NORTHERN POLICY INSTITUTE | INSTITUT DES POLITIQUES DU NORD

Research Paper No. 6 | January 2016

# The Mining Industry in Northwestern Ontario:

## An Analysis of Recent Developments and the Strategy for Success

By Karl Skogstad and Ayman Alahmar

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This report was made possible through the support of our partners Lakehead University, Laurentian University and Northern Ontario Heritage Fund Corporation. Northern Policy Institute expresses great appreciation for their generous support but emphasizes the following: The views expressed in this commentary are those of the author and do not necessarily reflect the opinions of the Institute, its Board of Directors or its supporters.


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Published by Northern Policy Institute
874 Tungsten St.
Thunder Bay, Ontario P7B 6T6

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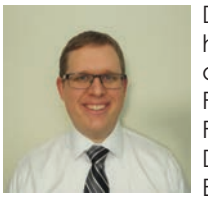

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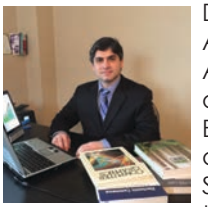


Dr. Ayman Alahmar is an Associate Professor of Mechanical Engineering and Information Systems with more than ten years of university teaching and academic/industrial research experience. He recently joined the Faculty of Business Administration at Lakehead University and received the Master of Business Administration (MBA) degree in 2015. He is currently working as a Research Assistant at Lakehead University and as an independent consultant and researcher.

# Executive Summary

In the early 2010s, Northwestern Ontario seemed to be on the verge of a major mining boom, with nine projects in particular seen as having the best chance of reaching the commercial production stage. With these mines and the five already in operation, it seemed possible that a total of fourteen mines could be operating in the region by the end of 2018. So far, however, none of the nine projects — with resource wealth valued in 2012 at US$135.4 billion, potential tax revenues exceeding C$16 billion, and predicted to create over 23,000 direct, indirect, and induced new employment positions — has begun commercial production, and only three might be operational by 2018.

The development of these projects has faced major challenges, including labour shortages, a lack of sufficient and coordinated consultation processes with First Nations and communities, the inadequacy of infrastructure — particularly in terms of the lack of rail, roads, and electrical power — the long environmental review process, taxation, the lack of access to capital, the need to foster collaboration between communities, the low level of involvement of supply and services firms and organizations operating in the region, and, above all, the volatility of commodity markets. The unpredictability of commodity prices combined with the length of time between the exploratory stage and the commercial production stage has meant that some mines were not able to act fast enough to capitalize on commodity prices when they were high.

Little can be done to overcome the fundamental economic conditions of the commodity market. If commodity prices are low, many projects will remain economically unfeasible, and the region's mineral wealth will remain in the ground until prices make it profitable for the resource to be extracted. However, capital and operating costs — particularly the cost of electricity, which is higher in Ontario than in other Canadian mining jurisdictions could be reduced, which would make the projects viable at lower commodity prices. With interest rates at historic lows, now is also the time to invest in energy production and transmission, as well as in other infrastructure, which would help make Northwestern Ontario's mines more internationally competitive. Another reason for high operating costs is the high cost of labour and the shortage of skilled labour in Ontario's mining sector; thus, providing incentives to students to train in this area in the region's post-secondary educational institutions should be a priority.

The mining sector could also be helped by shortening the development period of projects — particularly by reducing the time required for the environmental permitting process. For instance, funds could be made available to allow firms to hire the additional staff necessary to conduct reviews more quickly, and to allow local communities, both Aboriginal and non-Aboriginal, to hire the necessary professionals to help them quickly understand the potential environmental costs of projects. If the time it takes to open up a mine is shortened, more mines could ride the next wave of high commodity prices to the production phase.

Finally, clarity needs to be provided in dealing with Aboriginal groups. Many firms have been able to come to mutually beneficial agreements with Aboriginal stakeholders, but others have been unable to do so. This issue makes it difficult to secure investors, as any agreement ultimately could affect a mine's profitability. The rights of both parties should be made explicitly clear, so that the two sides can negotiate more easily over the project's benefits.

Ultimately, the reason for the failure of most of the nine projects to develop came down to their low expected profitability, but with improvements in infrastructure and labour supply, lower operating costs, a faster environmental permitting process, and better relations with Aboriginal groups, the next time commodity prices rise, the region might indeed experience the mining boom that was predicted three years ago.

# Introduction

In the early 2010s, there was a belief that Northwestern Ontario was on the verge of a major mining boom. Exploration and development in the Ring of Fire and, indeed, in the entire region was progressing rapidly, driven by high mineral prices. Nine projects in particular were seen as having the best chance of reaching the commercial production stage. Combined with the five mines already in operation, it was believed that a total of fourteen mines could be operating in the region by the end of 2018. Various reports detailed the potential economic benefits that could arise, as well as the challenges that needed to be overcome (Dadgostar et al. 2012; S.-L. Inc. and E.H.D. Consulting 2013). At the time of writing this study, however, none of these nine projects had begun commercial production, and it appears that only three of them might be operational by 2018. The purpose of this study is to analyse recent developments in the mining industry by examining these nine projects to determine what factors ultimately will lead to their success or failure. Our hope is that, by identifying trends in the data, we will be able to recommend a strategy for success to improve the likelihood that future mining projects in the region will reach the commercial production stage.

As of 2015, five mineral mines were operating in Northwestern Ontario:

- Red Lake Gold Mines, operated by Goldcorp Inc.;
- Musselwhite Mine, operated by Goldcorp Inc.;
- Williams Mine (Hemlo), operated by Barrick Gold Corporation;
- Lac des Iles Mine, operated by North American Palladium Ltd.; and
- Victor Diamond Mine, operated by De Beers Canada.

The three gold mines — Musselwhite, Red Lake, and Williams — are all relatively old, with the youngest, Musselwhite, having opened in 1997. Lac des Iles, primarily a palladium producer, began operations in 1993, while the Victor mine is the youngest, having begun production in 2008.

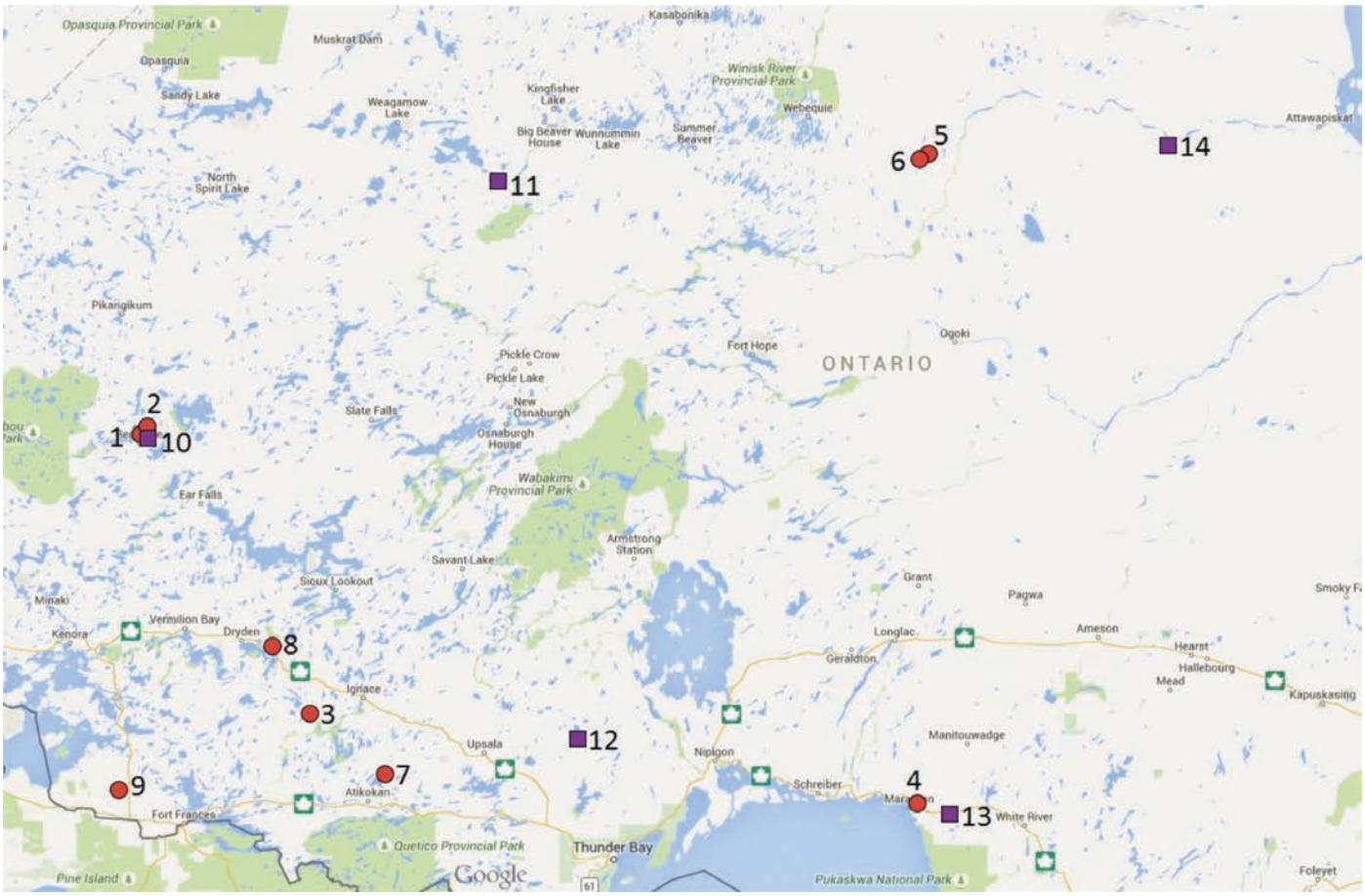
Development of the region's mining sector during the late 1990s and early 2000s was relatively slow, owing mostly to low commodity prices. As prices rose, so too did mining development. As of 2012, eighty-two mining projects were at various stages of development (Dadgostar et al. 2012). Included in this number were nine projects described as "mature exploration projects" because they were expected to move from exploration to production in the near future — that is, between 2013 and 2017. These nine mature exploration projects (and their current owners) are as follows:

- Cochenour/Bruce Channel (Goldcorp Inc.);
- Phoenix Gold Project (Rubicon Minerals Corporation);
- Josephine Cone Mine (Bending Lake Iron Group Ltd.);
- Marathon Cu-PGM Deposit (Stillwater Mining Company);
- Black Thor (Noront Resources Ltd.);
- Eagle's Nest (Noront Resources Ltd.);
- Hammond Reef (Canadian Malartic Corporation);
- Goliath Gold Project (Treasury Metals Inc.); and
- Rainy River Gold Project (New Gold Inc.).

Figure 1 shows the locations of these nine projects as well as those of the five currently operating mines. Even though the nine projects were considered mature in 2012, have resource wealth valued at US$135.4 billion, were expected to generate tax revenues exceeding $16 billion (all dollar values are Canadian dollars unless otherwise stated), and were predicted to create over 23,000 direct, indirect, and induced new employment positions (Dadgostar et al. 2012), none had started commercial production as of November 2015. Despite these substantial benefits, previous reports showed there are challenges in developing these projects, which we consider in this study, with special attention to changing economic conditions, the availability of infrastructure, the shortage of trained workers, local Aboriginal support, and the length of the environmental permitting process. We show, however, that some of these obstacles are more easily overcome than others.

The study is organized as follows. We begin with a summary of previous studies of mining projects in Northwestern Ontario. We then provide a summary of the movement of commodity prices over the past decade, followed by analyses of the nine mature exploration projects. We then assess likely future commodity price movements, and offer conclusions and recommendations in the final two sections.

*Figure 1: Operating Mines and Mature Exploration Projects, Northwestern Ontario, 2012*




*Circles are sites under development; squares are operating mines.*

1. *Cochenour/Bruce Channel (Goldcorp Inc.)*
2. *Phoenix Gold Project (Rubicon Minerals Corporation)*
3. *Josephine Cone Mine (Bending Lake Iron Group Ltd.)*
4. *Marathon Cu-PGM Deposit (Stillwater Mining Company)*
5. *Black Thor (Noront Resources Ltd.)*
6. *Eagle's Nest (Noront Resources Ltd.)*
7. *Hammond Reef (Canadian Malartic Corporation)*
8. *Goliath Gold Project (Treasury Metals Inc.)*
9. *Rainy River Gold Project (New Gold Inc.)*
10. *Red Lake Gold Mines (Goldcorp Inc.)*
11. *Musselwhite Mine (Goldcorp Inc.)*
12. *Lac des Iles Mine (North American Palladium Ltd.)*
13. *Hemlo Mine (Barrick Gold Corporation)*
14. *Victor Diamond Mine (De Beers Canada)*

*Source: Authors' compilation, from Google Earth.*

# Previous Studies

The most recent reports on the mature exploration projects we investigate in this study are *Mining in Northwestern Ontario: Opportunities and Challenges* (Dadgostar et al. 2012) and *Advantage Northwest: Mining Readiness Strategy* (S.-L. Inc. and E.H.D. Consulting 2013). Here we highlight the relevant results of these reports as they relate to these nine mining projects.

*Mining in Northwestern Ontario* found that the nine projects were well advanced through the development stage and could become active mines by 2017. It estimated the total value of the metals and minerals that could be extracted from these mines to be US$135.4 billion (at commodity prices as of June 1, 2012). The mines were expected to generate direct, indirect, and induced employment growth of 23,588 new jobs in the province, and the potential tax revenue for all three levels of government was conservatively estimated to exceed $16 billion. At the same time, however, the study identified three major challenges to the development of these projects: Aboriginal involvement, labour market dynamics, and the availability of infrastructure in terms of rail, roads, and electrical power.

*Advantage Northwest* examined ten mining projects that were anticipated to become operational by 2017 — namely, the nine mature exploration projects plus an expansion project at an existing mine (Lac des Iles). The study estimated that the growth of the mineral sector from the ten projects would create about 10,000 full-time equivalent positions per year over a ten-year period and economic revenues to Northwestern Ontario of between $1 billion and $1.7 billion per year. The estimated total economic impact on the Ontario economy over the ten years ranged from $14.92 billion to $20.89 billion, with much of the benefit remaining in Northwestern Ontario. The study also indicated that the projects faced a number of obstacles: labour shortages, the need to consult Aboriginal peoples, the inadequacy of infrastructure, mining regulation and taxation (for example, in the form of long environmental review processes), economics barriers such as lack of access to capital, the volatility of commodity markets, challenges in fostering collaboration between communities, a lack of understanding of the benefits of the mining sector, and the low level of involvement of supply and services firms and organizations operating in the region.

What both studies make clear is that, as of 2012 and 2013, there was a belief that Northwestern Ontario was about to witness a mining boom. Challenges certainly had to be overcome, but it was expected that the nine projects would bring substantial economic benefits to the region, the province, and the country. Understanding why these benefits never materialized is the focus of the rest of this study.

# Commodity Price History

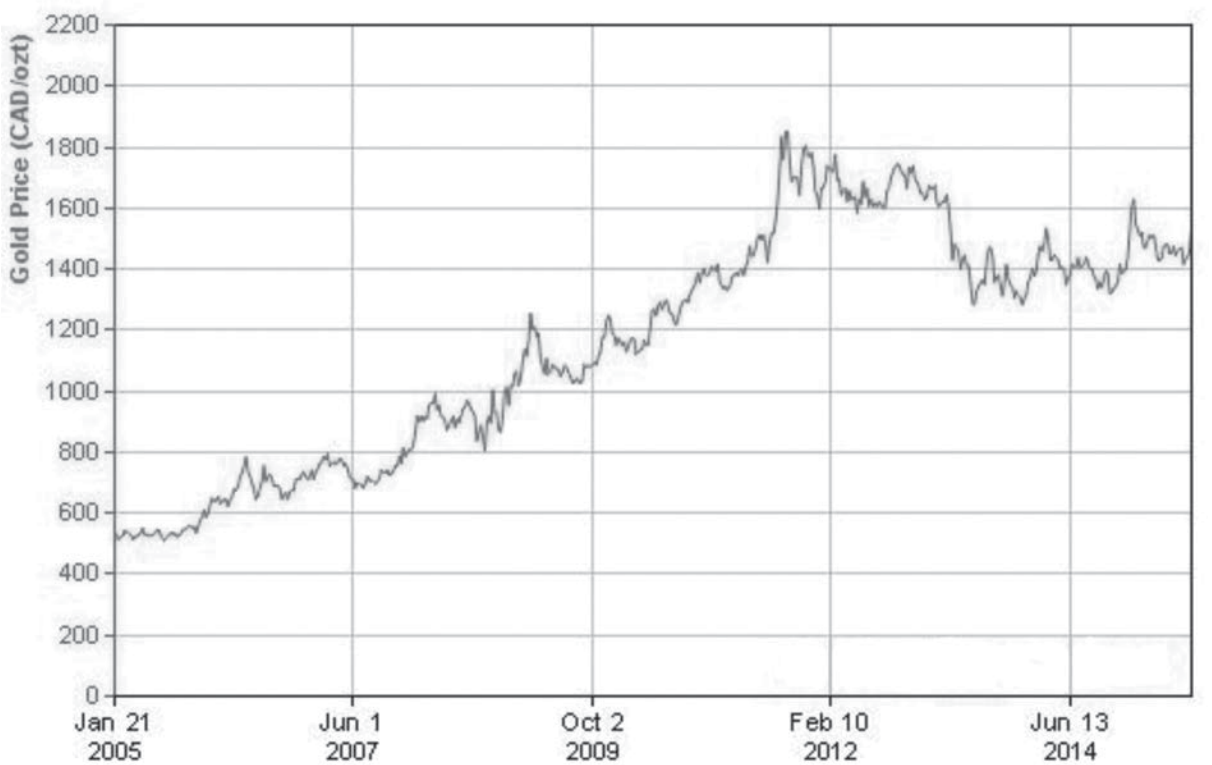
The first step in examining the mining development sector in Northwestern Ontario over the past few years is to understand how commodity prices have changed. Commodity prices have a significant influence on mining activities because the profitability of mining projects is highly dependent on market prices. Mining firms respond in direct correlation to the movement of commodity prices. As prices rise, resources that were uneconomical can now be extracted at a profit. Firms begin the environmental permitting process and conduct feasibility studies, in the hope that their project will become operational quickly enough to take advantage of higher commodity prices. As prices fall, some projects are no longer expected to return a profit, and development of these sites stop.

