6.83 g/t.

Processing will be conducted at 800 t/d to 600 t/d of run-of-mine high-grade material and rehandle of 200 t/d of stockpiled openpit lower-grade material.

Average gold production is estimated at 41 770 oz/y.

#### Potential Job Creation

There is potential for up to 200 jobs to be created at the peak of production.

#### Net Present Value/Internal Rate of Return

The project has a pretax net present value, at a 7% discount rate, of \$120-million and an internal rate of return of 38%, with a payback 2.9 years.

#### Value

Preproduction capital is estimated at \$47-million.



**Duration**

Not stated.

**Latest Developments**

Anaconda completed its 10 000 m drill programme, which began in July 2018, in December and is developing plans for an additional 5 000 m of drilling in the first half of 2019. Results from these programmes will be incorporated into an updated mineral resource estimate and form the basis of a feasibility study to be completed in this year.

**Key Contracts and Suppliers**

None stated.

**On Budget and on Time?**

Not stated.

**Contact Details for Project Information**

Anaconda Mining, tel +1 416304 6622,  
fax +416363 4567 or  
email [info@anacondamining.com](mailto:info@anacondamining.com).

**KNIGHT GOLD PROJECT****Name of the Project**

Knight gold project.

**Location**

The project is located in the Shining Tree district, in Ontario, Canada, within the prolific gold-producing Abitibi greenstone belt.

**Client**

Orefinders Resources.

**Project Description**

The project is a consolidation of six adjacent, high-potential properties with similar geology, along with significant drilling, exploration and development:

Tyrannite is past-producer with significant infrastructure in place and a historical resource of 472 000 t at 6.90 g/t gold, and 40 holes (8 762 m) drilled between 2009 and 2011. Minto is a very high-grade breccia pipe with a historical resource of 225 000 t at 6.20 g/t gold, and 16 holes (7 815 m) drilled between 2009 and 2012.

Porphyry Lake is a mineralised porphyry system with elevated gold values. This property hosts a similar high-grade breccia pipe to that of Minto, with five holes (853 m) drilled between 2011 and 2017.

Duggan has a similar high-grade geological setting and mineralisation to that of Tyrannite, with openpit potential, and 20 holes (7 680 m) drilled between 2007 and 2013.

Further, the Knight project abuts the Pan American Silver-owned multimillion-ounce Jubly gold project to the south.

Orefinders considers the Knight gold project on par with Iamgold's Cote Lake project, which would require further consolidation with Jubly to create a significant district-scale multimillion-ounce asset in the heart of Ontario that can easily be accessed by road.

**Potential Job Creation**

Not stated.

**Net Present Value/Internal Rate of Return**

Not stated.

**Value**

Not stated.

**Duration**

Not stated.

**Latest Developments**

Orefinders recently compiled and integrated all previous work on Knight, helping further define exploration plans and targets. Three-dimensional models were also generated for the Tyrannite, Minto, Porphyry Lake and Duggan properties as a result of the data compilation.

**Key Contracts and Suppliers**

None stated.

**On Budget and on Time?**

Not stated.

**Contact Details for Project Information**

Orefinders, tel +416 644 1567 or email [info@orefinders.ca](mailto:info@orefinders.ca).  
Orefinders CEO Stephen Stewart, email [ss Stewart@orefinders.ca](mailto:ss Stewart@orefinders.ca).





## MAGINO GOLD PROJECT

### Name of the Project

Magino gold project.

### Location

The project is located 40 km north-east of Wawa, Ontario, Canada.

### Client

Argonaut Gold.

### Project Description

A feasibility study on the project has determined that the Magino project is a strategic, long-life asset.

The project has total proven and probable reserves of 59-million ounces grading 1.13 g/t gold.

Envisaged is a 115 700 oz/y gold operation with a 17-year mine life.

Openpit mining operations will use a fleet comprising 16 m<sup>3</sup> front shovels, a 13 m<sup>3</sup> front-end loader and 140 t haul trucks.

This fleet will be supplemented by drills, graders, and track and rubber-tire dozers.

A 10 000 t/d processing facility has been selected for the feasibility study, compared with the 30 000 t/d plant presented in the January 2016 prefeasibility study.

The adopted flowsheet includes primary crushing, single-stage semiautogenous grinding and a gravity recovery circuit, as well as a cyanide leach and carbon-in-pulp gold adsorption circuit with cyanide recovery and detoxification, as well as thickening, before tailings are discharged to a tailings facility.

### Potential Job Creation

Not stated.

### Net Present Value/Internal Rate of Return

The project has a pretax net present value, at a 5% discount rate, of \$408-million and an internal rate of return of 22.6%, with a payback of 3.8 years.



Picture by Argonaut Gold

Magino gold project

### Value

Total capital costs have been estimated at \$405-million.

### Duration

The project is expected to be completed over 24 months.

### Latest Developments

Argonaut Gold has received a positive decision statement for the environmental assessment (EA) under the Canadian Environmental Assessment Act 2012 for its Magino project.

The decision follows an EA conducted by the Canadian Environmental Assessment Agency with participation of indigenous groups, public and federal departments, including Fisheries and Oceans Canada, Environment and Climate Change Canada, Natural Resources Canada, Health Canada and Transport Canada. Argonaut President and CEO Pete Dougherty has said the approval of the EA is a "major milestone".

Subsequent key authorisations under way for Magino include the conclusion of the provincial EA, the construction permit, the mine closure plan and the Schedule 2 authorisation.



The company expects the conclusion of the provincial EA later in the first half of 2019 and subsequent authorisations during 2020.

### Key Contracts and Suppliers

None stated.

### On Budget and on Time?

Not stated.

### Contact Details for Project Information

Argonaut Gold, tel +1 775 284 4422, fax +1 775 284 4426 or email [info@argonautgold.com](mailto:info@argonautgold.com).

## MIRADO GOLD PROJECT

### Name of the Project

Mirado gold project.

### Location

The project is located 35 km south-east of Kirkland Lake, in Ontario, Canada, within the prolific gold-producing Abitibi greenstone belt.

### Client

Orefinders Resources.

### Project Description

A preliminary economic assessment (PEA) has demonstrated positive economics for the extraction of the mineral resources using successive openpit phases.

The PEA considers production from a specific area only (the South zone), which encompasses about 5% of the Mirado project. The mineral resources contemplated by the PEA are within the South zone's openpit and are near-surface mineralisations that can be economically mined within a relatively short timeframe and without using on-site processing or a tailings facility.

Current mineral resources are estimated at 559 000 t at an average grade of 2.61 g/t gold for 46 900 oz of indicated mineral resource and an additional inferred mineral resource of 382 000 t at an average grade of 2.66 g/t gold for 32 700 oz, based on a cutoff grade of 1 g/t gold.

The PEA schedule proposes mining 996 000 t of mineralised material in the openpit at an average grade of 2.33 g/t. Mining recovery has been estimated at 97% and dilution at 15%. Proposed mining will begin with prestripping and then expanding Mirado's existing openpit. The PEA proposes a conventional truck-and-shovel operation with ramp access. Since the life-of-mine being considered is relatively short, the mining operation will be conducted on a contract basis.

### Potential Job Creation

Not stated.

