

PRESS RELEASE

Tuesday, 18 September 2018

ASX/TSX:CDV

2018-16

CARDINAL NAMDINI PRE-FEASIBILITY STUDY 4.76 Moz ORE RESERVE

Cardinal Resources Limited (ASX / TSX: CDV) (“Cardinal” or “the Company”) is pleased to announce the results of its Preliminary Feasibility Study (“PFS”) for the Namdini Gold Project (“Namdini”) in Ghana, West Africa.

HIGHLIGHTS

- **4.76 million ounces** from 129.6 Mt @ 1.14 g/t Au at 0.5 g/t cut-off Maiden Probable Ore Reserve estimate
- **US\$ 1,105/oz** gold price used to provide a Life of Mine (LOM) optimised pit converting **73%** of the 6.5Moz Indicated Mineral Resource to Probable Ore Reserves
- **US\$ 1,250** gold price financial model generated a **38% Post-Tax** Internal Rate of Return (IRR)
- **US\$ 599/oz** all-in sustaining costs (AISC) for the first 2.5 years inclusive of **1.8-year payback period**
- **US\$ 414M** (down from US\$ 426M) Capital development cost for the 9.5 Mtpa throughput plant
- **1.06 Moz** at **1.31 g/t Au** and strip ratio of **0.5 to 1** (waste to ore) **for first 2.5 years of production** (Starter Pit)
- **86%** Metallurgical recovery for Starter Pit and **84%** for LOM with ongoing optimisation testwork

Comments from Archie Koimtsidis, Managing Director and Chief Executive Officer:

“We now have a compelling Business Case to move into the Definitive Feasibility Study (DFS) phase for the 9.5 Mtpa throughput processing facility based upon the optimum Return On Capital Employed (ROCE). The Feasibility Study (FS) is fully funded and will form the basis for the development of our Namdini Project in Ghana with completion anticipated in Q3 2019.

The PFS study confirms the Namdini Project as one of Ghana’s and Africa’s most promising undeveloped, large gold assets. The financial modelling of the project shows it to be technically sound and financially viable and could generate **US\$ 1.4 billion free cash flow (pre-tax)** utilising the 9.5 Mtpa throughput model.”

FINANCIAL SUMMARY OF 9.5 Mtpa (Gold Price of US\$ 1,250 / oz)

KEY ECONOMIC RESULTS	UNIT	9.5 Mtpa
Development Capital Cost	US\$ M	414
All in Sustaining Costs (AISC) ¹		
<i>Starter Pit</i>		599
<i>Life of Mine</i>	US\$ / oz	769
Total Project Payback	Years	1.8
Pre-Tax NPV US\$ (@ 5% discount) ²	US\$ M	927
Post-Tax NPV US\$ (@ 5% discount) ²	US\$ M	586
Pre-Tax IRR	%	49
Post-Tax IRR	%	38

Table 1 Notes:

¹ Cash Costs + Royalties + Levies + Life of Mine Sustaining Capital Costs (World Gold Council Standard)

² Royalties calculated at flat rate of 5% & corporate tax rate of 35% used; both subject to negotiation.



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STARTER PIT:

PRODUCTION SUMMARY

Starter Pit (first 2.5 years of operation) - 24 Mt @ 1.31 g/t for 1.06 Moz at 0.5 g/t cut off

KEY ESTIMATED PRODUCTION RESULTS	UNIT	9.5 Mtpa
Gold Price	US\$ / oz	1,250
Gold Produced (Average for full production years)	(koz / yr)	361
All in Sustaining Costs (AISC) ¹	US\$ / oz	599
Gold Head Grade (Starter Pit)	g/t Au	1.31
Reserve Mined (0.5 g/t cut-off grade)	Tonnes (Mt)	24
Gold Recovery	%	86
Waste Mined	Tonnes (Mt)	12
Strip Ratio (Starter Pit)	W:O	0.5 : 1
Starter Pit Life (Inc. Ramp up)	Years	2.5
Total Project Payback	Years	1.8

Table 2 Notes:

¹ Cash Costs + Royalties + Levies + Life of Mine Sustaining Capital Costs (World Gold Council Standard)

LIFE OF MINE:

PRODUCTION SUMMARY (*including Starter Pit*)

MINERAL RESOURCE DATA – MARCH 2018

Indicated Mineral Resource ¹ 180 Mt @ 1.1 g/t for 6.5 Moz at 0.5 g/t cut off

RESERVE DATA – SEPTEMBER 2018

Probable Ore Reserve 129.6 Mt @ 1.14 g/t for 4.76 Moz at 0.5 g/t cut off

KEY ESTIMATED PRODUCTION RESULTS	UNIT	9.5 Mtpa
Gold Price	US\$ / oz	1,250
Gold Produced (Average for full production years)	(koz / yr)	294
Gold Produced (Life of Mine)	(koz)	3,975
Gold Head Grade (Life of Mine)	g/t Au	1.14
Gold Recovery (Life of Mine)	%	84
Reserve Mined (0.5 g/t cut-off grade)	Tonnes (Mt)	129.6
Waste Mined	Tonnes (Mt)	181
Strip Ratio (Life of Mine)	W:O	1.4 : 1
Mine Life (Inc ramp-up and mine closure)	years	14
Development Capital Cost (Including owner's cost and 15% contingencies)	US\$ M	414
Total Project Payback	Years	1.8

Table 3 Notes:

¹ This is in accordance with the guidelines of Reasonable Prospects for Eventual Economic Extraction ("RPEEE") per the Canadian Institute of Mining, Metallurgy and Petroleum "CIM Definition Standards for Mineral Resources and Mineral Reserves" (CIM, 2014) and the Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves (the JORC Code 2012).



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Based upon Life of Mine production and the cost parameters, the post-tax NPV sensitivities are shown in

Table 4 below for the **9.5 Mtpa** option.

POST TAX REAL DISCOUNT RATE (%)	GOLD PRICE (US\$/oz)				
	US\$ 1,150	US\$ 1,200	US\$ 1,250	US\$ 1,300	US\$ 1,350
0	682	805	928	1,051	1,174
5	415	501	586	672	758
10	251	314	376	439	501

Table Note: All NPVs are post-tax values shown in US\$M

Table 4: 9.5 Mtpa Option Net Present Value and Gold Price Sensitivities

The following four bar charts illustrate the 9.5 Mtpa option pre-tax and post-tax economic sensitivities at a gold price of US\$ 1,250 / oz.

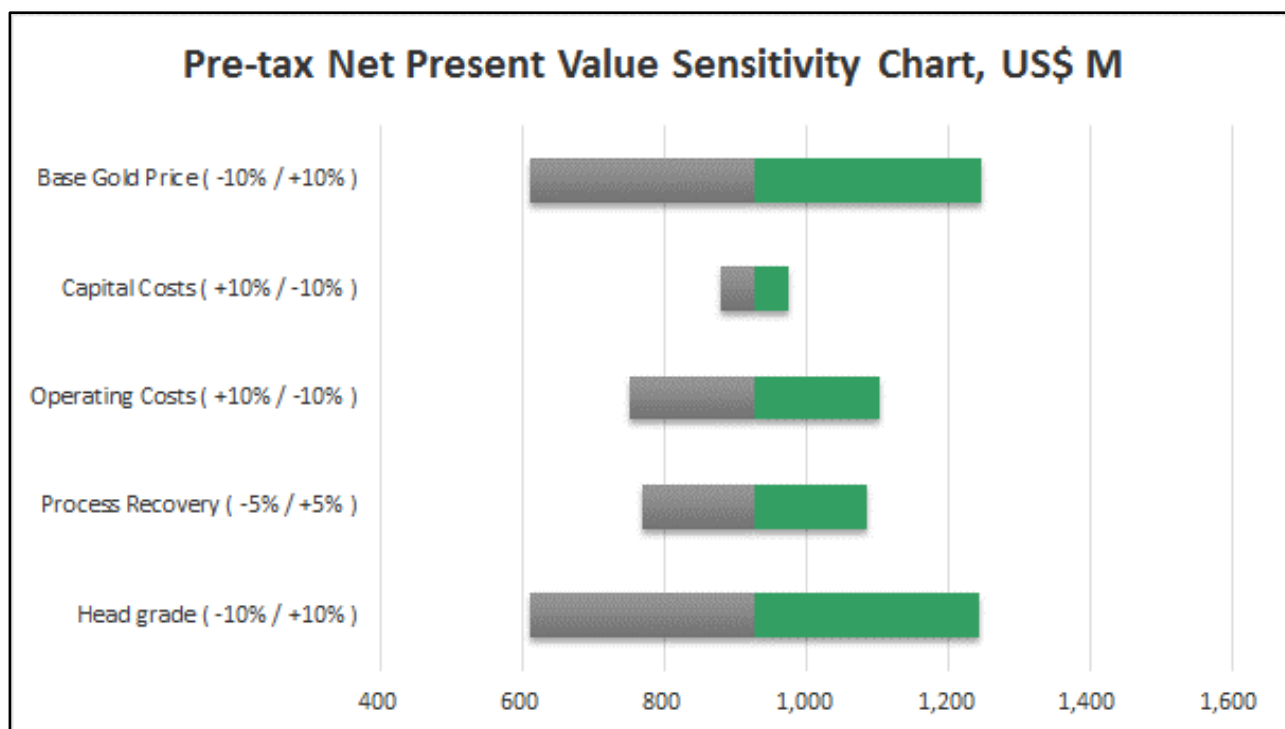


Figure 1 – 9.5 Mtpa option – Pre-tax NPV sensitivity at a 5% discount rate (US\$ M)

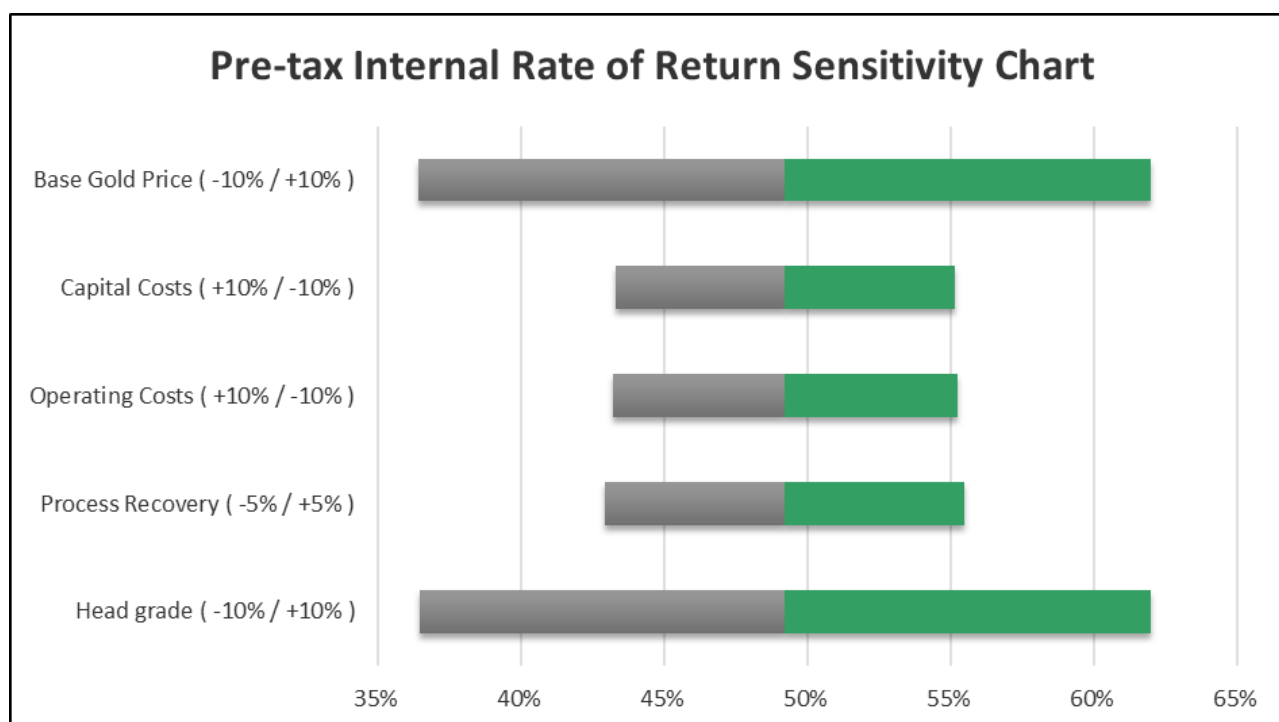


Figure 2 – 9.5 Mtpa option – Pre-tax Internal Rate of Return (%)

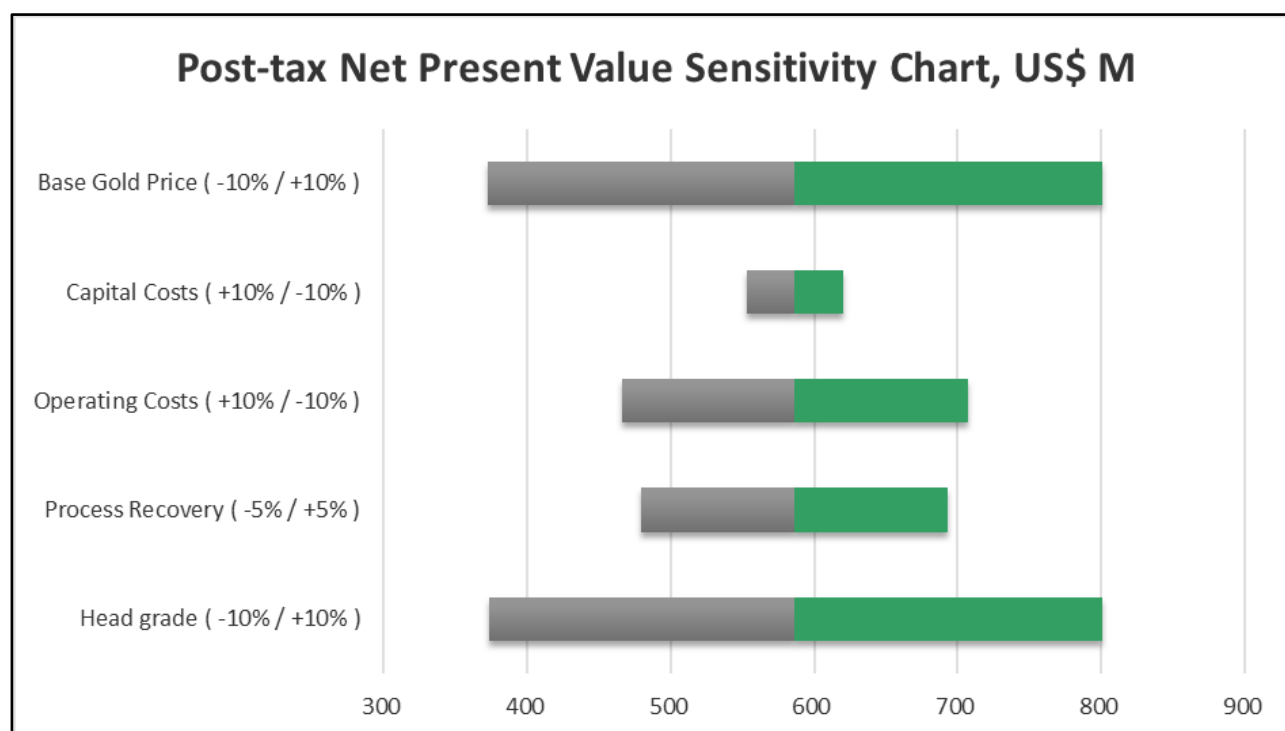


Figure 3 – 9.5 Mtpa option – Post-tax NPV sensitivity at a 5% discount rate (US\$ M)

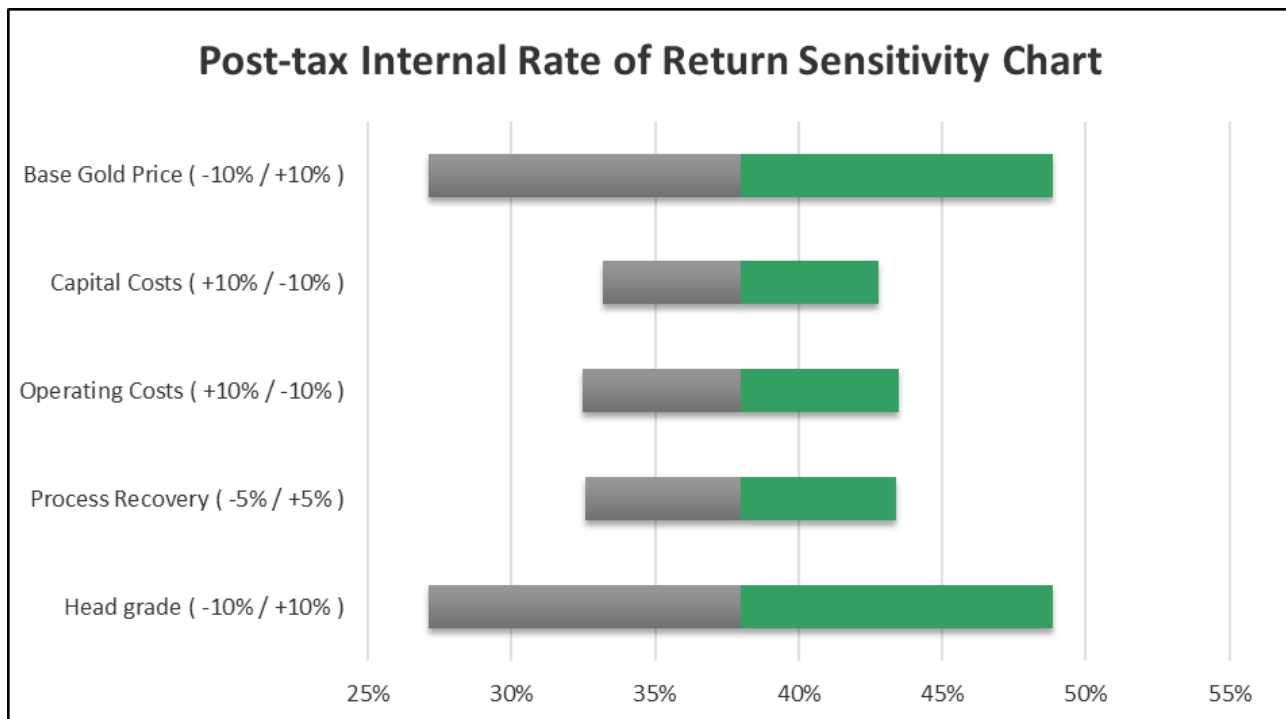


Figure 4 – 9.5 Mtpa option – Post-tax Internal Rate of Return (%)

STUDY INPUTS AND DERIVATION

The Namdini Gold Project PFS is based upon the following key input parameters:

- The revised Mineral Resource model referred to in the press release by Cardinal Resources Limited to the ASX, dated March 5, 2018 titled ‘Cardinal Upgrades Indicated Mineral Resource to 6.5 Moz’ (Cardinal, 2018), compiled by MPR Geological Consultants.
- A Probable Ore Reserve and detailed monthly mining and processing schedules, derived entirely from the Ore Reserve, produced by Golder Associates Pty Ltd (“Golder”) after the application of mining parameters, ore cartage costs based on in-country contractor miner supplier inputs, processing inputs and geotechnical pit design considerations.
- Geotechnical inputs and parameters for staged pit designs from Golder (Perth).
- Process engineering design, capital and operating costs by Lycopodium Limited (Perth).
- Metallurgical recovery inputs based on test work by ALS Global (Perth) and interpreted by Independent Metallurgical Operations (IMO, Perth).
- Waste, residue and water storage design and earthworks by Knight Piésold Consulting (Perth).
- Other cost inputs e.g. power, administration and accommodation by owner’s team and consultants’ inputs.
- Financial model compiled by owners’ team and verified by independent accounting companies.

PRE-FEASIBILITY STUDY PARAMETERS – CAUTIONARY STATEMENT

The term ‘Ore Reserve’ is synonymous with the term ‘Mineral Reserve’ as used by Canadian National Instrument 43-101 ‘Standards of Disclosure for Mineral Projects’ (NI 43-101, 2014) and conforms with CIM (2014). The JORC Code (2012) is defined as an ‘acceptable foreign code’ under NI 43-101.

The PFS referred to in this announcement is based upon a Probable Ore Reserve derived from Indicated Mineral Resources. No Inferred Mineral Resources have been included in the estimation of Ore Reserves. The Company advises that the Probable Ore Reserve provides 100% of the total tonnage and 100% of the total gold metal

underpinning the forecast production target and financial projections. No Inferred Mineral Resource material is included in the Life of Mine plan

Unless otherwise stated, all cash flows are in US dollars and are not subject to inflation/escalation factors and all years are calendar years. The PFS has been prepared to an overall capital expenditure (CAPEX) level of accuracy of approximately -30% to +20%. This announcement has been prepared in compliance with the JORC Code (2012) and the current ASX Listing Rules and in accordance with National Instrument 43-101 – Standards of Disclosure for Mineral Projects of the Canadian Securities Administrators (CIM 2014).

The Company has concluded that it has a reasonable basis for providing forward looking statements included in this announcement. The detailed reasons for this conclusion are outlined throughout this announcement and in Forward Looking and Cautionary Statements.

ABOUT CARDINAL

Cardinal Resources Limited (ASX/TSX: CDV) is a West African gold-focused exploration and development Company which holds interests in tenements within Ghana, West Africa.

The Company is focused on the development of the Namdini Project through a resource expansion drilling programme and is now advancing the feasibility study supported by additional multi-disciplinary engineering activities.

Exploration programmes are also underway at the Company's Bolgatanga (Northern Ghana) and Subranum (Southern Ghana) Projects.

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- A technical report containing the PFS and prepared in accordance with National Instrument 43-101 Standards of Disclosure for Mineral Projects (NI43-101) of the Canadian Securities Administrators will be available on SEDAR at www.sedar.com within 45 days.

Competent and Qualified Person Statement

All production targets for the Namdini Gold Mine referred to in this report are underpinned by estimated Mineral Resources and Ore Reserves which were prepared by competent persons and qualified persons in accordance with the requirements of the JORC Code and National Instrument 43-101- Standards of Disclosure for Mineral Projects ("NI43-101"), respectively.

Scientific and technical information contained in this press release has been reviewed and approved by **Mr. Daryl Evans**, Independent Metallurgical Operations Pty Ltd, who is a 'qualified person' as defined by National Instrument 43-101- Standards of Disclosure for Mineral Projects ("NI43-101"). Mr. Evans holds a Qualified Professional status being a Fellow of the Australasian Institute of Mining and Metallurgy (FAusIMM). Mr. Evans is an independent consultant appointed by Cardinal. Mr. Evans consents to the inclusion of the matters in this report of the statements based on the information in the form and context in which it appears.

The information in this press release that relates to Namdini Mineral Resources is based on information compiled and reviewed by **Mr Nicolas Johnson**, a Competent Person who is a Member of the Australian Institute of Geoscientists and a full-time employee of MPR Geological Consultants Pty Ltd. Mr Johnson has sufficient experience which is relevant to the style of mineralization and type of deposit under consideration and to the activity which he has undertaken to qualify as a Competent Person as defined in the JORC Code 2012 and is a qualified person for the purposes of NI43-101. Mr Johnson has no economic, financial or pecuniary interest in the company and consents to the inclusion in this report of the matters based on his information in the form and context in which it appears.

The scientific and technical information contained in this press release is based on information compiled and reviewed by **Mr Richard Bray**, a Competent Person who is a Registered Professional Geologist with the Australian Institute of Geoscientists and a full-time employee of Cardinal Resources Ltd. Mr Bray has sufficient experience which is relevant to the style of mineralization and type of deposit under consideration and to the activity which he has undertaken to qualify as a Competent Person as defined in the JORC Code 2012 and is a qualified person for the purposes of NI43-101. Mr. Bray is a full-time employee of Cardinal and holds equity securities in the Company. Mr. Bray has consented to the inclusion of the matters in this report based on the information in the form and context in which it appears.

The information in this press release that relates to Namdini Ore Reserves and mining studies is based on information compiled and reviewed by **Mr Glenn Turnbull**, a Competent Person who is a Chartered Engineer and Member of the Australasian Institute of Mining and Metallurgy and a full-time employee of Golder. Mr Turnbull has sufficient experience which is relevant to the style of mineralization and type of deposit under consideration and to the activity which he has undertaken to qualify as a Competent Person as defined in the JORC Code 2012 and is a qualified person for the purposes of NI43-101. Mr Turnbull has no economic, financial or pecuniary interest in the company and consents to the inclusion in this report of the matters based on his information in the form and context in which it appears.

Disclaimer

This ASX / TSX press release has been prepared by Cardinal Resources Limited (ABN: 56 147 325 620) ("Cardinal" or "the Company"). Neither the ASX or the TSX, nor their regulation service providers accept responsibility for the adequacy or accuracy of this press release.

This press release contains summary information about Cardinal, its subsidiaries and their activities, which is current as at the date of this press release. The information in this press release is of a general nature and does not purport to be complete nor does it contain all the information, which a prospective investor may require in evaluating a possible investment in Cardinal.

By its very nature exploration for minerals is a high-risk business and is not suitable for certain investors. Cardinal's securities are speculative. Potential investors should consult their stockbroker or financial advisor. There are a number of risks, both specific to Cardinal and of a general nature which may affect the future



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operating and financial performance of Cardinal and the value of an investment in Cardinal including but not limited to economic conditions, stock market fluctuations, gold price movements, regional infrastructure constraints, timing of approvals from relevant authorities, regulatory risks, operational risks and reliance on key personnel and foreign currency fluctuations.

