



SNC • LAVALIN

# GOLDCORP — ÉLÉONORE

MINE PROJECT



ASSOCIATION OF CONSULTING  
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CANADIAN CONSULTING  
ENGINEERING AWARDS 2015

Project Management Category

# Project Entry Brinder

# Introduction

Goldcorp – Éléonore Mine Project is a world-class gold mining facility comprising an underground mine, an ore processing plant, and infrastructure. The project is located on the Opinaca reservoir in the James-Bay Region of Northern Québec, a region that is remote, sparsely inhabited, and characterized by harsh arctic climate, which presented significant challenges in terms of schedule, location, climate, environment, and labour.

On October 1, 2014, the project achieved the critical milestone of “first gold pour”. Commercial production began in April 1, 2015 at the processing rate of 3,500 tonnes of ore per day (tpd). The project is progressively ramping-up to its nameplate 7,000 tpd.

The Éléonore Project is a key project milestone for the Northern Development Plan (“Plan Nord”) of Quebec. This investment of CA\$2.3B represents both a boost to Quebec's gross domestic product (GDP) and a considerable economic injection in the remote region. Over 2,000 direct jobs were created during project construction and today the operation employs over 1,000 permanent employees and contract personnel.

The Éléonore Project exemplified successful collaboration with the First Nations, delivered outstanding health and safety performance, and observed environmental criteria that surpassed Government requirements. The project was awarded the 2013 ACQ “Chantier d'importance” (important development) trophy by the Quebec Association of Construction. The trophy recognized Éléonore's valuable contribution to economic development, job creation, and quality of work performed on site in terms of labour relations, health, safety and environment management.

SNC-Lavalin provided EPCM services for the surface facilities of the project. The team managed the EPCM services until completion of the pre-operational verification (POV) and the achievement of a smooth turn-over of the facilities to Goldcorp for commercial process ramp-up and operation.

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## LOCATED

*190 km East of Wemindji*

*350 km North of Matagami*

*1,410 km driving distance from Montreal*

# Complexity

The Éléonore Mine Project, a complex and multifaceted development, was an ambitious undertaking facing significant challenges in terms of schedule, location, climate, environment, and labour.