### Net Present Value/Internal Rate of Return

The project has a pretax undiscounted net present value (NPV), at a 5% discount rate, of \$30.80-million and an after-tax NPV of \$20.50-million, and an after-tax internal rate of return of 158%. Payback has been estimated at seven months from the start of mill feed production of the openpit.

### Value

The initial preproduction expenditure to achieve first production from the openpit is estimated at \$2.40-million.

### Duration

The project life is three years, after approximately six months of openpit pre-stripping.

### Latest Developments

Orefinders recently compiled and integrated all previous work on Mirado, helping further define exploration plans and targets. A three-dimensional model was also generated as a result of the data compilation, and is consistent with previous interpretations. The next stages of the Mirado project will be to advance the current project to support a prefeasibility study and to develop other zones beyond the South zone and current PEA.

### Key Contracts and Suppliers

None stated.

### On Budget and on Time?

Not stated.

### Contact Details for Project Information

Orefinders CEO Stephen Stewart, tel +416 644 1567 or email [ss Stewart@orefinders.ca](mailto:ss Stewart@orefinders.ca)/info@orefinders.ca.



## RED MOUNTAIN UNDERGROUND GOLD PROJECT

### Name of the Project

Red Mountain underground gold project.

### Location

The project is located about 18 km north-east of the District of Stewart, in the Nass Wildlife Area, of British Columbia, in Canada.

### Client

IDM and Ascot Resources recently entered into a definitive arrangement agreement whereby Ascot will acquire all outstanding common shares of IDM. This transaction will result in the consolidation of Ascot's Premier gold project and IDM's Red Mountain project to create the leading high-grade gold development and exploration company in British Columbia's Golden Triangle.

### Project Description

IDM has proposed the construction of 147.20 ha underground gold and silver mine.

The mine is expected to extract an estimated 1 000 t/d of ore, with a net production of 365 000 t/y, during the mine's six-year operational life.

Envisaged is a year-round, high-grade underground gold/silver operation using bulk mining methods, primarily long-hole stoping.

Mineralised material will be trucked to a mill located within the adjacent Bitter Creek valley, producing gold/silver doré bars.

Tailings will be stored within a lined storage facility, with water treated prior to discharge.

### Potential Job Creation

The project is expected to create 103 direct full-time equivalent local jobs, with an additional 72 direct jobs generated in British Columbia.

### Net Present Value/Internal Rate of Return

Not stated.

### Value

Not stated.



Picture by IDM Mining

Red Mountain underground gold project site

### Duration

The project is expected to take 18 months to complete.

### Latest Developments

Canada's Environment and Climate Change Minister Catherine McKenna announced an environmental decision for the Red Mountain project in January 2019.

The Minister has said that the proposed mine is not likely to have significant adverse environmental effects, if the 120 stipulated conditions are met. These conditions include measures to protect fish and fish habitat, migration of birds, species at risk, human health, physical and cultural heritage, as well as the current use of lands and resources by traditional Indigenous peoples.

The Red Mountain project has already gained provincial environmental approval.

### Key Contracts and Suppliers

None stated.

### On Budget and on Time?

Not stated.

### Contact Details for Project Information

IDM Mining investor relations Vanessa Pickering  
tel +1 604 681 5672 or email vp@idmmining.com.



## VALENTINE LAKE GOLD CAMP PROJECT

### Name of the Project

Valentine Lake Gold Camp project.

### Location

Newfoundland, Canada.

### Client

Marathon Gold.

### Project Description

The Valentine Lake Gold Camp currently hosts four near-surface, mainly pit-shell constrained, deposits with measured and indicated resources totalling 2.69-million ounces of gold at 1.85 g/t and inferred resources totalling 1.53-million ounces of gold at 1.77 g/t. The majority of the resources occur in the Marathon and Leprechaun deposits, which also have resources below the pit shell. Both deposits are open to depth and on strike.

Gold mineralisation has been traced down more than 350 m vertically at Leprechaun and almost a kilometre at Marathon.

The four deposits outlined to date occur over a 20 km system of gold bearing veins, with much of the 24 000 ha property having had little detailed exploration activity to date.

An updated independent preliminary economic assessment (PEA) has optimised the development of the Valentine Lake Gold Camp mineral resource by employing openpit mining and will encompass two gold recovery operations – a milling/flotation/carbon-in-leach (CIL) plant and a heap-leach plant.

The mill will process three-million tonnes a year of high-grade mineralised material. The plant will consist of crushing, milling, gravity recovery, flotation of gravity tails, flotation concentrate regrind, cyanidation leaching of flotation concentrate and flotation tailings through a CIL circuit, carbon elution and gold recovery circuit. CIL tails will be treated for cyanide destruction and disposed of as tails in the tailings storage facility.

The heap-leach pad will process three-million tonnes a year of low-grade mineralised material from openpit operations and will consist of crushing, heap leaching and carbon-in-column gold adsorption. The loaded carbon from the heap-leach facility



Picture by Marathon Gold

Valentine Lake Gold Camp project

will be sent to the mill facility for gold recovery. The project is expected to produce 2.72-million ounces of gold over the life of the project, or an average of 225 100 oz/y over a 12-year mine life.

### Potential Job Creation

Not stated.

### Net Present Value/Internal Rate of Return

The project has an estimated net present value, at a 5% discount rate, of \$493-million and an internal rate of return of 30%, with a capital payback of 2.5 years.

### Value

Preproduction capital is estimated at \$355-million.

### Duration

Initial production is expected in 2022.

### Latest Developments

None stated.

### Key Contracts and Suppliers

Lycopodium Minerals Canada, John T Boyd Company, Apex Geoscience and Stantec Consulting (PEA).





**On Budget and on Time?**

Too early to state.

**Contact Details for Project Information**

Marathon Gold investor relations manager  
Christopher Haldane, tel +1 416 987 0714 or  
email [chaldane@marathon-gold.com](mailto:chaldane@marathon-gold.com).

**WASAMAC GOLD PROJECT****Name of the Project**

Wasamac gold project.

**Location**

The project is located 15 km west of Rouyn-Noranda, in Abitibi, Quebec, Canada.

**Client**

Monarques Gold.

**Project Description**

Monarques has reported positive feasibility results, which show that the Wasamac project is an economically viable and low-cost producing mine.

The project has total proven and probable reserves of 21.46-million tonnes grading 2.56 g/t.

The feasibility study provides a base case assessment for developing the Wasamac deposit as an underground mine with a plant throughput of 6 000 t/d.

The project will integrate Rail-Veyor technologies and a paste backfill system with a top-down mining approach, feeding a process plant located about 2 km from the mine site with a neutral dry-stacked tailings disposal facility about 5 km away to minimise the project footprint locally.

The carbon-in-pulp process plant is designed to have a capacity of 6 900 t/d.

Production of 1.56-million ounces of gold is estimated over the 11-year life-of-mine (LoM) from proven and probable reserves of 21.46-million tonnes grading 2.56 g/t gold.

The proposed mine plan eliminates the hefty initial capital expenditure (capex) associated with building a shaft, increases flexibility in mine planning, shortens the timeline to production and enables Monarques to significantly decrease the overall cost of the project. It is also believed that the Wasamac mine life could be extended beyond 11 years, as the deposit remains largely underexplored at depth and along strike.

