PRESS RELEASE **ASX/TSX:CDV**
28 October 2019 2019-18

FEASIBILITY STUDY CONFIRMS CARDINAL'S NAMDINI AS A TIER ONE GOLD PROJECT

5.1 Moz Ore Reserve and a 15 Year Mine Life with early payback*

Cardinal Resources Limited (ASX / TSX : CDV) ("**Cardinal**" or "**the Company**") is pleased to announce the results of the Feasibility Study ("**FS**") for the Namdini Gold Project ("**Namdini**" or the "**Project**") in Ghana, West Africa. The FS confirms Namdini as a gold project with attractive economic returns.

HIGHLIGHTS

- ☑ 5.1 million ounces (Moz) Ore Reserve* *(Pre-Feasibility Study◆ (PFS) 4.76 Moz†)*
- ☑ 421,000 oz in first 12 months *(PFS 420,000 oz)*; 1.1 Moz forecast for first 3 years of full production
- ☑ US$1.46 billion in undiscounted, pre-tax free cashflow forecast with the current life of mine (LOM) plan of 15 years at US$1,350/oz (*US$2.05 billion undiscounted, pre-tax free cashflow at US$1,500/oz*)
- ☑ US$324 million in undiscounted, pre-tax free cashflow, forecast during 1st Year of full production at US$1,350/oz (*US$384 million first year pre-tax free cashflow at US$1,500/oz*)
- ☑ US$348 million capital expenditure (CAPEX) plus US$42 million contingency allowed with a robust level of accuracy of +15/-5% *(PFS US$414 million total Capex; +30/-20% accuracy)*
- ☑ CAPEX payback of 21 months at US$1,350/oz *(12 months at USD$1,500/oz)*; driven by early higher grades and recoveries, low strip ratio and low costs, within the starter pit
- ☑ Low all-in sustaining costs (AISC) of US$585 during CAPEX payback *(PFS US$599)*
- ☑ Pit design LOM Strip Ratio 1.9:1 *(PFS 1.4:1)*; Starter pit Strip Ratio of 0.9:1; LOM pit design based on US$1,235/oz *(PFS US$1,105/oz)*
- ☑ Financial Model based on US$1,350/oz for 15 years *(PFS US$1,250/oz)*
- ☑ 4.2 Moz *(130 metric tonnes)* produced over 15 years *(PFS 3.9 Moz);* AISC US$895/oz *(PFS US$769/oz)*
- ☑ Aachen Process Technology has been adopted to provide economic benefits via operating cost savings; 85% gold recovery during first three years; 83% gold recovery for current LOM plan
- ☑ Namdini 9.5 Mtpa gold project is based upon a single, large open-pit with a conventional process plant design; crush, grind, float, regrind, high shear oxidation (Aachen™) and carbon in leach (CIL)
- ☑ First gold pour targeted for H2 2022 *(subject to financing in H1 2020)*
- ☑ Namdini Project Net Present Value (NPV) and Internal Rate of Return (IRR) at US$1,350/oz:

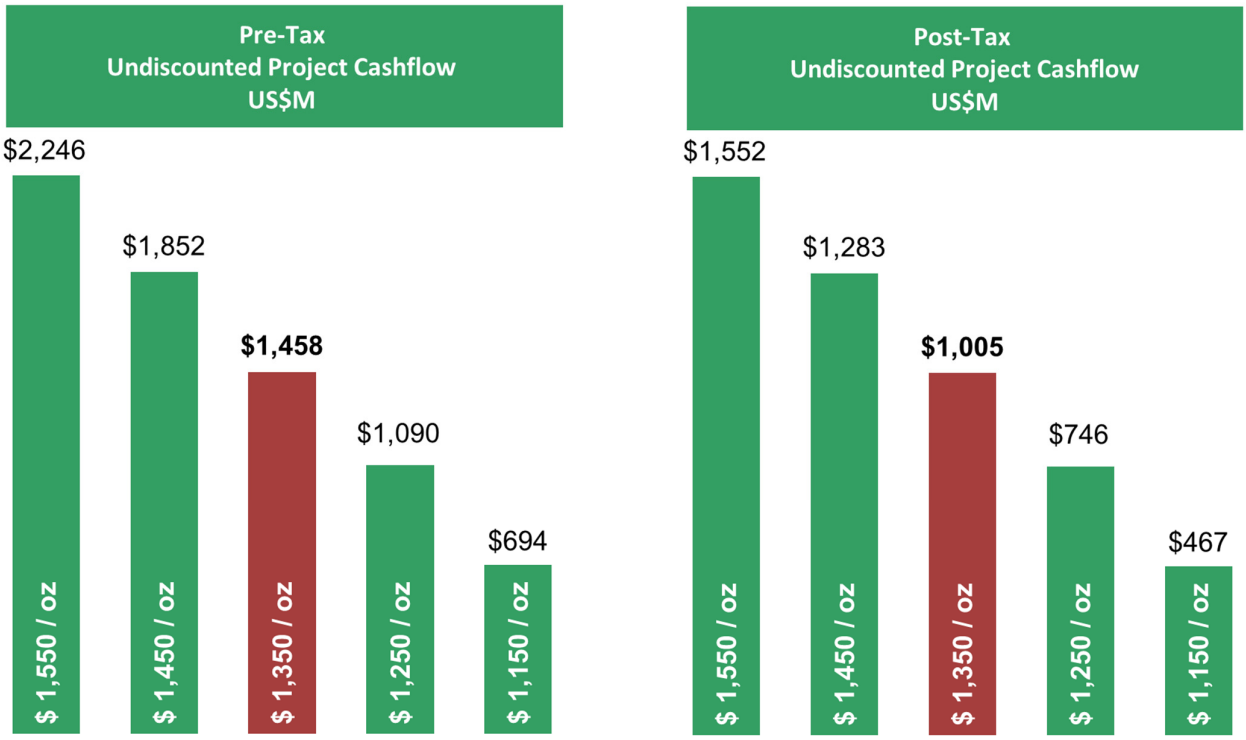
	Net Present Value (NPV_5)	Internal Rate of Return (IRR)
Pre-tax	US$914 Million	43.0%
Post-tax	US$590 Million	33.2%

- ☑ Cardinal's Board has approved this Feasibility Study and plans to further de-risk the project by commencing the Front End Engineering Design (FEED) programme and further enhancement of the Project Execution Plan (PEP). Early site works and advancement of engineering towards construction, will be funded through Cardinal's strong cash position of circa A$27 million.