Except for statutory liability which cannot be excluded and subject to applicable law, each of Cardinal's officers, employees and advisors expressly disclaim any responsibility for the accuracy or completeness of the material contained in this press release and excludes all liability whatsoever (including in negligence) for any loss or damage which may be suffered by any person as a consequence of any information in this Announcement or any error or omission here from. Except as required by applicable law, the Company is under no obligation to update any person regarding any inaccuracy, omission or change in information in this press release or any other information made available to a person nor any obligation to furnish the person with any further information. Recipients of this press release should make their own independent assessment and determination as to the Company's prospects, its business, assets and liabilities as well as the matters covered in this press release.

Forward-looking statements

Certain statements contained in this press release, including information as to the future financial or operating performance of Cardinal and its projects may also include statements which are 'forward-looking statements' that may include, amongst other things, statements regarding the feasibility of the Namdini Project, production targets, economic analysis of the Starter Pit and Life of Mine scenarios, estimates and assumptions in respect of mineral resources and anticipated grades and recovery rates, production and prices, recovery costs and results, capital expenditures and are or may be based on assumptions and estimates related to future technical, economic, market, political, social and other conditions. These 'forward – looking statements' are necessarily based upon a number of estimates and assumptions that, while considered reasonable by Cardinal, are inherently subject to significant technical, business, economic, competitive, political and social uncertainties and contingencies and involve known and unknown risks and uncertainties that could cause actual events or results to differ materially from estimated or anticipated events or results reflected in such forward-looking statements.

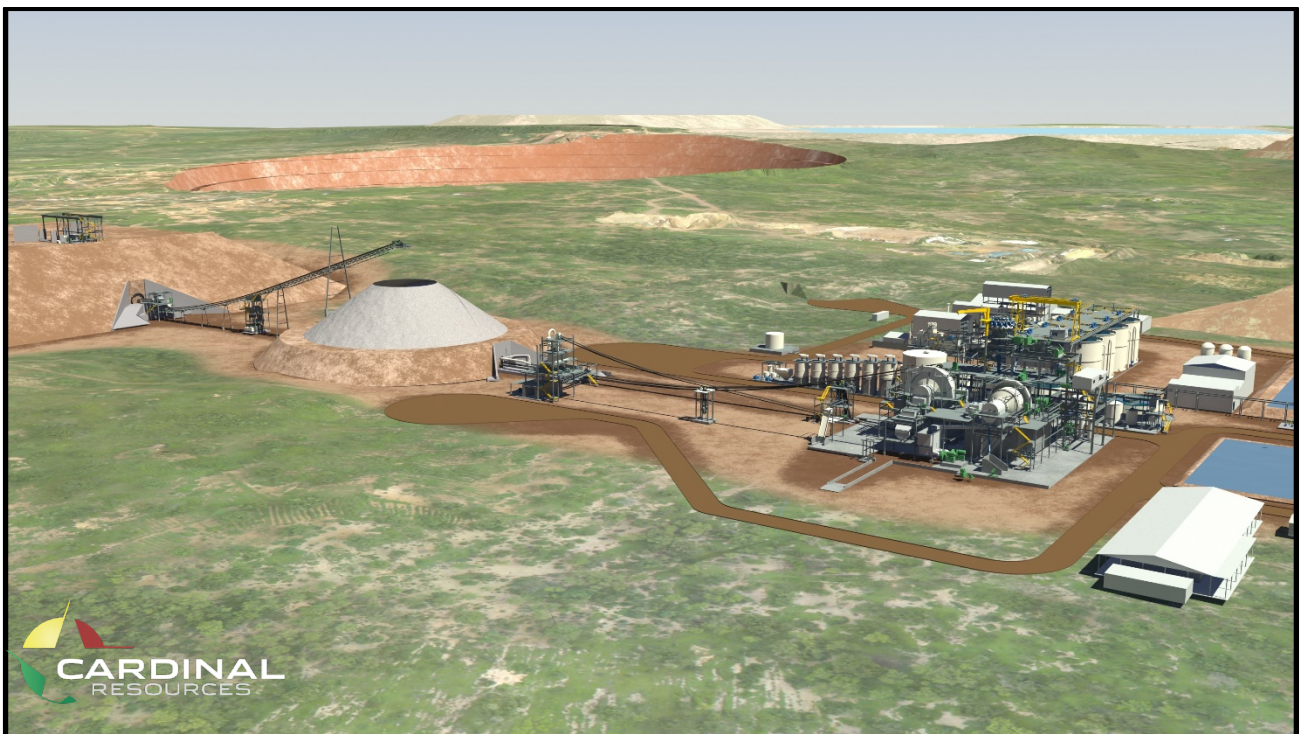
Cardinal disclaims any intent or obligation to update publicly or release any revisions to any forward-looking statements, whether as a result of new information, future events, circumstances or results or otherwise after today's date or to reflect the occurrence of unanticipated events, other than required by the Corporations Act and ASX and TSX Listing Rules. The words 'believe', 'expect', 'anticipate', 'indicate', 'contemplate', 'target', 'plan', 'intends', 'continue', 'budget', 'estimate', 'may', 'will', 'schedule' and similar expressions identify forward-looking statements.

All forward-looking statements made in this press release are qualified by the foregoing cautionary statements. Investors are cautioned that forward-looking statements are not guarantees of future performance and accordingly investors are cautioned not to put undue reliance on forward-looking statements due to the inherent uncertainty therein.

Preliminary Feasibility Study

Namdini Gold Project

Ghana, West Africa



Prepared By: Cardinal Resources

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1. Introduction

The principal activity of the Company (and its subsidiaries) is gold exploration in Ghana. The Company holds interests in five tenements prospective for gold mineralization in Ghana in two NE-SW trending Paleo-Proterozoic granite-greenstone belts: the Bolgatanga Project and the Namdini Gold Project (“**Namdini Gold Project**” or “**Namdini**”), which are, respectively, located within the Nangodi and Bole-Bolgatanga Greenstone Belts in northeast Ghana, and the Subranum Project, which is located within the Sefwi Greenstone Belt in southwest Ghana.

The main focus of activity is the Namdini Gold Project where an Indicated Mineral Resource of **180 Mt** grading **1.1 g/t Au** for **6.5 Moz Au** and an Inferred Mineral Resource of **13 Mt** grading **1.2 g/t Au** for **0.5 Moz Au** each at a 0.5 g/t Au cut-off grade, have been established. The map below shows the location of the Namdini Gold Project and the Company’s other properties in Ghana.

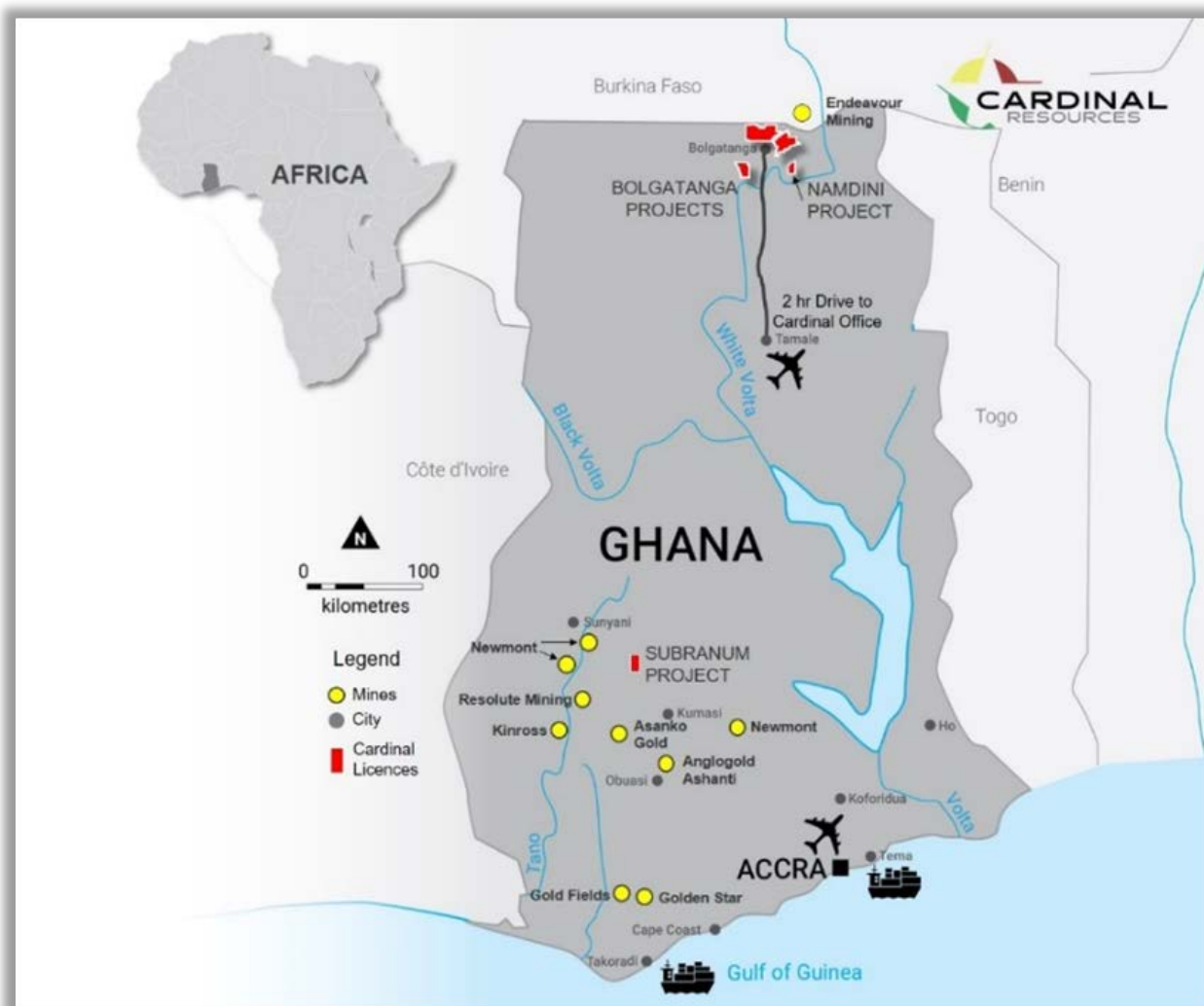


Figure 1 Cardinal Resource’s Tenements in Ghana

2. Preliminary Feasibility Study Parameters and Material Assumptions

The PFS study capital cost estimates, was completed to an accuracy of +30 % / -20 % for the 9.5 Mtpa option and was undertaken based on only open pit mining from the existing March 2018 Mineral Resources. The proposed plant comprises a primary crushing, milling (SAG + ball), re-crush, gravity, flotation, concentrate regrind and CIL

circuit. Three production throughputs were assessed by Cardinal, namely 9.5, 7.0 and 4.5 Mtpa. The 9.5 and 4.5 Mtpa throughput options were factored from the 7.0 Mtpa option (+20 / -15% accuracy) and are therefore lower in accuracy at +30 / -20%. A contingency factor of 5% was added to the 9.5 and 4.5 Mtpa options over and above the project contingency.

Metallurgical testwork carried out to date indicates that gold can be satisfactorily recovered from Namdini ore using conventional flotation, regrind and Carbon In Leach (CIL) of the flotation concentrate. The testwork is considered sufficient to determine that the Namdini Mineral Resource represents a deposit with potential economic extraction. Estimation of capital costs was prepared by Lycopodium for the process plant and associated infrastructure.

Golder Associates Pty Ltd ("Golder") provided open pit mine engineering services. The work comprised collation of input parameters, open pit optimisation studies, pit designs and detailed NPV optimised mine schedules. A series of shells from the open pit optimisations was selected and used to generate engineering pit designs that included a Starter Pit and Life Of Mine (LOM) stages for the LOM production schedule.

Golder estimated the Ore Reserve in accordance with the JORC Code (2012). The term 'Ore Reserve' is synonymous with the term 'Mineral Reserve' as used by Canadian National Instrument 43-101 'Standards of Disclosure for Mineral Projects' (NI 43-101, 2014) and conforms with CIM (2014). The JORC Code (2012) is defined as an 'acceptable foreign code' under NI 43-101. The JORC Table 1 is displayed in Appendix 1.

This Ore Reserve estimate is based on the revised Mineral Resource model referred to in the press release by Cardinal Resources Limited to the ASX and TSX, dated March 5, 2018 titled '*Cardinal Upgrades Indicated Mineral Resource to 6.5 Moz*' (Cardinal, 2018). Golder provided an estimate of mining, including haulage, drill and blast, rehabilitation and administration costs. Lycopodium provided processing cost estimates.

The Ore Reserve was estimated from the Mineral Resource after consideration of the level of confidence in the Mineral Resource and considering material and relevant modifying factors including mining, processing, infrastructure, environmental, legal, social and commercial factors. The Probable Ore Reserve estimate is based on Indicated Mineral Resources. No Inferred Mineral Resource was included in the Ore Reserve. The Ore Reserve represents the economically mineable part of the Indicated Mineral Resources. There is no Proved Ore Reserve since no Measured Mineral Resource has yet been defined.

The proposed mine plan is technically achievable. All technical proposals made for the operational phase involve the application of conventional technology that is widely utilised in the gold industry. Financial modelling completed as part of the PFS show that the Project is economically viable under current assumptions. Modifying Factors (mining, processing, infrastructure, environmental, legal, social and commercial) were considered during the Ore Reserve estimation process. The PFS incorporates a number of factors and assumptions as outlined in the sections below.

The financial model was completed as a real discounted model. A LOM financial analysis was performed using the discounted cash flow (DCF) method and varying real discount rates. The financial analysis was used to determine the potential economic return of the project over the LOM.

The following preliminary schedule (Table 1) is subject to available funding, positive outcomes for the PFS and DFS and favourable timelines for permitting;

Milestone	Target Timeline
Completion of PFS	Q3 2018
Completion of DFS	Q3 2019
Final Investment Decision	Q4 2019
Target Production Commencement	H2 2021

Table 1 Preliminary Schedule

3. Gold Price Used

Table 2 below describes the gold price assumptions used for the purposes of the PFS.

Selection Case	Gold Price
Mine scheduling was used to maximise value through deferring of larger strip-ratio cut-backs until later in the mine life. The maximum value pit was selected using a discounted average Net Present Value and determined to align with a Revenue Factor ("RF") shell of approximately \$1,105/oz using estimated LOM input prices and costs. Pit shells were converted into engineering designs prior to export of the contained resource model for scheduling purposes.	US\$ 1,105 / oz
Trial open pit optimisations were run in Whittle 4X at a US\$1,300/oz gold price (which was the appropriate gold price at the time of the optimisation runs) to define the base of potentially economic material. Four cut back pits were then selected and full mine designs applied.	US\$ 1,300 / oz
The Financial Model Input gold price for all options was US\$ 1,250 / oz.	US\$1,250 / oz

Table 2 Gold Price Table

4. Study Team

Cardinal commenced its PFS in October 2017 to further advance the Namdini Gold Project. This consisted of an Owner's Team and continuation with previously selected and newly selected consultants to assist with the phased development of the Namdini Gold Project. The consultants and their roles are tabulated below:

COMPANY	ROLE
Golder Associates Pty Ltd	Study Managers. Mine planning and Whittle Optimisation. Pit design and mine scheduling. Geotechnical, Hydrology and Hydrogeology engineering. Responsible for the compilation of the NI43-101 reports
Lycopodium Limited	Process plant and associated infrastructure. Capital and Operating cost estimation and input into the NI43-101 reports
Orway Minerals Consultants	Comminution data analysis and crushing and grinding circuit option study
ALS Laboratory (Perth)	Metallurgical testwork to support the process design and criteria
Knight Piésold Consulting	Tailings Storage Facility and associated infrastructure design
IMO Pty Ltd	Metallurgical testwork analysis and process flowsheet development
MPR Geological Consultants	Mineral Resource Modelling of the Namdini Deposit
Orefind Pty Ltd	Geology and deposit structural genesis
Intermine Engineering Consults	Mine Schedule Optimisation
NEMAS Consult Pty Ltd	Environmental Impact Assessment Study

COMPANY	ROLE
BDO	Financial Model Reviewer

Table 3 Study Team

5. Higher Throughput Option Study

During the PFS study, Cardinal evaluated higher process throughput options to assess whether the 6.5 Moz Mineral Resource was able to support higher throughputs. Golder Associates and Interline Engineering Consultants (Interline) were separately tasked to perform an order of magnitude study on the larger throughput options using different Whittle optimisations and pushbacks (stages). Cardinal provided order of magnitude capital and operating costs for the larger throughput options to Golder and Interline.

5.1 Inputs

Optimisation parameters applied included:

- Options were completed for mill throughputs of 4.5, 7.0, 9.5, 12.0 and 14.0 Mtpa with the 12.0 and 14.0 Mtpa scenario divided into a Diesel and High Voltage option. This was done in order to evaluate potential HV power supply limitations.
- Mining costs for ore and waste based on 10 metre incremental unit rates provided by local contractors for four pit stages designed by Golder were used.
- Overall slope angles of 45° were used.
- Process operating costs and capital costs for the study were factored for the larger options based off the 4.5, 7.0 and 9.5 Mtpa throughput costs that were available at the time.
- A discount factor (DCF) of 10% were used for economic comparison using the industry standard Whittle pit optimisation software.

5.2 Methodology

The methodology of the Whittle optimisation was as follows:

- Whittle shells were selected based on the weighted average of the best and worst discounted cashflow. The weighting was 60% to the best and 40% to the worst.
- Whittle NPV Pushback software was then utilised to evaluate the final Whittle shells to determine the number of stages that would return the best NPV for each of the mill throughput scenarios.
- A minimum mining width of 60m was used.
- All material was processed if cashflow positive. No high grading applied.
- The final pit shell was allowed to expand if necessary.
- Vertical advance rate was limited to 60m per year.
- No limit on total movement was applied.
- Stockpiles were used to store Oxide material mined in the initial years, until Fresh ore supply diminishes to the mill before processing of Oxide would commence to maintain the nominated mill capacity.

5.3 Results

The following NPV and IRR Comparison Graphs indicate the results from the evaluation.

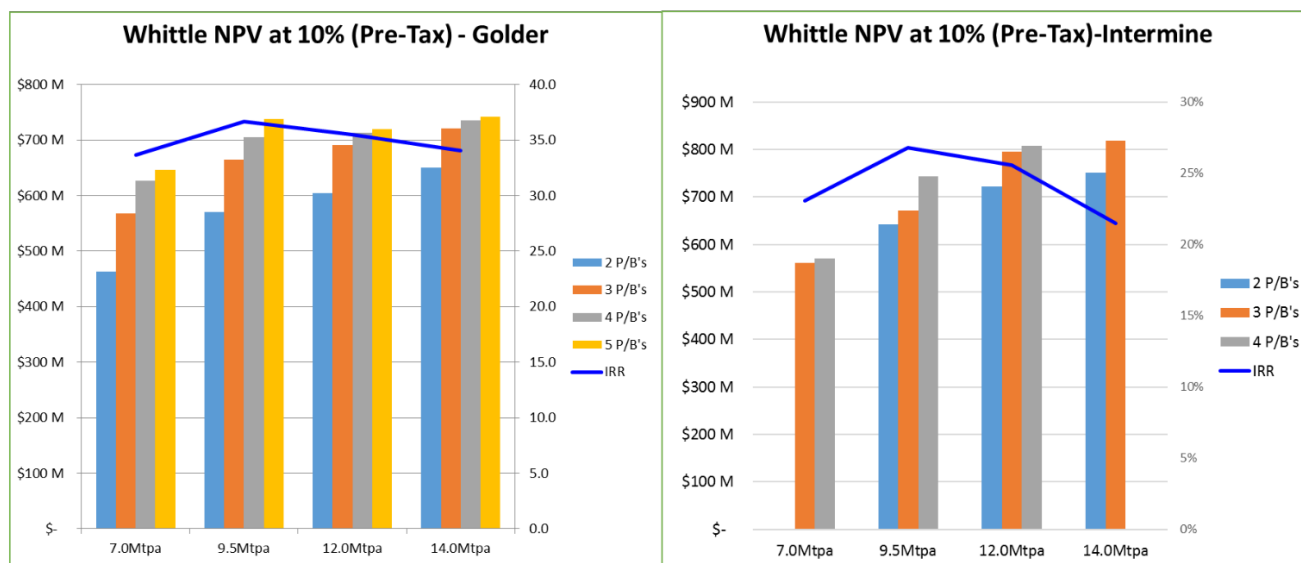


Figure 2 Whittle Optimisation NPV and IRR comparisons

5.4 Conclusions

From the work completed the following was concluded:

- The best economic scenario was the 9.5 Mtpa option using 4 pit stages. Following this would be a 7.0 Mtpa option with 4 stages of development.
- The 12.0 and 14.0 Mtpa throughput options showed practical mining extraction limitations at depth due to the number of working faces required and mining fleet numbers.
- Power supply for the 12.0 and 14.0 Mtpa larger options would require separate studies to assess whether the available grid could supply increased demand. Water supply would also need proper assessment for these options.
- There are some limitations as to the ability of Whittle to produce realistic nested stage shells and associated mining and production schedules in some cases. These include:
 - A global vertical advance rate limit of 60m has been applied or 6 x 10m benches in a Year. This has affected the potential in some of the scenarios to achieve the required mill throughput in the first year. For example, in the case of using either 3 or 4 stages in the 9.5 Mtpa option, in Year 1 only 4.5 Mt was processed using 3 stages compared to 9.2Mt for 4 stages. This is because by using 3 stages, the starting top bench of shell 15 is 240mRL and so can only be mined down to the 190mRL whereas for 4 stages using shell 14 the starting bench is 230mRL and goes down to the 180mRL, hence accessing another 3.1Mt of fresh mill feed.
 - Positioning of ramps in the practical design process can result in changes to the physicals when compared to those in the staged schedules.
 - The economic evaluation of the mill throughput and the number of stages could be combined with variable high grading scenarios as there is good potential for higher grades to be fed to the mill in the earlier years.

6. Mining Licence / Property Title

During the quarter ended 31 December 2017, a Large-Scale Mining Licence covering the Namdini Mining Lease was assigned to Cardinal Namdini Mining Limited (“**Cardinal Namdini**”), a wholly owned subsidiary of Cardinal, by the Minister of Lands and Natural Resources under the Ghanaian Minerals and Mining Act 2006 (Act 703). The Large-Scale Mining Licence, which covers 19.54 km² in the Dakoto area of the Talensi District Assembly in Upper East Region of Ghana evidenced by a Mining Lease, is for an initial period of 15 years and is renewable for up to a further thirty (30) years.

Savannah Mining Ghana Limited (“**Savannah**”) has completed an EIS (“Environmental Impact Statement”) scoping report for Namdini and has filed the EIS with the Environmental Protection Agency (“**EPA**”). In accordance with EPA Regulations 15(1b) and (1c) of the Environmental Assessment Regulations, 1999 (LI 1652) and Ghana’s Environmental Impact Assessment (EIA) Procedures, the Environmental Protection Agency (EPA) issued a public notification on the proposed Namdini Gold Mining Project. Cardinal will submit to the EPA and Minerals Commission an updated EIS for the selected project scale option envisioned for the DFS prior to commencement thereof.

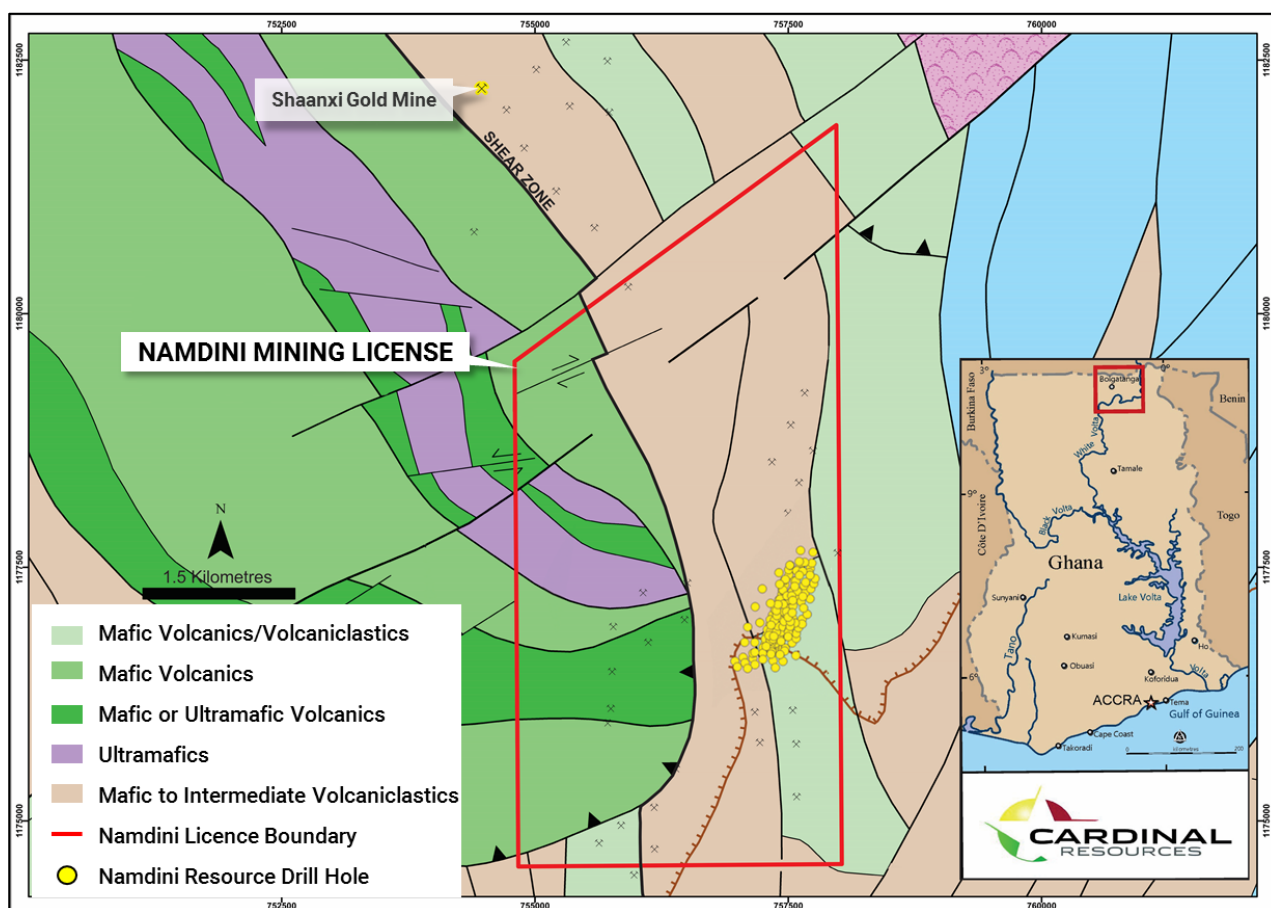


Figure 3 Namdini Project proximity map

7. Namdini Global Mineral Resources

Independent mining industry consultant, MPR Geological Consultants Pty Ltd (“MPR”) was commissioned by Cardinal to estimate the Mineral Resources of the Namdini deposit. The Mineral Resource estimate was reported in accordance with the JORC Code (2012) as shown in Appendix 1 – JORC Table 1. The Mineral Resource estimate, summarized in the following table (Table 2), reports the Mineral Resources by category and material type (weathering) above a 0.5 g/t gold cut-off grade. The classification categories of Inferred and Indicated Mineral Resources under the JORC Code (2012) are equivalent to the CIM categories of the same name (CIM, 2014).