Figures 2 and 3 show the price of gold over the past decade in both Canadian and US dollars. From 2005 to 2012, there was a clear upward movement in the price, tripling in value over that period. As the price rose, a number of gold projects in Northwestern Ontario began to move through the development cycle. Since 2012, however, the price of gold has fallen, particularly, as Figure 3 shows, when measured in globally traded US dollars. The price has not fallen as much when valued in Canadian dollars because of the recent depreciation of that currency against the US dollar.

The role of the exchange rate is important for mines operating in Canada, since most of their production costs are valued in Canadian dollars. On the other hand, when these mines sell their output on global markets, they receive payment in US dollars. All things being equal, when the Canadian dollar depreciates in value against the US dollar, mines in Ontario profit. For instance, the sale of 100 ounces of gold at US$1,500 per ounce at an exchange rate of 1:1 would yield revenue of $150,000, but at an exchange rate of 0.75:1 the sale would yield $200,000. Figure 4 shows the Canadian-US dollar exchange rate over the past ten years. Besides the short depreciation caused by the 2008 recession, the two currencies traded near parity between 2007 and 2012. Since 2013, however, the value of the Canadian dollar has fallen against the US dollar, with the result that falling commodity prices have not had as large an effect on mines in Ontario than otherwise might have been the case.

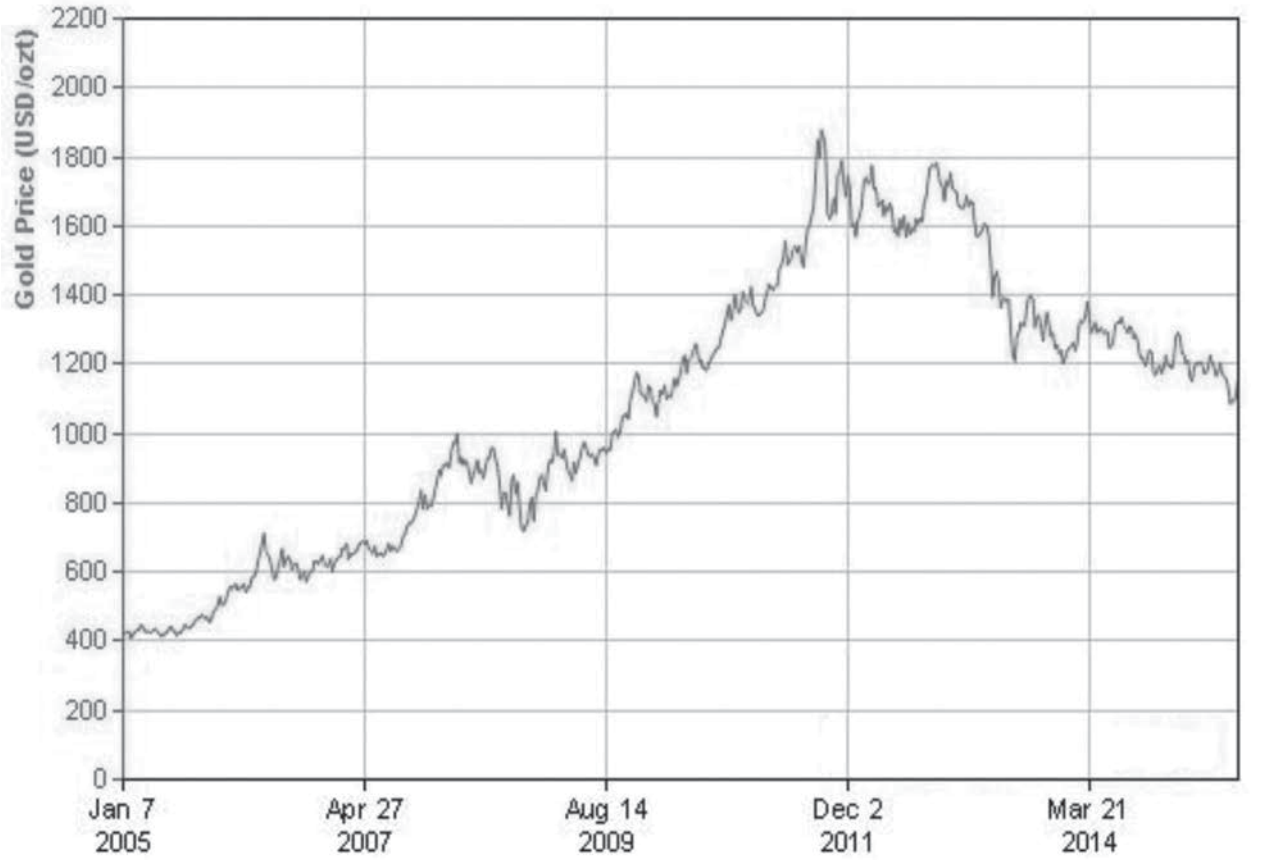
The prices of silver, copper, nickel, platinum, palladium, ferro chrome (chromite), and iron (pellets) for the past ten years can be found in the figures in the Appendix. The figures of prices in US dollars show that most of these resources have followed the same pattern as gold, with an inverted U-shaped curve indicating a

*Figure 2: Gold Prices in Canadian Dollars per Troy Ounce, 2005–15*




*Source: InfoMine.com; available online at http://www.infomine.com/ChartsAndData/ChartBuilder.aspx?g=127681&cd=1.*

*Figure 3: Gold Prices in US Dollars per Troy Ounce, 2005–15*




*Source: InfoMine.com; available online at http://www.infomine.com/ChartsAndData/ChartBuilder.aspx?g=127681&cd=1.*

rise in commodity prices in the late 2000s, followed by a decline. The timing of the peak in price differs depending on the resource. Gold peaked in late 2011/early 2012, silver in 2011, copper also in 2011 after a serious fall during the 2008 recession, and nickel in 2007. The price of palladium appears to have peaked in 2014, but its recent fall might not be indicative of an overall downward trend. The price of platinum peaked in 2008 before the recession, fell dramatically, recovered, and then began to fall again in 2011. The price of ferro chrome, which best reflects the price of chromite, peaked in 2008 prior to the recession, fell dramatically, and has remained low ever since. The price of iron pellets peaked in 2011 and has continued downward ever since.

The recent decline in the prices of these commodities is less obvious, however, when looked at in terms of Canadian dollars because of the depreciation of that currency. That is, the falling value of the Canadian dollar has sheltered Canadian mines from the full effect of the price drops, which implies that projects that certainly would no longer be feasible had the exchange rate remained at parity might still be viable. Even in Canadian dollars, the change in these resource prices demonstrates just how volatile commodity markets can be. Gold at one time was over $1,800 an ounce, but at the end of August 2015 was trading at around $1,530 an ounce. Also at the end of that month, silver was down to around $20 an ounce from its high of over $45, nickel was down to $6.09 a pound from its high of around $27 (a drop of over 75 percent), and ferro chrome was trading at $1.25 a pound, down from its high of $2.75.

Commodity prices are difficult to predict. For example, at the beginning of 2013, when gold prices were continuously rising, many major gold mining managers, commercial banks, and other experts predicted the price of gold would rise well above US$2,000 per ounce (see Trustable Gold 2013). As the figures in the Appendix make clear, however, this did not happen. This unpredictability in commodity prices combined with the long time (in Canada) between the exploratory stage and the commercial production stage poses a big challenge for the mining industry. As we show in the next section, some mines were not able to deal with this challenge by acting fast enough to capitalize on commodity prices when they were high.

*"The **falling** value of the Canadian dollar has sheltered **Canadian** mines from the full effect of the price **drops**. . .*

*Figure 4: The Canadian-US Dollar Exchange Rate, 2005–15*


*Source: Bank of Canada.*

*. . . which implies that **projects** that certainly would no longer be **feasible** had the exchange rate remained at parity might still be **viable**."*

# Analysis of Individual Projects

In this section, we provide an analysis of each of the nine projects listed previously. The goal is to identify which factors were essential in helping some projects develop and which factors hindered the development of others. We pay particular attention to economic factors, the availability of infrastructure, community support, Aboriginal support, the availability of labour, and the environmental permitting process. We also include a timeline noting important events that occurred during each project's development.

To facilitate the comparison of the various projects, we present a series of tables that provide detailed information on various factors relating to each project. We should note that feasibility reports for some projects have not been made public; in such cases, we used various other sources to provide as much detail as possible. We have separated the projects into three groups, based on the minerals being extracted. Table 1 provides information on the five gold projects, Table 2 on the two platinum group metal projects, and

*Table 1: Gold Projects, Northwestern Ontario, 2015*

| | Project | | | | |
|---|---|---|---|---|---|
| | **Phoenix** | **Goliath** | **Rainy River** | **Hammond Reef** | **Cochenour** |
| Financial | | | | | |
| **Revenues (LOM) *($ millions)*** | 3,127.00 | 1,143.20 | 4,795.00 | 4,742.30 | N/A |
| **Initial capital expenditure *($ millions)*** | 224.00 | 93.80 | 931.00 | 681.54 | 496.00 |
| **Sustaining capital expenditure *($ millions)*** | 426.00 | 106.00 | 366.30 | 175.38 | N/A |
| **Operating costs (LOM) *($ millions)*** | 1,378.00 | 579.40 | 2,514.00 | 2,568.70 | N/A |
| **Cash cost per ounce of gold milled *($)*** | 629.00 | 731.00 | 737.00 | 502.00 | 350.00 |
| **All-in cost per ounce of gold milled *($)*** | 926.00 | 913.00 | 1,080.00 | 658.00 | N/A |
| Operational | | | | | |
| **Tonnes milled per year *(thousands)*** | 689 | 875 | 7,670 | 17,500 | 548 |
| **Average gold grade (LOM) *(grams per tonne)*** | 8.06 | 2.87 | 1.12 | 0.71 | N/A |
| **Ounces of gold recovered (LOM) *(thousands)*** | 2,190 | 793 | 3,402 | 5,119 | 5,000 |
| **Ounces of silver recovered (LOM) *(thousands)*** | N/A | 1,892 | 6,004 | 3,808 | N/A |
| **Recovery *(%)*** | 92.50 | 96.85 | 90.60 | 93.00 | 93.60–97.50 |
| **Life of mine *(years)*** | 13.3 | 10.3 | 13.6 | 15.0 | 20.0 |
| **Workforce size *(number of employees)*** | 335 | 200 | 150–606 | 417–527 | N/A |
| Return on investment | | | | | |
| **Net present value (5%), after tax *($ millions)*** | 531.00 | 144.30 | 330.00 | 458.40 | N/A |
| **Internal rate of return after tax *(%)*** | 27.0 | 32.4 | 11.3 | 15.2 | N/A |
| **Payback period *(years)*** | 3.7 | 2.8 | 5.5 | 4.6 | N/A |
| Assumptions | | | | | |
| **Assumed gold price *(US$ per ounce)*** | 1,385 | 1,375 | 1,300 | 825 | N/A |
| **Assumed silver price *(US$ per ounce)*** | N/A | 26 | 22 | 13 | N/A |
| **Assumed US-Canadian dollar exchange rate** | 1.05 | 1.02 | 1.05 | 1.11 | N/A |
| **Date of report** | Feb. 2014 | Aug. 2012 | Feb. 2014 | Nov. 2009 | N/A |

*Notes: LOM is life of mine. All dollar amounts are in Canadian dollars unless otherwise specified. Sources: Phoenix: Bernier et al. (2014); Goliath: Roy et al. (2012); Rainy River: Hardie et al. (2014); Hammond Reef: Rennie, R.J. Lambert, and H. Krutzelmann (2009); Cochenour: Goldcorp (2011a, 2015a, 2015b); Tollinsky (2015).*

*Table 2: Platinum Group Metals Projects, Northwestern Ontario, 2015*

| | Project | |
|---|---|---|
| | **Marathon Cu-PGM** | **Eagle's Nest** |
| Financial | | |
| **Revenues (LOM) *($ millions)*** | 2,565.30 | 3,509.00 |
| **Initial capital expenditure *($ millions)*** | 351.10 | 609.40 |
| **Sustaining capital expenditure *($ millions)*** | 144.00 | 160.00 |
| **Operating costs (LOM) *($ millions)*** | 1,224.10 | 1,080.00 |
| **Cash cost of nickel milled *($ per pound)*** | | 3.47 |
| **Cash cost of copper milled *($ per pound)*** | 2.84 | |
| **Cash cost of ore milled *($ per tonne)*** | 16.64 | 97.01 |
| **All-in cost of nickel milled *($ per pound)*** | | 5.94 |
| **All-in cost of copper milled *($ per pound)*** | 3.98 | |
| **All-in cost of ore milled *($ per tonne)*** | 22.05 | 166.15 |
| Operational | | |
| **Tonnes milled per year *(thousands)*** | 8,030 | 1,095 |
| **Average gold grade (LOM) *(grams per tonne)*** | 0.085 | 0.179 |
| **Average silver grade (LOM) *(grams per tonne)*** | 1.442 | |
| **Average nickel grade (LOM) *(%)*** | | 1.68 |
| **Average copper grade (LOM) *(%)*** | 2.47 | 0.87 |
| **Average palladium grade (LOM) *(grams per tonne)*** | 0.834 | 3.09 |
| **Average platinum grade (LOM) *(grams per tonne)*** | 0.237 | 0.89 |
| **Pounds of nickel payable (LOM) *(thousands)*** | | 308,397 |
| **Pounds of copper payable (LOM) *(thousands)*** | 431,220 | 144,209 |
| **Ounces of palladium payable (LOM) *(thousands)*** | 1,812.6 | 675.5 |
| **Ounces of platinum payable (LOM) *(thousands)*** | 434.5 | 173.9 |
| **Ounces of gold payable (LOM) *(thousands)*** | 180.1 | 36.6 |
| **Ounces of silver payable (LOM) *(thousands)*** | 2,839.4 | |
| **Life of mine *(years)*** | 11.5 | 10.2 |
| **Workforce size *(number of employees)*** | 130–250 | 162 |
| Return on investment | | |
| **Net present value (5%) after tax *($ millions)*** | 293 | 748 |
| **Internal rate of return after tax *(%)*** | 17.40 | 28.30 |
| **Payback period *(years)*** | 4.4 | 2 |
| Assumptions | | |
| **Assumed nickel price *(US$ per pound)*** | | 9.43 |
| **Assumed copper price *(US$ per pound)*** | 2.91 | 3.60 |
| **Assumed platinum price *(US$ per ounce)*** | 1,346 | 1,601 |
| **Assumed palladium price *(US$ per ounce)*** | 321.44 | 599 |
| **Assumed gold price *(US$ per ounce)*** | 819.22 | 1,415 |
| **Assumed silver price *(US$ per ounce)*** | 14.10 | |
| **Assumed US-Canadian dollar exchange rate** | 1.099 | 1.015 |
| **Date of report** | Nov. 2008 | Oct. 2012 |

*Notes: LOM is life of mine. All dollar amounts are in Canadian dollars unless otherwise specified. Sources: Marathon: Fraser (2012); Murahwi et al. (2010); Stillwater (2011); Eagle's Nest: Burgess et al. (2012).*

Table 3 on the single iron project. (We were unable to provide a table on the Black Thor chromite project because of insufficient data.) When examining these tables, it is important to remember that many of these values are estimates, some of which have changed as market conditions have evolved. Additionally, the assumptions made by each report vary. For instance, the Hammond Reef project report was written using an estimated price of gold of US$825 per ounce, whereas Rubicon's Phoenix project used an estimate of US$1,385 per ounce. These values have a direct influence on the estimated rates of returns on the project, so care must be taken when comparing values between the mines. Despite this, these variables still provide a good indication of the size of each project, and their expected profitability.