**Potential Job Creation**

The preliminary on-site workforce requirement for construction, including infrastructure, a process plant, and the development of the underground mine, is expected to average 250 construction personnel, peaking at an estimated 420 (individuals) by the third quarter of 2021. It is expected that about 300 employees – staff and labour, peaking at 319 in year 2024 – will be required for the operations over the LoM.

**Net Present Value/Internal Rate of Return**

The project has a pretax net present value, at a 5% discount rate, of \$522-million and an internal rate of return (IRR) of 23.60%, with a payback of 3.6 years.

**Value**

Initial capex is estimated at \$464-million, including about \$230-million for the mill and tailings facility.

**Duration**

Pending the completion of all studies and receipt of the required permits and financing, the process plant construction is scheduled to begin in the fourth quarter of 2020, with full capacity production expected by the fourth quarter of 2022.

**Latest Developments**

The feasibility study has left the door open to a potential custom milling option, which if pursued, will increase the project's IRR and decrease the payback period.

**Key Contracts and Suppliers**

BBA (feasibility study).

**On Budget and on Time?**

Too early to state.

**Contact Details for Project Information**

Monarques Gold senior geologist – communications specialist  
Elisabeth Tremblay, email [e.tremblay@monarquesgold.com](mailto:e.tremblay@monarquesgold.com)







# GRAPHITE

## LAC GUÉRET GRAPHITE PROJECT

### Name of the Project

Lac Guéret graphite project.

### Location

North-eastern Quebec, Canada.

### Client

Mason Graphite.

### Project Description

An updated feasibility study has confirmed the project's robust economics. Lac Guéret has proven and probable reserves of 4.74-million tonnes grading 27.80% total graphitic carbon (TGC).

The study envisages an openpit mining operation using a 100% owner-operated fleet, which has been selected to deliver an average of 190 000 t/y of mill feed that will be crushed on site and then transported on an existing road to Baie-Comeau for processing. The concentrator will produce an average of 51 900 t/y graphite concentrate over a 25-year mine life.

The ore mined is projected to yield an average grade of 27.80% TGC. At the concentrator, the ore will go through a process involving grinding, flotation, dewatering, drying and commercial sieving.

The concentrator has been designed for the standard purity of 96% TGC for the coarse products and will be capable of

reaching purities of up to 97.50% TGC for the same sizes. The final products will be bagged and shipped by road to North American markets or shipped overseas in containers.

### Potential Job Creation

The project will create about 100 jobs.

### Net Present Value/Internal Rate of Return

The project has a pretax net present value, at an 8% discount rate, of C\$484-million and an internal rate of return of 27.70%, with a payback of 3.7 years.

### Value

Initial capital expenditure has increased from C\$200-million in the 2015 feasibility study to C\$258.20-million.

### Duration

The project is expected to take 13 to 16 months to complete.

### Latest Developments

Early construction work is under way.

### Key Contracts and Suppliers

GoldMinds Geoservices (technical and financial data).

### On Budget and on Time?

Too early to state.

### Contact Details for Project Information

Mason Graphite, tel +1 647 801 7273 or email [info@masongraphite.com](mailto:info@masongraphite.com).





# IRON-ORE

## KAMISTIATUSSET IRON-ORE PROJECT

### Name of the Project

Kamistiatuisset (Kami) iron-ore project.

### Location

Western Labrador, Canada.

### Client

Kami Mine Limited Partnership, a joint venture between Alderon Iron Ore (75%) and HBIS (25%).

### Project Description

The updated feasibility study on the Rose deposit of the Kami project, completed in September 2018, has demonstrated the strong economics of the project, which will produce a premium-quality iron-ore concentrate with higher iron content and ultralow impurities relative to the 62%-iron grade benchmark. The project hosts proven and probable reserves of 517.20-million tonnes grading 28.80% total iron.

The project will produce 7.84-million tonnes a year of 65.20% iron concentrate over a 23-year mine life.

### Potential Job Creation

Not stated.

### Net Present Value/Internal Rate of Return

The project has a pretax net present value, at an 8% discount rate, of \$1.70-billion and an internal rate of return of 24.60%, with a payback of four years.

### Value

The total estimated capital cost of the project is \$982.41-million.

### Duration

The project will take 26 months to construct.

### Latest Developments

None stated.

### Key Contracts and Suppliers

None stated.

### On Budget and on Time?

Too early to state.

### Contact Details for Project Information

Alderon Iron Ore, tel +1 604 681 8030 or email [info@alderonironore.com](mailto:info@alderonironore.com).



Picture by Bloomberg





# LITHIUM

## AUTHIER LITHIUM PROJECT

### Name of the Project

Authier lithium project.

### Location

La Motte, Quebec, Canada.

### Client

Sayona Mining.

### Project Description

A positive definitive feasibility study (DFS) for the Authier project has shown its potential to be a profitable and sustainable new lithium mine. The project has total reserves of 12.10-million tonnes grading 1% lithium oxide ( $\text{Li}_2\text{O}$ ), and total resources of 20.94-million tonnes grading 1.01%  $\text{Li}_2\text{O}$ .

The Authier deposit will be mined by openpit methods enhanced by the shallow and thick nature of the mineralisation, allowing for spodumene ore to be processed from the start of mining.

The DFS has demonstrated a life-of-mine (LoM) strip ratio of 6.9:1 (waste to ore) providing a low mining cost.

The DFS is based on an average ore feed of 1 850 t/d or about 675 500 t/y to the process plant to deliver average spodumene concentrate output of 87 400 t/y at 6%  $\text{Li}_2\text{O}$ .

The LoM production target of 12.10-million tonnes comprises entirely of proven and probable ore reserves.

The mine will produce 1.58-million tonnes of spodumene concentrate over its 18-year LoM.

### Potential Job Creation

The new mine could create 150 jobs in construction and up to 160 jobs in operation, with Sayona aiming to give priority to local employment and suppliers.

### Net Present Value/Internal Rate of Return

The project has a pretax net present value of C\$184.80-million and an internal rate of return of 33.70%, with an estimated payback of 2.6 years.

### Value

The cost to develop the project is estimated at C\$89.99-million.

### Duration

Production is schedule for 2020.

### Latest Developments

Sayona Mining is targeting the necessary permits for the project by September 2019. The project has been designed to access the permitting route under Section 22 of the Quebec Environmental Quality Act. This requires that the project remains under a maximum production threshold of 2 000 t/d.





Under this pathway, which includes environmental studies, public consultation is undertaken by the proponent in accordance with Mining Act specifications.

Following recent consultations with stakeholders in Quebec, Sayona has reaffirmed that the project does not have any major environmental issue, as demonstrated in the environmental assessment study delivered in May 2018 and the hydrogeological study.

The project has also received unanimous support from the municipal council of La Motte, where it is located.

Sayona has also completed a public consultation based on the Mining Act, which contains recommendations for project improvements.

A number of these measures will be adopted to further enhance the project.

#### Key Contracts and Suppliers

None stated.

#### On Budget and on Time?

Too early to state.

#### Contact Details for Project Information

Sayona Mining,  
tel +61 7 3369 7058 or  
email [info@sayonamining.com](mailto:info@sayonamining.com).