CategoryWeathering Profile - Indicated		Tonnage (Mt)	Grade (g/t Au)	Contained Gold (koz)
<i>Oxide</i>		4.0	1.1	150
Indicated	<i>Transition</i>	4.2	1.1	150
	<i>Fresh</i>	171.4	1.13	6,160
Total Indicated Mineral Resource		179.6	1.13	6,460

Table 4 Namdini Mineral Resource **Indicated** estimate at 0.5 g/t cut off – March 2018

CategoryWeathering Profile - Inferred		Tonnage (Mt)	Grade (g/t Au)	Contained Gold (koz)
<i>Oxide</i>		0.07	0.9	2
Inferred	<i>Transition</i>	0.02	0.7	0.5
	<i>Fresh</i>	12.9	1.3	538
Total Inferred Mineral Resource		13.1	1.3	540

Table 5 Namdini Mineral Resource **Inferred** estimate at 0.5 g/t cut off – March 2018

Table 4 and Table 5 Notes:

Mineral Resource estimates are reported inclusive of those Mineral Resources converted to Ore Reserves. The Mineral Resources and Ore Reserves conform with and use JORC Code (2012) recommendations and Canadian Institute of Mining, Metallurgy and Petroleum Standards (CIM, 2014)

8. Geology

The Namdini gold deposit is a large, structurally controlled, orogenic gold deposit with numerous features similar to deposits found elsewhere in late Proterozoic Birimian terranes of West Africa. The Namdini gold deposit has so far been delineated over a strike length of 1,150m, up to 300 m wide and 700m deep and is situated within the Nangodi Greenstone Belt.

In 2016, geological consultants from Orefind Pty Ltd conducted an on-site structural study and developed a structural framework with controls on, and geometry of, gold mineralization comprising the Namdini deposit.

Orefind concluded that the rock types comprising the Namdini Project included a steeply west dipping Birimian sequence of interbedded, foliated, metasedimentary and metavolcanic units which have been intruded by a medium-grained granitoid and diorite. The southern part of the Project is covered by flat-lying Voltaian Basin clastic sedimentary rocks that have been deposited unconformably on the Birimian sequence and postdate mineralization and the host sequence.

Underneath the weathering profile, the Birimian units include metasedimentary, metavolcanic, granitoid (tonalite) and diorite. The metasedimentary and volcanoclastic lithologies have been intensely altered with a resulting pyrite-carbonate-muscovite-chlorite-quartz assemblage. Alteration is most prevalent in the volcanoclastic units. Similarly, the tonalite is extensively altered and has been overprinted by silica-sericite-carbonate assemblages.

In all rock types, the mineralization is accompanied by visible disseminated sulphides of pyrite and very minor arsenopyrite in both the veins and wall rocks. In diamond drill core, the mineralized zones are visually distinctive due to the presence of millimetre to centimetre wide quartz-carbonate veins that are commonly folded and possess yellow-brown sericite-carbonate selvages. Rare visible gold occurs in strongly altered granite and is associated with sub-millimetre wide silica-sericite shears.

8.1 Drilling Techniques

The input dataset used for the Namdini Mineral Resource estimate comprises a total of 167 HQ diamond core holes and 144 RC drill holes totalling 82,870 m.

Reverse circulation drilling (nominally 5¼ inch diameter) was usually 200 m or less in depth. All reverse circulation holes were downhole surveyed at 30 m intervals.

Diamond drilling was HQ in both weathered and fresh rock. All diamond holes were downhole surveyed at 30 m intervals. All HQ core was orientated.

8.2 Sampling

All reverse circulation samples were collected at the drill site over 1 m intervals and split using a multi-stage riffle splitter.

Diamond core was generally sawn in half; with half sent for assaying, and half retained in core trays for future reference. One metre samples were taken and submitted to an independent laboratory for assaying. At the laboratory, both core and reverse circulation samples followed a standard procedure of drying, crushing and grinding. The pulverised samples were thoroughly mixed on a rolling mat ("carpet roll") and then 200 g of sub-sample was collected. Internal laboratory checks required at least 90% of the pulp passing 75 microns. A 50 g charge was produced for subsequent fire assay analysis.

Very good recovery of both core and reverse circulation samples were recorded and considered to be representative of the mineralisation defined by the drilling.

8.3 Sample Analytical Methods

Cardinal used two laboratories for its sample submissions, SGS Ouagadougou Laboratory in Burkina Faso and SGS Tarkwa Laboratory in Ghana. The independent SGS commercial geochemical analytical laboratories are officially recognized by the South African National Accreditation System (SANAS) for meeting the requirements of the ISO/IEC 17025 standard for specific registered tests for the Minerals Industry.

As part of the Cardinal QAQC, a suite of internationally accredited and certified reference material (standards) and locally sourced blanks were included in the sample submission sequence. The standards cover gold grade ranges expected at Namdini. Interlaboratory umpire analyses were also conducted.

Certified reference material (blanks and standards) were submitted into the sample stream at a rate of 1 in 22 samples. Duplicate samples of reverse circulation chips were taken at a rate of 1 in 22.

No employee, officer, director, or associate of Cardinal carried out any sample preparation on samples from the Namdini Project exploration programme. Drill core was transported from the drill site by a Cardinal vehicle to the secure core yard facility at the Bolgatanga Field Exploration Office only.

All samples collected for assaying are retained in a locked, secure storage facility until they are collected and transported by the SGS laboratory personnel. Retained drill core is securely stored in the core storage facility and pulps and coarse rejects returned from the laboratories are securely stored in the exploration core logging area and at a nearby secure location in Bolgatanga, Ghana.

8.4 Geological and structural modelling

Logging, interpretation and modelling were undertaken by Cardinal Resources' technical staff using Maxwell Geoservices (Perth) "Logchief" software and specialist structural consultants Orefind Pty Ltd, (Davis and Cowan, 2016-2017) resulting in a three-dimensional model of key lithologies, structures and weathering zones.

8.5 Estimation Methodology

MPR estimated recoverable resources for Namdini using Multiple Indicator Kriging ("MIK") with block support adjustment, a method that has been demonstrated to provide reliable estimates of recoverable open pit resources in gold deposits of diverse geological styles. The Mineral Resource was estimated using multiple indicator kriging using GS3M software developed by FSSI Consultants (Australia).

Estimation was constrained within a mineralization envelope (wireframe) based on geological logging and grade thresholds. The three-main host lithologies are granite, metavolcanics and diorite. Where geological contacts were not clearly controlling the distribution of mineralization, a grade cut-off of approximately 0.1 g/t Au was used to construct Mineral Resource boundaries.

The domain trends north-northeast over 1.3 km and dips approximately 60° to the west with an average horizontal width of approximately 350 m. The Mineral Resource can reasonably be expected to provide appropriately reliable estimates of potential mining outcomes at the assumed selectivity, without application of additional mining dilution or mining recovery factors. Validation of the MIK model was undertaken visually and statistically and reviewed independently.

Parent block dimensions of 12.5 mE by 25 mN by 5 mRL were used for estimation. All sample assays were composited to 2 m prior to estimation.

8.6 Classification

The Namdini Mineral Resource has been classified into the Indicated and Inferred categories, in accordance with the JORC Code (2012) and the CIM Standards (CIM, 2014). A range of criteria were considered in determining this classification including geological and grade continuity, data quality and drill hole spacing.

The key classification criteria are described as follows:

Resource model blocks have been classified as Indicated or Inferred on the basis of search passes and a wire-frame outlining more closely drilled portions of the mineralization. Blocks within the classification wire-frame informed by all search passes were classified as Indicated. Blocks outside the classification wire-frame and estimated by iteration 1 are classified as Indicated. All remaining blocks estimated by iterations 2 and 3 were assigned to the Inferred category.

The three progressively more relaxed search criteria used for MIK estimation are presented in Table 6. The search ellipsoids were aligned with the general mineralization orientation.

Search	Radii (m)	Minimum	Minimum	Maximum
	(x,y,z)	Data	Octants	Data
1	65, 65, 15	16	4	48
2	97.5, 97.5, 22.5	16	4	48
3	97.5, 97.5, 22.5	8	2	48

Table 6 Search criteria for Mineral Resource classification.

- The classification reflects the level of confidence in the geological continuity.
- Mineral Resource classification was also based on information and data provided from the Cardinal database. Descriptions of drilling techniques, survey, sampling, sample preparation, analytical techniques and database validation, indicate that data collection and management is well within industry standards. The database represents an accurate record of the drilling undertaken at the Project.
- A trial optimisation was run at a US\$1,500/oz gold price to define the basis for Reasonable Prospects for Eventual Economic Extraction ("RPEEE"). All blocks outside this shell are unclassified and not reported.
- Drill hole location plots were used to ensure that local drill spacing conformed to the minimum expected for the various resource categories.

MPR considers the estimation technique and parameters appropriate for this style of mineralisation.

The Ore Reserve estimation has converted 73% of the Indicated Mineral Resources to Probable Ore Reserves.

9. Mining

The mine design and Ore Reserve estimate is based on the revised Mineral Resource model referred to in the press release by Cardinal Resources Limited to the ASX and TSX, dated March 5, 2018 titled '*Cardinal Upgrades Indicated Mineral Resource to 6.5 Moz*' (Cardinal, 2018).

Trial open pit optimisations were run in Whittle 4X at a US\$1,300/oz gold price (which was the appropriate gold price at the time of the optimisation runs) to define the base of potentially economic material. Four cut back pits were then selected and full mine designs applied.

The Ore Reserve reported in the Preliminary Feasibility Study is a sub-set of the Indicated Mineral Resource which can be extracted from the mine and processed with an economically acceptable outcome.

Mining of the Namdini project has been assumed to be medium-scale using conventional open pit mining equipment. The mining process will include drill and blast as well as conventional load and haul operations. There is expected to be a limited amount of free-dig material with the majority of material assumed to require drilling and blasting.

Mining will be carried out using staged cut-backs with four identified stages incorporated within the LOM final pit. The mining schedule incorporates movement of ore and waste on 10m mining benches, by year for each of the four mining stages.

Except for the initial plant commissioning, Oxide ore will be stockpiled temporarily and batch-fed into the process plant when suitable volumes are available, ensuring that no more than 10% of the plant available time is occupied in processing oxide in any one year. Waste rock will be stockpiled separately on the western side of the pit.

The metallurgical work carried out to date indicates that gold can be satisfactorily recovered from Namdini ore using conventional flotation, regrind and Carbon In Leach (CIL) cyanidation techniques. The work is considered

sufficient to determine that the Namdini Mineral Resource represents a deposit with potential for economic extraction.

9.1 Mining Factors

The *in-situ* deposit Mineral Resource Model is the basis for the mining model used for the Starter Pit and Life Of Mine (LOM) pit planning and assessment reporting. The resource model has cell dimensions of 12.5m (east) by 25m (north) by 5m (elevation). The MIK adjustment assumes a moderately selective mining unit (SMU) of 10 m x 5 m x 2.5 m, which has been applied to Namdini's relatively low-grade, large-tonnage, disseminated deposit.

Mining will consist of a conventional hydraulic shovel operation typically using 400 t class excavators in a face-shovel configuration and 150 t class (Cat 785 or similar) rigid body dump trucks hauling on designed access roads. An auxiliary mining fleet of dozers, graders, water carts and utility vehicles will support the mining operation. The appropriately-sized equipment is of medium scale and is less amenable to selective mining. With 60m minimum mining width as noted, selective mining practices are limited for development of this orebody.

Mining is proposed on 3 to 5 m flitches in the ore, within 10 m benches. The base case optimisation was determined as part of the PFS and was run using Indicated Mineral Resources only. There is currently no Measured Mineral Resource within the Namdini resource model.

A gold cut-off grade of 0.5 g/t Au was applied to the mineralised material. Process costs and mining costs were supplied by independent consultants and compared with similar gold projects. Gold grades were supplied with the model as estimated proportional grades using the MIK recoverable resource estimation technique.

For purposes of selecting the optimum Whittle pit for mine design purposes, Golder estimated a mining cost of US\$3.50 per tonne of rock mined based on experience with similar mining operations in the region, which includes grade control sampling, laboratory assay, analysis and supervision costs. The input process and G&A cost for the baseline 7.0 Mtpa option was estimated at US\$14.50/t milled plus an additional US\$1.50/t allowance for stockpile (s/p) reclaim – all tonnes were assumed to be on a dry basis.

Once the optimum selected Whittle pit was selected and mine design completed, a detailed mining movement schedule was supplied to two prospective mining contract companies to assist with the provision of a detailed mining cost estimate. Quotations were provided by both companies which supported an all-in contract mining cost used in this PFS. Further discussions and negotiations will continue with suitable mining contractors prior to any award of the mining contract.

Metallurgical test work was used to estimate the recoverable fraction from the Oxide, Transition and Fresh ore components, with gold grade and proportion of the block at varying MIK cut-off points coded in the block model.

Using the identified marginal Cut-off Grade, the proportion of ore per parcel and gold grade above the Cut-off Grade were included within the mining model to allow export of the parcelled (ore + waste) blocks to the pit optimiser for open pit optimisation.

No consideration has been made for underground extensions of the operation in this PFS study. A minimum mining width of 60m was assumed. Mining dilution and recovery are addressed in the modelling method (MIK with variance adjustment) and the utilization of flitch mining. No Inferred Mineral Resources have been included for the PFS within the LOM planning. Mining Infrastructure requirements were assumed to be provided by the selected mining contractor with the mining performed on an outsourced basis.

Grade control will be based on sampling from reverse circulation drilling spaced at approximately 10mE by 15mN with samples taken at 1.5 metre intervals downhole. All Grade Control sampling assays are assumed to be determined by fire assay on the mine site. Standard QAQC protocols will be applied which comprise of 1 in every 10 samples. Minimal infrastructure is required for the selected mining method.

9.2 Geotechnical Parameters

In support of the mine design, Golder carried out a study of existing geotechnical information, reviewed information on mineral resource estimates, conducted a detailed pit geotechnical drilling campaign supervised by

a site visit by a senior Golder engineer and gathered detailed rotary core logging data from selected drill locations within the Namdini project area.

The life-of-mine pit design considers slope performance based on models developed from laboratory results of sampled drill core. The results present feasibility-level slope designs based on data collected in the field, and data and reports made available by Cardinal.

Based on geotechnical and hydrogeological considerations from site investigations at the project area, the design sectors were designated around Namdini Pit.

Inter-ramps (bench stacks) in slightly weathered to fresh rock should consist of four benches. These are to be separated by 25m ramps or geotechnical berms. (This means that a 25m geotechnical berm should be included after every 80m of fresh rock benches). The design table includes an alternative berm width of 5m, along with the corresponding inter-ramp angle.

Golder recommends that, at the beginning of excavation of the pits, this narrower width be used for benches in SOX, MOX and TRANS materials in temporary walls. Should this geometry perform well then it could be applied to the final walls as well. Should it prove inadequate or problematic, the wider 6-m berms could then be used for the final walls in SOX, MOX and TRANS materials.

9.3 Pit Optimisations

Pit optimisations were completed using the Lerchs-Grossman (LG) algorithm in Whittle 4X™ to calculate the optimal pit at specified input parameters that were determined prior to the study. A wireframe pit shell for each gold price considered was the resultant output. One of these was selected as the base for the final LOM pit design. A smaller pit approximately 1Moz was chosen for the Starter Pit to maximise discounted cash flow and minimise capital payback time.

9.4 Mine Scheduling

Mine scheduling was used to maximise value through deferring of larger strip-ratio cut-backs until later in the mine life. The maximum value pit was selected using a discounted average Net Present Value and determined to align with a Revenue Factor ("RF") shell of approximately \$1,105/oz using estimated LOM input prices and costs. Pit shells were converted into engineering designs prior to export of the contained resource model for scheduling purposes.

A commercial linear programming software package (Minemax™ Scheduler) was used to model the mining sequence, the processing plant and different ore feeds to maximise NPV for the nominated parameters and constraints. Major constraints included the mill throughput, mining limits and oxide feed proportion. The material selection to satisfy processing requirements was based on cut-off grade, mineable ore, processing and selling costs.

The mine scheduling programme includes revenue and cost information. The scheduling software assesses the value generated by each block to determine whether the block is fed directly to the plant, stockpiled or treated as waste. Further financial analysis to determine more realistic absolute financial indicators and sensitivity analysis are performed separately, using the tonnes and grades extracted from the schedule.

The mine design of the Namdini Project consists of a series of nested conventional pit layouts with orebody access provided by a series of ramps. The orebody can be considered a layered sequence consisting of strongly oxidised, moderately oxidised, transition, and fresh mineralised zones.

High-level mine production schedules were evaluated for the three scenarios considered (9.5, 7.0 and 4.5 Mtpa mill throughputs) using a Starter Pit with subsequent pushbacks to the final LOM pit extent.

The schedules allowed an initial ramp up for the process plant in each case before full process plant production was assumed. In order to gain maximum value from the 9.5 Mtpa option, an estimated total peak rock movement of some 30 Mtpa is required in year 7 of the schedule, whereas the 7.0 Mtpa option indicated a total peak required movement of some 17 Mtpa. The 4.5 Mtpa option saw a peak total required rock movement of some 15 Mtpa.

9.5 Mine Design Criteria

The mine design criteria were developed to allow for development and assessment of designs to provide plant feed rates of 9.5, 7.0 and 4.5 Mtpa.

For this mining study, the maximum mining movement has allowed for a strip ratio of up to 2:1 in order that the initial optimisations are not 'mining-limited'.

For the conceptual pit design, two geotechnical domains namely Zone 1 – Slightly and Moderately Oxidized Weathering Domain and Zone 2 – Transitional and Fresh Weathering Domain, were used to define pit bench heights, berm widths and slope angles.

Pit design criteria were based on Golder's geotechnical recommendations with the deposit broadly broken up into weathered (Oxide), partially weathered (Transition) and Fresh domains, with two distinct domains on the hangingwall and footwall sides of the ore zone (bearing 295°). Refer to Table 7 for the geotechnical configurations used for the mine pit design criteria.

State of Weathering	Bench Face Angle	Production Bench Height (m)	Vertical Bench Separation (m)	Berm Width (m)	Inter-Ramp Angle
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295° (Footwall) Wall Orientation

SOX (Saprolites & Saprock)	60°	5	10	6	40.3°
Transition (Moderately Weathered Rock) – Single Benching	60°	10	10	4	45.7°
Slightly Weathered to Fresh Rock	65°	10	20	7.5	49.9°

All Other Wall Directions

SOX (Saprolites & Saprock)	60°	5	10	6	40.3°
Transition (Moderately Weathered Rock) – Single Benching	60°	10	10	4	45.7°
Slightly Weathered to Fresh Rock	75°	10	20	8	56.3°

Table 7 Recommended geotechnical slope configurations for Namdini Pit

For practical pit design purposes, the berm widths were rationalised to an 8 m wide berm to avoid having multiple berm widths required on the same mining bench. Analysis of the block model indicated that the semi- weathered (Transition) material reaches a maximum depth of 160 m RL. Thus, it was deemed prudent to maintain single benches with 6 m berm widths above this level and adopt double-benching (20 m) with 8 m berms below it. Adoption of the 6 m berm in both the Oxide and Transition zones adds a level of increased safety and ease of management in the weathered part of the deposit.

The pit was designed with four stages, the initial stage (Starter Pit) being for early access to the higher-grade ore near the surface. The second stage is largely an expansion of the initial stage targeting the ore to a greater depth. The stage designs were created for optimal ore delivery from the first two stages, due to their low strip ratio and waste rock movement. The third and fourth stages contain a greater proportion of waste rock. A minimum mining width of 60 m was established between the stages.

The pit designs have targeted the maximum discounted value pit shell at a US\$1300/oz gold price (note that the US\$1,300 / oz gold price was applicable at the time of the Whittle optimisations performed in Q2 2018). The pit optimisation using the Whittle software was used to identify the optimum pit shell with the Inferred Resource material considered as waste rock. The identified pit was then considered for practical staging in order to minimise waste movement and improve the cashflow for the project. The analysis allowed the selection of four stages with the initial stage targeting a relatively higher-grade area of ore near surface. Access was allowed to the first three stages by a ramp from the northern edge of the pit as the volume of waste rock in the first three stages is considered modest. The final fourth stage has a main access ramp on the western side of the pit to provide a shorter haul to the waste rock dump, given that the final stage has a higher strip ratio than the preceding three stages. Having the primary access on the western side of the pit reduces waste rock haulage costs and thus improves the overall value.

Given limited opportunity outside the starter pit to target higher-grade zones, stage design was largely focused on targeting maximum value change points within practical mining constraint limits, such as the minimum mining width for the pushbacks. The first Stage is a relatively small 'mini-pit' on the northeastern side of the deposit. The first stage contains an estimated 19.9 Mt of Fresh ore with an additional 4.0 Mt of Oxide and Transition ore. This will be stockpiled and processed in campaigns such that a maximum of 10% of available processing time is used for treating the Oxide and Transition ore in any annual period. The remaining three pit Stages follow a traditional pit expansion with the pits pushing out towards the dip of the ore and the pit deepening with each stage.

The indicative production schedules are outlined in Table 8 as follows:

KEY ESTIMATED PRODUCTION RESULTS	UNIT	9.5 Mtpa	7.0 Mtpa	4.5 Mtpa
Gold Produced (Average for full production years)	(koz / yr)	294	216	140
Life of Mine Production – Gold	(koz)	3,975	3,975	3,975
Average Mine Head Grade	g/t Au	1.14	1.14	1.14
Ore Reserve Mined at 0.5 g/t cut-off grade	Tonnes (Mt)	129.6	129.6	129.6
Life of Mine Strip Ratio	W:O	1.4 : 1	1.4 : 1	1.4 : 1
Mine Life	years	14	19	29

Table 8 Key Estimated Production Results

9.6 Mining Cost

The PFS assumes the mining contractor will bear the total mining capital cost under an outsourced mining arrangement with the costs recovered by the mining contractor on a cost per tonne mined basis.

Mining costs were solicited from two of the largest in-country mining contractors. The estimated base mining cost has an applied incremental cost with depth, to account for increased haulage costs and the depth of mining increases in line with standard mining cost principles.

All costs have been determined on a US dollar basis.

9.7 Cut-off Parameters

An estimated marginal cut-off grade was established at 0.5g/t using an assumed long-term gold price of US\$1,300/ounce. The provided Mineral Resource model was validated and used to develop a mining model, as the basis for the Life Of Mine (“LOM”) plan and economic assessment.

Gold royalties were assumed at 5% of gold price, with payable gold estimated at 99.8% of doré exported. The net gold price was thus \$39.63/g. The input processing cost provided in May 2018 was \$14.49/t plus an additional \$1.50/t allowed for stockpile reclaim giving a total of \$15.99/t of mill feed (as dry tonnes). Thus, the marginal cut-off grade (“COG”) was estimated as: $\text{process cost} / (\text{net gold price} * \text{process recovery})$ giving 0.5 g/t (to one significant figure).

Using this marginal COG, the proportion of ore and the gold grade above the COG, were defined in the mining model and the parcelled proportions of ore, above cut-off within the blocks were exported for open pit optimisation.

The 0.5 g/t Au cut-off approximates an operational parameter that the Company believes to be applicable. This is in accordance with the guidelines of Reasonable Prospects for Eventual Economic Extraction (“RPEEE”) per the Canadian Institute of Mining, Metallurgy and Petroleum “CIM Definition Standards for Mineral Resources and Mineral Reserves” (CIM, 2014) and the Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves (the JORC Code 2012).

9.8 Ore Reserve

Ore Reserves were estimated for the Namdini Gold Project as part of this PFS by Golder, which is summarised in Table 9. The total Probable Ore Reserve is estimated at 129.6 Mt at 1.14 g/t Au with a contained gold content of 4,760 Koz.