All else being equal, a fall in the price of a commodity relative to the assumed value will lead to a fall in the projected net present value and its internal rate of return. However, the fall in the value of the Canadian dollar might partially or completely offset this. Examining the five gold projects in Table 1, we can see that the estimated value of gold in Canadian dollars ranges from $915.75 to $1,454.25 per ounce. With the current price of gold at $1,433.95 per ounce as of November 24, 2015, these projects should in fact be more profitable than predicted by the feasibility studies.

Turning to the two platinum group metals (PGM) projects, Table 2 reveals a different story. In both cases, the estimated prices of the commodities in Canadian dollars have changed in both directions: nickel, copper, and platinum are now worth substantially less than estimated, while palladium, gold, and silver are

worth more. Based on these changes, the value of the ore at the Marathon project has increased substantially, thanks mainly to the huge increase in the value of palladium, while the Eagle's Nest project's resources are worth substantially less, driven mainly by the fall in the prices of nickel and platinum. Finally, Table 3 shows that, although the Josephine Cone project assumed a price of iron ore pellets of US$128.31 per tonne, the price now sits at US$70 per tonne, so that, even with the fall in the Canadian dollar, the estimated return for this project is now well below expectations.

From Tables 4 through 6, which provide the resource estimates for these projects, it is clear that the projects vary greatly in both the amount and grade of ore present. All else being equal, projects with higher-grade ore will be more profitable than those with lower-grade ore: the more of a commodity that can be recovered per tonne of ore milled, the more revenue will be generated for a similar cost. Also note that the terms measured, indicated, and inferred have specific definitions when discussing the amount of resources estimated to be present in an ore body, and are listed in the tables in decreasing order of certainty. Therefore, all else being equal, a project with measured resources will be less risky than one with indicated resources, which, in turn, will be less risky than one that has only an inferred amount. When analyzing each of the mines in turn, these tables will be useful to make quick comparisons of the various projects.

*Table 3: Northwestern Ontario's Iron Mine Project, 2015*

| | Josephine Cone |
|---|---|
| Financial | |
| **Initial capital expenditure *($ millions)*** | 990 |
| **Sustaining capital expenditure *($ millions)*** | 320 |
| **Cash cost of iron milled *($ per tonne)*** | 52.99 |
| Operational | |
| **Tonnes milled per year *(millions)*** | 14.6 |
| **Tonnes of iron pellets recovered (LOM) *(millions)*** | 116 |
| **Life of mine *(years)*** | 29 |
| **Workforce size *(number of employees)*** | 300 |
| Return on investment | |
| **Net present value (10%) after tax *($ millions)*** | 980 |
| **Internal rate of return after tax *(%)*** | 25 |
| **Payback period *(years)*** | 3.5 |
| Assumptions | |
| **Assumed iron pellet price *(US$ per tonne)*** | 128.31 |

*Notes: LOM is life of mine. All dollar amounts are in Canadian dollars unless otherwise specified. Sources: Arnold et al. (2011); Bending Lake Iron Group (2011); Chronicle Journal (2011).*

*Table 4: Gold Resources, Northwestern Ontario, 2015*

| Project | Level of Certainty | Amount of Ore *(tonnes)* | Gold Grade *(grams per tonne)* | Amount of Gold *(troy ounces)* | Silver Grade *(grams per tonne)* | Amount of Silver *(troy ounces)* |
|---|---|---|---|---|---|---|
| **Cochenour** | inferred | 9,300,000 | 11.55 | 3,450,000 | | |
| **Phoenix** | indicated | 4,120,000 | 8.52 | 1,129,000 | | |
| | inferred | 7,452,000 | 9.26 | 2,219,000 | | |
| **Goliath** | indicated | 9,140,000 | 2.60 | 760,000 | 10.40 | 3,070,000 |
| | inferred | 15,900,000 | 1.70 | 870,000 | 3.90 | 1,990,000 |
| **Rainy River** | measured | 26,665,000 | 1.21 | 1,035,000 | 1.79 | 1,531,000 |
| | indicated | 150,696,000 | 1.07 | 5,202,000 | 2.70 | 13,104,000 |
| | inferred | 20,655,000 | 1.16 | 773,000 | 2.58 | 1,717,000 |
| **Hammond Reef** | measured | 123,500,000 | 0.90 | 3,590,000 | | |
| | indicated | 72,900,000 | 0.78 | 1,830,000 | | |
| | inferred | 75,700,000 | 0.72 | 1,750,000 | | |

*Sources: Cochenour: Goldcorp (2015a); Phoenix: Bernier et al. (2014); Goliath: Roy et al. (2012); Rainy River: Hardie et al. (2014); Hammond Reef: Osisko Mining Corporation (2013).*

*Table 5: Platinum Group Metals Resources, Northwestern Ontario, 2015*

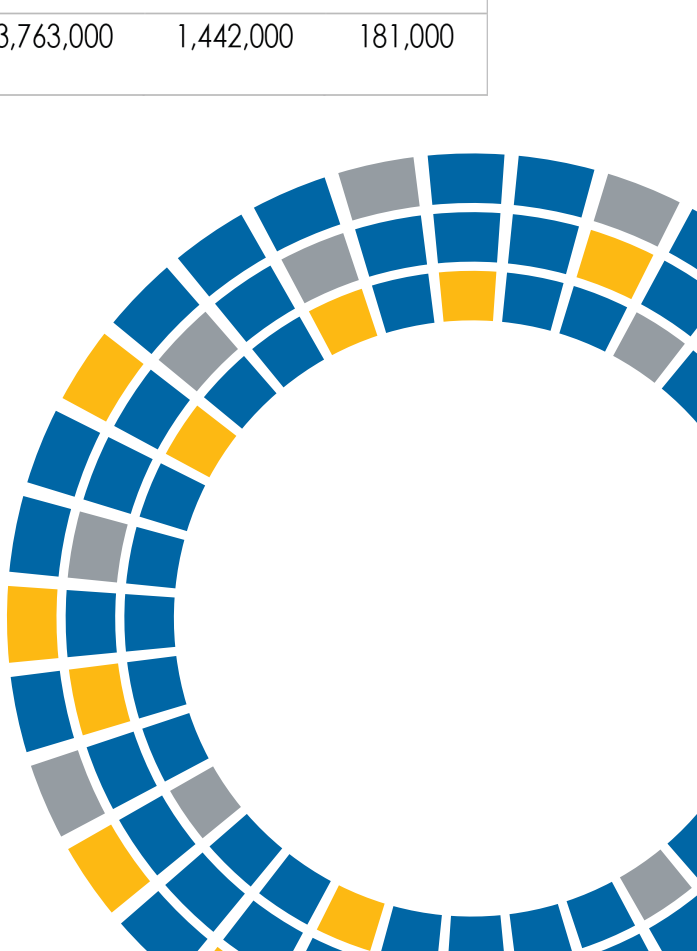
| | Project | | | | | |
|---|---|---|---|---|---|---|
| | **Eagle's Nest** | | | **Marathon Cu-PGM** | | |
| **Level of certainty** | measured | indicated | inferred | measured | indicated | inferred |
| **Amount of ore *(tonnes)*** | 5,346,000 | 5,643,000 | 8,966,000 | 69,500,000 | 27,900,000 | 2,700,000 |
| **Nickel *(%)*** | 2.08 | 1.50 | 1.10 | | | |
| **Nickel *(tonnes)*** | 111,197 | 84,645 | 98,626 | | | |
| **Copper *(%)*** | 1.07 | 0.89 | 1.14 | 0.30 | 0.21 | 0.20 |
| **Copper *(tonnes)*** | 57,202 | 50,223 | 102,212 | 206,384 | 58,059 | 5,443 |
| **Platinum *(grams per tonne)*** | 1.04 | 0.94 | 1.16 | 0.23 | 0.24 | 0.16 |
| **Platinum *(troy ounces)*** | 178,753 | 170,541 | 334,386 | 513,000 | 215,000 | 14,000 |
| **Palladium *(grams per tonne)*** | 3.55 | 3.27 | 3.49 | 0.79 | 0.66 | 0.50 |
| **Palladium *(troy ounces)*** | 610,167 | 593,265 | 1,006,040 | 1,761,000 | 588,000 | 43,000 |
| **Gold *(grams per tonne)*** | 0.20 | 0.20 | 0.30 | 0.09 | 0.08 | 0.07 |
| **Gold *(troy ounces)*** | 34,376 | 36,285 | 86,479 | 194,000 | 72,000 | 6,000 |
| **Silver *(grams per tonne)*** | | | | 1.70 | 1.60 | 2.10 |
| **Silver *(troy ounces)*** | | | | 3,763,000 | 1,442,000 | 181,000 |

*Sources: Marathon: Murahwi (2010); Eagle's Nest: Burgess et al. (2012).*

*Table 6: Iron Resources, Northwestern Ontario, 2015*

| Project | Level of Certainty | Amount of Ore *(tonnes)* |
|---|---|---|
| **Josephine Cone** | indicated | 56,200,000 |
| | inferred | 45,700,000 |

*Source: Arnold et al. (2011).*



## Cochenour/Bruce Channel — Goldcorp

It was originally believed that the Cochenour project, located in the Red Lake area, would begin production in 2014 (see the project timeline shown in Table 7). As of this writing, however, exploration drilling is still ongoing and no date has been made public regarding when production is expected to begin.[1] Despite this, a significant amount of development work has been done at the site, and there are still many signs that indicate that this project will begin production in the near future.

Goldcorp's operations in the area already consist of three complexes: the Campbell Complex, the Red Lake Complex, and the Balmer complex. The Bruce Channel and Western Discovery Zone ore bodies are located 5 kilometres west of the Campbell Complex, and are accessible through the old Cochenour mine site. With the mineral reserves at the Campbell Complex nearing depletion, the decision was made to use the milling facilities already present at that site instead of constructing a new mill at the Cochenour site. This decision reduced the amount of new capital investment that would be required to bring the site into production (Jenish 2014; Moore 2014). The mine workings needed to be drained and some surface construction was required, but the most time-consuming investment was the construction of a 5-kilometre underground rail link between the old Cochenour mine and the Campbell Complex (*Canadian Mining Journal* 2014). The rail link faced some engineering difficulties toward the end, when the rock became too weak to support the heavy railcars, but this was overcome (Tollinsky 2015). In the end, only $496 million of capital investment was required to bring the project into operation (Goldcorp 2015b). The other benefit of using the underground rail link was that it would limit the number of environmental permits required (Moore 2014). On top of the reasonable construction costs, the operating costs of the mine are also expected to be low, at only $350 per ounce of gold — much lower than the other gold mining projects examined here (Goldcorp 2011b).

Since the project is in the Red Lake area, it already has access to transportation infrastructure and to the provincial power grid (Blais, Osiowy, and Glazier 2011). (Originally, there was a lack of electrical transmission capacity in the region, but this was remedied; see CBC News 2014.) The community also has a number of suppliers set up to service the mining sector, a major factor contributing to the low operating costs. A workforce for the project is not expected to be hard

**Table 7: Timeline of the Cochenour Project**

| | |
|---|---|
| *1939-71* | *Original Cochenour mine in operation* |
| *1997* | *Goldcorp purchases Cochenour mine* |
| *2004* | *Bruce Channel and Western Discovery Zone deposits discovered* |
| *2008* | *Goldcorp acquires mineral rights from Gold Eagle Mines* |
| *May 2009* | *Goldcorp decides to use existing refining facilities at Campbell Mine site* |
| *2010* | *Underground connection to Campbell mine construction commences* |
| *2010-2011* | *New headframe and hoist plant erected* |
| *August 2013* | *Agreement reached with Lac Seul First Nation* |
| *March 2014* | *Mine shaft complete.* |
| *April 2014* | *Cochenour production closure plan filed* |
| *September 2014* | *Underground connection to Campbell mine construction complete* |
| *December 2014* | *Agreement reached with Waubuskang First Nation* |

1 See the website of Goldcorp, at http://www.goldcorp.com/English/Unrivalled-Assets/Mines-and-Projects/Canada-and-US/Development-Projects/Cochenour/Overview-and-Development-Highlights/default.aspx; accessed May 2015.

to come by, as employees are planned to be sourced mainly internally from the other three mine complexes (SomaBull 2015).

A further factor that allowed the project to develop quickly was that Goldcorp was able to reach agreements with the two First Nations with traditional land claims in the area: Lac Seul First Nation in August 2013 and Wabauskang First Nation in December 2014 (Goldcorp 2015a).

Despite these advantages, the project still faces a few hurdles. The presence of Rubicon's Phoenix project almost surely will drive up labour and supply costs as regional demand increases. More important, Cochenour, like other gold projects, continues to suffer from the economic uncertainty regarding the fast-falling price of gold. As the price of gold falls, the project becomes less profitable, but the falling value of the Canadian dollar might partially or completely offset this.

Overall, this project's location in an established mining camp with historical and existing infrastructure on site has made development relatively easy, and has allowed the project to benefit from low capital costs, low production costs, a simplified environmental permitting process, and strong local support. Table 8 summarizes the project's advantages and disadvantages.

**Table 8: Summary of the Cochenour Project**

## Advantages

- *Infrastructure already in place*
- *Workforce available from nearby operations*
- *Limited capital investment required*
- *Relatively low production costs*
- *First Nations support*

## Disadvantages

- *Falling gold prices*
- *Engineering challenges*

## Phoenix Gold — Rubicon Minerals Corporation

The Phoenix Gold Project,[2] owned by Rubicon, is set to begin operations in late 2016 (CBC News 2015); see Table 9. This is later than the 2013–14 predictions made earlier (see Dadgostar et al. 2012; S.-L. Inc. and E.H.D. Consulting 2013). Despite the delay, this project is still one of only two that have successfully reached the post-construction phase. Similar to Goldcorp's Cochenour project, the Phoenix project's success is the result of a number of locational advantages it enjoys.

The project is located in the Red Lake area, which has an extensive history of mining operations. This gave it easy access to infrastructure, mining supply firms, and an experienced workforce that allowed the project to develop quickly. There was no major cost necessary to connect the site to the road network or the electrical grid (Bernier et al. 2014). These factors kept the required initial capital expenditure lower than it otherwise would have been. Of the nine projects we examined, Phoenix required one of the lowest investments, with an estimated initial capital cost of only $224 million. In the end, the final cost ended up being closer to $373 million, which still makes it one of the least expensive projects. Its estimated operating costs are on par with the other mining projects, with an all-in cost of $926 per ounce of gold milled (Bernier et al. 2014). The fact that it was a brownfield site — that is, a historical development — allowed the environmental permitting process to proceed relatively smoothly. As well, the presence of other mines in the area meant that the community largely supported the development of the mine. Rubicon was also very proactive in engaging with local Aboriginal groups once it was determined that the project was situated on the traditional lands of Lac Seul First Nation and Wabauskang First Nation.

As with all projects, the Phoenix project has faced challenges. Despite reaching an early agreement with Lac Seul First Nation, Wabauskang First Nation named the company in a petition for judicial review of Ontario's authority to approve its production permits. In November 2014, Wabauskang First Nation and Rubicon reached a Settlement Agreement whereby the First Nation agreed to discontinue its appeal of the court's dismissal of the original application for judicial review (Hale 2014). In addition, although there is a trained workforce in the Red Lake community, unemployment in the area is relatively low — indeed, as of late 2013, there were no unemployed people

**Table 9: Timeline of the Phoenix Gold Project**

| | |
|---|---|
| 2002 | Rubicon acquires the site |
| 2002-12 | Exploratory drilling conducted (gold deposit discovered in 2008). |
| January 2010 | Exploration Accommodation Agreement signed with Lac Seul First Nation |
| October 2011 | Mine tied into the provincial power grid |
| March 2012 | Final permits acquired |
| 2012 | Mill construction begins |
| December 2012 | Wabauskang First Nation names Rubicon in an application for Judicial Review of the province of Ontario authority |
| December 2013 | Shaft sinking complete |
| November 2014 | Agreement reached with Wabauskang First Nation |
| April 2015 | Mill commissioning commences |
| November 2015 | Rubicon suspends underground activity and lays off nearly 90 percent of its workforce |

2 In January 2016 after additional exploration, it was determined that Rubicon had overestimated the gold reserves at the Phoenix project by 86%. With this information, Rubicon has determined that the project is no longer economically viable. Despite this unfortunate revelation, the project can in some sense still be considered a success as it was able to successfully complete most of the development process based on its belief of a large gold deposit being present.

with mining skills living in the area (Walters 2013). This forces the company to rely on workers from outside the community, leading to higher labour costs. There were also issues in the area regarding the availability of power, but this problem has been rectified (CBC News 2014). Finally, as with the other gold projects, the Phoenix project faces changing economic conditions. Its economic analysis was based on a gold price of US$1,385 per ounce and a Canadian dollar nearly at par with its US counterpart. With both the price of gold and the value of the Canadian dollar having fallen, it turns out that these two factors have nearly completely offset one another, meaning the mine's expected revenue remains unchanged. Indeed, since 80 percent of its costs are denominated in Canadian dollars, costs should not rise to a large degree (Rubicon Minerals Corporation 2015).