### SEPARATION RAPIDS LITHIUM PROJECT

#### Name of the Project

Separation Rapids lithium project.

#### Location

The project is located near Kenora, in Ontario, Canada.



Picture by Avalon Advanced Materials

Separation Rapids lithium project core samples



**Client**

Avalon Advanced Materials.

**Project Description**

Avalon has updated the preliminary economic assessment (PEA) on the Separation Rapids project, which reflects a simplified business model that focuses on initial production of lithium mineral concentrates, with potential for future expansion into production of the battery materials lithium carbonate and lithium hydroxide.

The project has estimated measured and indicated resources of 8.41-million tonnes grading 1.41% lithium oxide, 0.007% tantalum pentoxide, 0.02% caesium superoxide, 0.37% rubidium oxide. Inferred mineral resources are estimated at 1.71-million tonnes grading 1.35% lithium oxide, 0.007% tantalum pentoxide, 0.02% caesium superoxide and 0.37% rubidium oxide.

The updated PEA uses a plant throughput of 475 000 t/y, compared with the 950 000 t/y rate used in the 2016 PEA.

This will result in a 20-year operating life, based on the present known mineral resources, with production of 71 500 t/y of petalite concentrate and 11 800 t/y of lepidolite concentrate (both for 18.5 years) and, starting in Year 6, 100 000 t/y of feldspar (until Year 20).

**Potential Job Creation**

Not stated.

**Net Present Value/Internal Rate of Return**

The project has a pretax net present value, at an 8% discount rate, of C\$156-million and an internal rate of return of 27.10%.

**Value**

The upfront capital expenditure requirement is C\$77.70-million with a further C\$13.70-million planned for the feldspar circuit in Years 5 or 6, or once payback of the initial capital is complete.

**Duration**

Not stated.

**Latest Developments**

In September 2018, Avalon reported the discovery of a new lithium pegmatite on its 100%-owned Separation Rapids property. The new discovery, named the Snowbank pegmatite, occurs on the Paterson Lake claims acquired by Avalon in 2017,

about 4 km north-west of the main Separation Rapids lithium deposit. It was discovered in a large outcrop area traceable for more than 100 m along strike (open under overburden at both ends) averaging 6 m wide. Like the main deposit, the lithium occurs primarily in the ore mineral petalite, which occurs as large crystals up to 15 cm in diameter. Individual channel samples have yielded assays of up to 2.51% Li<sub>2</sub>O over 1.1 m, indicating that petalite comprises an estimated 50% of the mineral content in the rock sampled.

The new discovery has illustrated how challenging even coarse grained petalite can be to recognise in the field (due to its similar appearance to common feldspar), and how much potential there may be for more discoveries in the Separation Rapids area to extend the life and production capacity for the new operation planned for the main deposit.

Next steps will include a first phase drilling programme tentatively planned for late 2019.

**Key Contracts and Suppliers**

Micon International (updated PEA).

**On Budget and on Time?**

Not stated.

**Contact Details for Project Information**

Avalon Advanced Materials,  
tel +1 416364 4938, fax +1 416364 5162 or  
email office@AvalonAM.com.

**WHABOUCHI LITHIUM MINE AND CONCENTRATOR****Name of the Project**

Whabouchi lithium mine and concentrator.

**Location**

The mine will be located in the Eeyou Istchee James Bay territory, in Québec, and the concentrator at the hydrometallurgical (hydromet) plant in Shawinigan, Quebec, Canada.

**Client**

Nemaska Lithium.





### Project Description

The project has openpit and underground proven and probable reserves of 37-million tonnes at 1.40% lithium oxide.

The 2018 feasibility study outlines a combined openpit and underground mine with a 33-year mine life, concentration facilities, tailings and water management at the mine and a hydromet processing facility in Shawinigan. Over the life-of-mine, the mine is expected to produce seven-million tonnes of spodumene concentrate, which will be converted into 770 000 t battery-grade lithium hydroxide and 361 000 t of battery-grade lithium carbonate. During the first 23.6 years, production will be derived from an openpit developed to a maximum depth of 224 m and with an average strip ratio of 2.95:1.

The openpit will be mined using a standard fleet of off-road mining trucks and hydraulic excavators at a rate of 2 830 t/d of ore.

During the past 9.4 years, ore production will be derived from an underground operation at 3 665 t/d and accessed through a ramp in the openpit. The underground development will reach an average depth of 55 m below the pit bottom. The selected underground mining method is longhole stoping, with the crown pillar below the pit recovered at the end of the mine life.

The feasibility study includes the addition of an ore-sorting circuit at the mine. Additional equipment and buffer zones have also been added throughout the process at both sites to increase the operability, while enhancing process reliability as well as allowing ongoing maintenance without disrupting operations, thus ensuring optimal performance. The hydromet plant's capacity has been increased by 20%, from 27 000 t/y lithium carbonate equivalent (LCE) to 33 000 t/y LCE.

### Potential Job Creation

Not stated.

### Net Present Value/Internal Rate of Return

The feasibility study shows a base case pretax net present value, at an 8% discount rate, of \$3.30-billion and an internal rate of return of 34.40%, with an after-tax payback of 2.9 years.

### Value

The current capital expenditure (capex) for the mine, the concentrator and the hydromet plant is estimated at \$80-million, excluding \$74-million in capex already invested.

### Duration

Construction mobilisation started in the third quarter of 2016.

Concentrator commissioning is expected to start in the second quarter of 2019 and commercial production in the fourth quarter.

The hydromet plant is expected to start commissioning in the first quarter of 2020, with commercial production expected to start in the fourth quarter.

### Latest Developments

At the mine site, the construction of the commercial concentrator building and administrative offices is complete and most of the site preparation is done, while the 13 km 69 kV power line is under construction and should be connected to the grid in March.

### Key Contracts and Suppliers

None stated.

### On Budget and on Time?

Not stated.

### Contact Details for Project Information

Nemaska Lithium, tel +1 418 704 6038 or email [info@nemaskalithium.com](mailto:info@nemaskalithium.com).



Picture by Nemaska Lithium

Whabouchi lithium mine and concentrator project





# MAGNESIUM

## DRIFTWOOD CREEK MAGNESIUM PROJECT

### Name of the Project

Driftwood Creek magnesium project.

### Location

The project is located in southern British Columbia, Canada.

### Client

MGX Minerals.

### Project Description

The project has measured and indicated resources of 7.85-million tonnes grading 43.27% magnesium oxide.

The preliminary economic assessment (PEA) envisages the construction of a conventional quarry pit mine with a 1 200 t/d process plant using conventional crushing, grinding, flotation upgrading, calcination, and sintering to produce a saleable dead burn magnesium oxide product. The plant is expected to achieve an average recovery of 90%, with a magnesium purity of 94.60%. The dead burn magnesium product will be bagged and transported to market for sale as a powder.

The plant will also be able to produce caustic-calcined magnesium oxide as a separate salable product.

Dewatered tails will be trucked back to the mine site quarry for dry stacking in a tailings storage facility.

The PEA estimates average magnesium oxide production of 169 700 t/y over an 18.8-year mine life.

### Potential Job Creation

None stated.