* *138.6 Mt @ 1.13 g/t Au; 0.5 g/t cut-off, inclusive of 0.4Moz Proved (7.4 Mt @ 1.31 g/t Au) and 4.7Moz Probable (131.2 Mt @ 1.12 g/t Au); 0.5 g/t Au cut-off.*
◆ *Pre-Feasibility Study (PFS) released on ASX / TSX 18th September 2018*
† *129.6 Mt @ 1.14 g/t Au; 0.5 g/t cut-off, inclusive of 4.76 Moz Probable (129.6 Mt @ 1.14 g/t Au); 0.5 g/t Au cut-off.*

Project Sensitivity Analysis

Sensitivity to US$ Gold Price; Pre and Post-Tax

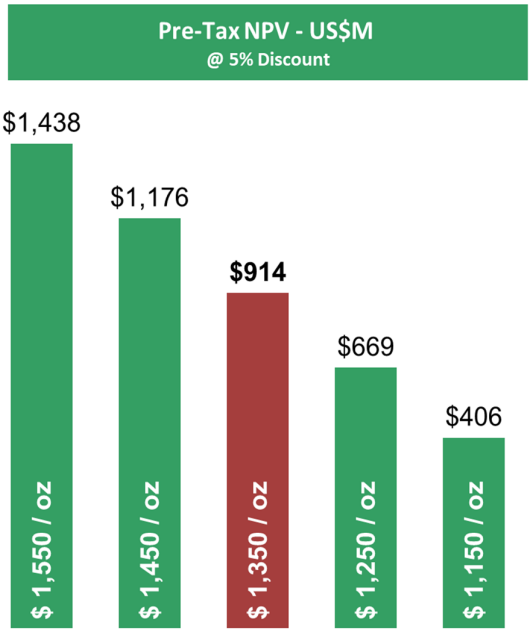


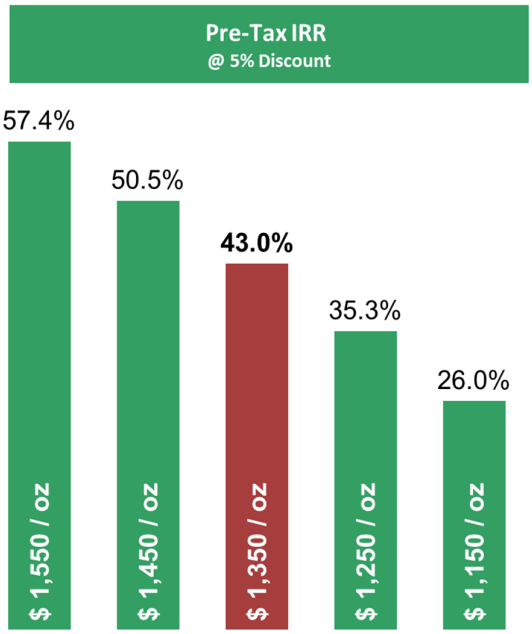
Capital Cost Estimate

The following Table compares the major Project parameters for the FS with those for the PFS:

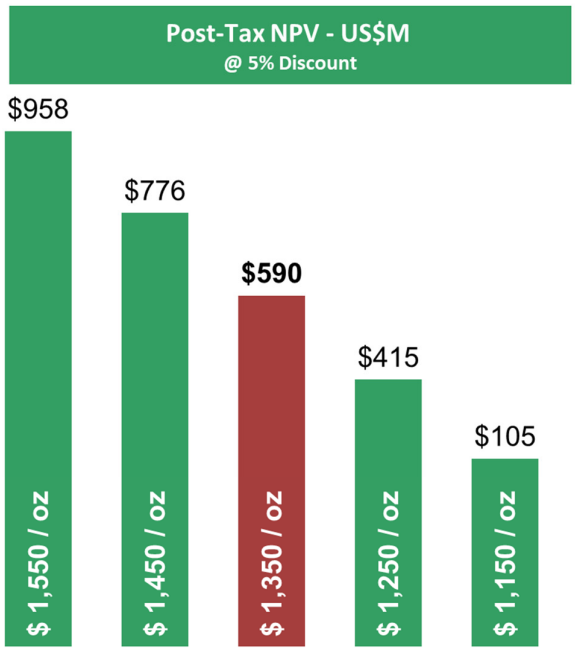
Direct	FS ($US Million) *+15/-5% accuracy*	PFS ($US Million) *+30/-20% accuracy*
Process Plant	230	205
Infrastructure & Utilities	57	76
Sub-total direct	**287**	**281**
Indirect	**FS ($US Million)**	**PFS ($US Million)**
Engineering & Contractors	36	37
Owners costs	25	35
Sub-total indirect	**61**	**72**
Contingency	42	61
Total Capital Cost	**390**	**414**

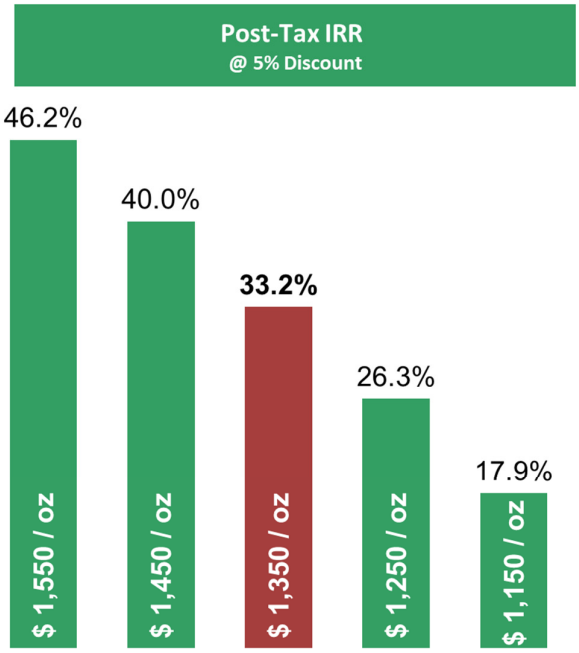
Sensitivity of Project Outcomes to US$ Gold Price; Pre-Tax





Sensitivity of Project Outcomes to US$ Gold Price; Post-Tax





US Dollar Gold Price Sensitives

The FS has been evaluated at a gold price of USD$1,350 per ounce. The average US$ gold price per gold ounce for the period from October 2017 to current day was US$1,387 per ounce. During the period, the US dollar gold price has been in steady uptrend from a low of US$1,177 in August 2018 to a high of US$1,550 per ounce traded during September 2019.

Key Technical and Financial Outcomes

The key technical and financial outcomes from the FS on a 100% basis are summarised in the following tables. Further details are provided in the Appendix to this announcement.

Financial Summary for 9.5 Mtpa throughput *(based upon a gold price of US$1,350/oz)*

KEY ECONOMIC RESULTS		UNIT	FEASIBILITY STUDY
Capital cost *(including 11% contingency)*		US$ M	390
All-in Sustaining Cost *(AISC)*[1]	*Starter Pit*	US$/oz	585
	Life of Mine	US$/oz	895
Total Project payback		Months	21
Pre-Tax NPV US$ *(5% discount rate)*		US$ M	914
Post-Tax NPV US$ *(5% discount rate)*		US$ M	590
Pre-Tax IRR		%	43
Post-Tax IRR		%	33

Table Notes:
[1] Cash Costs + Royalties + Levies + Life of Mine Sustaining Capital Costs (World Gold Council Standard)
Royalties calculated at a rate of 5.5% and a corporate tax rate of 32.5%; both subject to negotiation, and expected to be finalised over coming months.