Despite successfully making it through the construction phase, the project ran into a major obstacle while undergoing the start-up process. It was determined that the shape of the ore body was significantly different than earlier estimates had predicted. Because of this, Rubicon temporarily laid off nearly 90 percent of its workforce in November 2015 while it developed a new mining plan. Given that the mine has already been constructed, it is likely that operations will commence in late 2016 once the new plan has been developed and implemented (CBC News 2015). Overall, Phoenix's location in the Red Lake area has afforded it a number of advantages not enjoyed by other projects examined here. Its location has translated into relatively low development costs and limited objections from the local community, local Aboriginal groups, or environmental review agencies. Table 10 summarizes the project's advantages and disadvantages. For these reasons, the project was able to develop relatively quickly, and likely will be able to overcome its latest obstacle.

**Table 10: Summary of the Phoenix Gold Project**

## Advantages

- *Good access to infrastructure*
- *Supported by the community*
- *Limited capital investment required*
- *Relatively easy environmental permitting process*

## Disadvantages

- *Lack of skilled labour*
- *Limited electricity available*
- *Legal action by local First Nations*
- *Ore body discovered to be significantly different than predicted*

## Josephine Cone Mine Project — Bending Lake Iron Group Ltd.

Bending Lake Iron Group's (BLIG's) Josephine Cone Mine project is unique among the mines analysed in this study in that it is the only iron project (see Table 11). Unfortunately for BLIG, the price of iron has experienced the largest relative fall of any of the resources found at other sites, which has translated into a fall in the expected return on the project, leading to BLIG's being unable to obtain the necessary investment to finance the project (Ontario Superior Court of Justice 2014). Ultimately, in September 2014, BLIG went into receivership (see Smith 2014). Although the project still might come into operation in the future, it is unlikely to do so until the price of iron rebounds to a level sufficient to entice investment in the project.

*"The largest **obstacle** was the high capital **expenditures**, estimated at nearly **$1 billion**, required to get the mine operational."*

The project did benefit from some advantages during its development. The ore body is located close to a highway, giving easy access to the site. Additionally, a workforce could be acquired from the relatively close towns of Ignace, Dryden, and Atikokan — the latter having a history of iron mining (Bending Lake Iron Group 2011; Chronicle Journal 2011). It was also likely that the project would enjoy good relations with local Aboriginal groups, for a number of reasons. First and foremost, the company is owned by Aboriginal people (Bending Lake Iron Group 2012). Second, BLIG was actively engaging local Aboriginal groups, and was beginning to write a Memorandum of Understanding and Exploration Agreement Protocols with the communities of Wabigoon Lake First Nation and the Wabigoon Métis (Arnold et al. 2011).

These few advantages, however, were not able to overcome the challenges the project faced. The largest obstacle was the high capital expenditures, estimated at nearly $1 billion, required to get the mine operational. Part of the high capital cost was the requirements to run a rail line, hydro line, and natural gas line to the site (Summer 2013). Afterwards, production costs would be $53 per tonne. As the site planned to produce iron pellets, the potential profits

**Table 11: Timeline of the Josephine Cone Mine Project**

| | |
|---|---|
| *1950s* | *Property staked* |
| *1953-77* | *Initial exploration by Jalore Mining and Algoma Steel* |
| *1979-2003* | *Property sits idle* |
| *May 2003* | *Bending Lake Iron Group predecessor acquires property* |
| *2008* | *Bending Lake Iron Group forms* |
| *2008-2011* | *Exploratory drilling and resource estimations made* |
| *2012* | *Federal environmental assessment process begins* |
| *2011-12* | *Attempts to find investors fail* |
| *November 2012* | *Bending Lake Iron Group stops payments on debt* |
| *June 2013* | *Bending Lake Iron Group workforce falls to zero* |
| *September 2014* | *Bending Lake Iron Group goes into receivership* |

were staggering in January 2011, when the price of pellets was over $210 per tonne (Bending Lake Iron Group 2011). As of August 2015, however, the price had dropped to $90. Given the high capital costs and the much smaller margins than originally forecast, the return on investment would be much smaller than the 25 percent originally predicted.

Despite these small advantages the project enjoys in terms of potential labour availability and Aboriginal participation, it was simply not possible to overcome the basic economic fact that higher-return investments are to be made elsewhere. Future improvements in the market for iron someday might make the project economically viable, but an investment in infrastructure would still be required to bring it to fruition. Table 12 summarizes the project's advantages and disadvantages.

**Table 12: Summary of the Josephine Cone Mine Project**

## Advantages

- *Accessible by road*
- *Good community support*
- *Labour force nearby*

## Disadvantages

- *Investment in rail, power, and natural gas required*
- *Iron price has fallen sharply.*
- *Very high initial capital investment required*

## Marathon Cu-PGM Deposit — Stillwater Mining Company

Stillwater's Marathon site initially seemed like a project that would begin operations relatively quickly, as the company poured a lot of its resources into it (Stillwater Mining Company 2014). A reorganization of the company's leadership, however, has resulted in a sharp reduction in the amount invested there.[3] It was initially believed, when Stillwater acquired the site in 2010, that operations would begin by 2015 (Stillwater Mining Company 2011); see Table 13. As the company evaluated the site further and the environmental review process went forward, however, this date began to be pushed back further and further. During this time, commodity prices fell such that, ultimately, the company decide it could not recoup the investment necessary to bring the project into operation, and development of the site has ceased (*Northern Ontario Business* 2014a, 2014b).

Initially, the company was very aggressive in developing the project because it possessed a number of promising factors. The site was well situated in regards to infrastructure and labour force availability (Murahwi et al. 2010). It is located just off the TransCanada Highway, and has easy access to road, rail, and electricity. Its proximity to the town of Marathon meant that it would have easy access to an experienced workforce from the Barrick gold mines located there, as well as to firms in the mining sector supply chain. Local support for mining in the region is also relatively strong.

As the development moved forward, however, a number of obstacles were soon discovered. One issue was where the refinement of the resources would occur. Sudbury was one possibility, but the transportation costs were not trivial. In addition, the company discovered that the cost of refining in Ontario is quite high due to the high cost of electricity (Stillwater Mining Company 2012). Next, the environmental review process took longer than the firm had anticipated (Stillwater Mining Company 2011, 2013). When it acquired the site in 2010, the company expected the process to be complete by 2013, but it was still ongoing in 2014. Finally, in terms of coming to arrangements with local Aboriginal groups, the company initially identified fourteen communities that could have potential interest in the project, substantially more than most other projects have had to accommodate. Four of the fourteen expressed an interest in the project based on traditional and current land use (Fraser 2012).

Ultimately, though, it was the economics of the project that made it infeasible. The company initially believed it would require $350 million to develop the project, but

### Table 13: Timeline of the Marathon Cu-PGM Deposit Project

| | |
|---|---|
| *November 2012* | *Stillwater acquires site from Marathon PGM Corp* |
| *2010* | *Production projected to commence in 2014* |
| *2011* | *Estimated investment needed rises from $400–450 million to $550–650 million* |
| *July 2012* | *Environmental impact statement submitted to joint federal-provincial review panel* |
| *2012* | *Estimated start date pushed back to 2017* |
| *October 2012* | *Previous estimates of palladium content discovered to be too high* |
| *December 2012* | *Clinton Group begins process of ousting board of directors* |
| *May 2013* | *Clinton Group nominees win four of eight board seats* |
| *2013* | *Annual spending on Marathon operations cut by 60 percent* |
| *2013* | *Environmental assessment process put on hold* |
| *2013: Q4* | *Value of asset written down from $228.6 million to $57.2 million* |
| *January 2014* | *Permitting process suspended* |
| *2014* | *Employees at Marathon site down to three from eighteen* |
| *September 2014* | *Annual spending at Marathon reduced from $5–10 million per year to $1–3 million* |
| *October 2014* | *Joint review panel disbands* |

3 See the website of the Stillwater Mining Company, at https://www.stillwatermining.com/; accessed May 2015.

this estimate quickly rose to between $550 and $650 million (Stillwater Mining Company 2012). Moreover, the estimated life of the mine was only eleven and a half years, making it difficult to recoup these costs over such a short period of production (Stillwater Mining Company 2014). Later, it was determined that the palladium content of the ore body had been overestimated, making the returns on the project even lower (Ross 2014c). Finally, the company had to deal with falling commodity prices. In terms of Canadian dollars, the value of the resource is significantly more than estimated in 2008, but as Stillwater is a US firm operating primarily in that market, it is likely that more of its costs will be priced in US dollars. In late 2013, Stillwater wrote down the value of the asset in its books by US$171.4 million (Billings Gazette 2014).

What makes it unlikely that the project will come into operation soon is the change in governance of the company. Starting in late 2012, the Clinton Group, a hedge fund and shareholder of Stillwater, became unhappy with the direction the firm had taken (Zadvydas 2013). It organized the shareholders and ultimately elected four of its candidates to the board of directors (McAfee 2013). With a former governor of Montana as the new chairman of the board, the Clinton Group plans to focus the company's efforts on its Montana operations (Johnson 2013). This has led to minimal further investment in the Marathon site, and the cessation of nearly all development activity (Canadian Environmental Assessment Agency 2014). Additionally, the Clinton Group has stated it does not plan to sell the site in the immediate future (*Northern Ontario Business* 2014b). Thus, it is likely that the project will remain undeveloped for the time being. Resource prices will not need to experience that large a rebound, however, as prices are still above those assumed in the initial economic assessment. Table 14 summarizes the project's advantages and disadvantages.

**Table 14: Summary of the Marathon Cu-PGM Deposit Project**

## Advantages

- *Excellent access to infrastructure*
- *Experienced labour force available*
- *Mineral prices do not need a large rebound*
- *Good community support*

## Disadvantages

- *Rising capital costs*
- *Resources overestimated*
- *Short life span*
- *Many Aboriginal groups with which to negotiate*
- *Lengthy environmental review process*

## Black Thor — Noront Resources Ltd.

The Black Thor project, previously owned by Cliffs Natural Resources, faced a number of significant obstacles before the project could be put into production. Ultimately, the company was unable to overcome these challenges, and sold the site to Noront Resources, which now faces many of the same challenges, leaving the future development of the project in doubt — see Table 15 (Younglai and Marotte 2015).[4]

Cliffs entered the Ring of Fire in early 2010, when it acquired the mineral rights for the Black Thor deposit from Freewest Resources Canada. At that time, the company believed it would be able to bring the project into production by 2015, and it aggressively pursued this goal (Cliffs Natural Resources 2011). As the challenges of developing a mine in the Ring of Fire became evident, however, Cliffs steadily began to push back the expected opening date. By the end of 2013, the opening date had been pushed back to 2017 (Ross 2013a).

The two largest problems facing the Black Thor project are a complete lack of infrastructure in the region and poor economic conditions (Kuyek 2011). Additionally, the project faces environmental permitting challenges, including objections from local Aboriginal groups (Freeman 2013; Ross 2012; Scoffield 2010).

In terms of the economics of the project, a huge initial investment is required. Cliffs estimated that, for the mine, infrastructure, and ferrochrome production facility, the cost would be $3.3 billion (Ross 2012). The mine itself would require a massive $1.45 billion investment to become operational, far above any of the other projects examined here (S.-L. Inc. and E.H.D. Consulting 2013). The estimated cost of providing transportation and energy infrastructure to the mine site was $1.74 billion (Chong 2014). If Cliffs had been able to obtain public funding for this, it would have made the project more economically feasible. With an estimated yearly operational cost of $900 million, a relatively high price for chromite was needed to make the project feasible (S.-L. Inc. and E.H.D. Consulting 2013). Unfortunately for Cliffs, the price of chromite remained low throughout the development period (see Figures B-11 and B-12). In 2007 and 2008, the price of ferro chrome skyrocketed from $0.75 per pound to nearly $3.00 per pound, but by 2009 it had fallen back to around $1.25 per pound and has hovered around that level ever since. With supply of the material readily available from other mines, it seems unlikely that the price will rise to an economically feasible level soon (CBC News 2013a; Kuyek 2011).

**Table 15: Timeline of the Black Thor Project**

| | |
|---|---|
| *September 2008* | *Black Thor deposit discovered by Freewest Resources Canada* |
| *February 2011* | *Production expected to begin in 2015* |
| *May 2012* | *Agreement made with Ontario government to build ferrochrome processing facility near Sudbury.* |
| *June 2013* | *Environmental assessment activities suspended* |
| *September 2013* | *KWG Resources wins victory on road issue at provincial mining tribunal* |
| *November 2013* | *Start date pushed back to 2017* |
| *December 2013* | *Operations suspended indefinitely* |
| *January 2014* | *Casablanca Capital begins campaign to take over board of directors* |
| *July 2014* | *Casablanca takes control of board of directors of Cliffs; Ontario divisional court set aside previous road ruling* |
| *January 2015* | *Cliffs terminates federal environmental assessment* |
| *April 2015* | *Ring of Fire assets sold to Noront Resources* |

4 See also the website of Cliffs Natural Resources, at http://www.cli_snaturalresources.com/EN/Pages/default.aspx; accessed June 2015.

The other large obstacle that Cliffs faced was the need for infrastructure in the area. The Ring of Fire is extremely remote, and requires land-based transportation links to move the chromite to a processing facility. The cost was estimated at $600 million for a north-south road.[5] Competing interests in the Ring of Fire advocate different routes for the road. A legal battle was also fought between Cliffs and KWG Resources regarding claims on the preferred route (Ross 2013b, 2014a). Ultimately, although the Ontario government was ready to contribute funds for the construction of an overland link, but the federal government was not willing to match the funding (Ross 2014b). Until the transportation link is in place, the project cannot begin operation (Marotte 2013). With so many interested parties, coupled with environmental and political issues, the construction of a ground transportation link is far off.

Dealing with the First Nations was difficult for Cliffs. The Matawa Tribal Council began legal proceedings over the project's development, with Chief Peter Moonias calling Cliffs "an American bully hell-bent on making a road and a mine no matter what First Nations say" (quoted in Ross 2012). There were many complaints from First Nations about insufficient consultation by Cliffs (Freeman 2013; Mulligan 2014; Ross 2012). As well, ongoing negotiations between Ontario and the Matawa Tribal Council regarding revenue sharing and land use in the Ring of Fire have been a slow process, and the pursuit of piecemeal negotiations has been nearly impossible.[6]

Many First Nations' concerns stem from the project's potential environmental impact on the region (Ross 2014b). Chromite poses significant challenges to the environment that can be difficult to manage (Scoffield 2012). As well, since the area does not have the mining history that some of the other projects examined here enjoy, environmental assessments are taking a long time to conduct (Marotte 2013; Northern Ontario Business 2015a).[7]

Ultimately, all these challenges proved too much for the company to overcome. In January 2014, Casablanca Capital, an investment firm from New York that owned more than 5 percent of Cliffs' shares, began a campaign to oust the board of directors (MarketWatch 2014a). Casablanca's platform was based on Cliffs' refocusing on its US iron mines (Team 2015). Casablanca was successful, and in July 2014 took control of the board (Benoit & Miller 2014; Koven 2014). As promised, the company sold its claims in the Ring of Fire to Noront Resources in April 2015, although Noront has stated that it plans to focus on its Eagle's Nest property for the immediate future.[8] Although Noront enjoys better relations with local First Nations and a transportation link ultimately might be constructed to service its Eagle's Nest project, the Black Thor project still faces the economic challenges of a low chromite price and high costs as it did before. Until market conditions improve, it is unlikely that the project will be developed. Table 16 summarizes the project's advantages and disadvantages.

**Table 16: Summary of the Black Thor Project**

## Advantages

- *Strong provincial support*
- *Large ore body*

## Disadvantages

- *Complete lack of infrastructure*
- *Significant Aboriginal opposition*
- *Low commodity prices*
- *Difficult environmental review process*
- *High extraction costs*
- *Enormous capital investment required*

5 See the website of Noront Resources, at http://norontresources.com/; accessed June 2015.

6 Ibid.

7 See also the website of Cliffs Natural Resources, at http://www.cli_snaturalresources.com/EN/Pages/default.aspx; accessed June 2015.

8 See the website of Noront Resources, at http://norontresources.com/; accessed June 2015.

## Eagle's Nest — Noront Resources Ltd.

Noront's Eagle's Nest project in the Ring of Fire faces many challenges due to its remote location. These challenges have delayed the opening of the project beyond the initial predicted date of 2016 to at least 2018 and perhaps further (see Table 17). Despite these challenges, the company continues to invest in the project, and is optimistic that production can be achieved before the end of the decade.[9]

The project faces many of the same obstacles as Black Thor, while benefiting from certain advantages not enjoyed by Cliffs' old project. First, Eagle's Nest requires a much smaller initial capital investment of only $609 million (Burgess et al. 2012). This is still a relatively large investment compared with mining projects outside the Ring of Fire, but the amount is not unmanageable. However, this amount does not include the full cost of building a road to the region.