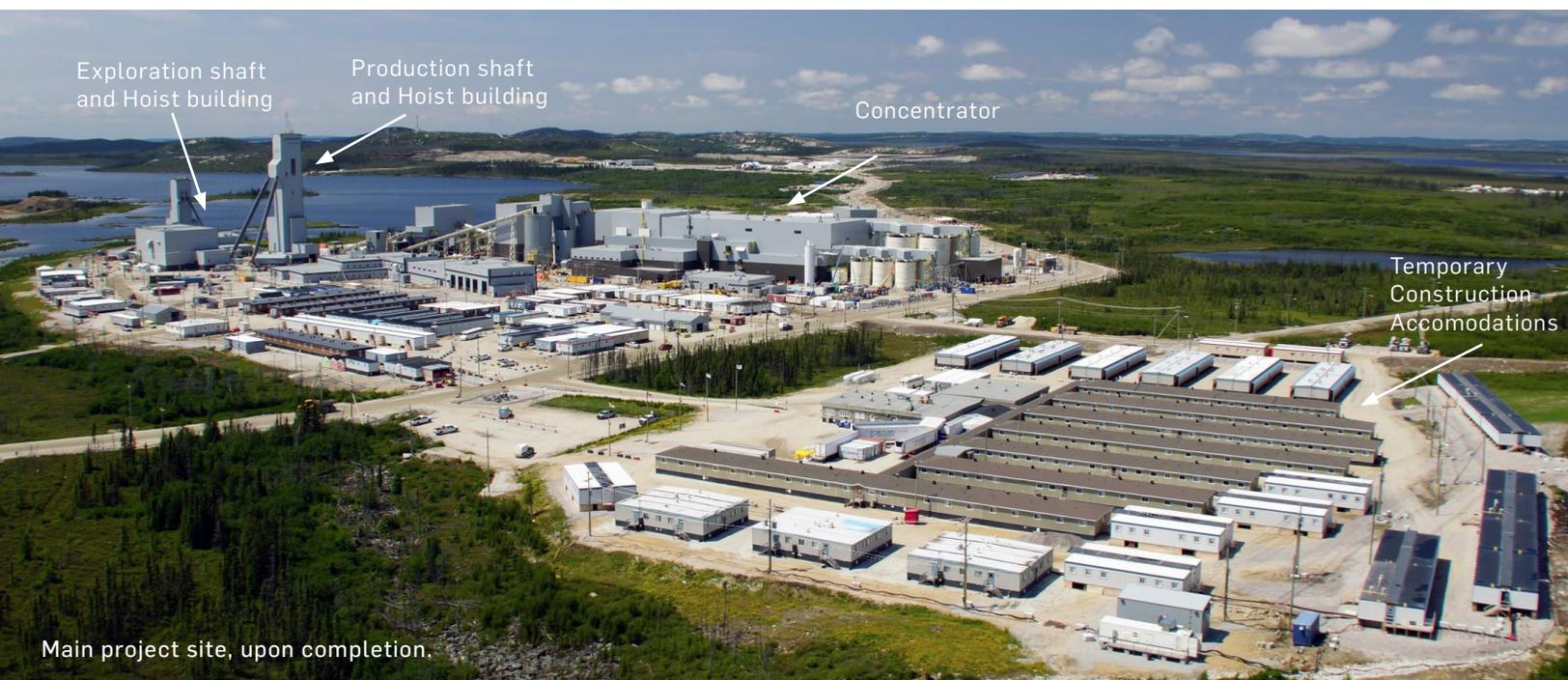
## Project Scope of Work and Services

While Goldcorp was responsible for the mine, SNC-Lavalin was engaged (between 2011 and 2014) to implement ore processing facilities—crushing plant, ore storage, ore processing plant, paste backfill plant and tailings filtration plant—and the following on-site infrastructure: permanent camp (with 400 rooms, a gymnasium, two conditioning rooms, and cafeteria), assay laboratory, warehouse and garage, administration building, industrial water treatment plant, water and waste water underground services, tailings management facilities (TMF), and on-site roads.

SNC-Lavalin's mandate was to:

- Establish, implement, and ensure compliance with project Health, Safety, and Environment
- Prepare required technical documentation by packages for tender inquiry, perform technical bid evaluation and prepare technical recommendations for Goldcorp
- Support the preparation of the capital cost estimate (Capex) and control budget (by work breakdown structure and by package)
- Manage all engineering deliverables, including those by other consultants and contractors, to meet project objectives
- Prepare supporting technical documentation required by Goldcorp for the preparation of the project's environmental and social impact assessment report (performed by another consultant)
- Manage construction execution on behalf of Goldcorp
- Perform mechanical completion including pre-operational verification (POV).

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Construction continued in winter



## Ambitious Schedule

Major complexity stemmed from the challenge of developing and maintaining a workable schedule based on the date of “first gold pour” set for October 1, 2014. SNC-Lavalin, together with Goldcorp, addressed this challenge right from the start.

Seasoned project management experts were mobilized to rigorously review the initial challenging schedule. As a result, selected infrastructure construction activities were rescheduled until after the time-critical first gold pour.

Upon SNC-Lavalin's recommendation, a project definition assessment (Project Definition Rating Index - PDRI) was completed to identify potential gaps, and actions to reduce risk and ensure project success. The exercise was undertaken in the areas of infrastructure, processing plant, tailings facilities, and waste-water treatment.

Following the PDRI study, SNC-Lavalin identified and completed additional FEED (front-end engineering design) studies, including metallurgical testing, to bring design to a level suitable for detail engineering.

To meet the fast-track delivery of the project, SNC-Lavalin also provided ongoing active deviation analysis (actual costs versus allocated budgets), and forecast management. Tight risk monitoring and management became an integral ingredient of the successful delivery.

The team also had to mitigate several unexpected schedule challenges, including:

- Delayed issue of some initial permits
- Two force-majeure events during summer 2013: a union strike followed by a forest fire causing a six-week delay, pushing some civil works and structural steel works into winter conditions
- Delayed deliveries of some major equipment caused by logistics constraints, delayed delivery of vendor/supplier documentation, delayed fabrication, and late changes during fabrication
- Strained camp room availability when the number of on-site workers was increased to accelerate progress.