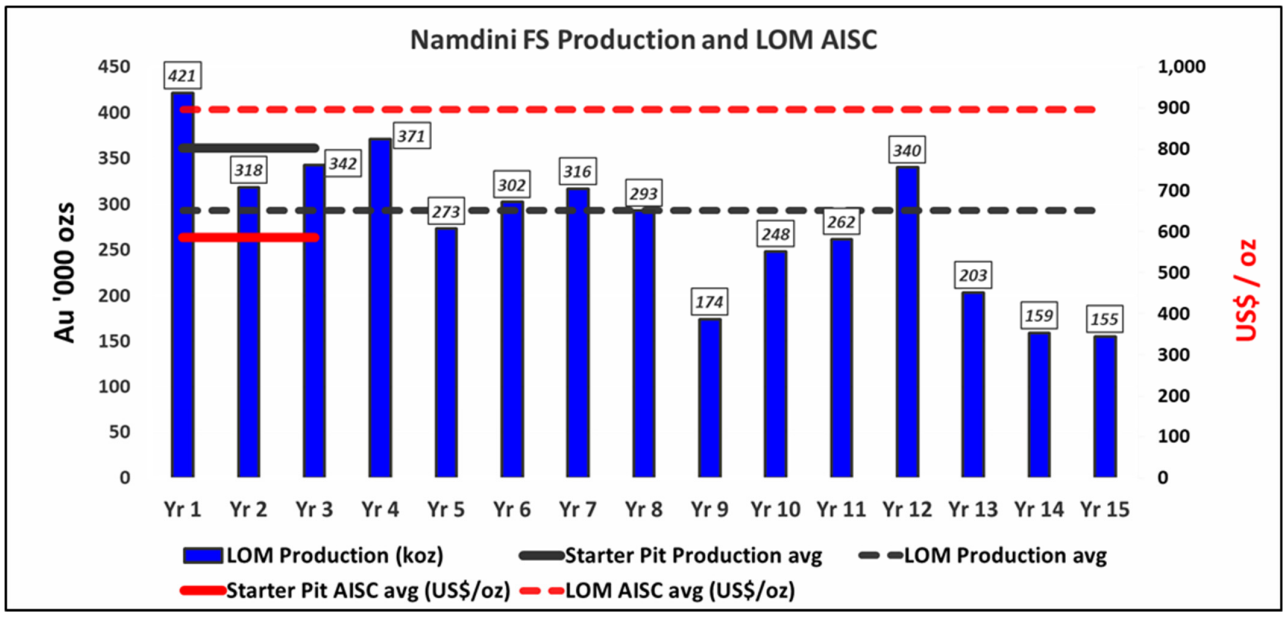
Starter Pit Production Summary

KEY ESTIMATED PRODUCTION RESULTS	UNIT	FEASIBILITY STUDY
Gold price	US$/oz	1,350
Gold produced *(average for full production years)*	(koz/yr)	361
Gold head grade *(Starter Pit, Ore Reserve)*	g/t Au	1.41
Gold recovery *(Starter Pit)*	%	85
Strip ratio *(Starter Pit)*	W:O	0.9 :1
Ore mined *(0.5 g/t cut-off grade)*	Tonnes (Mt)	47
Waste mined	Tonnes (Mt)	43
Starter Pit life *(including ramp-up)*	Months	27
Total Project payback	Months	21

LOM Production Summary *(including Starter Pit)*

KEY ESTIMATED PRODUCTION RESULTS	UNIT	FEASIBILITY STUDY
Gold price	US$/oz	1,350
Gold produced *(average for LOM full production years)*	(koz/yr)	287
Gold produced *(LOM)*	(Moz)	4.2
Gold head grade *(LOM, Ore Reserve)*	g/t Au	1.13
Gold recovery *(LOM)*	%	83
Strip ratio *(LOM)*	W:O	1.9 : 1
Ore mined *(0.5 g/t cut-off grade)*	Tonnes (Mt)	138.6
Waste mined	Tonnes (Mt)	263
Mine life *(Including ramp-up and mine closure)*	years	15
Capital cost *(including 11% contingency)*	US$ M	390
Total Project payback	Months	21

Production Profile and LOM AISC



Ongoing Activity

The activities summarised in the Project development schedule below are subject to favourable timelines for finalising project funding, permitting, contracting and procurement.

Further Project optimisation and regional exploration

In conjunction with moving the Project toward a financial investment decision, work continues on further project optimisation and regional exploration utilising Cardinal's strong cash at bank of approximately A$27 million.

Cardinal's ~900 km^2 of prospective exploration tenure within hauling distance of the proposed Namdini gold production plant remains a short-term opportunity for project enhancement.

Exploration activities, including drilling, will recommence shortly with the stated aim of identifying shallow, high grade deposits that can augment existing Namdini ore to further enhance the current project economics. Recent positive results from exploration activities, for example at Ndongo East[1], provide encouragement that higher grade gold systems may exist in the region within trucking distance to the Namdini deposit.

Funding and Strategic Alternatives

Cardinal's Board has approved this Feasibility Study and recommends progressing the Project to construction pending successful completion of financing activities.

The Company has been actively working with its appointed debt advisor, Cutfield Freeman & Co (London) to secure Project debt finance on competitive terms and continues to assess various funding options.

In early 2019, the Company commenced Project finance discussions with a number of Australian and International Banking groups from which the Company received a number of preliminary (non-binding) financing term sheets. Discussions with these interested financial institutions have progressed where financial and technical due diligence has commenced, with a data room prepared and accessed, with several technical site visits already conducted. Review of financing options for the Namdini Project will be completed in due course following the Feasibility Study.

In addition to traditional financing solutions, the Company is concurrently evaluating strategic alternatives to bring the project into production with a view to maximising economic outcomes for Cardinal shareholders.

A final financing decision will be made at a time assessed as most appropriate and beneficial to the Company.

In the meantime, the Company remains in a strong financial position with cash reserves of approximately A$27 million.

[1] *Refer to the announcements "Cardinal Intercepts High-Grade Shallow Gold at Ndongo East" released to the ASX and TSX on 27 March 2019 and "Cardinal Reports Further Shallow High-Grade Gold at Ndongo East" released to the ASX and TSX on 10 July 2019.*

Opportunities

The FS demonstrates a viable, globally significant, long-life gold project at Namdini. Potential remains for further improvements in Project economics which will form the basis of ongoing evaluation work, including:

- FEED and PEP programmes incorporating Whittle Consulting's mine and schedule optimisation plan.
- OPEX savings by evaluating a flotation cleaner circuit; potential to reduce required regrind power.
- Additional Mineral Resources that are **not** part of the current Ore Reserve which represent lateral strike and depth extensions to the current LOM pit design at US$1,235/oz. Subject to the outcome of additional drilling beyond the current pit design, any economic discovery **not** in the current mine plan may extend the life of the current mine plan which may also include a new underground mine plan.
- The Regional land package may also have potential to define satellite pits with close proximity to Namdini. Recent results from drilling completed within the Ndongo Project, located approximately 24 km north of Namdini are within hauling distance.[2] Drill testing new zones of high-grade gold mineralisation to define satellite pits will recommence soon.

Archie Koimtsidis, Managing Director and Chief Executive Officer, commented:

"Cardinal's Technical Team, led by our Chief Operating Officer Dave Anthony, along with Lycopodium, Golders and various study managers, have delivered a compelling and robust technical and economic outcome, paving the way for our planned development of the Namdini Gold Project.

With over 1 million ounces slated for production in the first three years; 421,000 oz in Year 1 alone, and an average annual gold production of 287,000 oz over a 15-year mine life, Namdini ranks amongst the world's largest known, financially robust, undeveloped gold projects.