Comparing this project to the Marathon Cu-PGM project, the other platinum group element development examined here, Eagle's Nest clearly is at a disadvantage. Its required capital investment is

higher, operating costs are much higher, the life of mine is shorter, and the value of the resources in the ground are worth less when evaluated at the same price. The feasibility study was conducted when commodity prices were near their peak, making the project seem particularly profitable. The return on investment is certainly lower than that reported in Table 2, and likely lower than that of the Marathon project.

Besides low commodity prices, the other major obstacle the project faces is infrastructure, mainly in terms of a land transportation link to the region. Noront hopes that a road will be built from the Pickle Lake region to the Ring of Fire, and the 2014 Ontario provincial budget announcement of $1 billion in infrastructure spending for the Ring of Fire will help to facilitate this (Noront Resources Ltd. 2015a). In March 2015, the federal and Ontario governments provided funds to conduct a study on the road through the region, although Ottawa has not yet promised any funds for construction (Koven 2015; Northern Ontario Business 2015b). The project cannot become operational, however, until the transportation link is in place.

A major advantage Noront enjoys here is relatively good relations with local First Nations. In an effort to build up a skilled workforce in the region, Noront has begun to train local Aboriginal people through a program at Confederation College in Thunder Bay. As of the start of 2015, 340 people had already completed

### Table 17: Timeline of the Eagle's Nest Project

| | |
|---|---|
| *September 2007* | *Eagle's Nest deposit discovered* |
| *March 2011* | *Project Description submitted, beginning the permitting process* |
| *March 2012* | *Terms of Reference submitted, beginning the environmental review process* |
| *September 2012* | *Production estimated to start in 2016* |
| *September 2012* | *Feasibility study returns positive results* |
| *2013* | *Ontario government and Matawa Tribal Council begin negotiations* |
| *March 2013* | *Ring of Fire Aboriginal Training Alliance announced* |
| *March 2014* | *Preliminary agreement signed between Ontario and Matawa Tribal Council* |
| *April 2014* | *Ontario commits $1 billion to Ring of Fire infrastructure* |
| *September 2014* | *Road construction expected to start in mid-2015* |
| *March 2015* | *Noront wins Prospectors & Developers Association of Canada Environmental and Social Responsibility Award* |
| *June 2015* | *Terms of Reference accepted* |
| *June 2015* | *Production estimated to start in 2018* |

9 See the website of Noront Resources, at http://norontresources.com/; accessed June 2015.

the program (Noront Resources Ltd. 2015b). Thanks to programs such as this and the obvious respect Noront has shown toward local communities, the project has a lot of local support (Mulligan 2015b; Sudol 2015). Noront's success in this regard was recognized by the Prospectors & Developers Association of Canada, which awarded the company an Environmental and Social Responsibility Award for its active involvement with local First Nations (Sudol 2015). Nonetheless, Noront still faces challenges in this regard. Local First Nations have little incentive to negotiate individual agreements with the company as long as negotiations between the province and the Matawa Tribal Council are ongoing (see CBC News 2013b; Mulligan 2015b). Noront also faces some criticism for not consulting with First Nations when it purchased Cliffs' claims in the area (NetNewsLedger 2015). Additionally, the Matawa Council is split over the transportation link issue, since the east-west road Noront supports would access only some of the Matawa reserves, whereas Cliffs' north-south road would have connected a separate set of Matawa reserves (Ross 2015a, 2015b).

In terms of environmental permits, the company is facing a number of challenges, as the region has been previously completely devoid of development. In June 2015, however, its Terms of References were finally accepted, with amendments, by the Ontario Ministry of the Environment after a three-year review process (Mulligan 2015a; Ross 2015b; Vis 2015).

Overall, Eagle's Nest still faces many challenges. Low commodity prices have driven down the expected return on the project, which will make acquiring investors difficult. There is still no clear plan on the construction of a transportation link to the area, although some progress is being made. Finally, no final agreement has been made with the Matawa Tribal Council regarding developing the Ring of Fire. Until all these uncertainties are resolved, it is unlikely that construction on the project will begin. Table 18 summarizes the project's advantages and disadvantages.

**Table 18: Summary of the Eagle's Nest Project**

## Advantages

- *Rich ore body*
- *Strong Aboriginal support*
- *Training program in place for local workforce*

## Disadvantages

- *Complete lack of infrastructure*
- *Low commodity prices*
- *Difficult environmental review process*
- *Discussions still ongoing between the province and the Matawa Tribal Council*

## Hammond Reef — Canadian Malartic Corporation

The Hammond Reef project has seen its ownership change three times in the past decade as companies attempt to profit from the large deposit of gold located there (*MarketWatch* 2014b).[10] What began as a promising opportunity has struggled in recent years, however, with rising costs and falling gold prices. The initial expected production date of 2016 can no longer be reached as construction has not yet begun. It appears unlikely that production will take place in the near future (McKinnon 2011; Ross 2013c); see Table 19.

The reason the project was seen as such a good investment opportunity by a number of mining companies is the large number of advantages it enjoys. It has good access to infrastructure, strong local support, a large supply of easily mined gold, and a relatively low operating cost (Danielson 2010; Meadows 2013b; Rennie, Lambert, and Krutzelmann 2009). The site is situated near Atikokan, a community with a long mining tradition (see Rennie and McDonough 2008). This has led to strong local support from that community and its government that includes the construction of a road to the project site (Meadows 2010b; Thompson 2015). In addition, the companies that have owned the project have successfully negotiated agreements with local First Nations and Métis groups (*Marketwired* 2015). In March 2010, Brett Resources signed an agreement with eight local First Nations that promised employment, shares in the company, and resources for education (Meadows 2010a). There has not been substantial opposition to the project's development by any group in the region.[11] Finally, the geology of the ore body leads to relatively low operating costs. With 97 percent of the resource within 300 metres of the surface, open-pit mining makes extracting the ore relatively inexpensive (Danielson 2010). There are an estimated 5.1 million ounces of gold in the deposit, with an initial estimated all-in extraction cost of around $658 per ounce (Rennie, Lambert, and Krutzelmann 2009). This cost has been recently revised upwards to between $800 and $850 per ounce (Meadows 2013a), which still makes it one of the lowest-cost producers of the five gold projects examined here. Even with the recent decline in gold prices, the margins are still significant.

Despite these advantages, the project faces two major challenges. One is high initial capital costs, which were estimated at $682 million in 2009 (Rennie, Lambert, and Krutzelmann 2009), but had risen to between $1.5 and $1.8 billion by August 2013 (Meadows 2013a). Despite the relatively healthy margins still present, it is difficult

**Table 19: Timeline of the Hammond Reef Project**

| | |
|---|---|
| 2006 | Brett Resources acquires the property |
| November 2009 | Brett produces economic feasibility study with promising results |
| January 2010 | A road link to the mine site is established |
| March 2010 | Brett signs an agreement with eight local First Nations |
| August 2010 | Osisko Mining Corporation acquires Brett |
| April 2012 | Osisko sign a Memorandum of Understanding with local Métis |
| May 2012 | Construction anticipated to begin in 2014 |
| May 2013 | Osisko cuts spending on Hammond Reef by $3.5 million |
| August 2013 | Osisko writes down the value of the project by $487.8 million; estimated capital cost of mine rises to $1.5 billion. |
| December 2013 | Osisko submits Environmental Impact Statement to the Canadian Environmental Assessment Agency. |
| June 2014 | Osisko acquired by Canadian Malartic |
| June 2015 | Shared Interest Agreement signed with the Métis Nation of Ontario |

10 See also the Agnico Eagle website," at http://www.agnicoeagle.com/en/exploration/advanced-projects/hammondreef/pages/default.aspx; accessed July 2015.

11 Ibid.

to raise the necessary capital to fund this substantial investment. In August 2013, its then owner, Osisko Mining Corporation, stated that the project was not economically feasible at current gold prices (Meadows 2013a). In light of this, Osisko reduced spending on the project and wrote down the value of the asset in its books by nearly $500 million (*Chronicle Journal* 2013b; Smith 2013b).

The second challenge the project faces is in its environmental permitting process. Although the community has provided strong support for the project, even knowing the potential environmental impacts, the process is taking a considerable amount of time due to the unique nature of the project. It is necessary to drain a lake to make the mine operational, local fisheries are expected to be negatively impacted, and a 60-metre-tall pile of rock is expected to partially obscure the view of the region (McKinnon 2011; Smith 2013a). Despite this, Osisko was able to arrive at private agreements with local hunters and campers to compensate for these negative aspects (Smith 2013a). However, the provincial Ministry of Natural Resources has expressed concern that the message delivered to the public regarding the impact of the project was "not truly reflective of the real impact of the project" (McKinnon 2015).

Overall, the project still has a large number of factors working in its favour. If the price of gold rises and capital costs can be brought down, the project likely will be able to move forward. Table 20 summarizes the project's advantages and disadvantages.

**Table 20: Summary of the Hammond Reef Project**

## Advantages

- *Rich ore body*
- *Strong Aboriginal support*
- *Strong local support*
- *Low cost of production*
- *Good access to infrastructure*

## Disadvantages

- *High capital costs*
- *Low commodity prices*
- *Difficult environmental permitting process*

## Goliath Gold — Treasury Metals Inc.

Treasury Metals' Goliath Gold project enjoys a number of locational advantages that led many to believe that the project would be able to begin production as early as 2015 (Treasury Metals Inc. 2012). However, a longer-than-expected environmental permitting process and falling gold prices have so far prevented construction. Although the company is still continuing to invest in the property, it is unlikely that the mine will begin production until 2017 at the earliest (Treasury Metals Inc. 2015a); see Table 21.

*"With good **infrastructure**, very low capital costs, and **competitive** operating costs, the **economic** conditions are ripe for the mine's **development**."*

The first major advantage the site enjoys is access to a large amount of infrastructure (Stokes 2015). It is located adjacent to the Trans-Canada Highway, and has a power line cutting across the property (Marchand 2012; Treasury Metals Inc. 2015b). Of note is that this project has the smallest amount of gold of those examined here, but its ore is relatively high grade (Lazenby 2014), implying that the mine will be a relatively small operation. These two facts — excellent access to infrastructure and the project's relatively small size — translate into an extremely low initial capital investment of only $94 million (Roy et al. 2012), significantly less than the other gold projects examined here. Costs are further kept down by being so close to the population centre of Dryden[12] and access to a source of labour. Although the community's economy historically has focused on the pulp and paper sector, recent cutbacks at the local mill could provide a workforce that possesses skills similar to those needed by the mining industry. Another advantage is that there

**Table 21: Timeline of the Goliath Gold Project**

| | |
|---|---|
| October 2007 | Laramide Resources Ltd. acquires the site |
| June 2008 | Attempts to engage with local Aboriginal groups begin |
| August 2008 | Treasury Metals Inc. is spun off from Laramide |
| June 2009 | Treasury acquires adjacent mining claims |
| August 2010 | Initial Preliminary Economic Analysis indicates large potential returns |
| November 2011 | Resource estimates revised substantially upward |
| November 2012 | Environmental Assessment process begins; production expected to begin in 2015 |
| August 2014 | Ontario Coalition of Aboriginal People expresses concern over project's environmental impact |
| June 2015 | Production expected to begin in 2017 |

12 As noted on the website of Treasury Metals Inc., at http://www.treasurymetals.com/s/Home.asp; accessed July 2015.

is strong support in Dryden for the mine development (Vaccaro 2012).

With falling gold prices, the site has certainly become less profitable, but this has been partially offset by the falling value of the Canadian dollar. The company believes the project will return a profit so long as the price of gold remains above $950 dollars per ounce (Roy et al. 2012). With good infrastructure, very low capital costs, and competitive operating costs, the economic conditions are ripe for the mine's development (Secutor Capital Management Corporation 2015).

Despite these benefits, the project still faces some obstacles. First, its operational life is expected to be only ten years, as a limited amount of gold has been identified at the location (Roy et al. 2012). Second, the company has identified eight Aboriginal groups with which consultation is necessary, but no formal agreements have yet been signed with any of them. One particular group, Wabigoon Lake Ojibway Nation, has a demand that Treasury Metals is unable or unwilling to accommodate (see Treasury Metals Inc. 2012) and that, since summer 2011, has caused the negotiation process to stall. In addition, the Ontario Coalition of Aboriginal People has raised concerns about the project's environmental impact, specifically with regard to the region's water (Meadows 2014b). The project's location near human habitation also makes the environmental permitting process more onerous (Marchand 2012).

Overall, the project enjoys a number of significant advantages over other projects examined here. This is reflected by strong investor support, as the company has stated that it already has the necessary funds to bring the project to the construction phase. It is still possible that this project will be operational before the end of the decade. Table 20 summarizes the project's advantages and disadvantages.

**Table 20: Summary of the Hammond Reef Project**

## Advantages

- *Rich ore body*
- *Strong Aboriginal support*
- *Strong local support*
- *Low cost of production*
- *Good access to infrastructure*

## Disadvantages

- *High capital costs*
- *Low commodity prices*
- *Difficult environmental permitting process*

## Rainy River Project — New Gold Inc.

New Gold's Rainy River project has entered the construction phase of its development, and the company has nearly raised all the necessary capital to complete the project.[13] It is expected that the mine will begin operations by the middle of 2017, later than the original predictions of 2015 (Chronicle Journal 2015b; Meadows 2011; New Gold Inc. 2015); see Table 23.

The most obvious advantage of the project is its location in a region of the province with relatively well developed infrastructure. It is adjacent to a highway — indeed, so close that the highway will be moved to accommodate the project — and only 17 kilometres away from a power line (New Gold Inc. 2014). This easy access to infrastructure has lowered the costs of exploring and developing the site. As well, the site is located in a relatively populated area of Northwestern Ontario, close to Fort Frances, a potential supply of the necessary workforce, as the local pulp and paper mill has recently closed (Hardie et al. 2014).[14] A large number of First Nations and Métis groups support the project, although some limited opposition has been registered (Chronicle Journal 2013a, 2014a; Meadows 2011; Porter 2014). It was determined through consultation that no traditional First Nations activities occurred on the site, making the development process less objectionable (Hardie et al. 2014). Finally, no major problems were encountered with the environmental permitting process, although it did take longer than initially expected (*Chronicle Journal* 2015a; Hardie et al. 2011).

Economic conditions offer a mixed blessing for the project. On the downside, a relatively large workforce of 600 is expected to be needed at the peak of the project. Skilled labour is already scarce in the province, however, and the cost of hiring 600 workers is not trivial. As well, initial capital costs are quite high at $931 million, 50 percent higher than the next closest gold project, based on the data presented in Table 4 (Hardie et al. 2014). With a life of only fourteen years, it will be difficult for the project to recoup such a large investment over such a short production run. In addition, operational costs are relatively high, in part due to the low-grade, high-tonnage nature of the deposit (Hardie et al. 2014). The project has also seen some cost escalation during its development, with operating cost estimates increasing by over $100 per ounce and capital costs by $250 million (Meadows 2011; Rainy River Resources 2015).[15] The latest projections indicate, however, that capital costs once again might fall due to a lull in

13 See the website of New Gold Inc., at http://www.newgold.com/; accessed July 2015.

14 See also ibid.

15 Ibid.

### Table 23: Timeline of the Rainy River Project

| | |
|---|---|
| June 2005 | Rainy River Resources Ltd. acquires the site |
| December 2011 | Preliminary Economic Assessment indicates promising results; projected opening date of 2015 |
| April 2012 | Rainy River Resources signs Participation Agreement with six First Nations |
| October 2012 | Terms of Reference submitted, beginning environmental review process |
| May 2013 | New Gold Inc. begins takeover bid of Rainy River Resources |
| July 2013 | Métis Nation of Ontario and Rainy River Resources sign a Memorandum of Understanding |
| October 2013 | Takeover by New Gold complete |
| August 2014 | Projected opening date of 2016 |
| October 2014 | Impact Benefit Agreement signed with two First Nations |
| November 2014 | Participation Agreement signed with Métis Nation of Ontario |
| January 2015 | Final environmental approval received from Ontario government |
| February 2015 | Production expected to begin by July 2017 |
| May 2015 | Groundbreaking ceremony begins construction |

the industry (Meadows 2014a). Overall, though, the expected rate of return for the project has decreased (Hardie et al. 2014; Rainy River Resources 2015). On

the other hand, the fall in the value of the Canadian dollar has worked in New Gold's favour, as expected revenues are now higher than previously estimated (Chronicle Journal 2014b).

At this point, New Gold appears to be in a strong position to move forward with the mine construction. Using its own financial assets plus a recent agreement with Royal Gold, the company has $738 million of the remaining $760 million required for mine construction.[16] With all the necessary approvals and permits in hand and with the financing in place, the project should continue to develop to meet its 2017 opening date. Table 24 summarizes the project's advantages and disadvantages.

**Table 24: Summary of the Rainy River Project**

## Advantages

- *Excellent access to infrastructure*
- *Access to labour*
- *Agreements signed with local Aboriginal groups*
- *No major environmental permitting obstacles*

## Disadvantages

- *High capital costs*
- *High production costs*

16 Ibid.

# Future Commodity Prices

These nine projects have all been adversely affected by the fall in commodity prices over the past three years. This section examines the forecast price of these commodities for the next ten years, to determine the likelihood that the remaining pre-construction projects will become economically viable during this time.