The Ore Reserve for the Project is reported according to the Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves, JORC Code 2012 and Canadian Institute of Mining, Metallurgy and Petroleum “CIM Definition Standards for Mineral Resources and Mineral Reserves” (CIM, 2014). The Mineral Resource was converted applying Modifying Factors. The Probable Ore Reserve estimate is based on the Mineral Resource classified as Indicated. Table 9 presents a summary of the Ore Reserves on a 100% Project basis at a US\$1,300/oz gold price.

Ore Reserve Category	Type	Tonnes (Mt)	Grade (g/t)	Contained Gold (koz)
Probable	Oxide	4.2	1.14	155.5
Probable	Transition	4.2	1.09	146.5
Probable	Fresh	121.2	1.14	4,458.1
Probable Ore Reserve	Total	129.6	1.14	4,760.0

Table 9 Ore Reserve Estimate

Table 6 Notes:

1. The Ore Reserve conforms with and uses JORC Code 2012 recommendations and Canadian Institute of Mining, Metallurgy and Petroleum “CIM Definition Standards for Mineral Resources and Mineral Reserves” (CIM, 2014)
2. The Ore Reserve was evaluated using a gold price of US\$1,300/oz with US\$1,105/oz pit optimisation chosen for ore reserve pit design to maximise cash flow.
3. The Ore Reserve was evaluated using an average cut-off grade of 0.5 g/t



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4. Ore block grade and tonnage dilution was incorporated through the use of an MIK recoverable resource estimation model which was demonstrated to incorporate an expected level of equivalent ore loss and dilution for the scale of mining envisaged
5. All figures are rounded to reflect appropriate levels of confidence. Apparent differences may occur due to rounding

10. Mineral Processing and Metallurgical Testing

10.1 Introduction

The PFS phase of metallurgical testwork continued to focus on the same flowsheet as presented in Cardinal's PEA study issued in February 2018. The flowsheet is described as a conventional primary crush, SAG/Ball mill, re-crush, flotation, regrind and carbon-in-leach circuit.

All fresh metallurgical testwork for the PFS was carried out by ALS Laboratory in Perth, Australia. No further oxide metallurgical testwork was necessary and therefore the oxide PEA results were carried into the PFS.

The PFS fresh metallurgical testing programmes were categorised in four main parts as follows:

- Comminution Testwork:
 - HQ Core Sample SMC Variability Testwork
 - PQ Core Sample JK Drop Weigh Test and SMC Testwork
- Starter Pit and Flotation Testwork:
 - Mineralogy and gold deportment
 - Gravity Recoverable Gold
 - Flotation (Sighter and Bulk)
 - Leach testwork of bulk flotation concentrate at various regrind sizes
- Life Of Mine Testwork:
 - Mineralogy and gold deportment
 - Gravity Recoverable Gold
 - Flotation (Sighter and Bulk)
 - Leach testwork of bulk flotation concentrate at various regrind sizes
- Variability Testwork:
 - Mineralogy and gold deportment
 - Gravity Recoverable Gold
 - Flotation (Sighter and Bulk)
 - Leach testwork of bulk flotation concentrate at various regrind sizes

10.2 Results

Key findings from the testwork were:

Comminution:

- The JK Drop Weight Test showed A*b values ranged between 30 and 42 for the PQ samples.
- The SMC Variability Test showed derived A*b values between 30 and 47 for the HQ samples.
- The BBWi test indicated a range between 14.7 and 19.7 with an average of 16.9 kwh/t.
- Bond Abrasion Index ranged between 0.03 and 0.29, with the Granite ore type having the highest values.

Mineralogy:

- Native gold is the predominant gold bearing mineral with very low silver (Ag) content (<2 ppm Ag).
- Pyrite is the dominant sulphide mineral in the composites where the majority of the gold is associated.
- P80 of the pyrite ranged from 82 µm to 93 µm.
- Pyrite is classified as 'well-liberated' from the host rock minerals with close to 85% liberation.
- Free gold particles were detected during a thorough optical search (using a binocular stereo-microscope) of the unmounted gravity concentrates. These gold grains are approximately 200 µm in diameter and rounded in appearance.
- Separate testing of the mineralisation confirms that it is not preg-robbing.

Flotation:

- High gold recoveries averaging 95% to concentrate for the majority of composites.
- Fast flotation kinetics observed with most of the gold recovered in less than 8 minutes.
- The addition of a co-collector blended with base case (PAX) collector did not show a definite benefit to gold recovery.
- Upfront gravity gold recovery improved total gold recovery and mostly eliminated variability in the flotation tails grade.
- Gravity and flotation resulted in average tail grades ranging from 0.05 to 0.14 g/t.
- Flotation mass recovery to concentrate averaged 7% w/w; concentrate grade based on the Starter Pit composite averaged approximately 30 g/t without gravity recovery and approximately 20 g/t with prior gravity recovery.
- All gravity gold, flotation, regrind and leach results were analysed to produce four regression recovery curves, two for the starter pit and two for the life of mine samples. These curves were then applied to the varying head grades of the mine schedule to yield an overall recovery result which for the starter pit was 86% and LOM (including the starter pit) was 84%. These were achieved at a grind size (P₉₈) of 15µm.

Leach:

- Concentrate leach feed grades based on Starter Pit and separate Life of Mine lithology composites ranged between 10 g/t and 27.5 g/t, ranging between 15 and 17 g/t on average.
- Leach residues ranged from 1.94 g/t for the Starter Pit composite to 2.28 g/t for the separate LOM lithology composites at a grind (P₉₈) of 15µm. This range in leach residue grade is equivalent to 0.14 – 0.16 g/t on a whole ore basis, assuming an average flotation concentrate mass recovery of 7%.

Comminution and metallurgical testwork has provided preliminary information about the physical characteristics and metallurgical response of the three Namdini lithologies.

The processing route for the Namdini ores would be: crush, primary grind, sulphide flotation followed by regrind and CIL cyanidation of the flotation concentrate.

Oreway Mineral Consultants (OMC) has utilised the comminution results for comminution circuit selection and mill sizing. A primary crushing and SABC comminution circuit (open circuit SAG mill with recycle pebble crushing followed by closed circuit ball mill/hydro-cyclones) was selected by OMC based on the available comminution parameters.

The process design based off the metallurgical testwork is as follows:

- A primary grind size of 80% passing 106 microns was utilised for the primary grind design of the PFS assessment.
- A gravity concentration circuit has been incorporated given the presence of gravity recoverable gold (GRG).
- The laboratory flotation testwork indicated fast sulphide flotation kinetics; the circuit comprises six (6) stages of rougher flotation.
- The flotation concentrate is reground and subjected to pre-aeration before CIL.
- Gold recovery will be via a conventional CIL with elution circuit, electrowinning and gold smelting to recover the gold from the loaded carbon to produce doré.
- Industry typical design parameters were assumed for the scoping study where testwork was not completed.
- Detailed metallurgical testwork is continuing for the Namdini project under the direction of Cardinal to support completion of the DFS.
- Gold is recovered using primary crushing, milling (SAG + ball), re-crush, gravity circuit (Knelson Concentrator), flotation, concentrate regrind circuit and a CN/CIL circuit.

10.3 Conclusions

Key aspects supporting selection of the process flowsheet include:

- The fresh metallurgical testwork yielded an overall life of mine recovery of 84% and a starter pit recovery of 86%
- The recovery results were calculated by totalising the gold recovered by gravity, flotation and leach recoverable gold. (gravity recovery plus flotation recovery multiplied by leach recovery)
- No further oxide testing was required to be performed as part of the PFS. The results as reported in the PEA were used in support of the PFS. The previous oxide metallurgical testwork was performed on a whole of ore leach recovery testwork regime which yielded a 90% recovery
- Metallurgical testwork carried out to date indicates that the Namdini project can utilise a standard gold recovery process plant design with no innovative technology required.
- The metallurgical process utilises well-tested technology for all unit operations.
- No deleterious elements were identified in the testwork that could affect the saleability or price of the gold doré produced.
- Namdini will produce readily saleable gold doré which will be exported for refining.

11. Process Plant

Annual nominal throughput processing options of 9.5, 7.0 and 4.5 Mtpa were investigated as part of the PFS. Note that all options were designed to meet the International Cyanide Management Code for the manufacture, transport, and use of cyanide in the production of gold (Cyanide Code).

An assessment of the comminution circuit identified upper and lower throughput limits as follows:

- 9.5 Mtpa as the largest throughput that could be achieved with dual pinion mill drives.
- 7.0 Mtpa throughput that could be accommodated with dual pinion mill drives.
- 4.5 Mtpa as the largest throughput that could be accommodated by a jaw crusher.

11.1 Flowsheet

The process plant design incorporates the following unit process operations:

- Single stage primary crushing with a gyratory crusher to produce a crushed product size of 80% passing (P_{80}) 150 mm.
- Crushed ore feeding a coarse ore stockpile (12 hours live) with ore reclaim via two apron feeders.
- Two stage SAG / Ball milling in closed circuit with cyclones to produce a P_{80} grind size of 106 μm and includes recrushing of pebbles from the SAG mill.
- Gravity recovery circuit consisting of a gravity scalping screen, a single 70-inch centrifugal concentrator and a CS4000 intensive leach reactor.
- Rougher flotation to produce a gold-rich sulphide concentrate.
- HIG mill technology is utilised to regrind flotation concentrate
- Thickening of the flotation tails for water recovery prior to disposal in a separate non-cyanide tailings storage facility (TSF).
- High Intensity regrind of the flotation concentrate followed by thickening to minimise carbon in leach (CIL) tankage and reduce overall reagent consumption.
- A concentrate CIL circuit incorporating one pre-leach tank and seven CIL tanks for gold and silver adsorption.
- A 3.5 tonne split AARL elution circuit, electrowinning and smelting to recover gold and silver and produce doré.
- CIL tailings treatment incorporating cyanide destruction by sulphur dioxide and oxygen.
- Concentrate CIL tailings disposal in a lined tailings storage facility.

Figure 4 indicates the selected PFS flowsheet for the Namdini project.

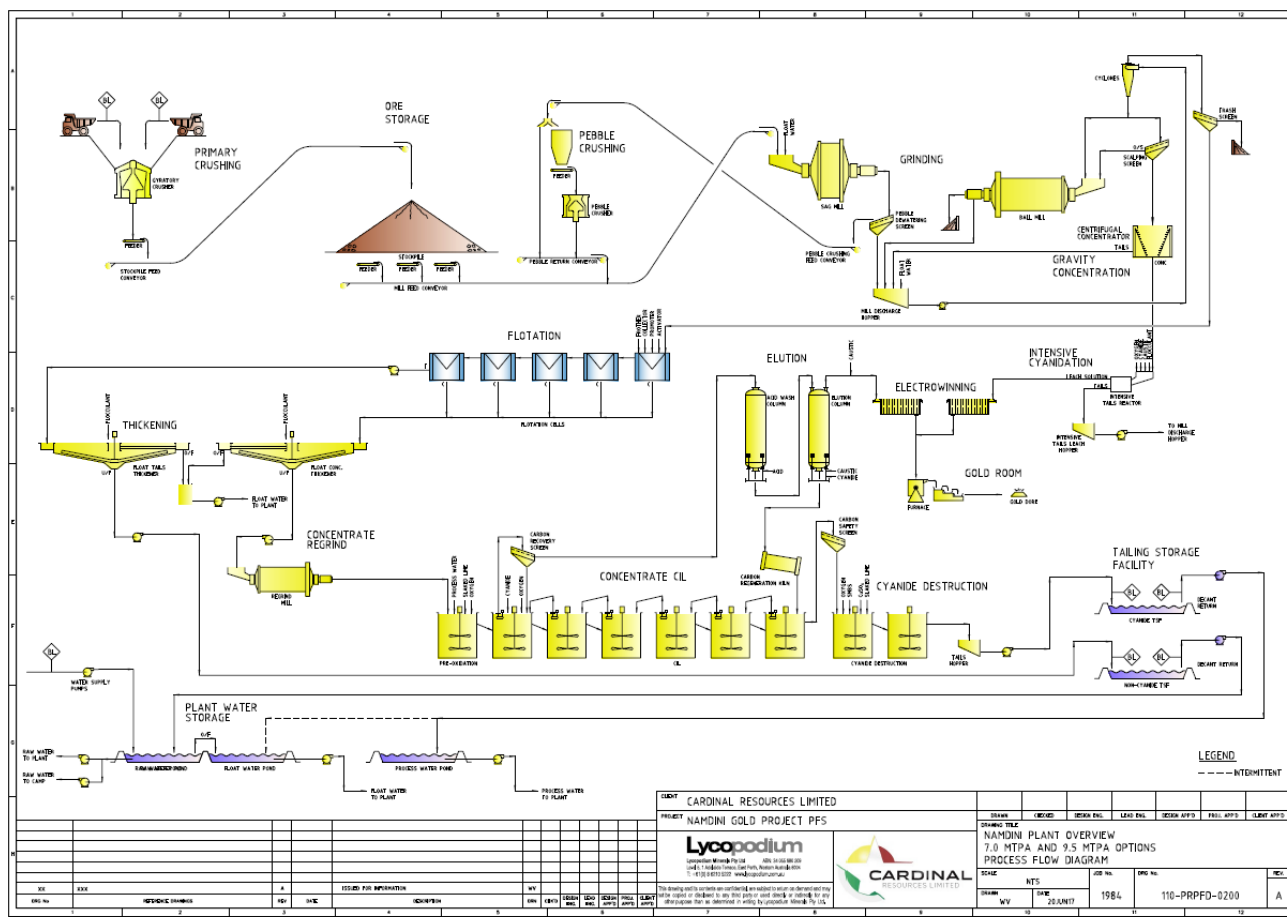


Figure 4 Overall process flow diagram (7.0 and 9.5 Mtpa options shown)

12. Infrastructure

Lycopodium have completed PFS level analysis covering all related aspects of the infrastructure requirement including power, water, road access and waste management.

The site will be accessed by road from the west with a new, approximately 25 km, gravel road linking the site to the existing national road N10 between Pwalagu and Winkogo. The N10 provides good access to the major cities and ports in southern Ghana and no upgrades of the N10 will be required. The site access road will follow a similar route to the proposed new power line for the existing substation north of Pwalagu.

Infrastructure will include the following dedicated elements:

- Unsealed road
- HV power line
- Water supply line from the White Volta River.

The site is located approximately 20km outside Bolgatanga and 180km from Tamale. Serviced camp style accommodation will also be integrated in the proximity of the operation. A shuttle bus service will operate to and from site as required.

Cardinal Resources has sufficient area on its leases to cater for its planned land requirements.

This study assumed that a new, approximately 30-km dual high voltage transmission power line will be constructed.

Power supply to the Process Plant includes the modifications necessary in the electricity grid connection, and associated GRIDCo Substations as well as the 161kV high voltage power line to the Process Plant.

The Ghana Grid Company Ltd (GRIDCo) currently supplies a 161 kV high voltage power line from Tamale Substation to the Bolgatanga Substation. The connection point for the Namdini Gold Project will be near Pwalugu and will traverse a corridor to a new GRIDCo Substation close to the Namdini Mine.

The Gridco Substation will transform power at 11kV to a plant feeder circuit breaker terminal in the Namdini Mine Substation at the plant site which will then be distributed mine-wide, including the accommodation and other site infrastructure facilities.

12.1 Site Facilities and Layout

12.1.1 General

A site layout was developed based on the following information:

- Total ore tonnage – 129.6 Mt
- Process throughput – 9.5 Mtpa.
- Flotation / Concentrate split – 92.5% : 7.5%)
- Tailings to Flotation TSF – 120 Mt
- Tailings to CIL TSF – 9.6 Mt
- Life Of Mine pit extent
- Life Of Mine waste dump footprint
- 1 m contour topography over approximately 9 km by 6 km plan area broadly encompassing the project area, together with a preliminary site access corridor from the west and north-west
- Mining lease boundary.

The site infrastructure lay-out is indicated in Figure 5.

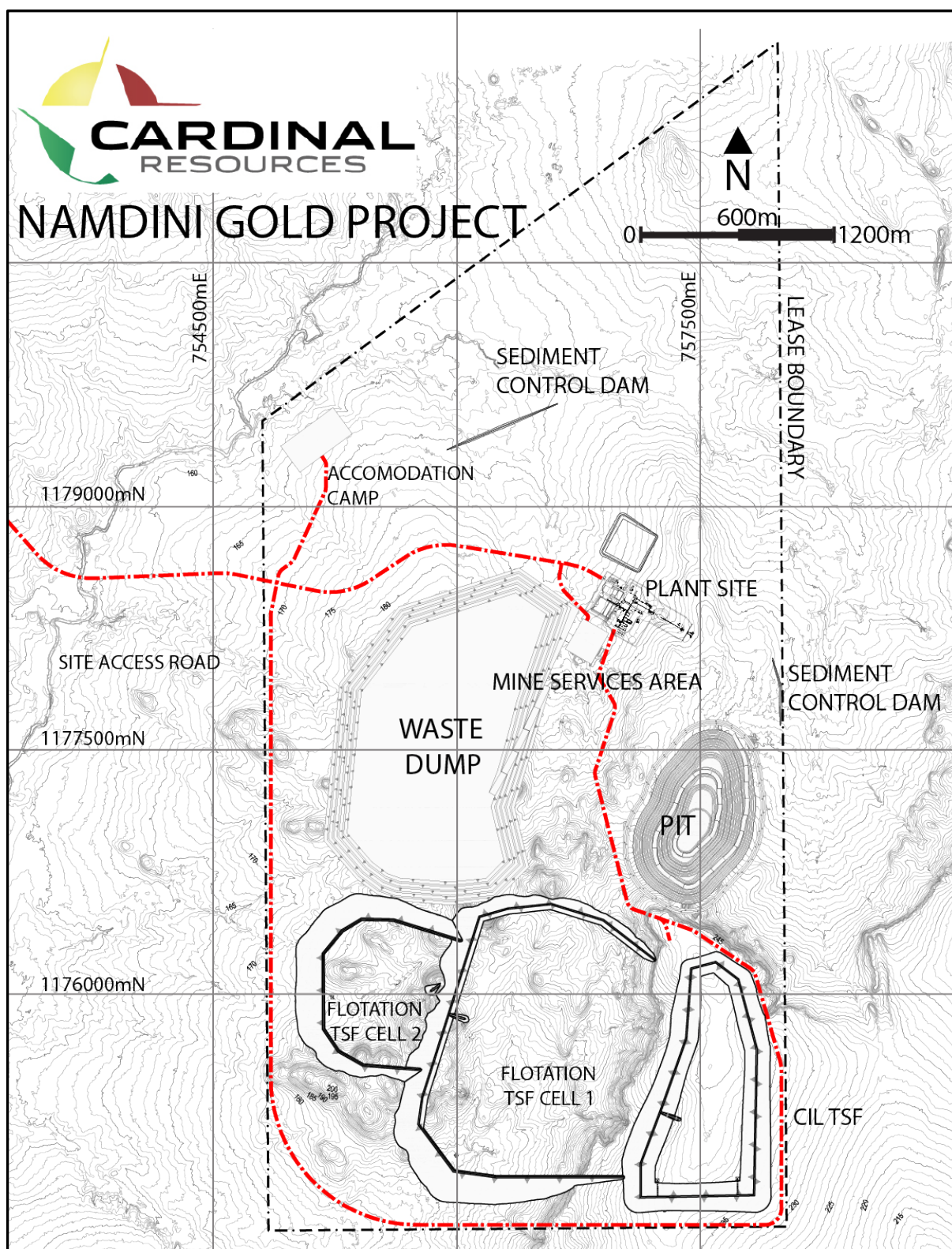


Figure 5 Site infrastructure layout

12.2 Waste Dump

Approximately 180 Mt (80 Mm³) of waste will be generated from the life of mine open pit development. The waste dump will be located directly to the west and northwest of the open pit, and is bounded to the east by the project mining lease. The waste dump design was carried out by others.

12.3 Process Plant and Mine Services Area

The process plant (and mine services area) will be located on relatively flat terrain to the north-northwest of the open pit and directly to the northeast of the waste dump.

12.3.1 Tailings Storage Facilities

The lease boundary, pit outline and waste dump footprint were provided. In addition, the consultant was advised of a number of medium to high grade anomalies to the north and northwest of the pit which were not yet sterilised. On this basis, the available area for siting of tailings storage facilities was limited to south and southwest of the open pit.

For the PEA (Scoping Study) the design concepts for the facilities were to site the Flotation TSF to the west of the plateau using the escarpment as the eastern perimeter of the facility and to site the CIL TSF on the plateau to the south of the open pit. For the PFS the TSF, designs have been further optimised using these locations and incorporating more recent topography for the site area together with the updated design parameters.

12.4 Hydrogeology / Hydrology

A hydrogeological fieldwork programme was undertaken comprising a hydro-census of surrounding properties to identify groundwater users. Groundwater exploration drilling of five pairs of boreholes converted to deep and shallow monitoring wells was completed. Characterisation of groundwater quality by sampling and laboratory analysis, groundwater monitoring and hydraulic testing was completed. Development of a conceptual model for assessment of pit inflows, potential impacts on mine dewatering on local, plus regional groundwater and surface water systems, has been completed in support of the mine design.

A hydrology programme including the development of a stormwater plan and overall site water balance was also completed. Hydrological design criteria are being developed, largely based on International Finance Corporation requirements.

12.5 Geotechnical Investigation

A geotechnical investigation of the Flotation TSF, CIL TSF and Process Plant sites was carried out as part of the pre-feasibility study in order to investigate the sub-surface conditions and to provide geotechnical parameters for design. The scope of the site investigation comprised the following:

- Four diamond cored boreholes within the Flotation TSF footprint
- 73 test pits within the Flotation TSF footprint
- 2 diamond cored boreholes within the CIL TSF footprint (BH-NM-05 and BH-NM-06)
- 24 test pits within the CIL TSF footprint (TP-NM-074 to TP-NM-097)
- Four diamond cored boreholes within the Process Plant footprint (BH-NM-07 to BH-NM-10)
- 18 test pits within the Process Plant footprint (TP-NM-098 to TP-NM-115)
- Standard Penetration Testing in the boreholes
- Disturbed sampling from the test pits
- Disturbed sampling from potential drainage medium borrow sources
- Laboratory testing of selected samples.

A summary of the findings is as follows:

- The sub-surface profiles at each of the proposed infrastructure locations generally comprises a variable thickness of alluvial / colluvial and/or residual / saprolite soils overlying bedrock. With depth the residual / saprolite soils increasingly exhibit parent rock structure and generally caused excavation refusal. Metavolcanic, metasediments or granite bedrock was encountered below the residual / saprolite horizon at each infrastructure location and at relatively shallow depth. The rocks exhibited extremely to very low strength becoming medium to high strength with depth. Details relating to individual horizons and depths at each infrastructure location are available in a separate report.
- Groundwater was not encountered during this investigation. It is understood that the groundwater is at an average depth of 42 m within the open pit footprint.
- A detailed laboratory testing programme is in progress, to support completion of the DFS.
- Recommended geotechnical parameters for analysis and design purposes were estimated and are available in a separate report.
- Substantial quantities of borrow material may be sourced from the alluvial, colluvial and residual / saprolite horizons which are present across the site. However, a detailed borrow materials assessment will be required as part of the next phase of the project development in order to delineate and quantify specific sources of particular materials for the earthworks construction.

12.6 Roads

12.6.1 Site Access

A new site access road is to be constructed between the main N10 route and the project site. The access corridor is aligned approximately west-southwest to east-northeast and will originate at a junction with N10 approximately 16 km south-southeast of Bolgatanga and terminate at the process plant. The corridor will be shared with the mains power supply to the project over the whole alignment and with the raw water supply from the White Volta River over the last 9 km. The site access road will connect with a network of internal roads which link the various site facilities.

The N10 provides good access to the major cities and ports in southern Ghana and no upgrades of the N10 will be undertaken. The national road N10 will be the most likely route used for transporting construction materials and operating supplies to the site from the ports in southern Ghana.

12.6.2 Site Roads

Site roads will be 'fit for purpose' and will comprise haul roads for mining use, full width gravel roads for frequent traffic by site light and heavy vehicles and basic access tracks for infrequent access by light vehicles to site infrastructure.

12.7 Power

12.7.1 Power Supply

The design is based on establishing a grid power supply to the process plant. This is achieved by constructing a new GRIDCo switchyard near the process plant to step-down the incoming 161 kV supply to 11.5 kV for plant power distribution. The preliminary scope includes:

- Augmentation to the existing GRIDCo's Bolgatanga substation
- Construction of a new 161 kV power line between Bolgatanga and new GRIDCo substation near the process plant
- Construction of a new 161/11.5 kV, 45/50 MVA, switchyard, near the process plant.

No allowance has been made for Reactive Compensators to stabilise the grid power supply during start-up of mill drives, as it was assumed that the grid supply is steady and healthy, based on the previous observations and measurements carried out by Cardinal.

12.7.2 Power Distribution

The plant power distribution voltage will be maintained at 11 kV. The 11 kV supply feeder from the GRIDCo switchyard will feed the plant main 11 kV distribution board located near the milling area switchroom for distribution of 11 kV power supply to various sections of the process plant.

For the process plant utilisation, the 11-kV supply will be stepped down to 415 V at the switchrooms using 11 kV / 415 V distribution transformers. These transformers will be fed from the main 11 kV switchroom / switchboard. These LV switchrooms will house 415 V motor control centres (MCCs). These LV MCC / switchrooms will be located at various load centres of the process plant for LV power distribution.