Namdini has a 5.1 Moz Ore Reserve that is projected to generate US$1.46 billion in undiscounted, pre-tax free cashflow over 15 years including US$324 million in undiscounted, pre-tax free cashflow during its 1st Year of full production, based on a gold price of US$1,350, which is significantly below the current spot gold price.

Since the discovery of Namdini in 2015, we have continued to be focused on de-risking the project and have reached a robust Project CAPEX accuracy level of +15/-5% for this Feasibility Study. Unlike whole of ore gold processing plants, we have the benefit of being able to produce a concentrate for gold extraction on site which means that we have a much smaller back half of the plant providing a huge positive impact on capital costs. Economic and technical optimisation confirms a large, single open-pit utilising a conventional process plant with a throughput of 9.5 Mtpa and a very attractive 24-month debt payback.

On a social level, Namdini is poised to become the first large scale operating mine in the Upper East Region of Ghana, delivering sustainable prosperity and opportunities to all stakeholders. We are grateful for the continued overwhelming support of these communities and their elders along with the Government of Ghana to bring this project into production."

[2] *Refer to the announcements "Cardinal Intercepts High-Grade Shallow Gold at Ndongo East" released to the ASX and TSX on the 27 March 2019 and "Cardinal Reports Further Shallow High-Grade Gold at Ndongo East" released to the ASX and TSX on the 10 July 2019*

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 flagship Namdini Gold Project.

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

For further information contact:

Archie Koimtsidis
CEO / MD
Cardinal Resources Limited
P: +61 8 6558 0573

Alec Rowlands
IR / Corp Dev
Cardinal Resources Limited
P: +1 647 256 1922

Cannings Purple
Andrew Rowell or Peta Baldwin
E: arowell@canningspurple.com.au
E: pbaldwin@canningspurple.com.au

Technical Report – NI 43-101

A Technical Report on the Feasibility Study prepared in accordance with NI 43-101 of the Canadian Securities Administrators will be available on SEDAR at www.sedar.com within 45 days, which will expand on the attached Technical Summary.

Feasibility Study Accuracy

This Feasibility Study has achieved an overall accuracy of +/- 15% on the following basis:

- Detailed geologic and mine engineering work has been conducted to define a Mineral Resource and Ore Reserve.
- Detailed testwork has been completed to develop all mining and processing parameters for pit slope design, hydrology, geotechnical, flow sheet development, equipment selection and sizing, consumables and power consumption, material balance, general arrangement drawings, production and development schedules, capital and operating cost estimates.
- Capital and operating cost estimates have been derived from take-offs and full vendor quotes.
- An Environmental Impact Statement (EIS) has been submitted to the Ghanaian regulatory body.
- The right to mine can be reasonably expected to be granted (allowed by NI 43-101 and JORC to declare Ore Reserves). Cardinal has been granted a 15 year Mining Lease for Namdini.
- Economic analysis with sensitivities is based on annual cash flow calculations for the mine life.
- For the purposes of The Canadian Institute of Mining, Metallurgy, and Petroleum (CIM) this Feasibility Study is "a comprehensive technical and economic study of the selected development option for a mineral project that includes appropriately detailed assessments of applicable Modifying Factors together with any other relevant operational factors and detailed financial analysis that are necessary to demonstrate, at the time of reporting, that extraction is reasonably justified (economically mineable). The results of the study may reasonably serve as the basis for a final decision by a proponent or financial institution to proceed with, or

finance, the development of the project. The confidence level of the study will be higher than that of a Pre-Feasibility Study."

Study Inputs

Key inputs for the Namdini FS are based upon the following recent studies:

- A revised Mineral Resource estimate, compiled by MPR Geological Consultants Pty Ltd (Perth WA), as disclosed in the announcement "Cardinal's Namdini Ore Reserve Now 5.1 Moz" released to the ASX and TSX on 3 April 2019
- A Proved and Probable Ore Reserve as disclosed in the announcement "Cardinal's Namdini Ore Reserve Now 5.1 Moz" released to the ASX and TSX on 3 April 2019, along with detailed monthly mining and processing schedules derived entirely from the Ore Reserve produced by Golder Associates Pty Ltd ("Golder", Perth WA) after the application of mining parameters, ore haulage costs based on in-country mining contractor inputs and owner-mining cost models, processing inputs and geotechnical pit design considerations
- Updated cut-off grade parameters, with the 0.5 g/t Au cut-off grade estimate remaining the same as disclosed in the announcement "Cardinal's Namdini Ore Reserve Now 5.1 Moz" released to the ASX and TSX on 3 April 2019
- Geotechnical inputs and parameters for the LOM pit design by Golder (Perth) as disclosed in the announcement "Cardinal's Namdini Pre-Feasibility Study" to the ASX and TSX on 18 September 2018
- Process engineering design, capital and operating costs by Lycopodium Minerals Pty Ltd, Perth as disclosed in this announcement
- Metallurgical recovery inputs based on testwork by ALS Global (Perth) as disclosed in the announcement "Cardinal's Namdini Pre-Feasibility Study" to the ASX and TSX on 18 September 2018 and recent testwork results from Maelgwyn Mineral Services Africa (Johannesburg, South Africa) and interpreted by Independent Metallurgical Operations (IMO, Perth) as disclosed in the announcement "Positive Metallurgical Update on the Namdini Project" to the ASX and TSX on 4 June 2019 and in this announcement
- Process infrastructure design including and not limited to, waste, residue, tailings storage and water management design by Knight Piésold Consulting (Perth) as disclosed in this announcement
- Other cost inputs (e.g. power, administration and accommodation) by Cardinal's team using inputs from external consultants as disclosed in this announcement
- The status of the social and environmental approvals, mining tenements, other government factors and other infrastructure requirements for the selected mining method remains the same as disclosed in the announcement "Cardinal's Namdini Pre-Feasibility Study" to the ASX and TSX on 18 September 2018
- The FS financial model as disclosed in this announcement was verified by independent accounting company, BDO Advisory Pty Ltd, Perth
- The FS has been evaluated at a gold price of USD$1,350 per ounce. The average US$ gold price per gold ounce for the period from October 2017 to current day was US$1,387 per ounce. During the period, the US dollar gold price has been in steady uptrend from a low of US$1,177 in August 2018 to a high of US1,550 per ounce traded during September 2019

Competent and Qualified Person Statements

All production targets for the Namdini Project referred to in this Report are underpinned by Mineral Resource and Ore Reserve estimates which were prepared by Competent Persons in accordance with the requirements of the JORC Code and who are also Qualified Persons in accordance with NI 43-101 respectively.