### Net Present Value/Internal Rate of Return

The project has a pretax net present value, at a 5% discount rate, of \$529.80-million, an internal rate of return of 24.50%, with a 3.5-year payback.

### Value

Initial capital costs have been estimated at \$235.90-million.

### Duration

Not stated.

### Latest Developments

MGX aims to further enhance the economics of the project with a PFS.

### Key Contracts and Suppliers

None stated.

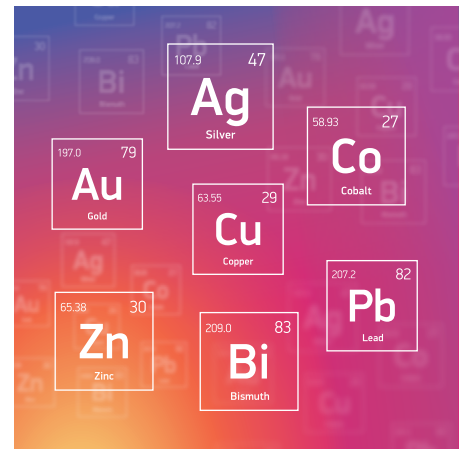
### On Budget and on Time?

Not stated.

### Contact Details for Project Information

MGX, tel +1 604 681 7735.





# OTHER MINING SECTORS

## MACMILLAN PASS ZINC/LEAD/SILVER PROJECT

### Name of the Project

Macmillan Pass zinc/lead/silver project.

### Location

Yukon, Canada.

### Client

Fireweed Zinc.

### Project Description

The preliminary economic assessment is based on a mine plan for the delivery of 32.66-million tonnes at a diluted head grade of 9.07% zinc equivalent (5.31% zinc, 3.56% lead and 43.41 g/t silver) delivered to the processing plant.

Initial material will be recovered at 5 000 t/d using conventional truck-and-shovel surface mining from the Tom and Jason deposits. During the third year, production will transition to underground mining using Avoca-style sublevel retreat longhole (LH) stoping, vertical crater retreat (VCR) and alimak stoping. Stopes will be filled with a combination of waste rock and paste and cemented rock fill.

Openpit mining will account for 13%, or 4.20-million tonnes, of the 32.70-million tonnes of material mined and processed. VCR and LH methods account for 75% of the material mined and processed by underground methods. Mining recovery

and dilution factors have been executed according to the mining method. Average openpit mining recovery and dilution are 95% and 10% respectively. Average underground mining recovery and dilution are 92% and 21% respectively.

The project incorporates a standard comminution, flotation-separation flowsheet, and includes a primary crusher feeding a semiautogenous mill, a ball mill and selective two and three-stage flotation to produce two concentrate products for shipment to offsite smelters.

### Potential Job Creation

Not stated.

### Net Present Value/Internal Rate of Return

In the base case the project has a pretax net present value, at an 8% discount rate, of C\$779-million and an internal rate of return of 32%, with a payback of about three years.

### Value

Preproduction capital expenditure is estimated at C\$404-million.

### Duration

Not stated.

### Latest Developments

In November, Fireweed announced the closing of the previously announced sale and purchase agreement with Teck Metals



to acquire the Nidd Property on the western extension of the Macmillan Pass zinc project.

With this acquisition Fireweed has consolidated the Macmillan Pass Zinc district and now controls 544 km<sup>2</sup> of highly prospective zinc claims, including all four known large zinc mineralised systems in the region – Tom, Jason, End Zone and Boundary Zone. This includes many other zinc exploration targets, including the entire highly prospective “fertile corridor” of exploration targets extending from Tom to the Boundary zone and beyond.

### Key Contracts and Suppliers

JDS Energy and Mining (PEA) and Knight Piésold Consulting (tailings and water studies).

### On Budget and on Time?

Not stated.

### Contact Details for Project Information

Fireweed Zinc, tel +1 604 646 8360 or email [info@Fireweedzinc.com](mailto:info@Fireweedzinc.com).

## NASH CREEK AND SUPERJACK ZINC/LEAD/SILVER PROJECTS

### Name of the Project

Nash Creek and Superjack zinc/lead/silver projects.

### Location

The projects are located in the Bathurst Mining District of New Brunswick, Canada.

### Client

Callinex Mines.

### Project Description

The project has indicated mineral resources of 9.14-million grading 3.64% zinc equivalent, 2.80% zinc, 0.58% lead and 17.8 g/t silver.

A preliminary economic assessment (PEA) has outlined a conventional truck-and-excavator openpit mining operation, with an average process plant production rate of 1.43-million tonnes a year over a mine life of about ten years. Mining operations will reach a yearly average total material movement

of ten-million tonnes using 11.5 m<sup>3</sup> diesel hydraulic excavators, 90 t haulage trucks, and track-mounted diesel-powered drill rigs, with up to 200-mm-diameter blastholes drilled on 5-m- and 10-m-high benches.

The mined material will be processed at a new 3 950 t/d dense-media separation plant and a 1 950 t/d grinding and flotation plant located on the project site.

Zinc/silver and lead/silver concentrates will be produced. It is expected that lead concentrates could be processed at the nearby Belledune smelter, and zinc concentrates at Valleyfield. The zinc concentrates also have the potential to be processed overseas using the deep-water port from Belledune, although this alternate option was outside the scope of the PEA and was not investigated.

Yearly production in concentrate is estimated at 95.50-million pounds of zinc equivalent, 76.70-million pounds of zinc, 14.60-million pounds of lead and 400 000 oz of silver.

A review of metallurgical testwork has not identified any deleterious elements that will impact on the marketability of the zinc and lead concentrates, which are considered of good quality.

### Potential Job Creation

The PEA assumes that the development of the project will create about 225 full-time jobs.

### Net Present Value/Internal Rate of Return

The project has a net present value, at an 8% discount rate, of C\$230-million (C\$128-million after-tax) and a pretax internal rate of return of 34.10% (25.20% after-tax), with a payback of 2.4 years (2.8 years after-tax).

### Value

Preproduction capital costs are estimated at C\$168-million.

### Duration

Not stated.

### Latest Developments

Callinex believes that there is a clear opportunity to significantly enhance the project economics through further exploration over the district-scale land package, which could allow for higher-grade material to be scheduled into the mine plan.



### Key Contracts and Suppliers

P&E Mining Consultants (PEA).

### On Budget and on Time?

Not stated.

### Contact Details for Project Information

Callinex Mines president and CEO Max Porterfield,  
tel +1 604 605 0885 or email [info@callinex.ca](mailto:info@callinex.ca).

## NICO GOLD/COBALT/BISMUTH/COPPER MINE PROJECT

### Name of the Project

NICO gold/cobalt/bismuth/copper mine project.

### Location

The proposed NICO mine is located 50 km north of the Tlicho community of Whati and 160 km north-west of Yellowknife, in Canada's Northwest Territories.

### Client

Fortune Minerals.

### Project Description

The NICO project is a development-stage primary cobalt asset consisting of a planned mine, mill and concentrator in the Northwest Territories and hydrometallurgical refinery in Saskatchewan to process concentrates from the mine to cobalt sulphate, gold, bismuth ingot and oxide, and a copper precipitate.