Tables 25 and 26 are the World Bank's forecast of the price of gold, silver, copper, nickel, platinum, and iron ore for the next ten years. Table 25 reports the prices in current US dollars, while Table 26 adjusts for predicted inflation by keeping prices in constant 2010 US$ values. Adjusting for inflation is necessary because, all else being equal, the cost of developing and operating the projects will increase with inflation. If commodity prices do not keep pace with inflation, the returns on the projects will decline over time.

The forecasts indicate that gold prices are expected to stay relatively low over the next decade. After adjusting for inflation, they are predicted to fall by over 20 percent. This is a worrisome projection for both those gold projects that have not yet developed in the region and for those that have. If the price of gold is not above the cash operating cost of a mine, it might lead to the mine's closure. If these projections are correct, it is unlikely that either the Goliath or Hammond Reef project will enter the construction phase in the next decade. The Phoenix and Rainy River projects would also be in danger of having to shut down if prices fall as low as predicted.

For the platinum group metal projects, the commodity price predictions are also worrying. Inflation-adjusted copper prices are expected to stay relatively constant, while nickel and platinum prices are predicted to have modest growth. The predicted rise in the price of nickel will help make the Eagle's Nest project more viable, as its ore body contains a large amount of nickel. It is unlikely that the predicted rise in prices would be sufficient to make the Marathon project viable, however, as its ore body is largely comprised of copper. Predictions for the price of palladium are unavailable, but it is possible that a sufficiently large increase could offset the lower prices of the other commodities.

Iron ore prices are predicted to remain relatively low over the next ten years. The Josephine Cone Mine would be economically unviable at the predicted prices. No predictions for the future price of chromite are available, but the price has largely remained around $1.25 per pound over the past five years; if this trend continues, the Black Thor project will remain economically unviable.

Along with the future movement of commodity prices, the other important economic variable to consider is the future movement of the US-Canadian dollar exchange rate. Two major Canadian banks, RBC and TD, both predict that, in 2016, the Canadian dollar will be worth around US$0.75 (RBC Economics 2015; TD Economics 2015). Predictions beyond 2016 are not available. If the exchange rate were to remain near

*Table 25: Price Forecasts in Current US Dollars, Selected Minerals, 2016–25*

| | Gold | Silver | Copper | Nickel | Platinum | Iron Ore |
|---|---|---|---|---|---|---|
| | *(US$ per troy ounce)* | | *(US$ per pound)* | | *(US$ per troy ounce)* | *(US$ per tonne)* |
| **2016** | 1,156 | 15.90 | 2.70 | 6.16 | 1,135 | 57 |
| **2017** | 1,138 | 16.00 | 2.75 | 6.43 | 1,170 | 59 |
| **2018** | 1,120 | 16.10 | 2.80 | 6.71 | 1,207 | 60 |
| **2019** | 1,102 | 16.20 | 2.85 | 7.01 | 1,245 | 62 |
| **2020** | 1,084 | 16.40 | 2.90 | 7.31 | 1,285 | 64 |
| **2021** | 1,067 | 16.50 | 2.96 | 7.64 | 1,325 | 66 |
| **2022** | 1,050 | 16.60 | 3.01 | 7.97 | 1,367 | 68 |
| **2023** | 1,033 | 16.70 | 3.06 | 8.32 | 1,410 | 70 |
| **2024** | 1,016 | 16.90 | 3.12 | 8.69 | 1,454 | 73 |
| **2025** | 1,000 | 17.00 | 3.18 | 9.07 | 1,500 | 75 |

*Source: World Bank 2015.*

*Table 26: Price Forecasts in Constant 2010 US Dollars, Selected Minerals, 2016–25*

| | Gold | Silver | Copper | Nickel | Platinum | Iron Ore |
|---|---|---|---|---|---|---|
| | *(US$ per troy ounce)* | | *(US$ per pound)* | | *(US$ per troy ounce)* | *(US$ per tonne)* |
| **2016** | 1,074 | 14.7 | 2.51 | 5.72 | 1,054 | 53 |
| **2017** | 1,040 | 14.6 | 2.51 | 5.87 | 1,070 | 53 |
| **2018** | 1,007 | 14.5 | 2.52 | 6.04 | 1,086 | 54 |
| **2019** | 975 | 14.4 | 2.52 | 6.20 | 1,103 | 55 |
| **2020** | 945 | 14.3 | 2.53 | 6.37 | 1,119 | 56 |
| **2021** | 915 | 14.1 | 2.53 | 6.55 | 1,136 | 57 |
| **2022** | 886 | 14.0 | 2.54 | 6.73 | 1,153 | 58 |
| **2023** | 857 | 13.9 | 2.54 | 6.91 | 1,170 | 58 |
| **2024** | 829 | 13.8 | 2.54 | 7.09 | 1,186 | 59 |
| **2025** | 802 | 13.6 | 2.55 | 7.28 | 1,203 | 60 |

*Source: World Bank 2015.*

that level for the foreseeable future, Canadian mines would experience a large advantage over their US counterparts. Since most of the costs of constructing and operating the mines are in Canadian dollars, these firms would see a large increase in their revenues with no corresponding increase in costs.

It is helpful to understand what is driving the low commodity prices and the relatively low value of the Canadian dollar in order to better understand what might lead to future changes in these values. The change in commodity prices is largely driven by two factors. One is lower global demand, driven primarily by slowing economic growth in China over the past five years; the growth rate there is not forecast to increase in the immediate future. The second factor is the increase in global output and the availability of large inventories of these minerals. New mine developments are further expected to add to the available supply in the coming years. Combined, low demand and high supply are expected to lead to low prices.

The future value of the Canadian dollar will depend heavily on the movement of oil prices, with low oil prices leading to a falling dollar. At the same time, the US dollar is performing exceptionally well against most global currencies. So it is not just Canadian mines that are benefiting from a weak currency — mining projects outside North America have seen their domestic currencies depreciate as well, increasing their competitiveness.

If these forecast commodity prices and exchange rates are correct, it is unlikely that any of the projects that have not yet reached the construction phase will become operational within the next decade.

# Conclusions

An examination of nine mining projects in Northwestern Ontario has provided insight as to why certain projects succeed and others do not. The evidence suggests that falling commodity prices have played the largest role in preventing many of these projects from moving forward. Other important factors include high development costs, often related to a lack of infrastructure, and high operating costs, caused by a lack of skilled labour and high energy costs. Finally, the long environmental permitting process has stopped many projects from capitalizing on high commodity prices.

The obvious first obstacle is the decline in commodity prices, which has affected all of the projects. However, this fall does not necessarily have to equate to the project's failure — if costs are sufficiently low, firms can overcome this problem.

As far as capital costs are concerned, six of the nine projects faced initial capital investment requirements of over $500 million. The success of both the Phoenix and Cochenour projects is due in part to their relatively low required initial capital investments. Other projects, such as Hammond Reef and Marathon, saw large capital cost escalations during the development process, while others, such as the Josephine Cone and Black Thor projects, required large investments from the outset. Often it is the need to provide infrastructure that causes this cost to be so high. This is certainly the case for the two Ring of Fire projects, as well as for the Josephine Cone and Hammond Reef sites. On the other hand, the Phoenix, Cochenour, and Rainy River projects all benefited from excellent access to infrastructure. Clearly, low capital costs, aided by access to infrastructure, were a major determinant of the success or failure of a project.

As for anticipated operating costs, they are relatively high in Ontario, as shown by the high cost per ounce of gold milled (see Tables 1 and 2), which indicates the minimum level the commodity price must attain to cover operating costs. All nine projects suffer from the relatively high electrical costs that all firms operating in the province face. Some projects are able to keep their operating costs relatively low by accessing different labour markets. For instance, Phoenix and Cochenour have access to the trained labour force present in Red Lake. Marathon can also access the labour force present from the Hemlo mines. Other projects, such as Goliath and Rainy River, can take advantage of the labour force made available from the slowdown in the pulp and paper sector. Phoenix and Cochenour can also access the supply chains created by the other mines in the Red Lake area to further reduce their costs. Again, these examples show that firms that are able to keep their production costs low are more likely to make it successfully through all stages of development.

The lengthy environmental permitting process is yet another obstacle that firms must overcome. Some projects, such as Phoenix and Cochenour, had the advantage of being situated on previous mine sites, which made the process relatively easy. Other projects, such as Rainy River, faced few objections and were able to obtain the required permits with relative ease. The Ring of Fire projects, however, face substantial difficulties: as no mines have previously been developed in that region, the potential effects of mines there are difficult to quantify. For other projects, such as Marathon and Hammond Reef, the review process took so long that the fall in resource prices made them no longer economically viable.

A final difficulty is the consultation process with local communities, both Aboriginal and non-Aboriginal. In general, the sites that had to deal with a larger number of interested parties required a longer development time. The two Red Lake projects had to consult only with the greater Red Lake community, which has a long history of mining, and two First Nations whose reserves are located a substantial distance away. The two Ring of Fire projects, however, must come to an agreement with the nine members of the Matawa Tribal Council. Other projects, such as Hammond Reef and Rainy River, also faced a large number of interested parties, but were able to reach accommodations. The evidence suggests that having to come to a greater number of arrangements slows down the process, but that when allowed to negotiate, mining firms and local communities are able to come to mutually beneficial arrangements.

Looking at the results in total, it is clear that the right combination of a number of factors is required for a project to make it successfully through the development process. Cochenour and Phoenix held advantages in all of these areas, and were thus able to develop relatively quickly. Rainy River faced high costs, but was able to overcome this challenge thanks to offsetting positive factors. Other projects, such as Black Thor, suffered from challenges in all of these areas that were simply too large to overcome. The other five projects faced challenges in some areas but not others. In the end, the balance was not in their favour, as demonstrated by their failure to develop successfully.

# Recommendations

Clearly, much unexploited mineral wealth remains in Northwestern Ontario. The high commodity prices of the recent past encouraged firms to begin developing projects that were previously uneconomical. Developing a mining project is time consuming, however, as it requires exploration, feasibility studies, community engagement, environmental permits, negotiations with Aboriginal groups, and a period of construction. For instance, Rubicon required thirteen years to reach the post-construction phase from when it first acquired the project. It took Goldcorp seven years from when it acquired the mineral rights to the Bruce Channel deposit. It will take at least twelve years from when Rainy River Resources acquired the site until New Gold begins operation in 2017.

If the goal is to increase the number of projects that reach the production phase, three types of changes should be made: make it less costly to operate a mine in Ontario, shorten the development period, and reduce the uncertainty in the process.

Little can be done to overcome the fundamental economic conditions of the commodity market. If commodity prices are low, many projects will remain economically unfeasible, and the region's mineral wealth will remain in the ground until prices make it profitable for the resource to be extracted. However, steps can be taken to help reduce capital and operating costs, which would make the projects viable at lower commodity prices.

Investment in infrastructure should be made now, while interest rates are at a historic low. Constructing transportation and energy links to the Ring of Fire now will allow projects in that region to become operational when commodity prices inevitably rise again. In the meantime, there would be immediate benefits from infrastructure investment. Connecting remote First Nations communities to year-round surface transportation links would provide its own economic benefits. The unexploited resources will not move, so building these links now would reduce the cost of accessing them in the future, while reducing the amount of time necessary to bring mines into operation when commodity prices rise.

Many of these projects face high expected operating costs for two notable reasons. One is high electricity prices. Mining is an energy-intensive process, and the costs in Ontario are high compared with those in other mining jurisdictions — double those in the two adjoining provinces of Quebec and Manitoba, for example (Ontario Hydro 2013). Again, with interest rates so low, now is the time to invest in energy production and transmission, which would help reduce operating costs and make the mines in Northwestern Ontario more internationally competitive. The second reason for high operating costs is the high cost of labour. There is a shortage of skilled labour in Ontario's mining sector. In the short term, employees must be trained to meet the immediate needs of mines that are facing an aging workforce. Providing information and incentives to students to receive training in this area is a good first step. Programs similar to Noront's and Confederation College's Ring of Fire Aboriginal Training Alliance are another possible avenue. In a similar vein, Lakehead University's Centre of Excellence for Sustainable

*"If the **goal** is to increase the number of projects that reach the **production** phase, three types of changes should be made: make it **less costly** to operate a mine in Ontario, **shorten the development** period, and **reduce the uncertainty** in the process."*

*"Investment in **infrastructure** should be made now, while interest rates are at a historic low. **Constructing** transportation and energy links to the **Ring of Fire** now will allow projects in that region to become **operational** when commodity prices inevitably **rise again**."*

Mining and Exploration provides an opportunity for stakeholders in the mining industry to engage with researchers on subjects such as mineral exploration, mine development, the socio-economic effects of mining, the environmental effectss of mining, and the engagement of Aboriginal communities.

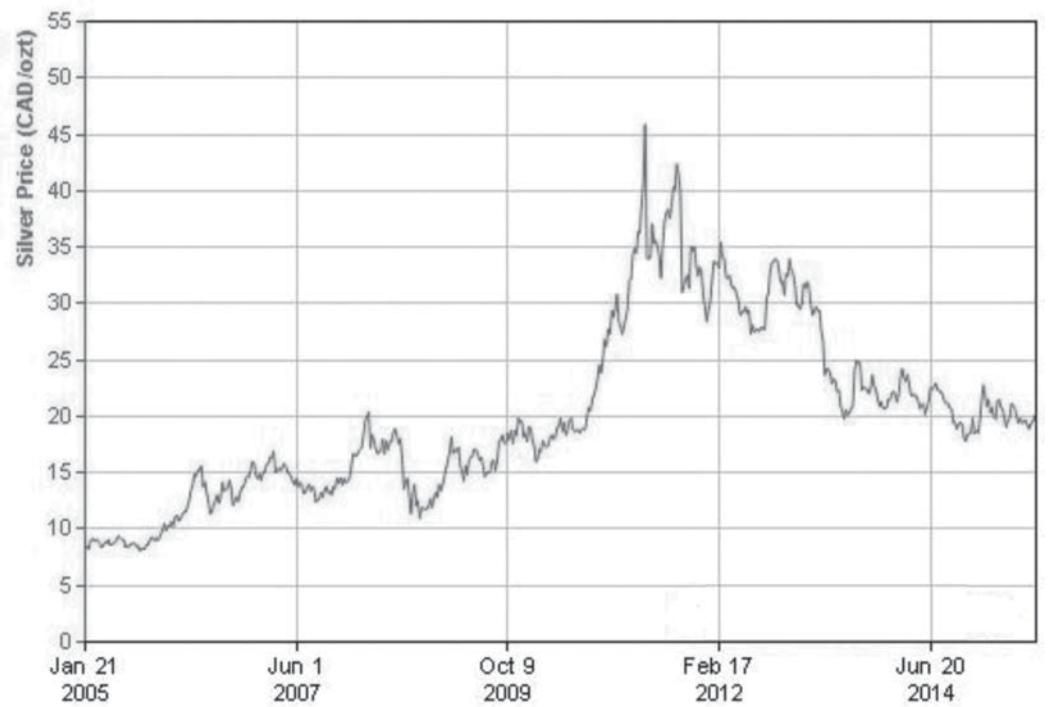
As for the second recommendation, shortening the development period of projects, investment in infrastructure will help, but of greater importance is finding a way to reduce the time required for the environmental permitting process. Legislated timeframes, such as those in the Canadian Environment Assessment Act, 2012, are a good first step, but the process can still take upward of three years. The experience of many of these projects show just how detrimental this wait can be. When commodity prices were high, the projects tried to develop quickly to exploit them. As they waited for their environmental permits, however, commodity prices fell such that many projects were no longer economically viable. Shortening the environmental permitting process could lessen this problem. This does not necessarily mean making the process less stringent. For instance, funds could be made available to allow firms to hire the additional staff necessary to conduct reviews more quickly. Funds could also be made available for local communities, both Aboriginal and non-Aboriginal, to hire the necessary professionals to help them quickly understand the potential environmental costs of projects; currently, delays occur when local communities request additional time and resources to undertake this process. If the time it takes to open up a mine is shortened, more mines could ride the next wave of high commodity prices to the production phase. As Figure 2 shows, even with seven straight years of increasing gold prices, only two new gold projects were able to reach the post-construction phase.

Finally, clarity needs to be provided in dealing with Aboriginal groups. Many firms — such as New Gold, Goldcorp, and Rubicon — have been able to come to mutually beneficial agreements with Aboriginal stakeholders. Others, such as Noront, have been unable to do so. This issue makes it difficult to secure investors, as any agreement ultimately could affect a mine's profitability. The rights of both parties should be made explicitly clear, so that the two sides can negotiate more easily over the project's benefits in a clear fashion. According to economic theory, when property rights are established, clear, and enforceable, it is easier for parties to reach an efficient outcome. In most cases, however, opposition from Aboriginal groups has not led to major disruptions or the failure of any individual project. Notably, in none of the nine cases examined was there serious opposition from non-Aboriginal communities — most nearby towns have previous experience in the resource extraction sector, and recognize the benefits and costs associated with it.