The MCCs will be double sided (back to back), demountable switchgear panel design with Form 4 segregation and Type 2 coordination as per Australian Standards. There are 8 LV switchrooms and 2 HV switchrooms within the process plant area.

These switchrooms are made of pre-fabricated buildings sized to 20 foot or 40-foot containers for easy handling and shipping. Prefabricated buildings have been selected as these can be partially fitted out at the factory reducing the need for skilled installation labour on site.

These buildings will be provided with air conditioners, sealed to prevent dust ingress and fire alarm and monitoring systems. The internal walls will be insulated as per industry standard.

The remote areas such as tailings, MSA, main camp, water harvesting pump station, etc. will be fed via 11 kV overhead lines with dedicated 11 / 0.415 kV, stepped down transformers or kiosks located near the facilities as applicable

12.7.3 Emergency Power Supply

Emergency power for process plant essential drives / facilities during grid power supply outages will be supplied from 2 x 2.5 MVA, High Speed (HS) diesel generator units operating on diesel fuel oil. These emergency power generators are connected to the process plant main 11 kV distribution switchboard to be operated during grid power outages. The emergency power is not meant to be used for sustaining the operations of the plant. The purpose of the emergency power supply is to provide power during grid power outage to the following critical areas of the process plant:

- Plant administration building.
- Guard house.
- 30% of area lighting.
- Control room power.
- Thickener rake system.
- CIL tank agitators.
- Thickener under flow pumps (50%).
- Fire detection and alarm systems.
- Essential facilities in the mine service area.

Based on the power supply reliability study done by Cardinal, the grid supply is assumed to be very reliable and the expected number of power outages per annum could be low, hence the utilisation of the emergency power station could be relatively low.

The changeover from the grid supply to the emergency power will be done manually. No automatic changeover has been allowed in the study.

12.7.4 Construction Power

The construction power demand is estimated to be about 1,500 kVA during peak construction activities. One 2,500 kVA diesel (natural gas) generator set will supply power to the different areas of the process plant and mine site during construction.

This diesel generator set will be used as part of the mine emergency power supply for the process plant and mine site upon the completion of the construction. All mining and construction contractors have based their quotes on construction site power supplied by generator sets.

12.8 Water Supply

A river abstraction system will be installed to provide any shortfall in process water requirements during the operation. An abstraction tower will be constructed on the northern bank of the White Volta River approximately 8.5 km to the west of the process plant. This will comprise submersible pumps situated within an intake tower located within a trench excavated into the northern bank of the White Volta River. A water storage facility will store 30 days' supply of process water to account for periods during which pumping from the river is not permitted. The facility will comprise a lined "turkey's nest" pond located directly to the north of the process plant.

A pipe branch from the main raw water pipeline will supply the potable water treatment plant located at the camp that will purify the water after which it will be reticulated across the site.

A vendor packaged modular potable water treatment plant including filtration, ultraviolet sterilisation and chlorination will be installed at the accommodation camp with the treated water reticulated to the site buildings, ablutions, safety showers and other potable water outlets.

12.9 Sewage and Waste Management

12.9.1 General

Grey water and effluent from all water fixtures will drain to gravity sewerage systems at the camp and plant site. Where gravity flow is not practicable, suitable macerator pumps will be used.

Effluent will be treated in a sewage treatment plant located adjacent to the camp. The effluent treatment demand for the plant has been estimated at 55 m³/day with the sewage treatment plant having been sized accordingly.

Treated effluent will be discharged into leach drains. Treatment plant sludge, following chlorination, will be suitable for direct landfill burial in unlined pits.

12.10 Solid Wastes

Wastes will be sorted and reused or recycled as far as the limited access to recycling facilities allows. General solid wastes will be deposited into a landfill and promptly covered to deter vermin and scavengers. Materials such as cyanide packaging will be burnt and the ashes buried, under supervision, on site beneath mine waste to prevent unauthorised use.

12.11 Hydrocarbon Wastes

Waste lubricating oils will be returned to the supplier for recycling. Hydrocarbon contaminated materials will be spread on volatilisation pads for decontamination before disposal in landfill sites.

12.12 Water Management

A water management model was developed in order to understand the TSF water balance and the TSF / plant interaction so as to determine the TSF water demand, and to generate design embankment crest levels to maintain containment throughout the operation. The model was developed in order to calculate process water shortfall and hence to quantify the volume of water required from external sources.

The main components of the water management model are:



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- Tailings storage facilities consisting of one CIL cell and two flotation cells
- Rainfall run-off from TSF catchment area
- Process plant balance.

The model was setup as a monthly time-stepped model to cover the whole operational life of each facility. A detailed water balance was carried out for both average conditions and a range of extreme climatic conditions, as follows:

- Average rainfall and evaporation conditions.
- 100-year ARI 72-hour storm events with no evaporation or decant return.
- 100-year ARI wet precipitation at the middle and towards the end of TSF operating life.

Results indicate the following:

- The CIL plant only requires a small quantity of the CIL decant return, hence no external make up other than a nominal raw water requirement is needed. As a result, a large proportion of the CIL decant return needs to feed the flotation plant as recycle.
- The flotation plant requires some additional water make up. This can be sourced either from the Flotation TSF in the wet season if available (currently limited to 90% of water in slurry, however higher values are possible) or the river abstraction system.

12.13 Tailings Storage Facilities

12.13.1 Tailings Testing

Tailings were subject to physical testing. Results indicate that flotation tails will have a rapid rate of supernatant release of 46% of contained water excluding rainfall. CIL tails would be similar but at a slower rate. Ultimate settled density (air dried) was 1.47 t/m³ for CIL tails and 1.67 t/m³ for flotation tails.

Geochemical testing indicated the following:

- The flotation tailings samples recorded negative net acid producing potential (NAPP) values and weakly alkaline net acid generating (NAG) pH values. Therefore, the diorite and metavolcanic flotation tailings are classified as Acid Consuming (AC) and the granite rougher tailings as Non-Acid Forming (NAF).
- The CIL tailings sample recorded a positive NAPP and a low NAG pH, resulting in a classification of Potentially Acid Forming (PAF).
- On the basis of the multi-element results, both the Flotation and CIL TSF's should be designed to prevent the loss of solids. The Flotation TSF will require a basic cover system on closure. The cover system for the CIL TSF will be driven by the need to control acid generation by precluding oxygen and water ingress to limit ongoing oxidation of the tailings and seepage.
- Based on supernatant analysis, the flotation tailings facility will require a compacted soil liner to limit seepage. In addition, the facility should have an underdrainage system to limit the hydraulic head acting on the soil liner. The CIL tailings facility will require a robust engineered liner system, likely comprising of a compacted soil liner with overlying HDPE liner and underdrainage system.

12.14 Tailings Storage Facility Design

12.14.1 Flotation TSF

The Flotation TSF will be constructed as a side valley-type storage facility to the southwest of the open pit. The facility will be constructed as two cells with zoned earth fill perimeter embankments and will be lined with a low permeability compacted soil liner. The total basin area will be 311 Ha and is designed to accommodate 113 Mt of tailings. The TSF embankments will be constructed in stages to suit storage requirements with Stage 1 constructed



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initially to provide capacity for the first 12 months of operation and subsequent stages constructed using downstream, modified centreline and upstream raise construction methods.

The TSF basin area will be cleared, grubbed and stripped of topsoil. A 300 mm depth compacted soil liner will be constructed over the entire TSF basin area as either reworked insitu material (assumed 70%) or imported Zone A (30%) material.

The TSF design incorporates an underdrainage system comprising a network of branch and collector drains in each cell. The underdrainage system drains by gravity to a collection sump located at the lowest point in each cell.

Supernatant water will be removed from the TSF via a submersible pump (designed by others) mounted in a decant tower. Temporary decants will be provided to suit the tailings deposition schedule in each cell. The final decants will be located along the divider embankment between the two cells.

12.14.2 CIL TSF

The CIL TSF will be constructed as a paddock-type storage facility to the south of the open pit. The facility will be constructed as a single cell with zoned earthfill perimeter embankments and will be lined with compacted soil liner overlain by a synthetic HDPE geomembrane. The total basin area will be approximately 45 Ha and is designed to accommodate 16 Mt of tailings. The TSF embankments will be constructed in stages to suit storage requirements with Stage 1 constructed initially to provide capacity for the first 12 months of operation and subsequent stages constructed using downstream raise construction methods to a final elevation of RL266.0 m (all throughput options). Staged embankment crest elevations will vary between throughput options.

The TSF basin area will be cleared, grubbed and topsoil stripped, and a 200 mm depth compacted soil liner will be constructed over the entire TSF basin area as either re-worked in-situ material (assumed 30%) or imported Zone A (70%) material. This will be overlain by a 1.5 mm thick smooth HDPE geomembrane liner.

The TSF design incorporates an underdrainage system comprising a network of branch and collector drains. The underdrainage system drains by gravity to two collection sumps located at the lowest points in the cell at the southeast and southwest corners.

Supernatant water will be removed from the TSF via a submersible pump (designed by others) mounted in a decant tower located along the western embankment of the facility.

In order to mitigate seepage losses through the basin area, minimise the phreatic surface in the embankments, and increase the settled density of the deposited tailings, a number of seepage control and underdrainage collection features have been integrated into the design of each facility. The seepage control and underdrainage collection systems will consist of the following components:

- Cut-off trench.
- Low permeability soil liner.
- Synthetic HDPE geomembrane.
- Basin underdrainage collection system.
- Underdrainage collection sump.
- Leak collection system.
- Upstream toe drain.

Each cell of the Flotation TSF will operate with a series of three decant towers which will be constructed, operated and subsequently decommissioned to suit the staged development of the facility and of the tailings beaches in each cell. The CIL TSF will operate with a single decant tower throughout the life of the facility.

The decant towers will be raised as required with each embankment lift and will consist of the following components:

- An access causeway constructed of local coarse gravel material.
- A slotted concrete decant tower consisting of 1.8 m square slotted precast concrete sections surrounded by clean waste rock with a minimum size of 100 mm.
- A submersible pump with float control switches mounted on a lifting hoist.
- The decant pump in each tower will be raised on a regular basis to ensure that no tailings enters the pump intake.
- The tailings storage facilities have been designed to completely contain storm events during operation up to and including an annual exceedance probability (AEP) of 1 in 1,000 (Flotation TSF Cell 2) or 1 in 10,000 (Flotation TSF Cell 1 and CIL TSF) on top of the predicted maximum pond level under average climatic conditions, without the emergency spillways operating. Consequently, exceeding the storm storage capacity of the facilities at any stage of operation is unlikely. Regardless, in the event that the storage capacity of a facility is exceeded, water which cannot be stored within the facility will discharge via an engineered spillway.

12.15 Workforce Accommodation

12.15.1 Construction Accommodation

An area adjacent to the permanent camp and the contractor laydown areas will be made available to be used by the early earthworks and accommodation camp installation contractors. All contractors will provide their own temporary accommodation and will not be accommodated in the permanent camp. The permanent camp will be used for the Owner, EPCM contractor staff and senior contractor personnel subject to availability.

12.15.2 Permanent Accommodation Camp

Where possible, employment will be offered to suitably qualified and experienced Ghanaians. All unskilled and semi-skilled positions will be filled by residents of local towns and villages. A bus service will be provided to and from local population centres for workers. It is anticipated that a significant number of skilled Ghanaians from outside the immediate area will be allocated their own accommodation in local towns such as Bolgatanga.

Expatriate and key Ghanaian employees from outside the local area will be provided with accommodation. The project is based on accommodating 200 persons in a permanent camp. The camp will include a dry mess / kitchens, laundry, gymnasium, wet mess and recreational facilities.

The cost estimate is based on a fully modular camp facility. However, it is likely that the camp will be a mix of imported, modular, prefabricated buildings and blockwork construction. Experience is that costs are similar but that modular units can be brought on site and ready to use in a shorter timeframe, and require a smaller site labour force for erection. A commitment to local content will drive the use of local blockwork construction where the building is not schedule critical.

12.16 Communication System Infrastructure

Site communications will consist of the following:

- Internal communications and IT services will be via a site wide fibre optic network.
- A local mobile phone provider will be contracted to upgrade existing facilities on site and provide a link into the local, national and international telecommunication network.
- A radio network will be established with dedicated operational, security and emergency channels.
- A local ground station will be installed to provide global satellite voice and data connection.
- Satellite TV and internet connection will be provided at the accommodation camp.

12.17 Fuel and Lubricant Supply

Diesel fuel will be stored on site. Allowance has been made for six 62.5 m³ self-bunded fuel storage tanks. These will be mounted on concrete plinths and will include piping, pumps, meters and an electrical fuel management system. A small office will be included.

Fire water and other services will be provided to the fuel depot.

12.18 Explosive Storage and Handling

It is anticipated that a contract will be entered into with a recognised supplier of mining explosives to establish their own facilities on site and supply emulsion explosives, initiators, detonators and other blasting consumables as needed.

12.19 Security and Fencing

Site security is based on concentric lines of fencing and control. Areas of the lease where operations are actively taking place or where items of decentralised infrastructure are located will be patrolled by the security team.

The process plant, mine services area and general administration area will be enclosed within a patrolled 2 m chain link fence line to discourage casual entry. The main point of entry will be where the main access road enters the site. This point of entry will be provided with a gate and manned security post. Access from the mine haul road through the mine services area will also be monitored by a manned security post. Entry into the fenced areas will require a mine identity card and/or proof of legitimate business beyond that point.

The process plant itself will be enclosed by a double line of security fencing monitored by closed circuit cameras. The fence line will be provided with perimeter lighting. Entry will be via a single monitored security post and will be strictly controlled. Exit from the plant area will be subject to a search of vehicles, toolboxes and 'pat down' and/or metal detector search of all persons.

Access to the Gold Room within the plant will be restricted and strictly controlled. Extensive camera surveillance will be installed and entry points will be monitored and alarmed. All personnel allowed into the area will be accompanied and monitored by members of the security team. Persons leaving the area will be subject to a comprehensive search of themselves and any tools or equipment leaving the building.

The accommodation camp will be fenced and provided with a manned entry gate to prevent unauthorised access.

The tailings storage facility will be provided with a perimeter stock fence comprising three strands of barbed wire to prevent wildlife access to the facility. Active landfill areas will be fenced to prevent wildlife and vermin access.

12.20 Operational Facilities

12.20.1 Administration

- Administration Office
- Site Warehouse
- Clinic / emergency response

12.20.2 Plant Area

Workshops, warehouses and the like will be of structural steel frame and metal cladding construction on concrete slabs. Office and amenity areas associated with the main structures will generally be of transportable / prefabricated style construction although concrete blockwork construction will be considered to provide additional local content if the schedule allows.

12.21 Mine Services Area Facilities

An area will be provided for the mining contractor to establish their offices, workshops and other facilities. Power, potable water and connection to the site sewerage facilities will be provided. The area will also have an office for

the Owner's geology / mining technical team who will share the contractor's facilities such as changerooms to avoid duplication.

The Mine Services Area facilities based on a quotation are summarised below:

- Vehicle workshop, tyre store and warehouse.
- Mine vehicle washdown bay.
- Mine contractor's offices.
- Explosives contractor facilities.
- Lube storage.
- Crib / Training rooms.
- Ablutions.

12.22 Airstrip

An airstrip is proposed to service the site with freight shipments both inwards and outwards, and gold shipments outwards. The airstrip will be located approximately 2.5 km to the west-southwest of the accommodation camp and directly to the south of the site access road.

13. Operating Costs

The purpose of this operating cost estimate is to provide substantiated costs which can be utilised for a preliminary assessment of the viability of the Namdini Project. The operating costs have been developed by:

- Lycopodium - Processing and General and Administration costs
- Golder - Mining costs
- Cardinal – Owners costs.

Operating costs have been determined for a mines operating 24 hours per day, 365 days per year. The operating estimate is considered to have an accuracy of $\pm 25\%$, is presented in United States dollars (US\$) and is based on prices obtained during the first quarter of 2018 (1Q18). Study currency exchange rates were confirmed by Cardinal Resources.

The 9.5 Mtpa and 4.5 Mtpa options were factored from the 7.0 Mtpa option.

The operating costs have been compiled from a variety of sources, including the following:

- The LOM expected mass recovery to flotation concentrate is 7.5%. This is based on recent testwork showing good gold recovery to concentrate at this mass pull.
- Flotation reagent consumption based on recent prefeasibility optimisation testwork.
- Leaching reagent consumption based on industry norms in anticipation of final testwork results.
- Calculated reagent usage regimes for cyanide detoxification prior to testwork.
- Modelling by OMC for crushing and grinding energy and consumables, based on the final comminution testwork.
- Typical industry data from equipment vendors.
- Budget pricing or Lycopodium's database of prices for consumables.
- Lycopodium's database of costs for similar sized operations.

- Additional operating costs were added by Cardinal to allow for the finer grind results
- Mining costs were solicited from two of the largest in-country mining contractors. The estimated base mining cost has an applied incremental cost with depth, to account for increased haulage costs and the depth of mining increases in line with standard mining cost principles.

Operating Costs per tonne of **ore processed (129.6 Mt of ore)** are tabulated below:

	9.5 Mtpa (US\$ / t)	7.0 Mtpa (US\$ / t)	4.5 Mtpa (US\$ / t)
Mining	7.9	8.5	8.6
Processing	10.8	11.5	12.9
G & A	0.7	0.9	1.4
TOTAL	19.4	20.9	22.9

Table 10 Operating Costs

Owners Costs are tabulated below

	9.5 Mtpa (US\$ / t)	7.0 Mtpa (US\$ / t)	4.5 Mtpa (US\$ / t)
Grade Control	0.5	0.5	0.5
Owners G & A	0.6	0.8	1.0
TOTAL	1.1	1.3	1.5

Table 11 Owners Cost

Sustaining costs provided by consultants and Cardinal were compiled from a variety of sources and compared against existing and planned operations elsewhere in Ghana.

Sustaining Costs which include rehabilitation and mine closure are tabulated below:

UNIT	9.5 Mtpa	7.0 Mtpa	4.5 Mtpa
US\$ (M)	170	159	164

Table 12 Sustaining Costs

14. Capital Costs

The mining establishment cost was provided by in-country mining contractors. The process plant and infrastructure costs were estimated by Lycopodium. The costs for the TSF were provided by Knight Piésold. The capital costs include owner's project cost and contingency as calculated by Lycopodium.

The PFS study capital cost estimates, was completed to an accuracy of +30 % / -20 % for the 9.5 Mtpa option and was undertaken based on only open pit mining from the existing March 2018 Mineral Resources. The proposed plant comprises a primary crushing, milling (SAG + ball), re-crush, gravity, flotation, concentrate regrind and CIL circuit. Three production throughputs were assessed by Cardinal, namely 9.5, 7.0 and 4.5 Mtpa. The 9.5 and 4.5 Mtpa throughput options were factored from the 7.0 Mtpa option (+20 / -15% accuracy) and are therefore lower

in accuracy at +30 / -20%. A contingency factor of 5% was added to the 9.5 and 4.5 Mtpa options over and above the project contingency.

The factored estimates were established by assessing the correlation between cost and the process design criteria with factors being determined by discipline for all areas of the estimate.

Capital Costs are tabulated below:

UNIT	9.5 Mtpa	7.0 Mtpa	4.5 Mtpa
US\$ (M)	414	348	300

Table 13 Capital Costs

The capital cost in all three throughput scenarios reduced compared to the PEA numbers, the main contributors to the reduction being the following:

- Flotation recovery mass pull was reduced from 15% to 7.5%, based on flotation testwork optimisation. This reduction effectively reduced this section of the processing plant by 50% in terms of duty.
- Optimised plant layout, which reduced the plant footprint.
- Optimised steel structures, which ensured that all structures are fit for purpose.
- More accurately designed plant based off engineered quantities, which allowed a reduction in the growth allowance and contingency.

Overall plant layout and equipment sizing was prepared with sufficient detail to permit an assessment of the engineering quantities for the majority of the facilities for earthworks, concrete, steelwork and mechanical items. The layouts enabled preliminary estimates of quantities to be taken for all areas and for interconnecting items such as pipe racks.

Unit rates for labour and materials were derived from responses to BQRs sent to fabricators and contractors experienced in the scale and type of work in the region.

Budget pricing for equipment was obtained from reputable suppliers with the exception of low value items which were costed from Lycopodium's database of recent project costs.

For the accommodation camp, offices, workshops and similar items, appropriate budget pricing was obtained from reputable suppliers of similar prefabricated designs.

Knight Piésold provided the design and quantities of the following infrastructure items that were subsequently costed by Lycopodium.

The capital cost estimate includes:

- Direct costs of the Project development
- Indirect costs associated with the design, construction and commissioning of the new facilities
- Owner's cost associated with the management of the Project from design, engineering and construction up to the handover to operations and Project close-out
- Insurance and operating spares, first fills
- Costs associated with operational readiness and pre-production operations
- Growth allowance on quantity, pricing and unit rates variance
- Contingency on project scope definition and risks.

The material quantities and unit cost estimates were developed from engineering drawings, estimates and calculations at the level required for PFS and validated against estimates from similar sized projects

Cardinal allowed for additional capital costs for a finer grind. These were factored costs obtained from Lycopodium.

15. Environmental

NEMAS Consult has undertaken a site reconnaissance visit and completed the scoping stage of the process in accordance with the Ghanaian Environmental Protection Agency procedures for the EIA. The scoping study included preliminary field surveys, literature reviews and examination of appropriate legal and regulatory frameworks.

In compliance with the above regulations, the Namdini Gold Project was registered with the Ghana EPA for environmental permitting. The EPA in response to the registration application by the Proponent in a letter dated 23 November, 2016 indicated that the project which falls under schedule 2 makes mandatory a full-scale Environmental Impact Assessment ("EIA") study and submission of Environmental Impact Statement ("EIS") to the EPA.

In compliance with directives by the EPA, a scoping report was prepared and submitted to the Agency on 22nd June, 2017, which also set out the Terms of Reference ("ToR") for the EIA and EIS (the "ESIA") study. The scoping report highlighted the following issues among others: Project Description, Environmental and Social baseline conditions (mostly from secondary sources) and key environmental and social issues of impact and some preliminary proposed mitigation measures. The scoping report also captured the various national and internal laws, policies and guidelines that shall be triggered in course of the study. Additionally, the concerns of some key stakeholders consulted were captured in the report and other key stakeholders needed to be consulted were also identified.

On receiving the Scoping Report the EPA posted a Scoping Report Notification on page 24 of the August 18, 2017 edition of the Ghanaian Times (a government owned daily newspaper with a wide national circulation) requesting persons who have an interest, concern or special knowledge relating to the potential environmental effect of the proposed undertaking to contact or submit such concerns, etc., before the Environmental Impact Statement notification, to the Executive Director at its National Office in Accra and/or the Regional Director at its Regional office in Bolgatanga or the Managing Director of the proponent's company in Bolgatanga. The EPA also provided copies of the Scoping Report to the Talensi District Assembly in Tongo and to its Regional Office in Bolgatanga.

NEMAS are in the process of a detailed environmental study which will be submitted to the Ghanaian EPA for approval.

16. Social

The PFS Environmental study was progressed by NEMAS, including active engagement of local and state regulatory bodies.

Cardinal has an excellent relationship with neighbouring stakeholders, including engagement with the local stakeholders. Granted mining leases cover all of the proposed mining and processing assets. There are no title claims pending.

Expatriate and skilled Ghanaians from outside the local community will be accommodated in a single status camp on site. An allowance for an accommodation camp to house up to 200 people has been made in the capital cost estimate.

The local workforce will be bussed from the neighbouring population centres.

Compensation agreements are being negotiated for the proposed mining operation.

17. Economic Evaluation

17.1 Forward-looking Information

The results of the economic analysis represent forward-looking information that is subject to a number of known and unknown risks, uncertainties and other factors that may cause actual results to differ materially from those presented within this report. Forward-looking statements in this report include, but are not limited to, statements with respect to future gold prices, the estimation of the Ore Reserves and Mineral Resources, the realisation of Ore Reserve estimates, unexpected variations in quantity of mineralized material, grade or recovery rates, geotechnical and hydrogeological factors, unexpected variations in geotechnical and hydrogeological assumptions used in mine designs including seismic events and water management during the construction, operations, closure, and post-closure periods, the timing and amount of estimated future production, costs of future production, capital expenditures, future operating costs, costs and timing of the development of new ore zones, success of exploration activities, permitting time lines and potential delays in the issuance of permits, currency exchange rate fluctuations, requirements for additional capital, failure of plant, equipment or processes to operate as anticipated, government regulation of mining operations, environmental, permitting and social risks, unrecognized environmental, permitting and social risks, closure costs and closure requirements, unanticipated reclamation expenses, title disputes or claims and limitations on insurance coverage.

17.2 Methodology Used

The Project has been evaluated using a discounted cash flow (DCF) analysis. Cash inflows consist of quarterly and annual revenue projections. Cash outflows consist of capital expenditures, operating costs, taxes and royalties. These are subtracted from the inflows to arrive at the annual cash flow projections.

To reflect the time value of money, annual net cash flow (NCF) projections are discounted back to the Project valuation date using selected discount rates. The discount rate appropriate to a specific project depends on many factors, including the type of commodity; and the level of project risks (e.g. market risk, technical risk and political risk). The discounted, present values of the cash flows are summed to arrive at the Project's net present value (NPV).

In addition to the NPV, the internal rate of return (IRR) and the payback period were also calculated. The IRR is defined as the discount rate that results in an NPV equal to zero. The payback period is calculated as the time required to achieve positive cumulative cash flow for the Project.