The information in this press release that relates to process plant, infrastructure, and capital costs is based on information compiled and reviewed by **Mr David Gordon**, who is a Fellow of the AusIMM and a full-time employee of **Lycopodium Minerals Ltd (Lycopodium)**. Mr Gordon has sufficient experience which is relevant to the activity which he has undertaken to be a Competent Person as defined in the JORC Code (2012) and a Qualified Person for the purposes of NI 43-101. He 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 information in this press release that relates to Ore Reserves and mining studies is based on information compiled and reviewed by **Mr Glenn Turnbull**, who is a Chartered Engineer, a Fellow of the Institute of Materials, Minerals and Mining, a Member of the Australasian Institute of Mining and Metallurgy, and an employee of **Golder Associates Pty Ltd (Golder)**. Mr Turnbull has sufficient experience which is relevant to the style of mineralisation and type of deposit under consideration and to the activity which he has undertaken to be a Competent Person as defined in the JORC Code (2012) and a Qualified Person for the purposes of NI 43-101. He 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 information in this press release that relates to Mineral Resources is based on information compiled and reviewed by **Mr Nicolas Johnson**, who is a Member of the Australian Institute of Geoscientists and a full-time employee of **MPR Geological Consultants Pty Ltd (MPR)**. Mr Johnson has sufficient experience which is relevant to the style of mineralisation and type of deposit under consideration and to the activity which he has undertaken to be a Competent Person as defined in the JORC Code (2012) and a Qualified Person for the purposes of NI 43-101. He 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.

Scientific and technical information contained in this press release that pertains to metallurgical results and interpretations has been reviewed by **Mr Daryl Evans**, who is a Fellow of the AusIMM and a full-time employee of **Independent Metallurgical Operations Pty Ltd (IMO)**. Mr Evans has sufficient experience which is relevant to the activity which he has undertaken to be a Competent Person as defined in the JORC Code (2012) and a Qualified Person for the purposes of NI 43-101. He 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 in this press release that relates to Exploration Results, Mineral Resources and Mineral Ore Reserves at the Namdini Gold Project has been reviewed and approved by **Mr. Richard Bray**, a Registered Professional Geoscientist with the Australian Institute of Geoscientists and **Mr. Ekow Taylor**, a Chartered Professional Member with the Australasian Institute of Mining and Metallurgy. They each have more than five years' experience relevant to the styles of mineralisation and type of deposits under consideration and to the activity which is being undertaken to be a Competent Person as defined in the JORC Code (2012) and a Qualified Person for the purposes of NI 43-101. Mr. Bray and Mr. Taylor are full-time employees of **Cardinal Resources Ltd (Cardinal)** and hold equity securities in the Company.

NOTE: The Competent Persons signing this press release have been advised that Cardinal has all permits required to conduct the proposed work on the Project. The authors of the attached Technical Summary and the other signatories are not aware of any specific environmental liabilities on the Project. They consider that Cardinal has all permits required to conduct the proposed work on the Project. They are not aware of any other significant factors and risks that may affect access, title, or the right or ability to perform ongoing work programmes on the Project.

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 FS referred to in this announcement is based upon a Proved and Probable Ore Reserve derived from Measured and Indicated Mineral Resources. No Inferred Mineral Resource is included in the estimation of Ore Reserves. The Company advises that the Proved and Probable 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 is included in the Life of Mine plan.

Project approval and development remains subject to market conditions, project financing, and Board and regulatory approvals. There is no certainty that the FS or the Ore Reserve from which it was derived will result in commercial production or the assumptions used in the FS and resulting economic outcomes that are included in this announcement will be realised.

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 FS has been prepared to an overall capital expenditure level of accuracy of approximately +15% to -5%. This announcement has been prepared in accordance with the JORC Code (2012) and the current ASX Listing Rules and in compliance 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. Your attention is drawn to the preceding Cautionary Statement, the following Disclaimer and the following Forward-looking Statements.

No New Information or Data

Cardinal confirms that it is not aware of any new information or data that materially affects the information included in the original market announcements and, in the case of estimates of Mineral Resources and Ore Reserves, which all material assumptions and technical parameters underpinning the estimates in the relevant market announcement continue to apply and have not materially changed. The Company confirms that the form and context in which the Competent Person's findings are presented have not materially changed from the original market announcement.

Disclaimer

This ASX / TSX press release has been prepared by Cardinal Resources Limited (ABN: 56 147 325 620). 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 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 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 targets, 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 does not intend 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 various Corporations Acts, 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.

Namdini Gold Project Feasibility Study
Technical Summary

Ghana, West Africa

Prepared By:

Mr David Gordon, FAusIMM
Lycopodium Minerals Pty Ltd

Mr Daryl Evans, FAusIMM
Independent Metallurgical Operations Pty Ltd

Mr Nicolas Johnson, MAIG
MPR Geological Consultants Pty Ltd

Mr Glenn Turnbull, FIMMM, MAusIMM, Eur. Ing, C.Eng
Golder Associates Pty Ltd

Effective date: Monday 28th October 2019

A Technical Report on the Feasibility Study prepared in accordance with NI 43-101 of the Canadian Securities Administrators will be available on SEDAR at www.sedar.com within 45 days, which will expand on the following Technical Summary.

Important Notice

This notice is an integral component of the 2019 Cardinal Resources Limited Namdini Gold Project Feasibility Study (the "**2019 Namdini FS**") and should be read in its entirety and must accompany every copy made of the 2019 Namdini FS. The attached Technical Summary conforms with the Canadian National Instrument 43-101 Standards of Disclosure for Mineral Projects and is the Summary Section of a more comprehensive Technical Report that complies with NI 43-101, to be released within 45 days.

The 2019 Namdini FS was prepared for Cardinal Resources Limited (TSX:CDV) (**"Cardinal**" or "**the Company**") by Golder Associates Pty Ltd, Perth ("**Golder**"), Lycopodium Minerals Pty Ltd ("**Lycopodium**") and others (the "**Study Team**", see Section 3.0). The 2019 Namdini FS is based on information and data supplied by Cardinal, Lycopodium, Golder and other consultants who have signed this "**Technical Summary**" ("**the Authors**"). The quality of information, conclusions, and estimates contained herein are consistent with the level of effort involved in the services of the Authors, based on: i) information available at the time of preparation, ii) data supplied by outside sources, and iii) the assumptions, conditions, and qualifications set forth in the 2019 Namdini FS. Each portion of the 2019 FS report is intended for use by Cardinal subject to the terms and conditions of its contract with the Authors. Except for the purposes legislated under Canadian provincial and territorial securities law, any other uses of the Technical Summary, by any third party, is at that party's sole risk. Recognizing that Cardinal has legal and regulatory obligations, the Authors have consented to the filing of this Technical Summary with Canadian Securities Administrators and its System for Electronic Document Analysis and Retrieval (SEDAR).

Readers are cautioned that actual results may vary from those presented. The factors and assumptions used to develop the forward-looking information, and the risks that could cause the actual results to differ materially are presented in the body of this report under each relevant section. The conclusions and estimates stated in the 2019 Namdini FS are to the accuracy stated in the 2019 Namdini FS only and rely on assumptions stated in the 2019 Namdini FS. The results of further work may indicate that the conclusions, estimates and assumptions in the 2019 Namdini FS need to be revised or reviewed. Project approval and development remains subject to market conditions, project financing, and Board and regulatory approvals.

The Authors have used their experience and industry expertise to produce the estimates and approximations in the 2019 Namdini FS. Where the Authors have made those estimates and approximations, they are subject to qualifications and assumptions and it should also be noted that all estimates and approximations contained in the 2019 Namdini FS will be prone to fluctuations with time and changing industry circumstances. The 2019 Namdini FS should be construed in light of the methodology, procedures and techniques used to prepare the 2019 Namdini FS. Sections or parts of the 2019 Namdini FS should not be read or removed from their original context.