The NICO deposit contains open pit and underground proven and probable mineral reserves totalling 33.1-million tonnes containing 1.11-million oz of gold, 82.3-million pounds of cobalt, 102.1-million pounds of bismuth and 27.2-million pounds of copper.

According to the project's 2014 feasibility study, at the planned mill throughput rate of 4 650 t/d of ore, the mineral reserves will sustain operations for 20 years.

Open pit methods will be used, with underground ores contributing 22% of the mill feed during the second year of operations. The open pit part of the mine will be a conventional truck-and-shovel/loader operation, accomplished in four phases at an average waste-to-ore strip ratio of 3.0:1.

The underground portion of the mine will be mined by a contractor using retreat blasthole open stoping, providing access for gold-rich, higher-grade ores.

The ore will be processed in two stages at the NICO mine site and at the Saskatchewan metals processing plant. At the NICO site, an average of 4 650 t/d of ore will be processed in a crushing, grinding and flotation concentrator to produce about 180 t/d of wet bulk concentrate.

Construction of the NICO mine and concentrator is planned using the existing winter ice road, but all-season road access is required for mine operations. The Tlicho road will be a permanent 97 km highway, extending north from Highway 3 to Whati in the Northwest Territories. The Tlicho government and governments of Canada and the Northwest Territories are enabling the NICO project by building this all-season road. The environmental assessment approval for this road was recently completed, the contractor has been selected and construction is expected to start in the third quarter of 2019. Fortune has received environmental assessment approval to construct a spur road to the mine site.

### Potential Job Creation

About 200 employees at mine site and 100 at the refinery.



Aerial view of the NICO gold/cobalt/bismuth/copper mine project





**Net Present Value/Internal Rate of Return**

According to the 2014 feasibility study the project has a levered pretax net present value, at a 7% discount rate of \$254-million in the base case, and an internal rate of return of 15.6%.

**Value**

The 2014 feasibility estimated capital expenditure at C\$589-million plus working capital.

**Duration**

Construction of the mine facilities is subject to financing, but could begin in 2020 and is expected to take about two years depending on ice-road logistics.

The refinery requires about 18 months for construction unless it is deferred. This construction timeline would allow the NICO Project to be in commercial production in the early 2020s as the global automotive industry intensifies electric vehicle production.

**Latest Developments**

Hatch, P&E Mining Consultants and Micon International have been contracted to update the NICO project's technical report on the feasibility study, based on design developments and improvements, current capital and operating costs, commodity prices and currency exchange rates. The technical report is also assessing the economies of scale of a 30% expanded mill throughput rate, higher mining rate, and other mine, process and environmental improvements made to the NICO project.

To allow for the flexibility of selling metal concentrates directly from the mine, Fortune has instructed Hatch to adjust the engineering design and move the bulk concentrate regrind circuit and secondary flotation concentration process back to the Northwest Territories site. With the flexibility of proceeding with, or deferring the downstream process plant in Saskatchewan, Fortune will not only have the ability to reduce up-front capital costs, but also to stage the various unit operations as required to reduce commissioning risks.

**Key Contracts and Suppliers**

Hatch, P&E Mining Consultants and Micon International (updated technical report on 2014 feasibility study).

**On Budget and on Time?**

Construction has not started and will not start until project financing has been secured.

**Contact Details for Project Information**

Fortune Minerals, tel +1 519 858 8188,  
fax +1 519 858 8155 or  
email [info@fortuneminerals.com](mailto:info@fortuneminerals.com).

**PRAIRIE CREEK ZINC/LEAD/SILVER PROJECT****Name of the Project**

Prairie Creek zinc/lead/silver project.

**Location**

Northwest Territories, Canada.

**Client**

NorZinc.

**Project Description**

Prairie Creek has total proven and probable reserves of 8.07-million tonnes grading 124.22 g/t silver, 8.10% lead and 8.64% zinc.

A feasibility study completed on the project has confirmed that the Prairie Creek mine can support a significant increase in the mining rate and mill throughput, which will allow for the production of higher quantities of zinc, lead and silver at lower operating costs, compared with the mine plan presented in the 2016 prefeasibility study (PFS).

The feasibility mine plan covers a 15-year life-of-mine from mill start-up.

The study estimates a mining rate of 1 600 t/d, an increase of 18.50% on the 2016 PFS. Mill throughput after dense-media separation has also increased by 25% to 1 200 t/d.

Average yearly production of lead concentrates for the first ten years of operation, has increased by 16 000 t/y to 71 600 t/y, compared with the 2016 PFS, while the grade of lead in the lead concentrates has also improved.

Average yearly total contained lead in zinc and lead concentrates, for the first ten years of operation, is 105-million pounds a year, an increase of 23-million pounds, while the average yearly production of silver has also increased 25% to 2.10-million ounces a year.



Average yearly total contained zinc in the zinc and lead concentrates, for the first ten years of operation, have increased by about 7% from 82-million pounds in the 2016 PFS to 95-million pounds a year.

### Potential Job Creation

A maximum of 211 jobs will be created during construction. During steady-state operations, the mine will employ about 330 people on site, working in two alternating shifts with a two week in, two week out schedule.

### Net Present Value/Internal Rate of Return

The project has an estimated pretax net present value, at an 8% discount rate, of C\$344.50-million, a 21% increase on the 2016 PFS, with an internal rate of return of 23.80%. Payback has been estimated at 4.4 years.

### Value

Preproduction capital costs have increased from C\$244-million in the 2016 PFS to C\$278.90-million, including contingency, primarily because of the expansion in mine and mill throughput and accelerated mine development.

### Duration

The project has a 15-year mine life, or more with the conversion of the seven-million-tonne inferred resource.

### Latest Developments

The permitting process has entered the regulatory phase, conducted by the Mackenzie Valley Land and Water Board,

which will receive input from territorial and federal agencies, culminating in road permits being issued by the water board and by Parks Canada. These permits will incorporate the recommended mitigation measures included in the environmental assessment report.

The regulatory phase is expected to be completed in the third quarter of 2019.

In January this year, NorZinc signed a traditional land use agreement (TLUA) with the Nahʔa Dehé Dene Band for the construction and operation of the all season road to connect the Prairie Creek project to the Liard highway in the Northwest Territories.

The all season road follows the general alignment of the already permitted winter road, while reflecting the terrain, site characteristics, and road specifications suitable and preferred for an all season road.

The road from the mine to Km 37.4 is permitted for all season use but needs upgrading along this section, including realignments and new watercourse crossings.

NorZinc plans to build the road over three years.

Dependent on the permitting and financing timeline, construction of the all season road is planned to start from a winter road in early 2020 and continue into 2022, in parallel with continuous and ongoing site construction and mine development.



Aerial view of Prairie Creek zinc/lead/silver project



In addition to the TLUA, NorZinc is negotiating a road benefit agreement with the Łíídljı́ Kúę First Nation of Fort Simpson, in the Northwest Territories. Fort Simpson is the largest community within the Dehcho region, located about 185 km east of the mine site.

### Key Contracts and Suppliers

None stated.

### On Budget and on Time?

Not stated.

### Contact Details for Project Information

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## VOISEY'S BAY MINE EXTENSION UNDERGROUND PROJECT DEVELOPMENT

### Name of the Project

Voisey's Bay mine extension underground development project.

### Location

The project is located in Labrador, Canada.