To help address these issues, project management, engineering, and construction management teams pursued flexible solutions, such as overlapping of specific construction activities that are normally sequenced, and introducing night shifts for some disciplines.

### PM+

SNC-Lavalin's proven project management system, provided the required 24/7 access to project data, including engineering planning, estimating, procurement, budget forecast, and construction progress. The system was used for tracking and monitoring of purchase orders, construction contracts, work hours, mechanical pieces of equipment, and bulk materials.

## Remoteness and Climate

Complexity factors on this project included the remote location, arctic climate, constrained logistics, lack of infrastructure, extensive regulations, and the need to minimize environmental impact.

Helping to address these challenges, SNC-Lavalin's use of modular components for camp design shortened construction time, reduced requirements for on-site infrastructure, equipment and human resources, and lowered the construction cost. Modules were used for building camp accommodations; prefabricated components were used to build stairwells, ore conveyors, building envelopes, and silo structures.

Also, some buildings were enclosed prior to the start of cold weather, such that construction could continue in the deep of winter. Physical constraints of winter conditions were incorporated into the designs of all buildings.

Rigorous and sound logistics, adapted to the short shipping season, ensured safe implementation while meeting schedule, budget, and quality constraints. A site access plan was developed for equipment, materials, as well as contractor and supplier personnel. The plan took into account lessons learned from recent projects located in similar climatic conditions.

## Labour Requirements

Labour requirements on this project were impressive. SNC-Lavalin supplied additional expertise and resources when required during the project, to ensure product quality, particularly during the construction phase. At the height of engineering, additional resources were assigned to site to finalize design. Labour mobilization peaked at 750 construction workers on site.

Since project participants worked in multiple offices, their efforts had to be integrated while ensuring progress towards common goals and a common culture and approach. SNC-Lavalin organized frequent communications and coordination meetings via video / audio conferencing, as well as travel between cities.

A Steering Committee of project management personnel from both Goldcorp and SNC-Lavalin was set up to provide ongoing support to the project team and to deal with any human resource issues.

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Ore conveyors were assembled from prefabricated components



First gold pour, October 1, 2014

## Meeting Client Needs

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### Safety Culture

The need for excellent Health, Safety and Environment (HSE) performance was answered with SNC-Lavalin's extensive program that included:

- Comprehensive HSE plan and "zero-accident" construction culture across the project
- Worker H&S orientation sessions, with strong emphasis on preventive measures (Leading Indicators)
- Weekly HSE meetings
- Daily toolbox meetings
- Project HSE risk register
- Safety leadership training for supervisors and managers
- Critical risk control protocols
- Ongoing presence for daily assessments of risk culture at each work site; HSE interactions
- Emergency plan
- Immediate reporting of near miss incidents and imminent dangers to supervisors and project manager.



The HSE measures on the project helped to complete the work with results about 25 times superior to the provincial average

With over 3 million work-hours spent between September 2012 and October 2014, the lost time incident frequency (LTIF) was 0.42, and the total recordable incident frequency (TRIF) was 1.3, both per 200,000 hours. Furthermore, the last 1.65 million hours on the project were accident-free.

## Tight Collaboration with the Client

On this fast-paced project execution, extra measures were needed to ensure common vision and alignment with the client:

- Goldcorp personnel were integrated into the main project office in Montreal
- Goldcorp's operations personnel were included in the design team's visits of specific suppliers and other mining complexes
- For camp concept development, a "needs" survey of Goldcorp's mine workers was conducted
- A joint team of Goldcorp and SNC-Lavalin was formed to actively pursue the prioritization and fast-tracking of all activities leading to advanced first gold.



First gold pour October 1, 2014



Cafeteria



Accommodation complex

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## Local Involvement

Goldcorp required that local communities benefit from the project and that procurement activities respect the Opinagow Collaboration Agreement struck among Goldcorp, the Grand Council of the Crees, the Cree Regional Authority, and the Cree Nation of Wemindji in 2011. As such, concerns of the Cree community were considered during design and the Cree community participation in the project was maximized.