Except for statements of historical fact relating to Cardinal, certain statements contained in the 2019 Namdini FS constitute forward-looking information, future oriented financial information, or financial outlooks (collectively "**forward-looking information**") within the meaning of applicable Canadian securities legislation and "forward-looking statements" within the meaning of the "safe harbour" provisions of the United States Private Securities Litigation Reform Act of 1995. Forward-looking statements and information may be contained in this document and other public filings of Cardinal. Forward-looking information and statements relate to future events or future performance, reflect current expectations or beliefs regarding future events and are typically identified by words such as "anticipate", "could", "should", "expect", "seek", "may", "intend", "likely", "plan", "estimate", "will", "believe" and similar expressions suggesting future outcomes or statements regarding an outlook. These include, but are not limited to, statements respecting anticipated business activities; planned expenditures; corporate strategies; and other statements that are not historical facts.

Forward-looking statements and information includes statements concerning, among other things, cost reporting in the 2019 Namdini FS, production, cost and capital expenditure guidance; development plans for processing

resources; the generation of cashflow; matters relating to proposed exploration and expansion; communications with local stakeholders and community relations; negotiation and completion of transactions; commodity prices; Mineral Resources, Ore Reserves, realization of Ore Reserves, existence or realization of Mineral Resource estimates; the development approach, the timing and amount of future production; timing of studies, announcements and analyses, the timing of construction and development of proposed additional mines and process facilities; capital and operating expenditures; economic conditions; availability of project financing on terms reasonably acceptable to Cardinal; exploration plans and any and all other timing, exploration, development, operational, financial, budgetary, economic, legal, social, regulatory and political matters that may influence or be influenced by future events or conditions. Actual results may vary from such forward-looking information for a variety of reasons, including but not limited to risks and uncertainties disclosed in other Cardinal filings at www.sedar.com.

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Study Limitations

The 2019 Namdini FS has been developed by the Authors in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering and science professions currently practicing under similar conditions in the jurisdiction in which the services are provided, subject to the time limits and physical constraints applicable to this document. No warranty, express or implied, is made.

This Technical Summary, including all text, data, tables, plans, figures, drawings and other documents contained herein, was prepared by the Authors for the sole benefit of Cardinal. It represents professional judgement based on the knowledge and information available at the time of completion. The Authors are not responsible for any unauthorized use or modification of this document. All third parties relying on this Technical Summary do so at their own risk.

The factual data, interpretations, suggestions, recommendations and opinions expressed in this Technical Summary pertain to the specific project, site conditions, design objective, development and purpose described to Golder and Lycopodium by Cardinal, and are not applicable to any other project or site location. In order to properly understand the factual data, interpretations, suggestions, recommendations and opinions expressed in this Technical Summary, reference must be made to the entire document.

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1.0 INTRODUCTION

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

The main focus of activity is the Namdini Gold Project where a Measured and Indicated Mineral Resource of 182 Mt grading 1.1 g/t Au for 6.5 Moz Au and an Inferred Mineral Resource of 12 Mt grading 1.2 g/t Au for 0.5 Moz Au, reported at a 0.5 g/t Au cut-off grade, have been established as announced to the ASX and TSX on 3 April 2019 (Cardinal, 2019a).

Contained within this, the Ore Reserve estimate forming the basis of the Namdini Gold Project Feasibility Study (the "**2019 Namdini FS**") is 7.4 Mt at 1.31 g/t Au for 0.4 Moz Au of Proved Ore Reserve and 131 Mt at 1.12 g/t Au for 4.7 Moz of Probable Ore Reserve, as previously announced to the ASX and TSX on 3 April 2019 and 18 April 2019 (Cardinal, 2019b).

This Technical Summary presents the result of the Feasibility Study ("**FS**") carried out by Cardinal on the Namdini Gold Project. This FS updates and supersedes the Pre-feasibility Study ("**PFS**") released to the TSX and ASX on 18 September 2018.

Figure 1 shows the location of the Namdini Gold Project and the Company's other projects in Ghana.

Figure 1: Map of Cardinal Resources' projects in Ghana (source: Cardinal 2019)

2.0 FEASIBILITY STUDY MATERIAL ASSUMPTIONS

The capital cost estimates were completed to an accuracy of +15% to -5% for the planned process plant run of mine ("**ROM**") throughput of 9.5 Mtpa and based on open pit mining of the 3 April 2019 Measured and Indicated Mineral Resource as announced to the ASX and TSX on 3 April 2019 (Cardinal, 2019b).

Metallurgical testwork carried out to date indicates that gold can be satisfactorily recovered from Namdini ore using conventional process routes comprising crushing, grinding, gravity, flotation, regrind and carbon-in-leach (CIL) treatment of the flotation concentrate. The testwork was considered sufficient to determine that the Namdini Mineral Resource represents a deposit with a reasonable prospect of eventual economic extraction ("**RPEEE**"), for which the Modifying Factors and economic parameters have been applied to declare an Ore Reserve. Estimates of capital costs for the process plant and associated infrastructure were prepared by Lycopodium Limited ("**Lycopodium**").

The proposed process plant incorporates primary crushing, grinding, gravity, flotation, concentrate regrind, high shear oxidation (AachenTM) and CIL gold extraction. Planned production throughput is 9.5 Mtpa of ROM ore.

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 optimisation was selected and used to generate engineering pit designs that included a Starter Pit and Phases for the Life of Mine ("**LOM**") production schedule.

Golder estimated the Ore Reserve in accordance with the Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves or 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 the Canadian Institute of Mining, Metallurgy and Petroleum 'CIM Definition Standards for Mineral Resources and Mineral Reserves' (CIM, 2014). The JORC Code (2012) is defined as an 'acceptable foreign code' under NI 43-101. A JORC Code Table 1 is provided in Appendix 1 of this press release.

The Ore Reserve estimate is based on the revised Mineral Resource estimate announced on 3 April 2019 (Cardinal, 2019a). The Ore Reserve was derived from the Mineral Resource after consideration of the level of confidence in the Mineral Resource and application of relevant modifying factors including mining, processing, infrastructure, environmental, legal, social and commercial factors under the guidelines of ASX Listing Rule LR 5.9.1. The Ore Reserve announced to the ASX and TSX on 3rd April and 18 April 2019 (Cardinal, 2019b) represents the economically mineable part of the Measured and Indicated Mineral Resources.

The Proved and Probable Ore Reserve estimate is based on Measured and Indicated Mineral Resources. No Inferred Mineral Resource was included in the Ore Reserve. The Ore Reserve represents the economically mineable part of the Measured plus Indicated Mineral Resources. Mineral Resource estimates are reported inclusive of those Mineral Resources converted to Ore Reserves.

The proposed mine plan is technically achievable. All technical proposals made for the operational phase involve the application of conventional technology that is widely used in the gold industry. The financial modelling completed as part of the FS demonstrates 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 FS incorporates a number of factors and assumptions as outlined in the various sections within this Technical Summary.

Golder provided an estimate of mining costs, including drill and blast, haulage, rehabilitation and administration costs. Lycopodium provided process plant design and cost estimates.