Cardinal's Free Cash Flow calculation is derived by the total revenue generated, minus total costs. The calculation therefore is total recovered ounces (3.975 Moz), multiplied by the gold price selected (US\$ 1,250 / oz), minus the total cost per ounce (US\$ / oz). Pre-Tax cash flow is before tax is deducted, while Post-Tax is after tax deduction.

17.3 Financial Summary at US\$1,250 / oz Gold Price

KEY ECONOMIC RESULTS	UNIT	9.5 Mtpa	7.0 Mtpa	4.5 Mtpa
Development Capital Cost	US\$ M	414	348	300
All in Sustaining Costs (AISC) ¹	<i>Starter Pit</i>	599	652	708
	<i>Life of Mine</i>	769	823	895
Total Project Payback	Years	1.8	2.5	2.8
Pre-Tax NPV US\$ (@ 5% discount) ²	US\$ M	927	759	514
Post-Tax NPV US\$ (@ 5% discount) ²	US\$ M	586	478	317
Pre-Tax IRR	%	49	42	31
Post-Tax IRR	%	38	32	24
Pre-Tax Free Cash Flow	US\$ M	1,469	1,324	1,044
Post-Tax Free Cash Flow	US\$ M	945	849	667

Table 14 Key Economic Results

Table 11 Notes:

¹ Cash Costs + Royalties + Levies + Life of Mine Sustaining Capital Costs (World Gold Council Standard)

² Royalties calculated at flat rate of 5% & corporate tax rate of 35% used; both subject to negotiation.

17.4 PRODUCTION SUMMARY – STARTER PIT AND LIFE OF MINE

STARTER PIT:

Starter Pit 24 Mt @ 1.31 g/t for 1.06 Moz within Starter Pit at 0.5 g/t cut off

KEY ESTIMATED PRODUCTION RESULTS	UNIT	9.5 Mtpa	7.0 Mtpa	4.5 Mtpa
		Starter Pit	Starter Pit	Starter Pit
Gold Price	US\$ / oz	1,250	1,250	1,250
Gold Produced (Average for full production years)	(koz / yr)	361	257	171
All in Sustaining Costs (AISC) ¹	US\$ / oz	599	652	708
Gold Head Grade (Starter Pit)	g/t Au	1.31	1.31	1.31
Ore Reserve Mined (0.5 g/t cut-off grade)	Tonnes (Mt)	24.0	24.0	24.0
Gold Recovery (Starter Pit)	%	86	86	86
Waste Mined (Starter Pit)	Tonnes (Mt)	12.0	12.0	12.0
Strip Ratio (Starter Pit)	W:O	0.5 : 1	0.5 : 1	0.5 : 1
Starter Pit Life (Inc. Ramp up)	Years	2.5	3	5
Total Project Payback	Years	1.8	2.5	2.8

Table 15 Starter Pit Production Summary

Table Notes:

¹ Cash Costs + Royalties + Levies + Life of Mine Sustaining Capital Costs (World Gold Council Standard)

LIFE OF MINE (Including Starter Pit):

MINERAL RESOURCE DATA USED – MARCH 2018 RESOURCE MODEL

Indicated Mineral Resource 180 Mt @ 1.1 g/t for 6.5 Moz at 0.5 g/t cut off

RESERVE DATA – SEPTEMBER 2018

Probable Ore Reserve 129.6 Mt @ 1.14 g/t for 4.76 Moz within Life of Mine Pit at 0.5 g/t cut off

KEY ESTIMATED PRODUCTION RESULTS	UNIT	9.5 Mtpa	7.0 Mtpa	4.5 Mtpa
		Life Of Mine	Life Of Mine	Life Of Mine
Gold Price	US\$ / oz	1,250	1,250	1,250
Gold Produced (Average for full production years)	(koz / yr)	294	216	140
Gold Processed (Life of Mine)	(koz)	4,760	4,760	4,760
Gold Head Grade (Life of Mine)	g/t Au	1.14	1.14	1.14
Gold Recovery (Life of Mine)	%	84	84	84
Reserve Mined (0.5 g/t cut-off grade)	Tonnes (Mt)	129.6	129.6	129.6
Waste Mined	Tonnes (Mt)	181	181	181
Strip Ratio (Life of Mine)	W:O	1.4 : 1	1.4 : 1	1.4 : 1
Mine Life (Inc ramp-up and mine closure)	years	14	19	29
Development Capital Cost (Including owner's cost and 15% contingencies)	US\$ M	414	348	300
Total Project Payback	Years	1.8	2.5	2.8

Table 16 LOM Production Summary

17.5 Sensitivities

Based upon Life of Mine production and cost parameters, the post-tax NPV sensitivities are shown in Table 14 below for the 9.5 Mtpa option.

POST TAX REAL DISCOUNT RATE (%)	GOLD PRICE (US\$/oz)				
	US\$ 1,150	US\$ 1,200	US\$ 1,250	US\$ 1,300	US\$ 1,350
0	682	805	928	1,051	1,174
5	415	501	586	672	758
10	251	314	376	439	501

Table Note: All NPVs are post-tax values shown in US\$M

Table 17 9.5 Mtpa Option Net Present Value and Gold Price Sensitivities

The following four bar charts illustrate the 9.5 Mtpa option pre-tax and post-tax economic sensitivities at a gold price of US\$1,250 / oz.

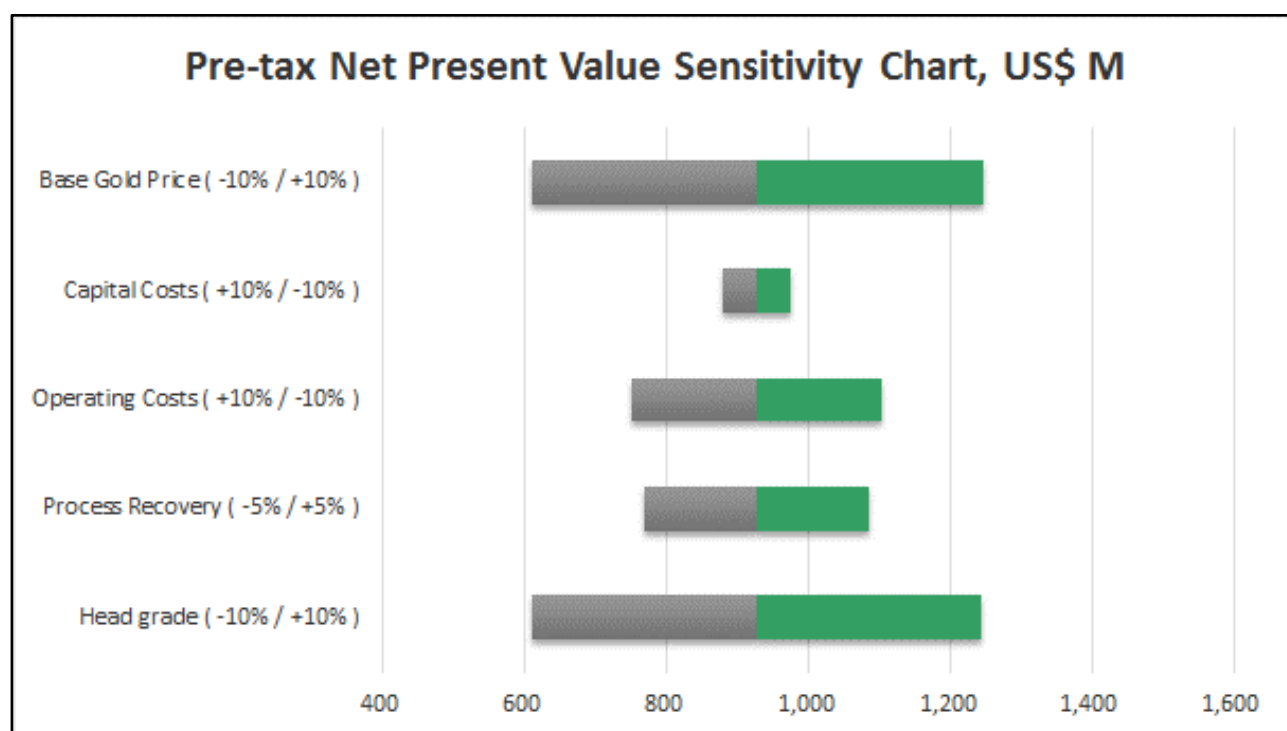


Figure 6 9.5 Mtpa Option – Pre-tax NPV Sensitivity at 5% discount (US\$M)

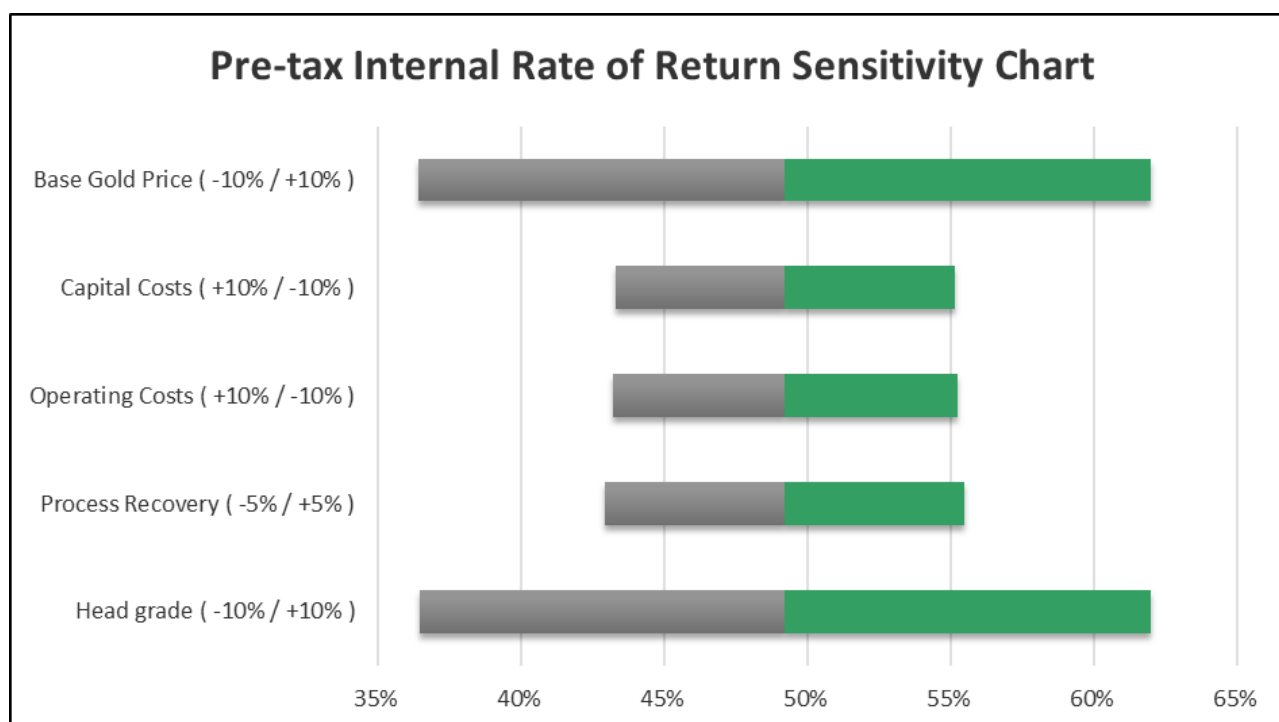


Figure 7 9.5 Mtpa Option – Pre-tax Internal Rate of Return (%)

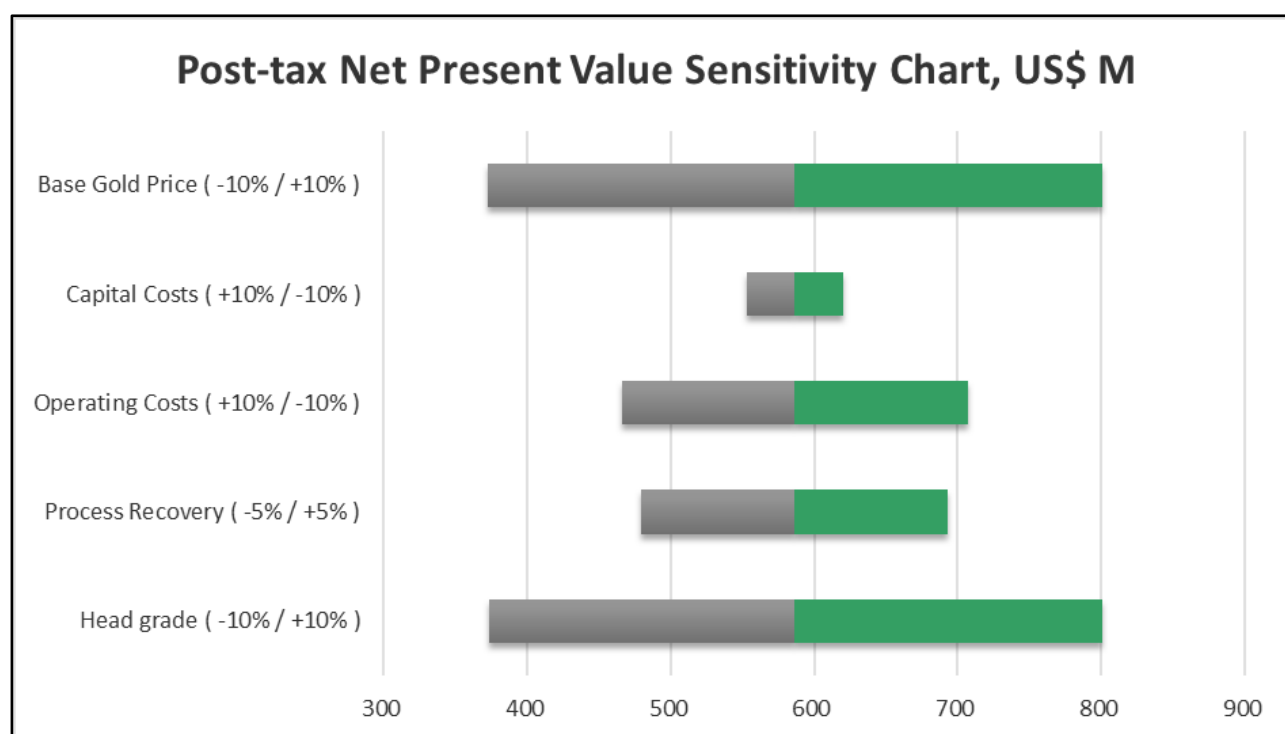


Figure 8 9.5 Mtpa Option – Post-tax NPV Sensitivity at 5% discount (US\$M)

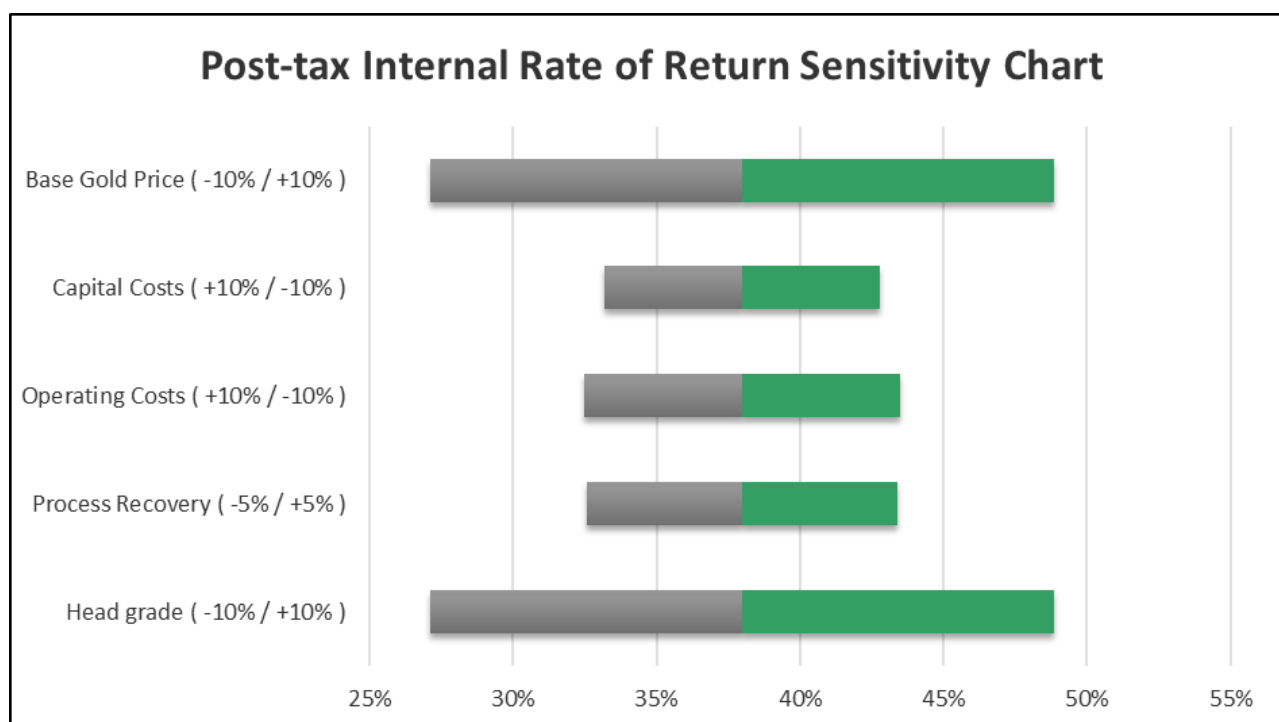


Figure 9 9.5 Mtpa Option – Post-tax Internal Rate of Return (%)

18. Funding

Cardinal will utilise a staged funding approach for the ongoing development of the Namdini project. Cardinal has budgeted for the Feasibility Study out of their existing cash balance, which includes the recent senior secured credit facility of US\$25M with Spratt (Release 2018-14 “Cardinal Successfully Finalises US\$25M Spratt Facility”). The Board believes that there are strong reasonable grounds to assume that future funding will be available to fund Cardinal’s pre-production capital for the development of Namdini as envisaged in this announcement.

- Cardinal is confident that it will continue to increase Mineral Resources at the project to extend the mine life beyond what is currently assumed in the PFS.
- The gold price is currently trading at approximately US\$1,200/oz which compares favourably to the project’s financial assumption of US\$1,250/oz. The recent improvement in market conditions and an encouraging outlook for the gold market enhances the Company’s view of the ability to finance the Namdini project.
- The strong production and economic outcomes delivered in the Namdini PFS are considered by the Cardinal Board to be sufficiently robust to provide confidence in the Company’s ability to fund its pre-production capital through conventional debt and equity financing.
- Cardinal is in early stage discussions with a number of financial advisors and substantial mining investment funds with a view to fund Namdini in stages to production. These financiers have extensive track records of funding similar stage companies through the PFS and DFS stages, construction financing and into commercial production.
- Cardinal’s Board has a financial track record and experience in developing projects:
 - Non-Executive Chairman Kevin Tomlinson, possesses over 30 years’ experience in Mining and Finance within Toronto, Australian and London Stock markets. Mr Tomlinson has extensive experience in development and financing of mining projects internationally.
 - Non-Executive Director Jacques McMullen has had a distinguished 35-year career in the mining

industry of which the last 17 years were with Barrick Gold Corporation where he held the positions of Senior VP Special Projects and Technical Services. In his role as Senior VP of Barrick, Jacques was instrumental in the development of many mines including Goldstrike, Veladero, Lagunas Norte, Cowal and Bulyanhulu. His experience includes all phases of development including feasibility, construction, commissioning, ramp-up and operation's optimization.

19. Next Stages

Based on the positive PFS outcome, the Cardinal Board has approved the immediate progression to a Feasibility Study (FS) on the Project to further define and support the case for full project funding and development.

20. References

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MPR, 2018. Technical Report on Mineral Resource Estimation for the Namdini Gold Project, Ghana by MPR Geological Consultants Pty Ltd, 18 April, authored by Nic Johnson.

NI 43-101, 2014. Canadian National Instrument 43-101, 'Standards of Disclosure for Mineral Projects', Form 43-101F1 and Companion Policy 43-101CP, May.

21. Appendix 1

22. JORC Code 2012 Edition – Table 1

Section 1 – Sampling Technique and Data

Criteria	JORC Code Explanation	Commentary
Sampling techniques	<p><i>Nature and quality of sampling (e.g. cut channels, random chips, or specific specialised industry standard measurement tools appropriate to the minerals under investigation, such as down hole gamma sondes, or handheld XRF instruments, etc.). These examples should not be taken as limiting the broad meaning of sampling.</i></p> <p><i>Include reference to measures taken to ensure sample representivity and the appropriate calibration of any measurement tools or systems used.</i></p> <p><i>Aspects of the determination of mineralisation that are Material to the Public Report.</i></p>	<p>Sampling is by a combination of diamond drill and reverse circulation holes.</p> <p>Nature and quality of sampling is carried out under QAQC procedures as per industry standards.</p> <p>Diamond sampling include both half-core and quarter-core samples of HQ core size and RC samples are collected by a three-tier riffle splitter using downhole sampling hammers with nominal 127 to 140mm holes.</p> <p>Sampling is guided by Cardinal Namdini protocols and Quality Control procedures as per industry standard.</p> <p>Sample representativity is ensured for by:</p> <p>RC samples, by collecting 1m samples from a cyclone, passing them through a 3-tier riffle splitter, and taking duplicate samplers every 20th sample.</p> <p>HQ core, through sampling the various lithological units at 1m intervals. The original system used was to sample each unit separately, but after statistical analyses of the results found there was no material grade variation between the units, the quarter core was sampled at 1m intervals throughout the drill hole.</p> <p>Recent HQ core sampling has been conducted by half core. Test work comparing half-core and quarter core samples has been completed with results confirming that sampling at either size is representative of the in-situ material.</p> <p>Diamond drill samples are firstly crushed using a Jaw Crusher and thereafter crushed to -2mm using a RSD Boyd crusher. A less than 1kg split sample is then pulverised via LM2 to a nominal 85% passing 75 microns.</p>

Criteria	JORC Code Explanation	Commentary
	<i>In cases where 'industry standard' work has been done this would be relatively simple (e.g. 'reverse circulation drilling was used to obtain 1 m samples from which 3 kg was pulverised to produce a 30 g charge for fire assay'). In other cases, more explanation may be required, such as where there is coarse gold that has inherent sampling problems. Unusual commodities or mineralisation types (e.g. submarine nodules) may warrant disclosure of detailed information.</i>	Reverse circulation drill samples are only crushed through a RSD Boyd crusher to -2mm and pulverised via LM2 to a nominal 85% passing 75 microns. A 200g sub-sample is taken for analysis. A 50g charge weight is fused with litharge-based flux, cupelled and the prill dissolved in aqua regia and gold tenor is determined by AAS.
Drilling techniques	<i>Drill type (e.g. core, reverse circulation, open-hole hammer, rotary air blast, auger, Bangka, sonic, etc.) and details (e.g. core diameter, triple or standard tube, depth of diamond tails, face-sampling bit or other type, whether core is oriented and if so, by what method, etc.).</i>	Diamond core drilling is completed with core size of HQ with a standard tube. Triple tube is used in saprolite at the tops of the hole. Core is orientated using a digital Reflex ACT II RD orientation tool. Reverse circulation drilling uses a sampling hammer of nominal 127 to 140mm holes. All holes are inclined at varying angles for optimal zone intersection. All drill collars are surveyed using a RTK GPS with downhole surveying every 30m.
Drill sample recovery	<i>Method of recording and assessing core and chip sample recoveries and results assessed.</i>	Diamond core recovery is logged and captured into the database. The method of recording chip and core sample recoveries was to enter the relevant data on a hand-held Motion F5te Tablet PC using a set of standard templates supplied by Maxwell Geoservices, Perth (Maxwell). Reverse circulation sampling is good. RC chips are logged and weighed and captured to the database. RC sample recoveries are assessed by weighing 1m samples from the cyclone on a scale in the field and comparing with the theoretical volume contained in a 1m x 140mm diameter hole to calculate an estimated percentage sample recovery. For RC drilling, average recoveries are in the order of 76% and considered acceptable. Core recovered from each drill run is measured and compared with the drill run length drilled to calculate an estimated percentage core recovery. For core drilling overall recoveries are excellent, weighted average recovery is greater than 98%.