To further increase local involvement, responsibility for engineering of infrastructure buildings was entrusted to SNC-Lavalin's regional Rouyn-Noranda office located near Goldcorp's regional offices. Ultimately, this arrangement also delivered buildings better suited to the needs expressed during the project.



# Environmental Benefits

## Environmental Mindset

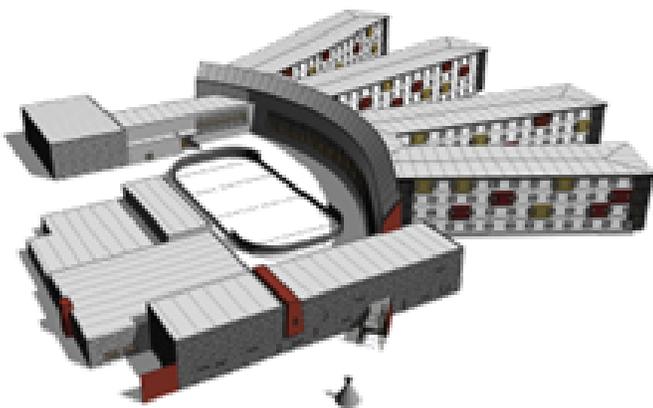
An environmental protection culture exceeding Government requirements was established early on in the project by Goldcorp. To promote this culture, each project meeting started with an overview of environmental-related activities, and all contracts and purchase orders included environmental clauses specifically developed for the Éléonore Project.

## Building Design Criteria

A sustainable development approach was part of Goldcorp's expectations during design and construction, especially for buildings.

Design criteria included:

- Maximizing green space
- Reducing light pollution
- Reducing water consumption
- Improving building energy performance by using efficient building envelopes and recovery systems
- Collecting and storing recyclable materials
- Reducing construction waste by adopting prefabricated solutions and specifying, local, low emission, and recycled materials.





## Tailings Design

The location of the tailings in a bog presented a major challenge with regard to site design and land preparation. In response to Cree communities' concerns and based on a responsible environmental risk management objective, Goldcorp opted for a filtration mine tailings approach (using filter-pressed tailings in stacks) instead of a traditional mine tailings approach. Moreover, the tailings pond design was based on a seepage control objective that exceeded standard Government requirements.

In the final design, sulfide tailings are pumped to the paste backfill plant to be solidified with cement to be stored underground and avoid acid mine drainage. Non-sulfide tailings are filtered before being sent to the paste backfill plant or trucked to the tailings storage area, where both the base and cover of the tailings pond include a waterproofing geomembrane.

This concept allows for maximum recovery of process water in the plant, eliminates the risk of dam breakage including waste spills, and allows gradual tailings rehabilitation over the life of mine.



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# Innovation

An innovative approach was an absolute requirement to meet the challenges of schedule, complexity, and the team's wide geographical distribution. Since personnel contributed from Montreal, Quebec, and Rouyn-Noranda, with additional expertise in Toronto and Vancouver, the most advanced collaborative software tools were used to keep the project engineers and design reviewers on the same page.

## Plant Design

Using cutting-edge modelling software, SNC-Lavalin experts developed a 3D design model of the Éléonore process plant facilities. All discipline staff, whatever their location, were able to collaborate on this single platform, working in parallel and using a single source of information throughout project phases.

The 3D model enabled engineering discipline coordination, conflict resolution, bulk material reporting and control, and client design reviews.