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

The preliminary Project development schedule is shown in Table 1. This schedule is focused on further de-risk of the project and subject to finalising funding plus favourable timelines for permitting, contracting and procurement.

Table 1: Project Schedule

Milestone	Target timeline
Commence Front End Engineering and Design ("**FEED**")	Q4 2019
Advance Relocation Action Plan to Completion	H1 2020
Target production commencement	H2 2022

The gold price assumptions used for this FS and the financial analysis are described in Table 2.

Table 2: Gold Price Assumptions

Selection case	Gold price
Trial open pit optimisations were run in Whittle 4X at a US$1,300/oz gold price to define the base of potentially economic material. Five cut-back pits (Phases) were then selected and full mine designs applied.	US$1,300/oz
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 $1,235/oz using estimated LOM input prices and costs. Pit shells were converted into engineering designs.	US$1,235/oz
The Financial Model Input gold price was based on a long-term average of US$1,350/oz.	US1,350/oz

The FS has been evaluated at a gold price of USD$1,350 per ounce. The average US$ gold price per gold ounce for the period from October 2017 to current day is US$1,387 per ounce. During the period, the US dollar gold price has been in steady uptrend from a low of US$1,177 in August 2018 to a high of US1,550 per ounce traded during September 2019.

3.0 STUDY TEAM

Cardinal commenced its FS in January 2019 to further advance the Namdini Gold Project. The resources utilized included an Owner's Team, continued engagement with previous consultants and the appointment of new consultants to assist with phased development of the Namdini Gold Project.

Study Manager Lycopodium managed the full integration of all project disciplines and coordinated the efforts of Cardinal's other study partners.

Lycopodium is a highly respected mining services company with over 25 years' global experience in the minerals industry, designing and building large-scale mines, processing plants and associated infrastructure, particularly in Africa and West Africa. The independent specialist consultants and their roles are shown in Table 3.

Table 3: The Namdini FS independent specialist consultants

Company	Role
Lycopodium Minerals Pty Ltd ("**Lycopodium**")	Feasibility Study manager. Process plant and associated infrastructure. Capital cost and process operating cost estimates.
Golder Associates Pty Ltd ("**Golder**")	Mine design, planning, optimisation and scheduling. Mine operational costs. Compilation of the JORC, NI 43-101 and Feasibility Study reports.
Golder Associates Africa (Pty) Ltd	Hydrology and hydrogeological engineering studies.
Golder Associates Ghana Limited	Geotechnical engineering studies.
Knight Piésold Consulting Pty Ltd ("**Knight Piésold**")	Tailings Storage Facility Environmental ("**TSF**") and selected infrastructure design.
ALS Laboratory (Perth) ("**ALS**")	Metallurgical testwork to support the process design criteria.
Orway Mineral Consultants Pty Ltd ("**OMC**")	Comminution data analysis, crushing and grinding option studies.
Independent Metallurgical Operations Pty Ltd ("**IMO**")	Metallurgical testwork management, analysis and process flowsheet development.
Maelgwyn Mineral Services Africa Pty Ltd ("**MMSA**")	Aachen™ process metallurgical optimisation.
MPR Geological Consultants Pty Ltd ("**MPR**")	Mineral Resource modelling of the Namdini Deposit.
Orefind Pty Ltd ("**Orefind**")	Geology and deposit structural genesis.
NEMAS Consult Pty Ltd ("**NEMAS**")	Environmental Impact Assessment Study.
Geosystems Consulting Limited ("**Geosystems**")	TSF Environmental Impact Assessment Study.
MKM Social Limited ("**MKM**")	Socio-Economic Study and Resettlement Action Plan.
Sebbag Group International Pty Ltd ("**SGI**")	Mine design review.
Whittle Consulting Pty Ltd ("**WC**")	Enterprise optimisation.
BDO Advisory Pty Ltd ("**BDO**")	Financial model integrity and reviewer.

4.0 MINING LICENCE

During the quarter ended 31 December 2017, Large-Scale Mining Licence LVB14619/09 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 (Figure 2), which covers 19.54 km^2 in the Datoko 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 30 years.

5.0 ACCESSIBILITY

Namdini is located approximately 50 km southeast of Bolgatanga, the capital of the Bolgatanga Municipal District, within the Talensi District in the Upper East Region of northern Ghana. This District is close to the southern border of Burkina Faso. The property is readily accessible from Bolgatanga along paved highway followed by 15 km of well-travelled gravel roads. Access during the rainy season is slower due to waterlogged roads, but the main access roads are passable all year round.

The nearest airport is at Tamale, 160 km south of Bolgatanga via paved road on National Highway N10. Tamale is serviced by daily scheduled commercial flights from the capital Accra. Travel time from Accra to the Namdini Gold Project is approximately four hours using a combination of air and road travel or 14 hours solely by road. Accra is serviced by direct flights to the United Kingdom, Europe, South Africa, the Middle East and USA.

Cardinal's surface rights cover areas sufficient for potential process plant sites, tailings storage areas, and waste disposal areas. The national Ghana power grid 161 kV above-ground transmission line runs approximately 30 km west of the Namdini Gold Project. The Namdini Gold Project is approximately 6 km southeast of the operating Shaanxi underground gold mine, which is supplied by grid power.