### Client

Vale.

### Project Description

The project will extend the operational life of Voisey's Bay, currently an openpit mine, from 2023 to 2034. The mine has total estimated mineral reserves of 32.40-million tonnes, with a nickel grade of 2.13% and a cobalt grade of 0.13%. The openpit reserves and resources comprise the Main Ovoid, the Mini Ovoid and the SE Extension. The underground reserves and resources comprise Reid Brook and Eastern Deeps. Of the total estimated mineral reserves, the underground reserves contain 23.60-million tonnes, with a nickel grade of 2.17% and a cobalt grade of 0.14%. A feasibility study was completed in early 2015 to expand Voisey's Bay operations underground to mine the Reid Brook and Eastern Deeps deposits through two decline and ramp systems.

The scope of the project includes underground development to access the two deposits; fresh and return air fans; increased

power generation and fuel storage; expansion of accommodation, offices, warehousing and maintenance facilities; upgrades to water and sewage treatment facilities; and paste backfill and shotcrete plants.

As a brownfield project, the mine expansion will use the existing concentrator, port and support facilities, as well as the Long Harbour processing plant, leading to reduced implementation risks.

### Potential Job Creation

The expansion project will create 16 000 person years of employment during the five-year construction period, peaking at 4 800 in 2020. Once operational, 1 700 jobs will be created at the underground mine and the Long Harbour processing plant.

### Net Present Value/Internal Rate of Return

Not stated.

### Value

The total capital expenditure is estimated at about \$1.70-billion: \$100-million to \$150-million in 2018, \$300-million to \$350-million in 2019, \$450-million to \$500-million in 2020 and 2021, \$150-million to \$200-million in 2022, and less than \$50-million in 2023.

### Duration

The first full year of underground production is expected to be 2021, when current openpit mining begins to ramp down.

### Latest Developments

None stated.

### Key Contracts and Suppliers

None stated.

### On Budget and on Time?

The project was approved in July 2015; however, owing to difficult market conditions in recent years, the project was put on hold.

### Contact Details for Project Information

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# RARE EARTHS

## KWYJIBO RARE EARTH ELEMENT PROJECT

### Name of the Project

Kwyjibo rare earth element (REE) project.

### Location

The project is located 125 km north-east of Sept-Îles, Quebec, Canada.

### Client

The project is a 50:50 joint venture between Focus Graphite and SOQUEM, with SOQUEM acting as operator.

### Project Description

A preliminary economic assessment (PEA) has determined that the Kwyjibo REE project is unique in Quebec in terms of geological setting, style of mineralisation and economic potential. The Kwyjibo mineralisation system comprises six historical showings, distributed in a 4-km-long corridor, with the main iron/REE mineralisation being the Josette Horizon.

The Josette Horizon is divided into two zones: Josette Northeast and Josette Southwest.

The combined resource for the Josette Northeast and Josette Southwest zones is 6.92-million tonnes grading 2.72% total rare earth oxides (TREO) in the measured and indicated categories and 1.33-million tonnes grading 3.64% TREO in the inferred category.

The PEA focuses exclusively on the Josette Northeast zone and envisages the mining and milling of REE-bearing magnetite material from an underground mine, with a mine life of ten years and a concentrator located on the Kwyjibo property. Processing includes crushing, grinding, magnetic separation, thickening and filtering of run-of-mine. The TREO concentrate produced at the on-site mill will be shipped to a hydrometallurgical plant located outside the mine site.

The hydrometallurgical processing plant is designed to transform REE concentrate into three separate refined rare-earth oxide products for production of 9 500 t/y of TREO. The hydrometallurgical process leaches the concentrate in three steps using solid conversion and is completed by a multistage solvent extraction process to produce neodymium/praseodymium oxides, dysprosium oxide and a combination of the remaining rare-earth and yttrium oxides.

The magnetic separation at the concentrator is designed to produce a 7% TREO concentrate, with a recovery of 96%. The recovery of TREO from concentrate processed at the hydrometallurgical plant is 78%. The overall TREO recovery is estimated at 75%. Concentrate production is estimated at 174 000 t/y.

The project has a ten-year life-of-mine (LoM), with total LoM production estimated at 3.55-million tonnes grading 3.29% TREO. The Kwyjibo REE deposit remains open at depth, with the potential to increase mine life through additional drilling and technical studies.





**Potential Job Creation**

Not stated.

**Net Present Value/Internal Rate of Return**

The project has an estimated base case pretax net present value, at an 7% discount rate, of C\$572.90-million and an internal rate of return of 21.40%, with a payback of 3.4 years.

These figures are based on a basket price of C\$2.81/kg of TREO.

**Value**

The project value is estimated at C\$723.60-million.

**Duration**

Not stated.

**Latest Developments**

None stated.

**Key Contracts and Suppliers**

Met-Chem (PEA).

**On Budget and on Time?**

Not stated.

**Contact Details for Project Information**

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Picture by Focus Graphite

Kwyjibo rare earth element project





# URANIUM

## ARROW URANIUM PROJECT

### Name of the Project

Arrow uranium project.

### Location

The project is located in the Athabasca basin in Saskatchewan, Canada.

### Client

NexGen Energy.

### Project Description

A prefeasibility study (PFS) on the Arrow project has delivered a substantial improvement on the July 2017 preliminary economic assessment (PEA).

Indicated mineral resources have increased 43% from 179.50-million pounds of uranium ( $U_3O_8$ ) contained in 1.18-million tonnes grading 6.88%  $U_3O_8$  in the March 2017 PEA mineral resource estimate, to 256.60-million pounds of  $U_3O_8$  contained in 2.89-million tonnes grading 4.03%  $U_3O_8$  in the PFS.

The PFS mine plan, using a 0.25%  $U_3O_8$  cutoff grade, includes probable mineral reserves comprising 234.10-million pounds of  $U_3O_8$  contained in 3.43-million tonnes grading 3.09%  $U_3O_8$ , which will be extracted by underground mining over an initial nine-year mine life, rather than the previously estimated 15 years.

Average production has increased from 18.50-million pounds a year of  $U_3O_8$  in the PEA to 25.40-million pounds a year of  $U_3O_8$  in the PFS, owing to head grades increasing from 1.73%  $U_3O_8$  in the PEA to 3.09%  $U_3O_8$  in the PFS.

The underground mining rate is expected to drop from 1 448 t/d to 1 039 t/d. The underground workings will be accessed by two shafts, the first supporting personnel movements, materials, ore, waste and fresh air. The production shaft will have divided compartments, ensuring that fresh air, and personnel entering the mine, remain isolated from ore being shipped to surface. The second shaft will be used for exhaust air and secondary egress.

The PFS has confirmed that conventional processing technology will be used to process and produce yellowcake from the Arrow deposit. The main components of the processing plant include grinding, leaching, liquid-solid separation through counter current decantation, solvent extraction, yellowcake precipitation, yellowcake packaging and paste tailings plant.

A metallurgical pilot plant and bench-scale testing have optimised recovery resulting in an increased total processing recovery rate to 97.60% versus 96% in the PEA.

In addition, the ammonia strip process envisioned in the PEA has been updated to an acid strip process in the PFS, resulting in the complete elimination of ammonia in the processing facility. Elimination of ammonia from the processing facility will ultimately lead to improved effluent discharge performance.