## Documentation

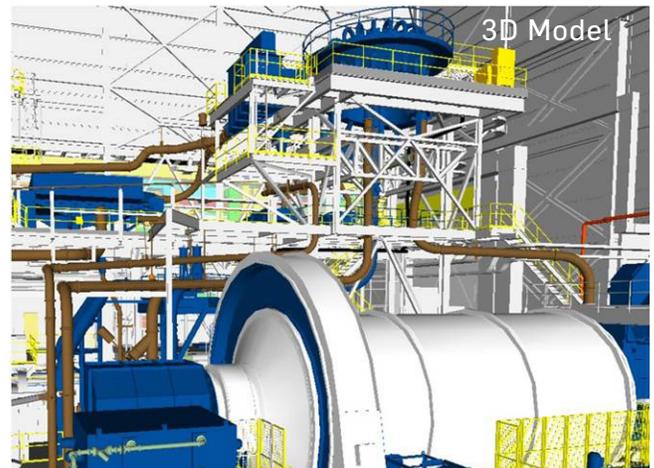
The project also involved the formidable task of managing over 110,000 documents, of which 45,000 were issued for coordination to more than 850 different stakeholders (SNC-Lavalin, Goldcorp, and various suppliers). A single state-of-the-art online Project Document Management system (PDM) was used to create, publish, and distribute all project documents. PDM ensured document integrity and was available 24/7.

Crucial for the distributed design team, PDM also enabled electronic red-lining (review of documents online). Electronic red-lining is a new capability in the industry. It replaces traditional "pink room" design reviews that would require substantial effort to incorporate the input of remotely located team members.

PDM also features integrated workflows which ensure that document owners receive automatic notifications on comments, suggested modifications, or for approval.

## Risk Monitoring

A very proactive risk monitoring approach was adopted on the project. Frequent risk workshops were held to identify new risks/opportunities in engineering and HSE and to closely monitor adopted risk mitigation strategies (avoidance, reduction, exposure separation, task duplication or transfer).





## Social and Economic Benefits

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### Cree Inclusion

Social acceptability, a key project objective, was being addressed by Goldcorp well before the EPCM mandate. Since the Éléonore mine is located near the Cree Nation of Wemindji community, Goldcorp wanted the local workforce to benefit both during both the project construction and over the operation for the next fifteen years. SNC-Lavalin helped implement the strategy that supported meeting this expectation. For example, project scope was subdivided to maximize the ability to grant contracts to Cree partners, while respecting the degree of expertise necessary to fulfill these contracts.

Within the mine operators training program, SNC-Lavalin prepared a Cree Inclusion Plan to formalize a process for incorporating Aboriginal stakeholders' input. The plan also provides local Cree workers both technical training and job coaching, enabling them to benefit from jobs created by the project. Several members of the Nation Cree of Wemindji have benefited during construction and now during operation from well remunerated employment.

### Investment and Jobs

The Éléonore Project remains, at present, one of the largest private projects of Quebec's "Plan Nord" program.

*"The Éléonore Project is an excellent example of the promising projects we want .... Carried out in partnership with local and Aboriginal communities, and implemented according to best practices, this project has generated significant benefits across Québec and will continue to do so for many years."* Pierre Arcand, Minister of Energy and Natural Resources, Minister responsible for the Plan Nord, and Minister responsible for the Côte-Nord region

The Éléonore Mine operation contributes significantly to the provincial GDP. This investment of CA\$2.3B has generated and continues generating major economic spinoffs for local and regional communities, for suppliers of goods and services, and Quebec entrepreneurs. An estimated 50% to 60% of the construction workforce came from the Abitibi-Témiscamingue and Nord-du-Québec Regions. Currently, the operation has 650 permanent employees and over 450 contract personnel.

# Éléonore Mine Project by the numbers

## ÉLÉONORE ACHIEVES COMMERCIAL PRODUCTION, EFFECTIVE APRIL 1, 2015

- The total construction cost was 2.1B\$
- 268,100 ounces of gold were produced in 2015
- Éléonore provided employment to 2,000 workers during construction
- Up to this day, and every year, 90% to 95% of spending on goods and services are made locally in Quebec. The remainder is mostly spent in Canada
- 110,000 documents were managed by SNC-Lavalin
- From October 2013 to December 2014, a total of 35,645 m<sup>3</sup> of concrete was poured
- By the end of 2014, the kitchen highlighted 1 million meals that year. In 2015, the kitchen served almost 720,000 meals
- The lowest temperature during the he winter months was between -45 and -50, with a wind chill between -60 and -70
- There were more than 67,500 passengers on planes in 2015
- There were 1,860 flights in 2015