Criteria	JORC Code Explanation	Commentary
	<i>Measures taken to maximise sample recovery and ensure representative nature of the samples.</i>	<p>Measures taken include the use of bigger HQ core size diamond drilling to maximise recovery, having a geologist onsite to examine core and core metres marked and orientated to check against the driller's blocks and ensuring that all core loss is considered.</p> <p>At the reverse circulation rig, sampling systems are routinely cleaned to minimise the opportunity for contamination and drilling methods are focused on sample quality. The measures taken to maximize RC sample recovery are through a cyclone and a 3-tier riffle splitter. Each 1m sample is passed twice through the splitter before sampling to ensure maximum homogenisation of each sample and to collect an unbiased representative sample to be assayed.</p> <p>Most of the reverse circulation rigs have auxiliary compressors and boosters to help maintain dry samples. Where wet samples are encountered, the reverse circulation drilling is discontinued and is progressed with diamond core drilling.</p>
	<i>Whether a relationship exists between sample recovery and grade and whether sample bias may have occurred due to preferential loss/gain of fine/coarse material.</i>	No relationship is seen to exist between sample recovery and grade, and no sample bias is due to preferential loss/gain of any fine/coarse material due to the acceptable sample recoveries obtained by both drilling methods employed.
Logging	<i>Whether core and chip samples have been geologically and geotechnically logged to a level of detail to support appropriate Mineral Resource estimation, mining studies and metallurgical studies.</i>	<p>All drill holes are fully logged. The lithology, alteration and geotechnical characteristics of core are logged directly to a digital format on a Field Toughbook laptop logging system following procedures and using Cardinal geologic codes. Data is imported into Cardinal's central database after validation in LogChief™.</p> <p>All geological logging is to a level of detail to support Mineral Resource estimation.</p>
	<i>Whether logging is qualitative or quantitative in nature. Core (or costean, channel, etc.) photography.</i>	<p>Logging is both qualitative and quantitative depending on the field being logged.</p> <p>Both RC chips in trays and HQ core are photographed both in dry and wet form.</p>

Criteria	JORC Code Explanation	Commentary
	<i>The total length and percentage of the relevant intersections logged.</i>	All drillholes are logged in full and to the total length of each drill hole.
Sub-sampling techniques and sample preparation	<p><i>If core, whether cut or sawn and whether quarter, half or all core taken.</i></p> <p><i>If non-core, whether riffled, tube sampled, rotary split, etc. and whether sampled wet or dry.</i></p> <p><i>For all sample types, the nature, quality and appropriateness of the sample preparation technique.</i></p>	<p>100% of each relevant intersection is logged in detail.</p> <p>Core orientation is completed for all diamond holes and all are marked prior to sampling. Longitudinally cut half core samples are produced using a Core Saw. Samples are weighed and recorded.</p> <p>Some quarter core samples have been used and statistical testwork has shown them to be as equally representative as half core.</p> <p>RC samples are split using a three-tier riffle splitter. The majority of RC samples are dry. On occasions when wet samples are encountered, they are dried prior to splitting with a riffle splitter.</p> <p>Drill core samples are sorted, dried at 105°C for four hours and weighed. Samples are firstly Jaw Crushed and a second stage crushing uses a RSD Jaques crusher to a nominal -2mm and then split to <1.0kg. The reject sample is retained in the original bag and stored. The split is pulverised in a LM2 to a nominal 85% passing 75 microns and an approximately 200g sub-sample of the pulverised material is used for assay.</p> <p>Chip samples are sorted and dried in an oven for eight hours and weighed. They are then crushed to -2mm using a RSD Boyd crusher and a <1.0kg split is taken. The reject sample is retained in the original bag and stored. The split is pulverised in a LM2 to a nominal 85% passing 75 microns and a 200g sub-sample is used for analysis.</p> <p>All preparation equipment is flushed with barren material prior to commencement of the job.</p> <p>Cardinal Resources has protocols that cover sample preparation at the laboratories and the collection and assessment of data to ensure that accurate steps are used in producing representative samples for the analytical process. Key performance indices include:</p> <ul style="list-style-type: none"> • Contamination index of 95% (that is at least 95% of blanks pass); failures can only be attributed to probable minor laboratory contamination. • Crushed Size index of 95% passing 2mm (1:50 sample screened).
	<i>Quality control procedures adopted for all sub-sampling stages to maximise representivity of samples.</i>	

Criteria	JORC Code Explanation	Commentary
		<ul style="list-style-type: none"> Grind Size index of 85% passing 75 microns (1:50 sample screened). Check Samples returning at worst 20% precision at 90th percentile and bias of 5% or better. <p>Crusher and pulveriser are flushed with barren material at the start of every batch.</p> <p>Measures taken to ensure that the sampling is representative of the in-situ material collected, including for instance results for field duplicate/second-half sampling.</p> <p>Sampling is carried out in accordance with Cardinal protocols as per industry best practice. Quality control procedures adopted for all sub-sampling stages to maximize representation of samples is to insert commercial certified reference material (CRM) for standards and in-house blanks every 20 samples.</p> <p>Whether sample sizes are appropriate to the grain size of the material being sampled.</p> <p>SGS Laboratory assays duplicate samples of each sample batch (20%) so that representation of the samples can be checked. Field duplicates have been taken and analysis of results have shown the sampling to be representative.</p> <p>Measures taken to ensure that the RC sampling is representative of the in-situ material collected are to take field duplicate samples every 20th sample. Approximately 3kg samples from the splitter are retained from each sample and stored at the company's secured premises for possible re-assay.</p> <p>Measures taken to ensure that the core sampling is representative is to sample half core at 1m intervals irrespective of lithologies due to the similarities in grade of the main lithologies.</p> <p>Results of field duplicates, standards and blanks are all plotted graphically to ensure that the results of each assay batch are acceptable.</p> <p>Quality of Assay data and laboratory tests</p> <p><i>The nature, quality and appropriateness of the assaying and laboratory procedures used and whether the technique is considered partial or total.</i></p> <p>Samples are analysed for gold by lead collection fire assay of a 50g charge with ASS finish; the assay charge is fused with the litharge-based flux, cupelled and prill dissolved in aqua regia and gold tenor determined by flame AAS.</p> <p>The quality of the Fire Assaying and laboratory procedures are considered to be entirely appropriate for this deposit type. The analytical method is considered appropriate for this mineralization style and is of industry standard.</p> <p><i>For geophysical tools, spectrometers, handheld XRF instruments, etc., the parameters used in determining the</i></p> <p>No hand-held geophysical tools are used.</p>

Criteria	JORC Code Explanation	Commentary
	<p><i>analysis including instrument make and model, reading times, calibrations factors applied and their derivation, etc.</i></p> <p><i>Nature of quality control procedures adopted (e.g. standards, blanks, duplicates, external laboratory checks) and whether acceptable levels of accuracy (i.e. lack of bias) and precision have been established.</i></p>	<p>Sample preparation checks for pulp fineness are carried out by the laboratory as part of their internal procedures to ensure the grind size of 85% passing 75 microns is being attained.</p> <p>Cardinal's QAQC protocol is considered industry standard with standard reference material (standards) submitted on a regular basis with routine samples. The standards having a range of values and blanks are inserted in the ratio of 1:20. Duplicates are taken at the riffle splitter at a ratio of 1:20 samples. No duplicate samples are taken from core samples.</p> <p>Pulps are submitted to a secondary laboratory for checks on accuracy and precision of the primary laboratory. Coarse rejects are submitted back to the primary laboratory to access the adequacy of the sub-sampling process.</p> <p>Laboratory internal QAQC involves the use of standards and blanks. These quality results are reported along with samples results in the final reports. Cardinal has not verified the laboratory internal QC data.</p>
Verification of sampling and assaying	<p><i>The verification of significant intersections by either independent or alternative company personnel.</i></p> <p><i>The use of twinned holes.</i></p> <p><i>Documentation of primary data, data entry procedures, data verification, data storage (physical and electronic) protocols.</i></p> <p><i>Discuss any adjustment to assay data.</i></p>	<p>Significant intersections have been verified by alternative company personnel.</p> <p>None of the drill holes in this report are twinned.</p> <p>Primary data are captured on field tough book laptops using LogChief™ Software. The software has validation routines and data is then imported onto a secure central database.</p> <p>The primary data is always kept and is never replaced by adjusted or interpreted data.</p>
Location of data points	<p><i>Accuracy and quality of surveys used to locate drill holes (collar and down-hole surveys), trenches, mine workings and other locations used in Mineral Resource estimation.</i></p>	<p>Planned drillhole collar coordinates are surveyed using handheld Garmin GPSmap 62s GPS within ±3m accuracy.</p> <p>All drill collars are accurately surveyed using Tremble R8 RTK GPS system within ±10mm of accuracy (X, Y, Z).</p> <p>Coordinates are based on 12 control stations established on the Namdini site by Sahara Mining Services. Downhole</p>

Criteria	JORC Code Explanation	Commentary
		surveying is completed by using a Reflex Ez-Shot survey instrument at regular intervals.
		Gyroscopic downhole surveys were completed on selected drillholes using a Reflex Ez-Gyro (North Seeking) instrument as part of the quality checks on the downhole surveys.
	<i>Specification of the grid system used.</i>	Coordinate and azimuth are reported in UTM WGS84 Zone 30 North.
	<i>Quality and adequacy of topographic control.</i>	Topographic control was established from aerial photography using a series of 12 surveyed control points. A 1m ground resolution DTM was produced by Sahara Mining Services from the survey completed in 24 flights using the DJI Inspire 1 UAV at an altitude of 100m with an overlap of 70%.
Data spacing and distribution	<i>Data spacing for reporting of Exploration Results.</i>	Drill spacing is at 50m x 100m line spacing with infill to 50m x 50m and 10m x 15m in areas to establish mineralization continuity and upgrade the Mineral Resource.
	<i>Whether the data spacing and distribution is sufficient to establish the degree of geological and grade continuity appropriate for the Mineral Resource and Ore Reserve estimation procedure(s) and classifications applied.</i>	Drill data spacing and distribution are sufficient to establish the geological and grade continuity and appropriate Mineral Resource and Ore Reserve classifications were applied utilising this information.
Orientation of data in relation to geological structure	<i>Whether sample compositing has been applied.</i>	No sample compositing has been applied.
	<i>Whether the orientation of sampling achieves unbiased sampling of possible structures and the extent to which this is known, considering the deposit type.</i>	The majority of the drill holes are orientated to achieve intersection angles as close to perpendicular to the mineralization as practicable. This achieves unbiased sampling of possible structures as drilling is orientated normal to the dip and foliation of the deposit. Structural measurements confirm that the foliation of the entire deposit dips -60°W so that the sampling achieves unbiased sampling of the lithologies
	<i>If the relationship between the drilling orientation and the orientation of key mineralised structures is considered to have introduced a sampling bias, this should be assessed and reported if material.</i>	No significant orientation-based sampling bias is known at this time.
Sample security	<i>The measures taken to ensure sample security.</i>	An independent Ghanaian security contractor is used to ensure sample security. The drilling contractor is accountable for drill core and RC chip production at the drill site. Final delivery from the drill site to the laydown area within the core yard is managed by

Criteria	JORC Code Explanation	Commentary
		Cardinal. The core yard technicians, field technicians and Geologists ensure the core and chips are logged, prepared and stored under security until collected by the laboratory for delivery to the assay laboratory.
		At the time of sample collection, a sign-off process between Cardinal and the laboratory delivery truck driver ensures that samples and paperwork correspond. The samples are then transported to the Tarkwa (Ghana) or Ouagadougou (Burkina Faso) laboratory where they are receipted against the dispatch documents. The assay laboratories are responsible for the samples from the time of collection from Namdini Project site until final results are returned and checked by Cardinal Geologists.
		Sample pulps and coarse rejects are retained by the laboratories and are shipped back to Namdini after final results are returned where they are stored under security.
Audits or reviews	<i>The results of any audits or reviews of sampling techniques and data.</i>	Sampling techniques are of industry standards. Data is audited by Maxwell Geoservices (Perth), who have not made any other recommendations.

Section 2 – Reporting of Exploration Results

(Criteria listed in section 1 will also apply to this section where relevant)

Criteria	JORC Code Explanation	Commentary
Mineral Tenement and Land Status	<i>Type, name/reference number, location and ownership including agreements or material issues with third parties including joint ventures, partnerships, overriding royalties, native title interests, historical sites, wilderness or national park and environmental settings.</i>	<p>The Mining Licence covering Cardinal's Namdini Project over an area of approximately 19.54 sq. Km is located in the Northeast region of Ghana.</p> <p>The previous holder of the Mining Licence, Savannah Mining Ghana Limited (Savanah) completed an initial Environmental Impact Statement (EIS) and lodged the EIS with the Environmental Protection Agency of Ghana.</p> <p>The application by Savannah for a Large-Scale Mining Licence over an area of approximately 19.54 Sq. Km in the Upper East Region of Ghana covering Cardinal's Namdini Project has been granted by the Minister of Lands and Natural Resources of Ghana.</p>

Criteria	JORC Code Explanation	Commentary
	<i>The security of the tenure held at the time of reporting along with any known impediments to obtaining a license to operate in the area.</i>	Savannah applied for the assignment of this Large-Scale Mining Licence to Cardinal Namdini Mining Limited (Namdini), a wholly owned Subsidiary of Cardinal. The assignment has been granted by the Minister of Lands and Natural Resources of Ghana.
Exploration Done by Other Parties	<i>Acknowledgment and appraisal of exploration by other parties.</i>	All tenements are current and in good standing. The Mining Lease for Namdini was granted for an initial 15 years which is renewable.
Geology	<i>Deposit type, geological setting and style of mineralisation</i>	Aside from Cardinal there has been no recent systematic exploration undertaken on the Namdini Project.
		The deposit type comprises gold mineralization within sheared and highly altered rocks containing sulphides; mainly pyrite with minor arsenopyrite. The geological setting is a Paleoproterozoic Greenstone Belt comprising Birimian metavolcanics, volcanoclastics and metasediments located in close proximity to a major 30 km ~N-S regional shear zone with splays. The style of mineralization is hydrothermal alteration containing disseminated gold-bearing sulphides.
Drill hole information	<p><i>A summary of all information material to the understanding of the exploration results including tabulation of the following information for all Material drill holes:</i></p> <ul style="list-style-type: none"> • Easting and northing of the drill hole collar • Elevation or RL (Reduced Level – elevation above sea level in meters) of the drill hole collar • Dip and azimuth of the hole • Down hole length and interception depth • Hole length <p><i>If the exclusion of this information is justified on the basis that the information is not Material and this exclusion does not detract from the understanding of the report, the Competent Person should clearly explain why this is the case.</i></p>	<p>Further information is provided in “Technical Report Mineral Resource Estimation for the Namdini Gold Project, Ghana, 05 March 2018”. This document can be downloaded from the Cardinal Resources website.</p> <p>http://www.cardinalresources.com.au/technical-reports/</p> <p>or from</p> <p>http://www.sedar.com</p> <p>There has been no exclusion of information.</p>
Data aggregation methods	<i>In reporting Exploration Results, weighting averaging techniques, maximum and/or minimum grade truncations (e.g. cutting of high grades)</i>	Not applicable in this document as no exploration results are announced.

Criteria	JORC Code Explanation	Commentary
	<i>and cut-off grades are usually Material and should be stated.</i>	
	<i>Where aggregated intercepts incorporate short lengths of high grade results and longer lengths of low grade results, the procedure used for such aggregation should be stated and some typical examples of such aggregations should be shown in detail.</i>	Not applicable in this document as no exploration results are announced.
	<i>The assumptions used for any reporting of metal equivalent values should be clearly stated.</i>	Not applicable in this document.
Relationship between mineralisation widths and intercept lengths	<i>These relationships are particularly important in the reporting of exploration results.</i>	Not applicable in this document as no exploration results are announced.
	<i>If the geometry of the mineralisation with respect to the drill hole angle is known, its nature should be reported.</i>	Not applicable in this document as no exploration results are announced.
	<i>If it is not known and only the down hole lengths are reported, there should be a clear statement to this effect (e.g. 'down hole length, true width not known').</i>	Not applicable in this document as no exploration results are announced.
Diagrams	<i>Appropriate maps and sections (with scales) and tabulations of intercepts should be included for any significant discovery being reported. These should include, but not be limited to a plan view of drill hole collar locations and appropriate sectional views.</i>	Appropriate maps with scale are included within the body of the accompanying document.
Balanced Reporting	<i>Where comprehensive reporting of all Exploration Results is not practical, representative reporting of both low and high grades and/or widths should be practiced to avoid misleading reporting of Exploration Results.</i>	The accompanying document is considered to represent a balanced report.
Other substantive exploration data	<i>Other exploration data, if meaningful and material, should be reported including (but not limited to): geological observation; geophysical survey results; geochemical survey results; bulk samples – size and method of treatment; metallurgical test results; bulk density, groundwater, geotechnical and rock characteristics; potential deleterious or contaminating substances.</i>	Other exploration data collected is not considered material to this document at this stage. Further data collection will be reviewed and reported when considered material.

Criteria	JORC Code Explanation	Commentary
Further Work	<p><i>The nature and scale of planned further work (e.g. tests for lateral extensions or depth extensions or large – scale step – out drilling).</i></p> <p><i>Diagrams clearly highlighting the areas of possible extensions, including the main geological interpretations and future drilling areas, provided this information is not commercially sensitive.</i></p>	Exploration drilling will continue to target projected lateral and depth extensions of the mineralization and infill drilling to increase the confidence in the Mineral Resource.

Section 3 – Estimation and Reporting of Mineral Resources

Criteria	JORC Code Explanation	Commentary
Database integrity	<p><i>Measures taken to ensure that data has not been corrupted by, for example, transcription or keying errors, between its initial collection and its use for Mineral Resource estimation purposes.</i></p>	<p>The database is managed using DataShed® drill hole management software (Maxwell Geoservices) using SQL database techniques. Validation checks were conducted using SQL and DataShed relational database standards.</p> <p>All geological and field data is entered using data-loggers and software developed by Maxwell GeoServices, that includes lookup tables and fixed formatting (and protected from modification) thus only allowing data to be entered using the Cardinal geological code system and sample protocol. Data is then loaded to the DataShed database, which was managed by consultants Maxwell GeoServices.</p> <p>Cardinal technical personnel validated the database using Micromine software. The DataShed database is then reviewed against the original logging spreadsheets and the assay data checked against the supplied assay certificates.</p> <p>The Competent Person's independent checks of database validity included checking for internal consistency between, and within database tables and comparing 97% of database assay entries with laboratory source files supplied by Cardinal. These checks showed no significant discrepancies in the database used for the Mineral Resource estimation.</p> <p>Following importation, the data goes through a series of digital checks for duplication and non-conformity, followed by manual validation by the relevant project geologist who manually checks the collar, survey, assay and geology for errors against the original field data and final paper copies of the assays. The process is documented, including the</p>

Data validation procedures used.

Criteria	JORC Code Explanation	Commentary
		recording of holes checked, errors found, corrections made and the date of database update.
Site visits	<i>Comment on any site visits undertaken by the Competent Person and the outcome of those visits.</i>	Basic validation checks were carried out to confirm the data is valid and acceptable to support Mineral Resource estimation work. MPR Geological Consultants Pty Ltd ("MPR") reviewed the QA/QC results. Mr. Nicolas Johnson of MPR Geological Consultants Pty Ltd (MPR) visited the Namdini Gold Project in January 2017 to review the operation as part of the 2017 Mineral Resource update. Mr. Richard Bray is a full-time employee of Cardinal and undertakes regular site visits.
	<i>If no site visits have been undertaken indicate why this is the case.</i>	Site visits have been undertaken by the Competent Persons.
Geological interpretation	<i>Confidence in (or conversely, the uncertainty of) the geological interpretation of the mineral deposit.</i>	Gold mineralization above the cut-off of grade is widespread within the metavolcanic, granite and dioritic lithologies which can be interpreted and modelled with a high degree of confidence. There is a sharp mineralization boundary with the metasediments in the footwall while the hanging wall contact exhibits a more diffuse mineralization boundary. Higher-grade mineralization (>0.5 g/t Au) can be traced along structural corridors related to a pervasive NW-SE foliation which has been warped around the more competent granite. There is abundant structural information from oriented core which confirms this assumption. Based on these observations, and geological interpretations, a broad (0.1g/t Au) low-grade mineralization package was developed. The mineralization constraint was traceable at low grades for 1,300m and is up to 300m wide. The mineralization dips approximately 55° to 60° towards the west. The drill hole database used for the Mineral Resource estimation consists of DD core and RC samples. Numerous validation steps have been taken by MPR and Cardinal Competent Persons and various independent consultants. MPR is of the opinion that the drill hole database is of sufficient quality to support the estimation of Mineral Resources.
	<i>Nature of the data used and of any assumptions made.</i>	The geological data used to construct the geological model includes regional and surface mapping and logging of RC and

Criteria	JORC Code Explanation	Commentary
		diamond core drilling. A nominal 0.1g/t Au lower cut-off grade was applied to the mineralization model.
	<i>The effect, if any, of alternative interpretations on Mineral Resource estimation.</i>	<p>Oxidation codes and densities were assigned to model estimates from triangulated surfaces representing the base of oxidation, and base of transitional material (top of fresh rock) respectively which were interpreted from geological logging.</p> <p>The geology of the deposit is relatively simple, and the interpretation is considered robust. There is no apparent alternative to the interpretation in the company's opinion at this point.</p>
	<i>The use of geology in guiding and controlling Mineral Resource estimation.</i>	<p>As the project advances towards the declaration of Ore Reserves, the characterization and treatment of higher-grade mineralization and the application of a litho-structural model including mineralization wireframes may become necessary.</p> <p>The Mineral Resource estimate uses lithological and structural information collected to guide the interpretation.</p> <p>The mineralization geometry has a strong relationship with interpreted alteration and structure. The lithology contacts and the weathering changes do not appear to materially control the mineralization although the metavolcanic and the tonalite (granite) mineralization is on average higher grade than the diorite and metasediment mineralization. Little grade variation is noted between the different weathering groupings.</p>
	<i>The factors affecting continuity both of grade and geology.</i>	<p>The grade estimate is based on a gold grades and the mineralization package defined above a 0.1gt Au lower cut-off grade.</p> <p>The continuity of grade is associated with a pervasive foliation, alteration, sulphides and the spatial distribution of lithologies including the interaction between structure and lithological competency contrasts. A broad zone of anomalous mineralization is interpreted.</p> <p>The grade continuity at lower cut-off grades is good, however this grade continuity is materially reduced at higher cut-off grades as expected in a gold deposit. Geological setting and mineralization controls have been established with sufficient confidence for the current estimates.</p>

Criteria	JORC Code Explanation	Commentary
Dimensions	<i>The extent and variability of the Mineral Resource expressed as length (along strike or otherwise), plan width, and depth below surface to the upper and lower limits of the Mineral Resource.</i>	The Mineral Resource is widespread, extending over an area 350 m wide (horizontal thickness), 1.2 km along strike and to a depth of 600 m below surface. Mineralization generally dips at 55° towards the northwest with local changes in dip corresponding to lithological contacts and foliation directions.
Estimation and modelling techniques	<i>The nature and appropriateness of the estimation technique(s) applied and key assumptions, including treatment of extreme grade values, domaining, interpolation parameters and maximum distance of extrapolation from data points. If a computer assisted estimation method was chosen include a description of computer software and parameters used.</i>	<p>MPR used the method of Multiple Indicator Kriging (MIK) with block support adjustment to estimate Mineral Resources into blocks with dimensions of 12.5 m (East) by 25 m (North) by 5m (Elevation). MIK used indicator variography based on the two-metre composite sample grades. Gold grade continuity was characterised by indicator variograms at 14 indicator thresholds spanning the global range of grades. A block support adjustment was used to estimate the Mineral Resources at Namdini. The shape of the local block gold grade distribution has been assumed lognormal and an additional adjustment for the “Information Effect” has been applied to arrive at the final Mineral Resource.</p> <p>MIK was used as the preferred method for estimation of Mineral Resources at Namdini as the approach has been demonstrated to work well in a large number of deposits of diverse geological styles. The gold mineralization seen at Namdini is typical of that seen in most structurally controlled gold deposits where the MIK method has been found to be of most benefit.</p> <p>In the MPR study, data viewing, compositing and wire-framing have been performed using Micromine software. Exploratory data analysis, variogram analysis and modelling, and Mineral Resource estimation have been performed using FSSI Consultants (Australia) Pty Ltd (FSSI) GS3M software. GS3M is designed specifically for estimation of recoverable resources using MIK.</p> <p>The sample data set containing all available assaying were composited to two metre intervals each located by their mid-point co-ordinates and assigned a length weighted average gold grade. The composite length of two metres was chosen because it is a multiple of the most common sampling interval (1.0 metre) and is also an appropriate choice for the kriging of gold into the model blocks where open pit mining is undertaken on 2.5 metre benches.</p>

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	<i>The availability of check estimates, previous estimates and/or mine production records and whether the Mineral Resource estimate takes appropriate account of such data.</i>	Resulting Mineral Resource estimates were compared with the previous estimate performed by Roscoe Postle Associates Inc. ("RPA"). For the same area covered by RPA, the MPR estimate statistics and results are within 5% for grade, tonnes and ounces at the cut-off grade. MPR's estimate has the benefit of additional drilling and covers a larger area accounting for the global variances.
	<i>The assumptions made regarding recovery of by-products.</i>	There is no assumption made regarding the recovery of any by-product.
	<i>Estimation of deleterious elements or other non-grade variables of economic significance (eg sulphur for acid mine drainage characterisation).</i>	Estimates include elements S and As.
	<i>In the case of block model interpolation, the block size in relation to the average sample spacing and the search employed.</i>	Block dimensions used were 12.5 mE by 25 mN by 5 mRL and chosen due to this dimension approximating the average drill spacing in the modelled Mineral Resource areas and is consistent with the north-northwest mineralized strike. A three-pass octant search strategy was used to define the local neighbourhood data used in the kriging to produce the three modelled Mineral Resource confidence categories.
		The highest confidence blocks are estimated using search radii of 65 mE by 65 mN by 15mRL and a minimum of 16 data coming from a minimum of 4 octants. The second and third pass estimates were estimated using an expanded search of 50% with 8 and 4 minimum data and 4 and 2 minimum octants, respectively. All estimation passes use a maximum of 48 data.
	<i>Any assumptions behind modelling of selective mining units.</i>	The selective mining unit at Namdini is expected to be in the order of 5 mE by 10 mN by 2.5 mRL
	<i>Any assumptions about correlation between variables.</i>	The modelling did not include any specific assumptions about correlation between attributes.
	<i>Description of how the geological interpretation was used to control the resource estimates.</i>	The mineralized domain used for the current study was interpreted by MPR and Cardinal geologists on the basis of two metre down-hole composited gold grades and captures zones of continuous mineralization with composite grades of greater than nominally 0.1 g/t Au.
	<i>Discussion of basis for using or not using grade cutting or capping.</i>	Statistical analysis showed the gold population in the mineralized domains to be highly skewed and generally having moderate to high coefficient of variation.
		A disproportionate amount of metal is located within the upper tails of the gold distributions. Histograms, log probability plots and decile analyses were used to evaluate

Criteria	JORC Code Explanation	Commentary
		the proportions of metal at risk and to establish appropriate capping levels.
	<i>The process of validation, the checking process used, the comparison of model data to drill hole data, and use of reconciliation data if available.</i>	All indicator class grades were determined from class mean grades, with the exception of upper bin, which were derived either after exclusion of a few extreme grades or by selecting the class median as the average grade of the highest indicator bin. Standard validation procedures were performed on the block model including: visual inspection of composite versus block grades on plan and vertical sections. Geological elements coded to the block model include the weathering surfaces, geology model for the granite, metavolcanics, diorite and the metasediments.
Moisture	<i>Whether the tonnages are estimated on a dry basis or with natural moisture, and the method of determination of the moisture content.</i>	Tonnages are estimated on a dry basis.
Cut-off parameters	<i>The basis of the adopted cut-off grade(s) or quality parameters applied.</i>	The cut-off grades used for Mineral Resource reporting reflect Cardinal's interpretation of the potential project range of gold prices and process plant recoveries and operating costs for a potential operation. The Mineral Resource estimate was reported using a 0.5 g/t Au cut-off grade and is constrained by an optimal pit shell based on a long-term gold price of US\$1,500 /oz using factors relevant to location and proposed mining method.
Mining factors or assumptions	<i>Assumptions made regarding possible mining methods, minimum mining dimensions and internal (or, if applicable, external) mining dilution. It is always necessary as part of the process of determining reasonable prospects for eventual economic extraction to consider potential mining methods, but the assumptions made regarding mining methods and parameters when estimating Mineral Resources may not always be rigorous. Where this is the case, this should be reported with an explanation of the basis of the mining assumptions made.</i>	Conventional open pit operation with drill, blast, load and haul unit operations. It is anticipated that large scale open pit mining methods will be applied for the Namdini Project Mineral Resources. Grade control of ore blocks will be based on sampling from high quality reverse circulation drilling spaced at approximately 10mE by 15mN with samples taken at 1 metre intervals downhole.
Metallurgical factors or assumptions	<i>The basis for assumptions or predictions regarding metallurgical amenability. It is always necessary as part of the process of determining reasonable prospects for eventual economic extraction to consider potential metallurgical methods, but the</i>	Conventional milling of mineralized material, followed by flotation, regrinding and cyanide leaching of the concentrate.