The PFS has also confirmed that all processed waste streams can be stored in an underground tailings management facility, which will significantly reduce the surface footprint of the project and allow for continued and ongoing reclamation during operations, enabling industry leading environmental sensitivity.

Further, the PFS has confirmed proof of concept for uranium tailings to be used for cemented paste backfill underground.

### Potential Job Creation

Not stated.

### Net Present Value/Internal Rate of Return

The PFS estimates an after-tax net present value, at an 8% discount rate, of C\$3.70-billion, compared with C\$3.49-billion in the July 2017 PEA. The internal rate of return has increased from 56.70% in the PEA to 56.80% in the PFS.

The payback has also increased marginally from 1.1 years to 1.2 years.

### Value

Initial capital costs have increased from C\$1.19-billion in the July 2017 PEA to C\$1.25-billion in the PFS. Capital expenditure has increased owing to the introduction of provincial sales tax applicable to capital projects.

### Duration

Not stated.

### Latest Developments

With these strong PFS results, NexGen is expediting Arrow to feasibility by initiating a two-stage 125 000 m (ten rig) high-density drilling programme.

### Key Contracts and Suppliers

Wood Group and Roscoe Postle Associates (PFS) and Arcadis (modelling and assessment of radiological effects of underground uranium mining)

### On Budget and on Time?

Not stated.

### Contact Details for Project Information

NexGen Energy, tel +1 604 428 4112 or email [tmcpherson@nxg-energy.ca](mailto:tmcpherson@nxg-energy.ca).

## WHEELER RIVER URANIUM PROJECT

### Name of the Project

Wheeler River uranium project.

### Location

The project is located in northern Saskatchewan, Canada.

### Client

The project is a joint venture (JV) between Denison Mines Corp (90%) and JCU (Canada) Exploration Company (10%).

### Project Description

The Wheeler River project is the largest undeveloped uranium project in the eastern portion of the Athabasca basin. It comprises of two high-grade deposits – Phoenix and Gryphon.

A prefeasibility study on the Wheeler River project has evaluated the potential economic merit of co-developing the deposits.

The Phoenix high-grade deposit has been designed as an *in situ* recovery (ISR) mining operation, with associated processing to a finished product occurring at a plant to be built on site at Wheeler River. The Gryphon deposit has been designed as an underground mining operation, using a conventional long-hole mining approach with processing of mine production at the McClean Lake mill.

The Phoenix ISR and Gryphon underground operations together have probable mineral reserves of 109.40-million pounds of uranium ( $U_3O_8$ ) from 1.39-million tonnes – Phoenix has 59.70-million pounds of  $U_3O_8$  from 141 000 t at 19.10%  $U_3O_8$ , while Gryphon has 49.70-million pounds  $U_3O_8$  from 1.26-million tonnes at 1.80%  $U_3O_8$ .

The project has a mine life estimated at about 14 years, with average yearly production estimated at 7.80-million pounds of  $U_3O_8$ .

### Potential Job Creation

Not stated.

### Net Present Value/Internal Rate of Return

Wheeler River has a pretax net present value (NPV), at an 8% discount rate, of \$1.31-billion and an internal rate return (IRR) of 38.70%, with a payback of about 24 months.





Phoenix has a pretax NPV, at an 8% discount rate, of \$930.40-million and an IRR of 43.30%.

Gryphon has a pretax NPV, at an 8% discount rate, of \$560.60-million and an IRR of 23.20%.

### Value

Initial capital costs are estimated at \$322.50-million.

### Duration

Preproduction activities are estimated to begin in 2021, assuming receipt of required regulatory approvals, with first production from the Phoenix deposit expected in 2024. Initial construction at Gryphon is expected to start by 2026, with first production expected to be achieved in 2030.

### Latest Developments

Spurred on by the positive results of its PFS for Wheeler River project, Denison Mines announced in December 2018 that C\$10.30-million would be spent on advancing the project in 2019.

The budget approved by the Wheeler River JV will be used to initiate the environmental assessment process, as well as

engineering studies and related programmes required to advance the high-grade Phoenix deposit as an ISR mining operation.

The initiation of the environmental assessment process and studies designed to ultimately support a feasibility study, illustrate the company's commitment to achieving the project development timeline outlined in the PFS, Denison president and CEO David Cates has said.

The company plans to complete the feasibility study by the end of 2020 and to have its final environmental approvals in hand by 2021 or 2022, at which point a definitive development decision will be announced.

### Key Contracts and Suppliers

None stated.

### On Budget and on Time?

Not stated.

### Contact Details for Project Information

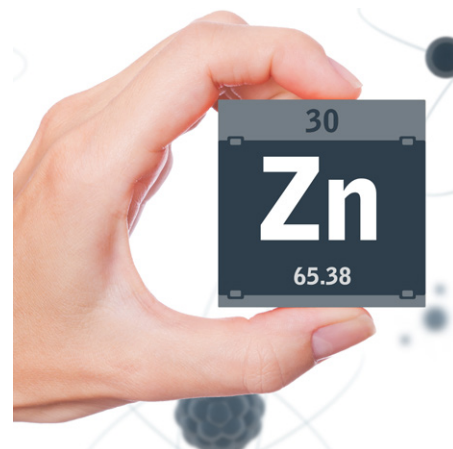
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Wheeler River uranium project camp







# ZINC

## SUPERIOR LAKE ZINC MINE RESTART PROJECT

### Name of the Project

Superior Lake zinc mine restart project.

### Location

The project is located in Ontario, Canada.

### Client

Superior Lake Resources.

### Project Description

The project has indicated and inferred mineral resources of 2.15-million tonnes grading 17.70% zinc, 0.90% copper, 0.4 g/t gold and 33.5 g/t silver. A restart study has confirmed that the Superior Lake project has the potential to be one of the lowest-cost zinc producers globally. The project includes a 1 000 t/d concentrator, comprising a comminution circuit and a two-stage flotation circuit for copper and zinc respectively. The plant will produce 88 000 t/y zinc concentrate and 6 700 t/y of copper concentrate at steady state. The project will have a six-and-a-half-year mine life.

### Potential Job Creation

Not stated.

### Net Present Value/Internal Rate of Return

The project has a pretax net present value, at a 10% discount rate, of \$164.80-million and an internal rate of return of 56%.

### Value

Start-up capital is estimated at \$75.15-million.

### Duration

Not stated.

### Latest Developments

The restart study has given the board confidence to advance the project towards a definitive feasibility study, which it aims to complete this year.

Meanwhile, Superior Lake announced in December 2018 that an exploration drill programme at the project had intersected high-grade zinc at the Mid Pick zone and identified a new footwall zone within 9 m of the Pick Lake deposit.

Both areas are outside the current Joint Ore Reserves Committee resource, giving potential to increase it.

### Key Contracts and Suppliers

None stated.

### On Budget and on Time?

Not stated.

### Contact Details for Project Information

Superior Lake Resources, tel +61 8 6142 5088, fax +61 8 9200 5638 or email [info@superiorlake.com.au](mailto:info@superiorlake.com.au).



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### **CANADA MINING PROJECTS IN PROGRESS 2018**

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