Ultimately, the reason for the failure of most of these nine projects to develop came down to the low expected profitability of the mine. If the three areas mentioned above are improved, however, the next time commodity prices rise the region might indeed experience the mining boom that was predicted three years ago.

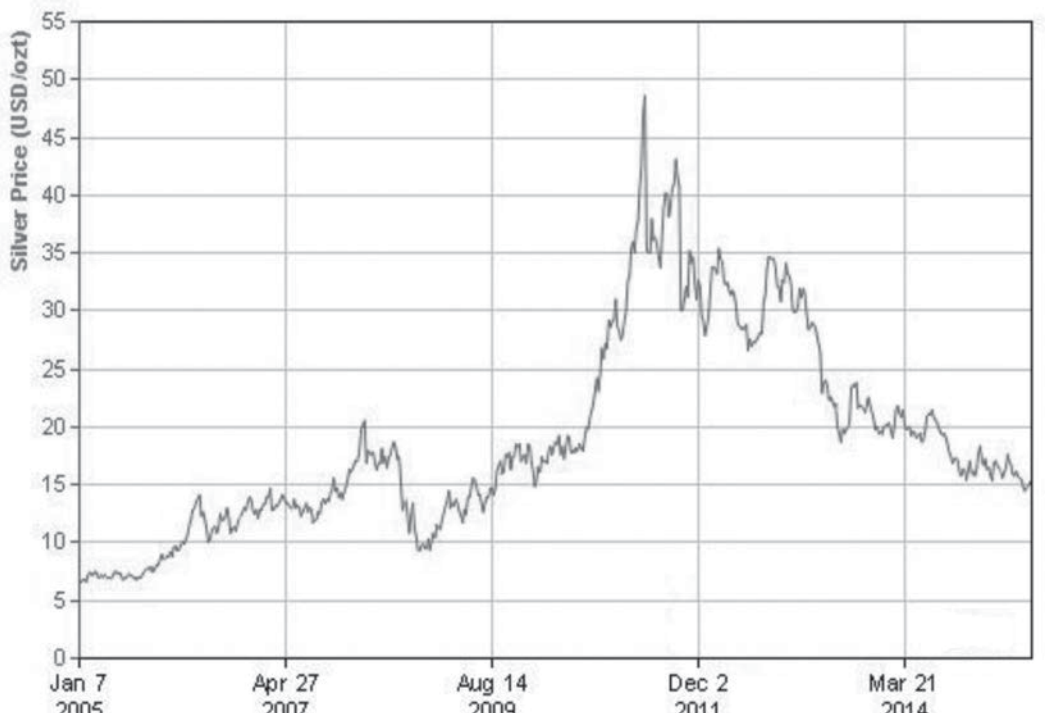
# Appendix: Figures of Commodity Prices

*Figure A-1: Silver Price in Canadian Dollars per Troy Ounce, 2005–15*



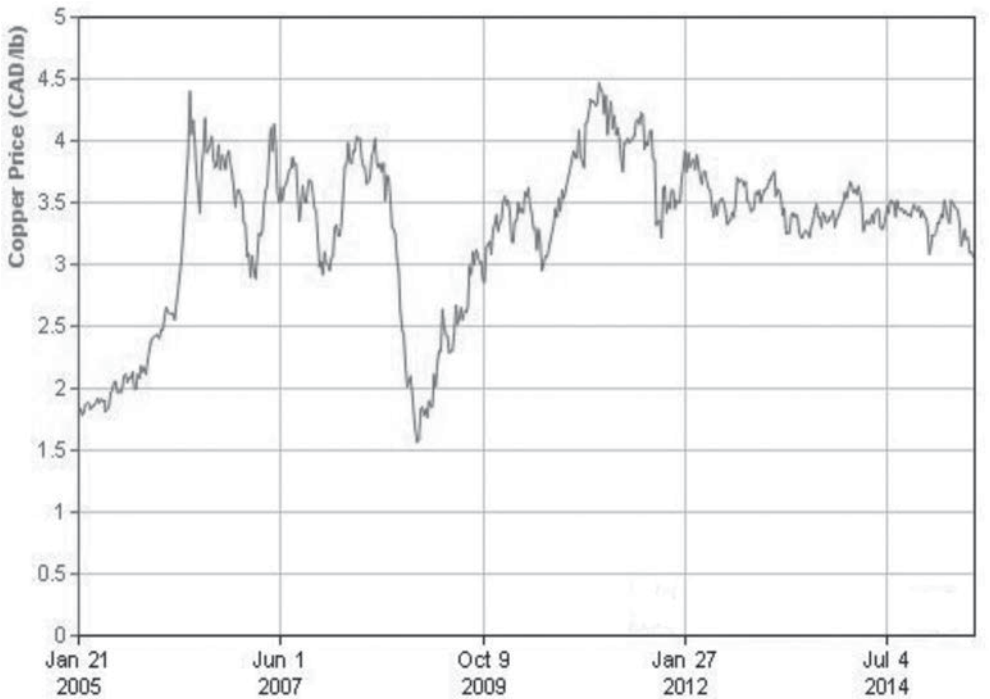

*Source: InfoMine.com; available online at http://www.infomine.com/ChartsAndData/ChartBuilder.aspx?g=127681&cd=1.*

*Figure A-2: Silver Price in US per Troy Ounce, 2005–15*



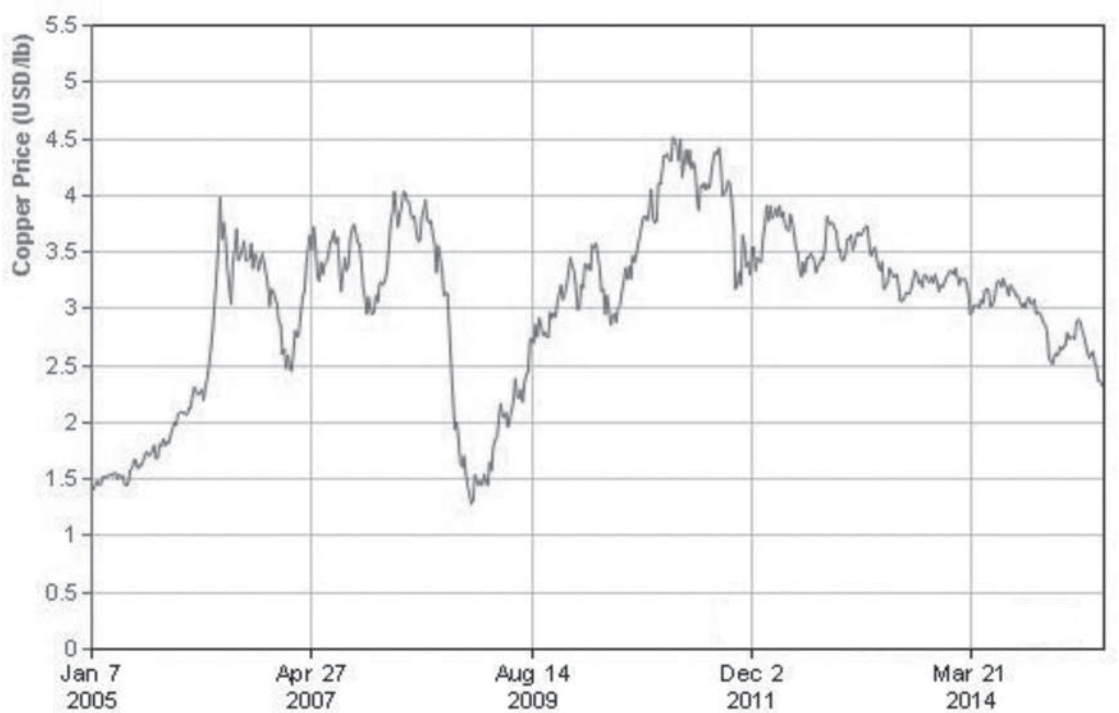

*Source: InfoMine.com; available online at http://www.infomine.com/ChartsAndData/ChartBuilder.aspx?g=127681&cd=1.*

*Figure A-3: Copper Price in Canadian Dollars per Pound, 2005–15*



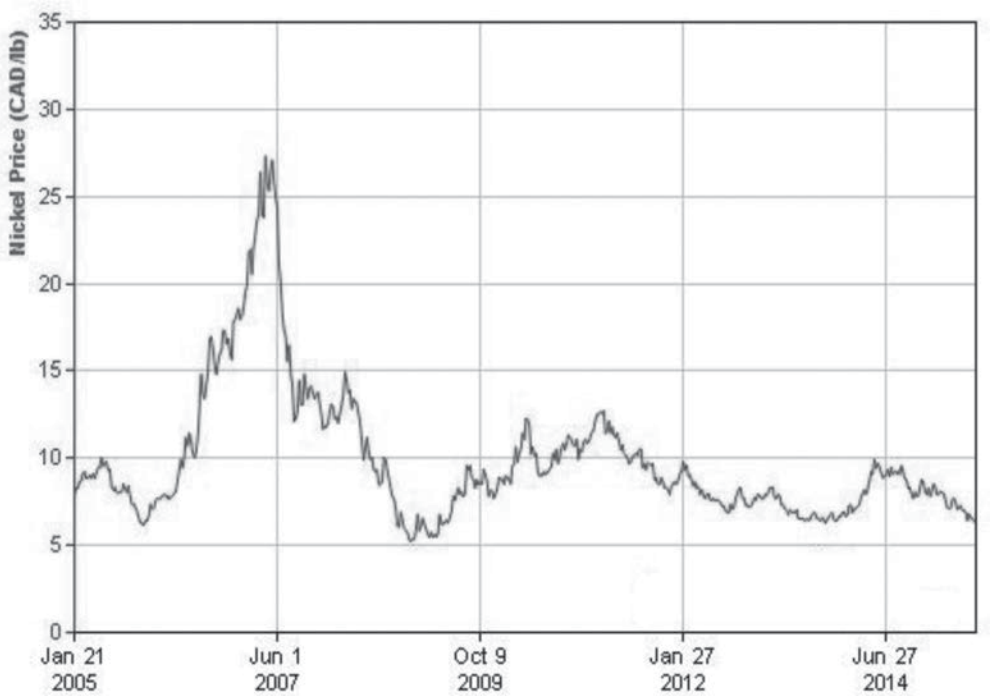

*Source: InfoMine.com; available online at http://www.infomine.com/ChartsAndData/ChartBuilder.aspx?g=127681&cd=1.*

*Figure A-4: Copper Price in US Dollars per Pound, 2005–15*



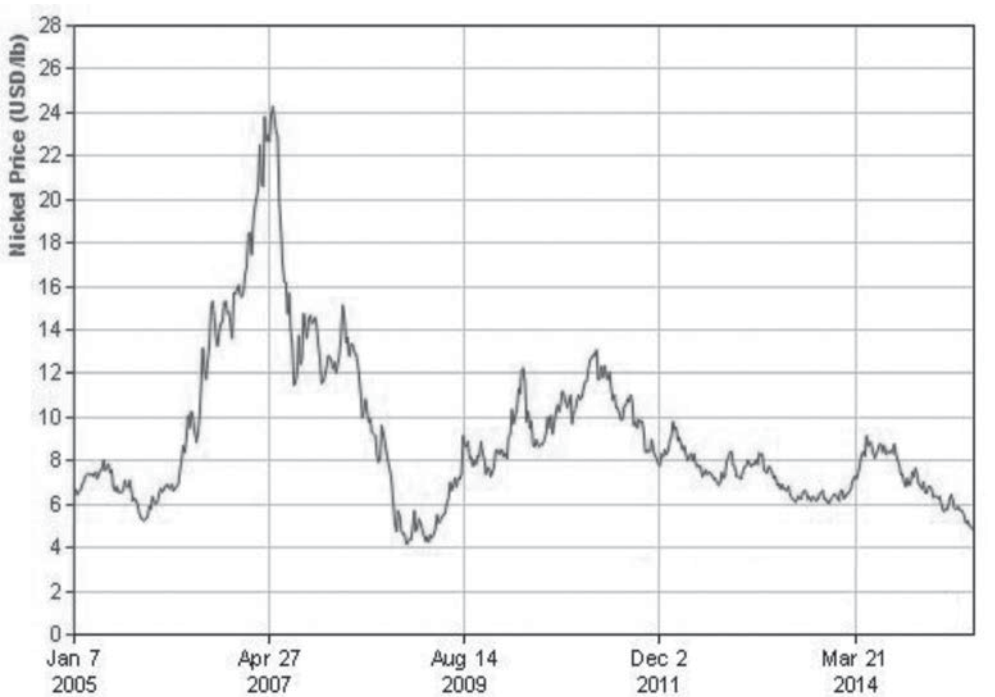

*Source: InfoMine.com; available online at http://www.infomine.com/ChartsAndData/ChartBuilder.aspx?g=127681&cd=1.*

*Figure A-5: Nickel Price in Canadian Dollars per Pound, 2005–15*



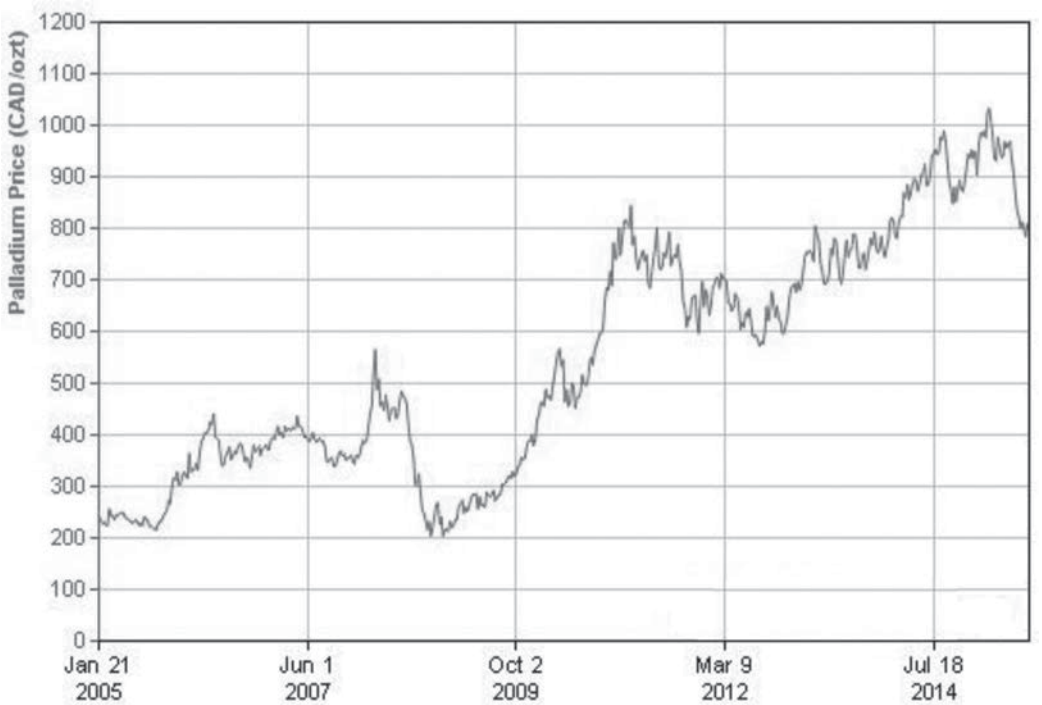

*Source: InfoMine.com; available online at http://www.infomine.com/ChartsAndData/ChartBuilder.aspx?g=127681&cd=1.*

*Figure A-6: Nickel Price in US Dollars per Pound, 2005–15*



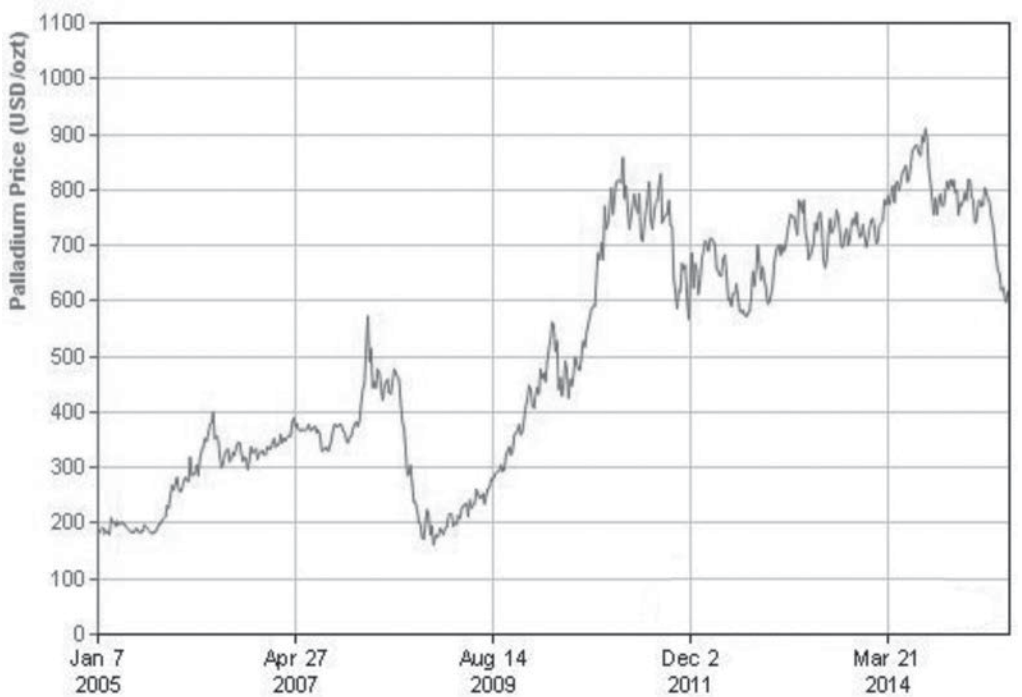

*Source: InfoMine.com; available online at http://www.infomine.com/ChartsAndData/ChartBuilder.aspx?g=127681&cd=1.*