Criteria	JORC Code Explanation	Commentary
	<i>assumptions regarding metallurgical treatment processes and parameters made when reporting Mineral Resources may not always be rigorous. Where this is the case, this should be reported with an explanation of the basis of the metallurgical assumptions made.</i>	<p>Utilising standard gold recovery techniques has demonstrated a starter pit gold recovery of 86% and a LOM gold recovery rate of 84%.</p> <p>A conventional grind-flotation-regrind-CIL flowsheet continues to be the preferred process option.</p> <p>Recovery appears to be dependent on head grade and upon the ratio of the different lithologies, which change as the Mineral Resource model is updated and depending upon the cut-off grade.</p>
Environmental factors or assumptions	<i>Assumptions made regarding possible waste and process residue disposal options. It is always necessary as part of the process of determining reasonable prospects for eventual economic extraction to consider the potential environmental impacts of the mining and processing operation. While at this stage the determination of potential environmental impacts, particularly for a greenfields project, may not always be well advanced, the status of early consideration of these potential environmental impacts should be reported. Where these aspects have not been considered this should be reported with an explanation of the environmental assumptions made.</i>	<p>Cardinal's exploration activities are undertaken such that any potential emissions and effects associated exploration activities, which could include habitat modification and associated visual effects, are kept to a minimum.</p> <p>NEMAS Consult Ltd (NEMAS), of Accra, Ghana, has been contracted by Cardinal to undertake the Environmental Impact Assessment study for the Project. NEMAS has undertaken a site reconnaissance visit and completed the Scoping stage of the process in accordance with the Ghanaian Environmental Protection Agency procedures for the EIA.</p> <p>The scoping study has been submitted to commence the process of Environmental Impact Statement (EIS) in accordance with Regulations 15(1b) and (1c) of the Environmental Assessment Regulations, 1999 (LI 1652) and Ghana's Environmental Impact Assessment (EIA) Procedures, the Environmental Protection Agency (EPA). Further detailed environmental studies are continuing.</p> <p>Cardinal believes that there are unlikely to be any specific environmental issues that would preclude potential eventual economic extraction.</p>
Bulk density	<i>Whether assumed or determined. If assumed, the basis for the assumptions. If determined, the method used, whether wet or dry, the frequency of the measurements, the nature, size and representativeness of the samples.</i>	<p>A substantial body of rock density (SG) measurements for the Namdini deposits were collected.</p> <p>Bulk density is determined using Archimedes principal on DD core samples.</p> <ul style="list-style-type: none"> ➤ Oxide – 2.06 ➤ Transition Metavolcanics – 2.54 ➤ Transition Granite – 2.54

Criteria	JORC Code Explanation	Commentary
		<ul style="list-style-type: none"> ➤ Transition Diorite – 2.58 ➤ Transition Metasediments – 2.58 ➤ Fresh Metavolcanics – 2.81 ➤ Fresh Granite – 2.73 ➤ Fresh Diorite – 2.82 ➤ Fresh Metasediments - 2.82
	<i>The bulk density for bulk material must have been measured by methods that adequately account for void spaces (vugs, porosity, etc), moisture and differences between rock and alteration zones within the deposit.</i>	Weathered samples are wrapped in foil and dried out before being wax coated.
	<i>Discuss assumptions for bulk density estimates used in the evaluation process of the different materials.</i>	Assigned bulk density values were determined for lithological and weathering domains. Density outliers were removed using Rosner outlier detections applying a 95% confidence interval. A density of 1.8 t/m ³ was assigned to the strongly oxidised horizon since the average measured density appears too high.
Classification	<i>The basis for the classification of the Mineral Resources into varying confidence categories.</i>	Mineral Resources were classified on the basis of estimation search passes. A progressively less stringent three pass search strategy produced the three categories of confidence. The highest confident estimate uses a search ellipse of approximately the same dimension of the dominant drill spacing and a significant number of resource composites selected from within an octant constraint. The search radii are expanded and sample criteria relaxed for the second and third categories.
		The current drill hole spacing does not support Measured Mineral Resources, only Indicated (search pass 1) and Inferred (combined search pass 2 and 3) is reported.
	<i>Whether appropriate account has been taken of all relevant factors (ie., relative confidence in tonnage/grade estimations, reliability of input data, confidence in continuity of geology and metal values, quality, quantity and distribution of the data).</i>	The resource classification accounts for all relevant factors and reflect the competent person's views of the deposit. There is an acceptable degree of confidence for tonnes above the cut-off grade due to the pervasive gold mineralization exceeding the cut-off grade. The average grade of the deposit above the cut-off grade is sensitive to the treatment and volumes applied to high grades. The majority of the resources require additional drilling to facilitate conversion to Measured category and the current classification designation support this.
	<i>Whether the result appropriately reflects the Competent Person's view of the deposit.</i>	The resulting classification reflects the Competent Person's view of the deposit.

Criteria	JORC Code Explanation	Commentary
Audits or reviews	<i>The results of any audits or reviews of Mineral Resource estimates.</i>	Mineral Resources have been previously undertaken by independent external consultants.
Discussion of relative accuracy/confidence	<p><i>Where appropriate a statement of the relative accuracy and confidence level in the Mineral Resource estimate using an approach or procedure deemed appropriate by the Competent Person. For example, the application of statistical or geostatistical procedures to quantify the relative accuracy of the resource within stated confidence limits, or, if such an approach is not deemed appropriate, a qualitative discussion of the factors that could affect the relative accuracy and confidence of the estimate.</i></p> <p><i>The statement should specify whether it relates to global or local estimates, and, if local, state the relevant tonnages, which should be relevant to technical and economic evaluation. Documentation should include assumptions made and the procedures used.</i></p> <p><i>These statements of relative accuracy and confidence of the estimate should be compared with production data, where available.</i></p>	<p>MPR's model (Sept 2017) has an overall increase in tonnages and contained metal from previous Mineral Resource estimates by RPA (April 2017). The difference can be attributed to:</p> <ul style="list-style-type: none"> • Additional 86 drill holes totalling 33,406.15 metres • Changes to the classification criteria • Changes to the Mineral Resource Estimation Methodology • Changes to cut-off grade • Mineral Resource constrained by an Optimised pit shell • For the assessment of reasonable prospects of economic extraction, Mineral Resources have been assessed using pit optimisation based on a gold price of US\$1,500/oz, and the following key input parameters: mill-flotation-concentrate regrind-CIL process route with metallurgical recovery of 90% for oxidized mineralization, 86% for transitional mineralization, 86% for fresh mineralization; assuming a bulk mining, low to moderate mining selectivity open pit operation with operating costs appropriate for Ghana, dependent on key parameters, such as gold price, annual throughput, process plant recoveries and operating costs. <p>The Mineral Resource has been classified as Indicated and Inferred with the Indicated Resource considered to be of sufficient confidence to allow mine planning studies to be completed.</p> <p>The geostatistical techniques applied to estimate the Namdini deposit are deemed appropriate for the anticipated bulk mining method proposed.</p>

Section 4 - Estimation and Reporting of Ore Reserves

Golder Associates Pty Ltd estimated the Ore Reserve in accordance with the JORC Code (2012). The term 'Ore Reserve' is synonymous with the term 'Mineral Reserve' as used by Canadian National Instrument 43-101 'Standards of Disclosure for Mineral Projects' (NI 43-101, 2014) and conforms with CIM (2014). The JORC Code (2012) is defined as an 'acceptable foreign code' under NI 43-101.

Criteria	JORC Code Explanation	Commentary																									
Mineral Resource estimate for conversion to Mineral Reserves	<p><i>Description of the Mineral Resource estimate used as a basis for the conversion to an Ore Reserve.</i></p> <p><i>Clear statement as to whether the Mineral Resources are reported additional to, or inclusive of, the Ore Reserves.</i></p>	<p>The Mineral Resource model used as input to the mining model was the MIK model supplied by MPR (February 2018) using parent cell sizes of 12.5x25x5 m (X, Y, Z).</p> <p>The Ore Reserve is wholly inclusive of the Mineral Resource for the Namdini Gold Project.</p>																									
Site visits	<p><i>Comment on any site visits undertaken by the Competent Person and the outcome of those visits.</i></p> <p><i>If no site visits have been undertaken indicate why this is the case.</i></p>	<p>The Competent Person (Ore Reserves) visited the Namdini Gold Project site in Ghana on 14 and 15 December 2017.</p> <p>The site has road access and is readily accessible for power, water and additional infrastructure requirements.</p>																									
Study status	<p><i>The type and level of study undertaken to enable Mineral Resources to be converted to Ore Reserves.</i></p> <p><i>The Code requires that a study to at least Pre-Feasibility Study level has been undertaken to convert Mineral Resources to Ore Reserves. Such studies will have been carried out and will have determined a mine plan that is technically achievable and economically viable, and that material Modifying Factors have been considered.</i></p>	<p>A Preliminary Feasibility Study has been completed and a NI43-101 Technical Report for the TSX is in preparation.</p> <p>Ore Reserves are declared for the Namdini Gold Project based upon a mine plan and mine designs that are deemed technically achievable and have been tested for economic viability using input costs, metallurgical recovery and expected long term gold price, after due allowances for royalties.</p> <table><tr><th>Class</th><th>Type</th><th>Ore tonnes (Mt)</th><th>Contained ounces (koz)</th><th>Grade (Au g/t)</th></tr><tr><td>Probable</td><td>Oxide</td><td>4.2</td><td>155.5</td><td>1.1</td></tr><tr><td>Probable</td><td>Transition</td><td>4.2</td><td>146.5</td><td>1.1</td></tr><tr><td>Probable</td><td>Fresh</td><td>121.2</td><td>4,458.1</td><td>1.1</td></tr><tr><td>Probable</td><td>Total</td><td>129.6</td><td>4,760.0</td><td>1.1</td></tr></table>	Class	Type	Ore tonnes (Mt)	Contained ounces (koz)	Grade (Au g/t)	Probable	Oxide	4.2	155.5	1.1	Probable	Transition	4.2	146.5	1.1	Probable	Fresh	121.2	4,458.1	1.1	Probable	Total	129.6	4,760.0	1.1
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Cut-off parameters	<p><i>The basis of the cut-off grade(s) or quality parameters applied.</i></p>	<p>A marginal cut-off grade (COG) was estimated for gold using a gross long-term gold price of US\$1300/oz. Input processing costs of \$14.49/t plus \$1.50/t stockpile reclaim using an estimated 86% metallurgical recovery. A marginal</p>																									

Criteria	JORC Code Explanation	Commentary
		<p>COG was estimated as: $\text{process cost} / (\text{net gold price} * \text{process recovery})$</p> <p>i.e. $\text{COG} = (\\$14.49 + \\$1.50) / (\\$39.63 * 86\%)$</p> <p>giving 0.5 g/t (to one significant figure)</p> <p>Using this marginal COG, the proportion of ore, and the gold grade above the COG, were defined in the mining model and the parcelled (ore + waste) blocks were exported for open pit optimisation.</p>
Mining factors or assumptions	<p><i>The method and assumptions used as reported in the Pre-Feasibility or Feasibility Study to convert the Mineral Resource to an Ore Reserve (i.e. either by application of appropriate factors by optimisation or by preliminary or detailed design).</i></p> <p><i>The choice, nature and appropriateness of the selected mining method(s) and other mining parameters including associated design issues such as pre-strip, access, etc.</i></p> <p><i>The assumptions made regarding geotechnical parameters (eg pit slopes, stope sizes, etc), grade control and pre-production drilling.</i></p> <p><i>The major assumptions made and Mineral Resource model used for pit and stope optimisation (if appropriate).</i></p> <p><i>The mining dilution factors used.</i></p> <p><i>The mining recovery factors used.</i></p> <p><i>Any minimum mining widths used.</i></p> <p><i>The manner in which Inferred Mineral Resources are utilised in mining studies and the sensitivity of the outcome to their inclusion.</i></p> <p><i>The infrastructure requirements of the selected mining methods.</i></p>	<p>The Namdini Gold Project will be mined by medium scale conventional open pit mining equipment. The mining process will include drill and blast, and conventional load and haul operations. There is a minimal amount of free-dig material with the majority of material requiring drilling and blasting.</p> <p>Mining will be carried out using staged cut-backs with four identified Stages being incorporated into the LOM final pit. Oxide ore will be stockpiled temporarily and treated separately within the process plant as a batch process. Waste rock will be dumped separately with the waste rock piles on the western side of the pit.</p> <p>The pit slopes have been assessed from a detailed geotechnical investigation by Golder with the Oxide (upper material) requiring an estimated overall slope angle of 40°, whilst an overall slope angle of 45° was allowed for in Fresh rock.</p> <p>Grade control drilling will precede ore identification and ore mark-out on a bench basis.</p> <p>The mining model has assumed that sufficient account for estimated ore loss and dilution was incorporated into the Mineral Resource model through the resource estimation (MIK with post-processing of variance adjustment and change of support) technique. Moderate bulk mining (minimal selectivity) was assumed with 400~600 t excavators feeding 100~150 t rigid body haul trucks.</p> <p>A minimum mining width of 60 m was assumed.</p> <p>Inferred Mineral Resources have been considered as waste material. There is minimal Inferred Resource material within the final pit design.</p> <p>Mining infrastructure requirements will be provided by the selected mining contractor with the mining performed on an outsourced basis.</p>

Criteria	JORC Code Explanation	Commentary
Metallurgical factors or assumptions	<p><i>The metallurgical process proposed and the appropriateness of that process to the style of mineralisation.</i></p> <p><i>Whether the metallurgical process is well-tested technology or novel in nature.</i></p> <p><i>The nature, amount and representativeness of metallurgical test work undertaken, the nature of the metallurgical domaining applied and the corresponding metallurgical recovery factors applied.</i></p> <p><i>Any assumptions or allowances made for deleterious elements.</i></p> <p><i>The existence of any bulk sample or pilot scale test work and the degree to which such samples are considered representative of the orebody as a whole.</i></p> <p><i>For minerals that are defined by a specification, has the ore reserve estimation been based on the appropriate mineralogy to meet the specifications?</i></p>	<p>Metallurgical process recoveries have been defined on various samples for Oxide and Fresh ore. Metallurgical testwork was carried out by ALS Laboratories Perth, Australia. An average estimated 90% for the oxide ore and 84% recovery for the Fresh ore was applied in the LOM plan and the pit optimisation process. Testwork is ongoing.</p> <p>The process plant will be a conventional crush, grind, flotation, regrind (of flotation concentrate), Carbon-In-Leach with elution circuit, electrowinning and gold smelting to recover the gold from the loaded carbon to produce doré.</p> <p>No deleterious elements have been identified in the testwork that could affect the saleability or price of the gold doré produced.</p> <p>Testwork carried out to date indicates that the Namdini Gold Project can use a standard gold recovery process plant design with no innovative technology required.</p> <p>Namdini will produce a readily saleable gold doré which will be exported for refining.</p>
Environmental	<p><i>The status of studies of potential environmental impacts of the mining and processing operation. Details of waste rock characterisation and the consideration of potential sites, status of design options considered and, where applicable, the status of approvals for process residue storage and waste dumps should be reported.</i></p>	<p>An initial environmental study was completed by NEMAS. This study was commenced in early 2017 with the PFS report component expected in September 2018.</p> <p>Further detailed environmental studies are continuing.</p>
Infrastructure	<p><i>The existence of appropriate infrastructure: availability of land for plant development, power, water, transportation (particularly for bulk commodities), labour, accommodation; or the ease with which the infrastructure can be provided, or accessed.</i></p>	<p>Lycopodium completed PFS level study of the infrastructure requirements including power, water, road access, and waste management.</p> <p>The site will be accessed by a new ~25 km gravel road linking the site to the existing national road N10 between Pwalgu and Shia. The N10 provides good access to the major cities and ports in southern Ghana and no upgrades of the N10 will be undertaken. The site access road will follow a similar route to the proposed new power line for the existing substation north of Pwalu.</p>

Criteria	JORC Code Explanation	Commentary
Costs	<i>The derivation of, or assumptions made, regarding projected capital costs in the study.</i>	Costs were provided by Lycopodium to a PFS level. Capital and operating costs were estimated for three process plant ore feed throughputs: 4.5 Mtpa, 7.0 Mtpa and 9.5 Mtpa.
	<i>The methodology used to estimate operating costs.</i>	Operating costs were compiled from quotations, database and a variety of sources and compared against existing and planned operations elsewhere in Ghana.
	<i>Allowances made for the content of deleterious elements.</i>	Mining costs were provided by Golder based on fully quoted submissions from the two largest in country mining contractors and supported by similar mining operations in Africa. The estimated base mining cost used an incremental cost with depth to account for increased haulage costs. The depth of mining increases in line with standard mining cost principles.
	<i>The derivation of assumptions made of metal or commodity price(s), for the principal minerals and co-products.</i>	
	<i>The source of exchange rates used in the study.</i>	
	<i>Derivation of transportation charges.</i>	All costs were determined on a US dollar (US\$) basis.
	<i>The basis for forecasting or source of treatment and refining charges, penalties for failure to meet specification, etc.</i>	
Revenue factors	<i>The allowances made for royalties payable, both Government and private.</i>	
	<i>The derivation of, or assumptions made regarding revenue factors including head grade, metal or commodity price(s) exchange rates, transportation and treatment charges, penalties, net smelter returns, etc.</i>	An allowance for 5% royalties was used in the Optimisations and financial modelling associated with the LOM planning assessment. Gold will be the single product commodity from the Namdini Gold Project with the gold product being exported as doré.
	<i>The derivation of assumptions made of metal or commodity price(s), for the principal metals, minerals and co-products.</i>	
Market assessment	<i>The demand, supply and stock situation for the particular commodity, consumption trends and factors likely to affect supply and demand into the future.</i>	Gold is a readily traded commodity and no specific market study has been carried out. Advice regarding the forward-looking gold price was provided by Cardinal Resources.
	<i>A customer and competitor analysis along with the identification of likely market windows for the product.</i>	No projected or oversupply of gold is envisaged which could affect the product market pricing.
	<i>Price and volume forecasts and the basis for these forecasts.</i>	The long-term price of gold has been assumed to be US\$1,250 for the financial model evaluation metrics
	<i>For industrial minerals the customer specification, testing and acceptance requirements prior to a supply contract.</i>	The gold will be sold as doré.

Criteria	JORC Code Explanation	Commentary
Economic	<p><i>The inputs to the economic analysis to produce the net present value (NPV) in the study, the source and confidence of these economic inputs including estimated inflation, discount rate, etc.</i></p> <p><i>NPV ranges and sensitivity to variations in the significant assumptions and inputs.</i></p>	<p>The economic assessments in the Whittle Optimisations and optimised schedules have used a discount rate of 10%.</p> <p>Schedules were based upon engineer pit designs.</p> <p>Sensitivity estimates have been carried out on the primary cost drivers: gold price, capital cost, process plant operating costs, mining costs and process plant recovery efficiency.</p>
Social	<p><i>The status of agreements with key stakeholders and matters leading to social licence to operate.</i></p>	<p>A Pre-feasibility level environmental and social study is currently being carried out by NEMAS including active engagement of local and state regulatory bodies.</p>
Other	<p><i>To the extent relevant, the impact of the following on the project and/or on the estimation and classification of the Ore Reserves:</i></p> <p><i>Any identified material naturally occurring risks.</i></p> <p><i>The status of material legal agreements and marketing arrangements.</i></p> <p><i>The status of governmental agreements and approvals critical to the viability of the project, such as mineral tenement status, and government and statutory approvals. There must be reasonable grounds to expect that all necessary Government approvals will be received within the timeframes anticipated in the Pre-Feasibility or Feasibility study. Highlight and discuss the materiality of any unresolved matter that is dependent on a third party on which extraction of the reserve is contingent.</i></p>	<p>There are no known current impediments to the progression of the project or foreseen encumbrances to the granting of a licence to operate.</p> <p>Continued discussions with the regulatory authorities and submission of the mine plan and closure plan to the Ghanaian authorities will be done during the course of the proposed Feasibility study</p>
Classification	<p><i>The basis for the classification of the Ore Reserves into varying confidence categories.</i></p> <p><i>Whether the result appropriately reflects the Competent Person's view of the deposit.</i></p> <p><i>The proportion of Probable Mineral Reserves that have been derived from Measured Mineral Resources (if any).</i></p>	<p>Only Probable Ore Reserves are declared for the Namdini Gold Project. No Measured Resource is present in the current Mineral Resource model.</p> <p>Indicated Mineral Resource material was converted to Probable Ore Reserves where that material was within the final pit design and was scheduled for processing after application of the Modifying Factors.</p>
Audits or reviews	<p><i>The results of any audits or reviews of Ore Reserve estimates.</i></p>	<p>The Pre-feasibility and scoping study outputs have been the subject of internal review by the contributing parties and external review by other consultants.</p> <p>No fatal flaws were identified by external consultants</p>

Criteria	JORC Code Explanation	Commentary
Discussion of relative accuracy/confidence	<p><i>Where appropriate a statement of the relative accuracy and confidence level in the Ore Reserve estimate using an approach or procedure deemed appropriate by the Competent Person. For example, the application of statistical or geostatistical procedures to quantify the relative accuracy of the reserve within stated confidence limits, or, if such an approach is not deemed appropriate, a qualitative discussion of the factors which could affect the relative accuracy and confidence of the estimate.</i></p> <p><i>The statement should specify whether it relates to global or local estimates, and, if local, state the relevant tonnages, which should be relevant to technical and economic evaluation. Documentation should include assumptions made and the procedures used.</i></p> <p><i>Accuracy and confidence discussions should extend to specific discussions of any applied Modifying Factors that may have a material impact on Ore Reserve viability, or for which there are remaining areas of uncertainty at the current study stage.</i></p> <p><i>It is recognised that this may not be possible or appropriate in all circumstances. These statements of relative accuracy and confidence of the estimate should be compared with production data, where available.</i></p>	<p>The Ore Reserves have been classified as Probable by conversion of Indicated Resource material above the 0.5 g/t Au cut-off grade within the final pit design.</p> <p>The Ore Reserve was estimated from the Mineral Resource after consideration of the level of confidence in the Mineral Resource and taking account of material and relevant modifying factors including mining, processing, infrastructure, environmental, legal, social and commercial factors. The Probable Ore Reserve estimate is based on Indicated Mineral Resources. No Inferred Mineral Resource was included in the Ore Reserve. The Ore Reserve represents the economically mineable part of the Indicated Mineral Resources. There is no Proved Ore Reserves since no Measured Mineral Resource has yet been defined.</p> <p>The key to the accuracy of the Ore Reserve is the underpinning Mineral Resource that is considered to be of sufficient confidence to allow mine planning studies to be completed.</p> <p>The proposed mine plan is technically achievable. All technical proposals made for the operational phase involve the application of conventional technology that is widely utilised in the gold industry.</p> <p>Financial modelling completed as part of the PFS shows that the Project is economically viable under current assumptions. Material Modifying Factors (mining, processing, infrastructure, environmental, legal, social and commercial) were considered during the Ore Reserve estimation process.</p> <p>The key factors that are likely to affect the accuracy and confidence in the Ore Reserves are:</p> <ul style="list-style-type: none"> • Changes in gold prices and sales agreements • Accuracy of the underlying Resource Block Models • Changes in metallurgical recovery • Mining loss and dilution