*Figure A-7: Palladium Price in Canadian Dollars per Troy Ounce, 2005–15*



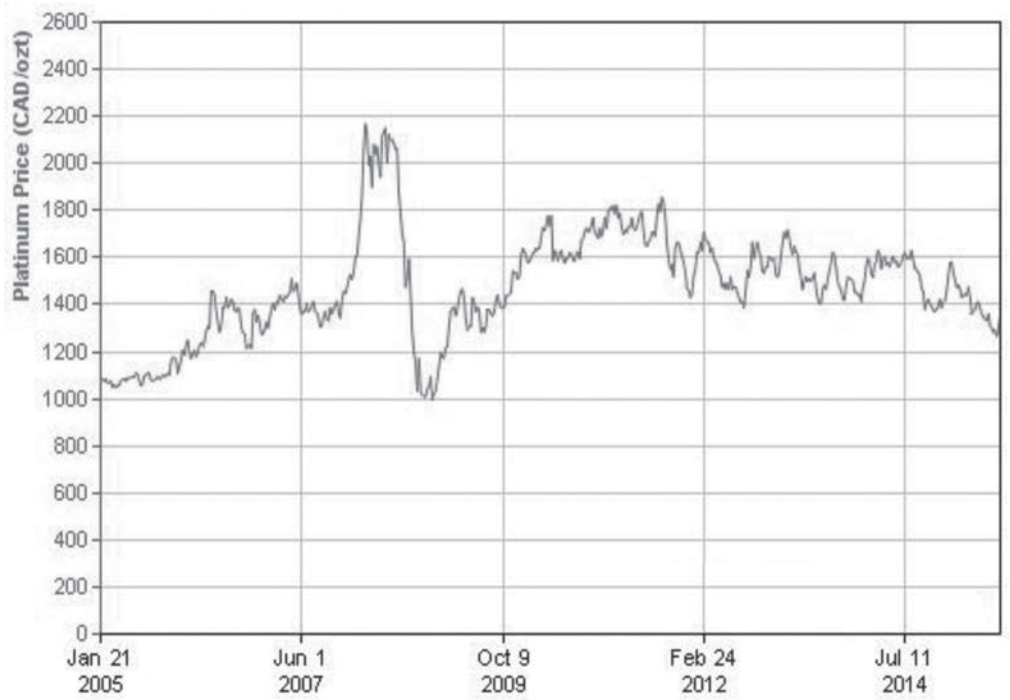

*Source: InfoMine.com; available online at http://www.infomine.com/ChartsAndData/ChartBuilder.aspx?g=127681&cd=1.*

*Figure A-8: Palladium Price in US Dollars per Troy Ounce, 2005–15*



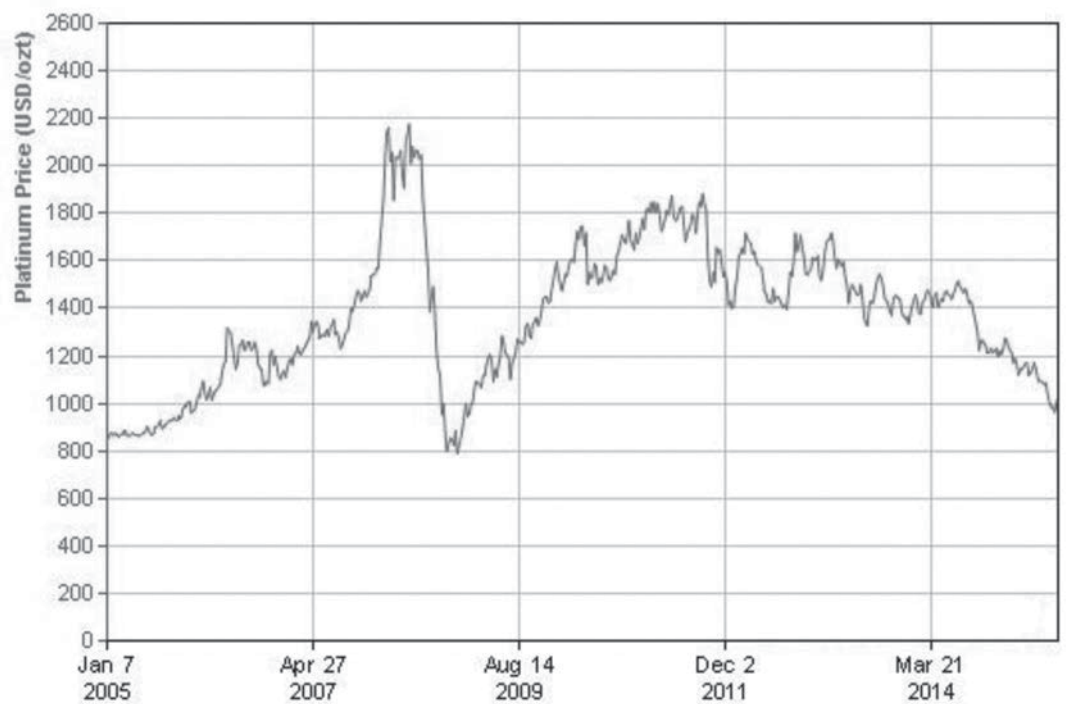

*Source: InfoMine.com; available online at http://www.infomine.com/ChartsAndData/ChartBuilder.aspx?g=127681&cd=1.*

*Figure A-9: Platinum Price in Canadian Dollars per Troy Ounce, 2005–15*



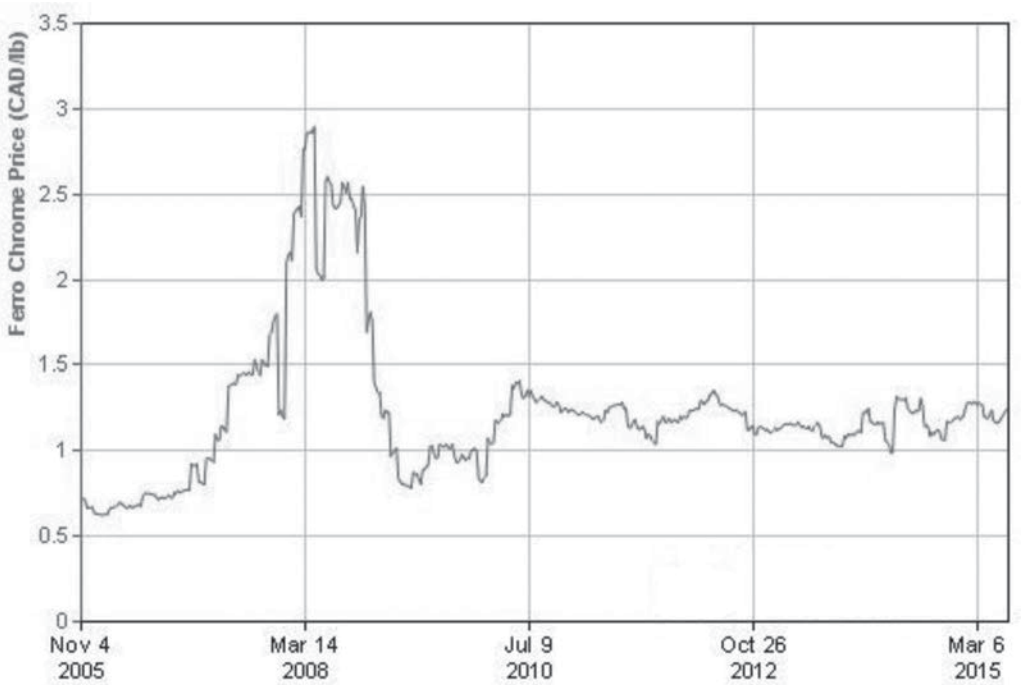

*Source: InfoMine.com; available online at http://www.infomine.com/ChartsAndData/ChartBuilder.aspx?g=127681&cd=1.*

*Figure A-10: Platinum Price in US Dollars per Troy Ounce, 2005–15*



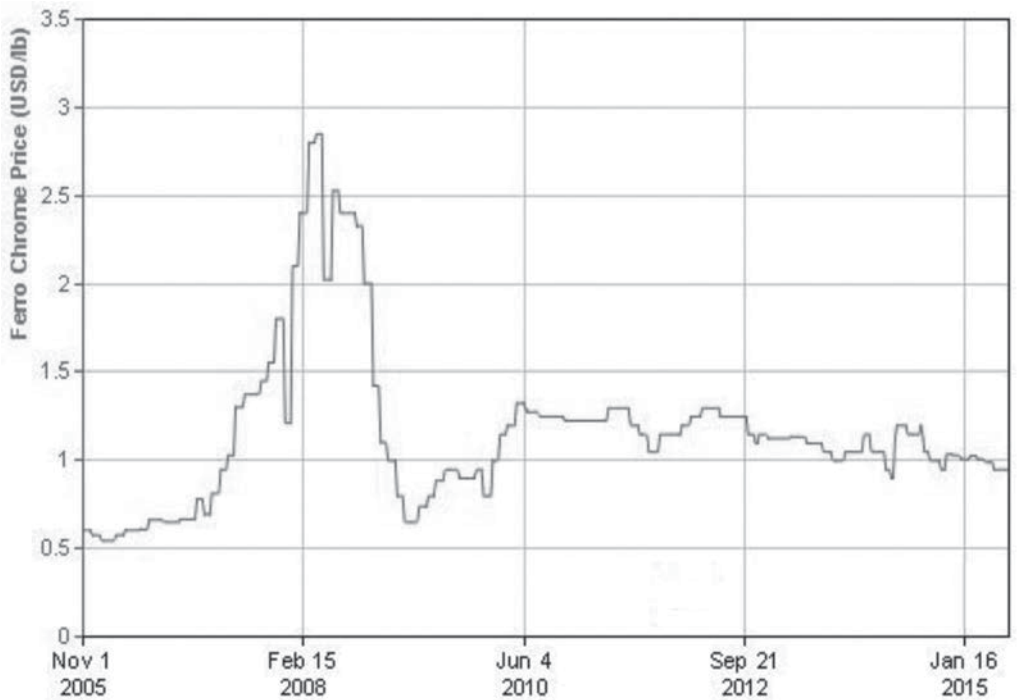

*Source: InfoMine.com; available online at http://www.infomine.com/ChartsAndData/ChartBuilder.aspx?g=127681&cd=1.*

*Figure A-11: Ferro Chrome Price in Canadian Dollars per Pound, 2005–15*



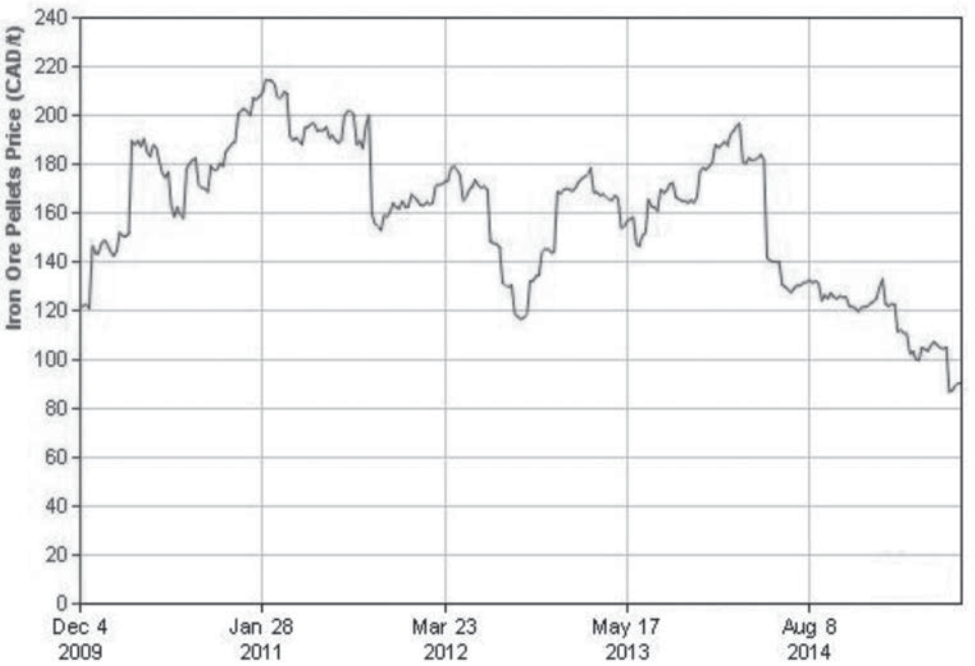

*Source: InfoMine.com; available online at http://www.infomine.com/ChartsAndData/ChartBuilder.aspx?g=127681&cd=1.*

*Figure A-12: Ferro Chrome Price in US Dollars per Pound, 2005–15*



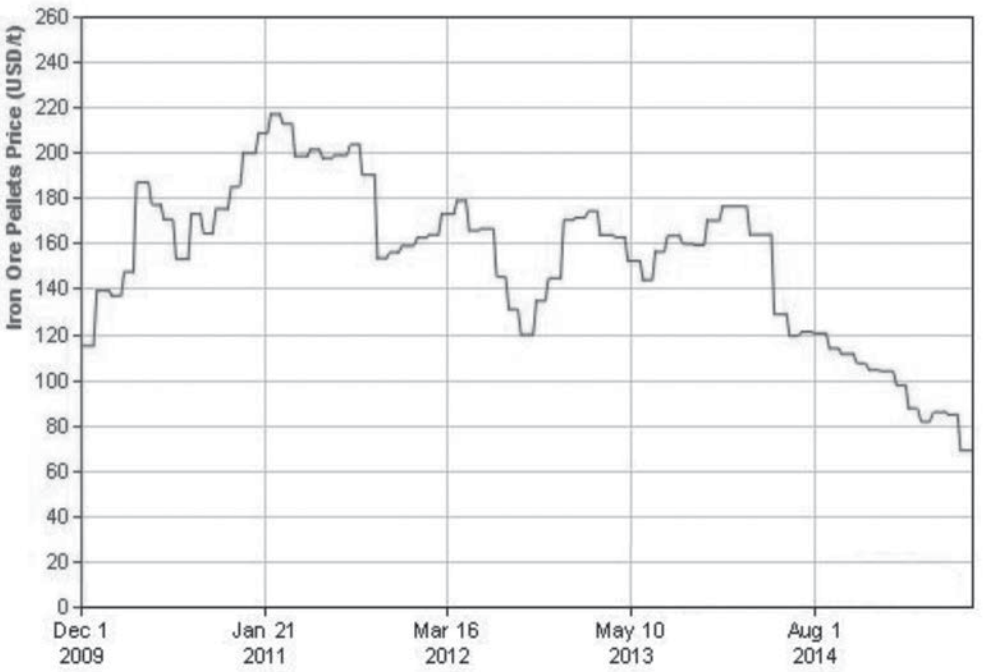

*Source: InfoMine.com; available online at http://www.infomine.com/ChartsAndData/ChartBuilder.aspx?g=127681&cd=1.*

*Figure A-13: Iron Pellet Price in Canadian Dollars per Tonne, 2009–15*




*Source: InfoMine.com; available online at http://www.infomine.com/ChartsAndData/ChartBuilder.aspx?g=127681&cd=1.*

*Figure A-14: Iron Pellet Price in US Dollars per Tonne, 2009–15*




*Source: InfoMine.com; available online at http://www.infomine.com/ChartsAndData/ChartBuilder.aspx?g=127681&cd=1.*

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# About Northern Policy Institute

*Northern Policy Institute is Northern Ontario's independent think tank. We perform research, collect and disseminate evidence, and identify policy opportunities to support the growth of sustainable Northern Communities. We operate throughout Northern Ontario. We seek to enhance Northern Ontario's capacity to take the lead position on socio-economic policy that impacts Northern Ontario, Ontario, and Canada as a whole.*

# Related Research

## Transportation Authority Model
**Nick Mulder**

The Airport/Port Transportation Authority Model; Is It Applicable for Ontario's Ring of Fire Mineral Development?

## Ring of Fire Infrastructure
**Julien Bonin**

Ring of Fire Transportation Infrastructure Map

## Mid-Canada Corridor
**John van Nostrand**

Policy in a Pub with John van Nostrand: A discussion about the Mid-Canada Corridor

## Roads, Rail, and the Ring of Fire
**Rick Millette and Mike Commito**

Adapted from a presentation given on 24 February 2015 at the Ontario Good Roads/Rural Ontario Municipal Association Combined Conference.

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