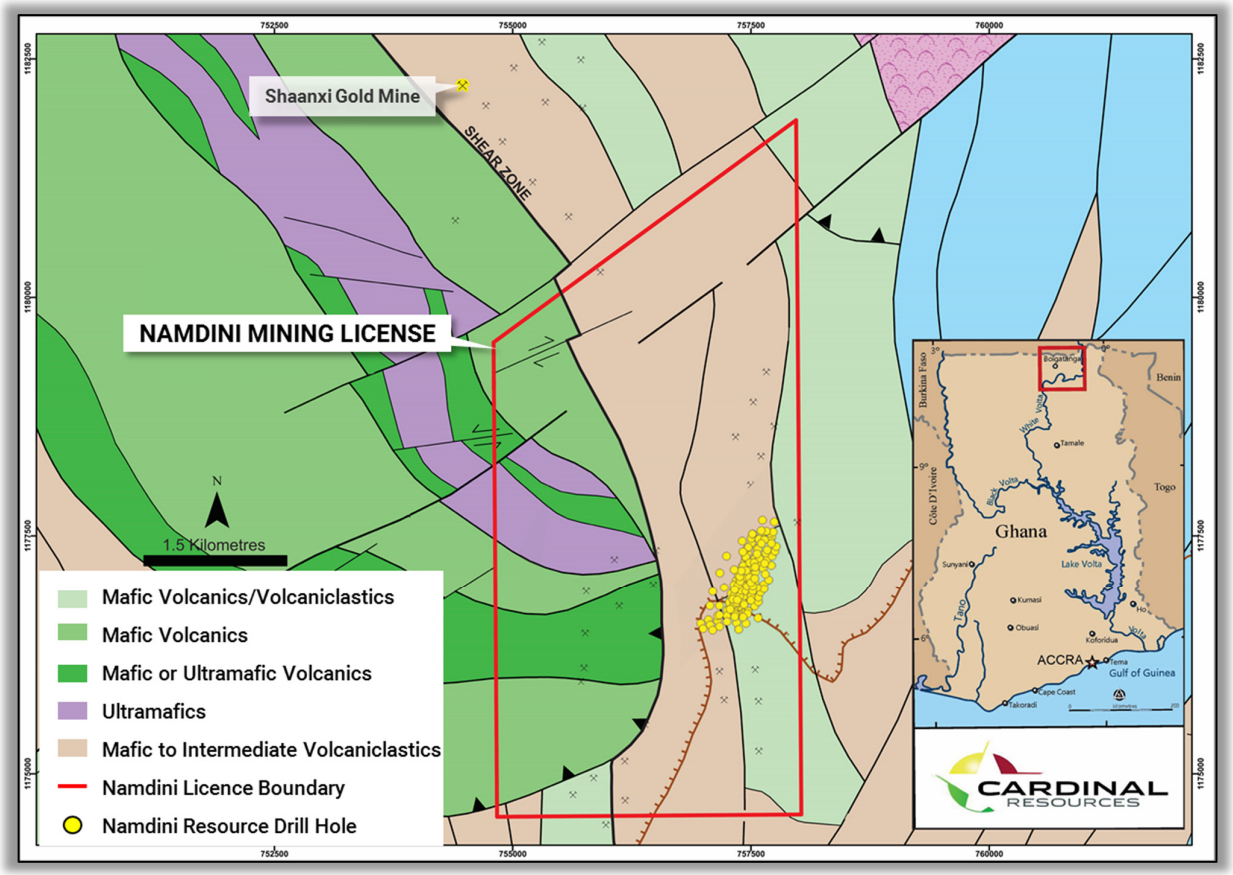


Figure 2: Namdini Gold Project area geology and Mining Licence boundary (source: Cardinal 2019)

6.0 HISTORY

Ghana has a long mining history and has experienced technical personnel including geologists and engineers. Exploration and mining supplies are readily available within Ghana. In 2002 the Upper East Ghana region had a total population of approximately 964,500. In 2012 Bolgatanga reported a population of 66,685. There are two small settlements in the vicinity of the Namdini Gold Project which generally rely on subsistence farming, artisanal mining, and harvesting of wood. There is a significant local labour pool available for recruitment for any envisioned mining operation.

Numerous historical trenches and adits, as well as organized artisanal gold mining sites, are located throughout the property and approximately 5% of the Licence area is affected by these activities. Artisanal miners extract gold from the saprolite horizon, but also sink shafts as deep as 20 m to recover gold from quartz veins. These artisanal workings can result in pits and subsidence, which pose hazards for people and animals.

Savannah Mining Ghana Limited ("**Savannah**") discovered the Namdini gold mineralisation in 2013 under a Heads of Agreement with Cardinal. A small-scale mining license, of approximately 6.25 Ha, was applied for by Savannah and approved in 2014. An application by Savannah for a Large-Scale Mining Licence over an area

of approximately 19.54 km^2 the covering the Namdini Gold Project was subsequently granted by the Minister of Lands and Natural Resources of Ghana.

During the December 2017 quarter, the 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. This Mining Licence is for an initial period of 15 years and is renewable for up to a further 30 years.

7.0 GEOLOGY

The Namdini gold deposit is a large, structurally controlled, orogenic gold deposit within the Nangodi Greenstone Belt, 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 1,150 m, up to 300 m wide and 700 m deep.

A geological map showing the gold deposits of north-eastern Ghana is provided as Figure 3.

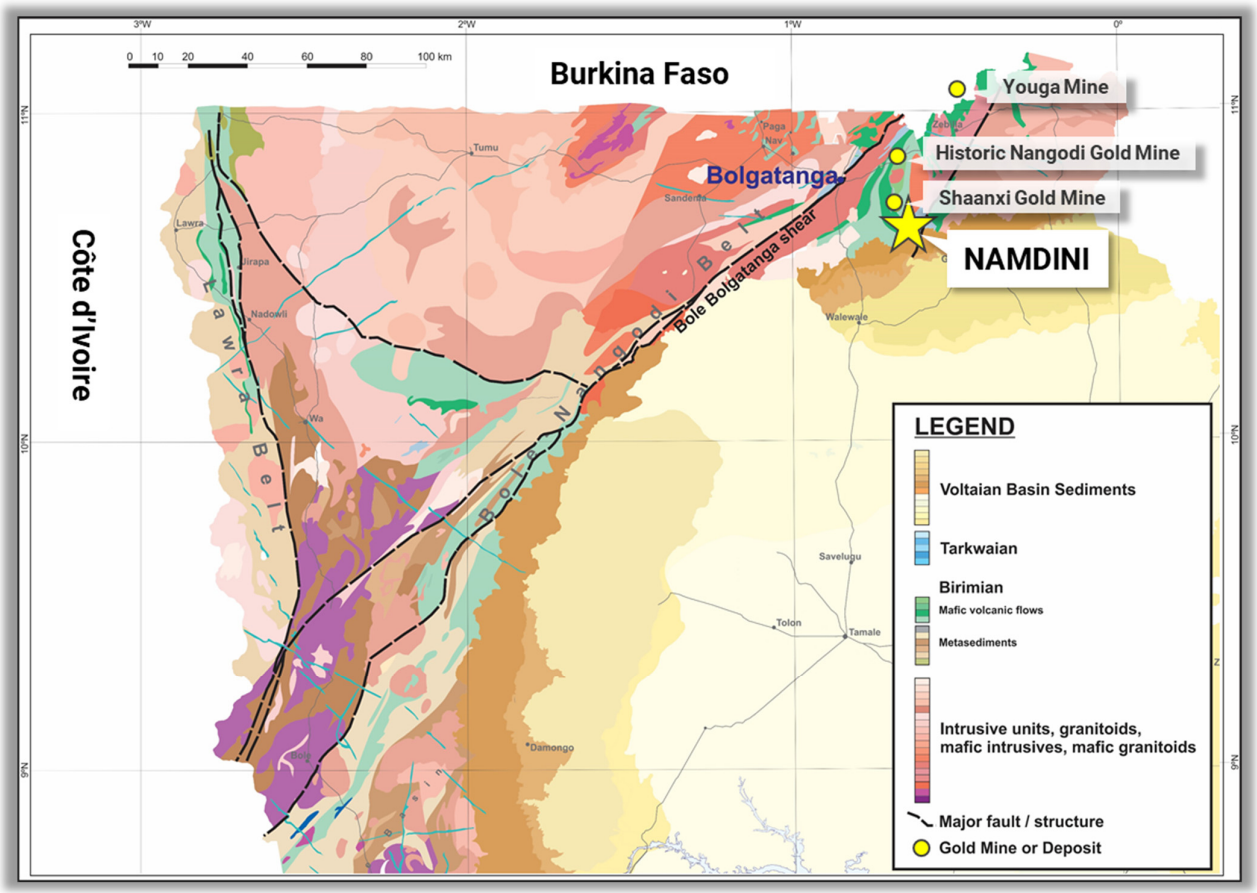


Figure 3: Map of north-eastern Ghana showing geology and gold deposits (source: Cardinal 2019)

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

Orefind concluded that the rock types include a steeply west-dipping Birimian sequence of interbedded, foliated, metasedimentary and metavolcanic units which have been intruded by a medium-grained granitoid and a 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 mineralisation and the host sequence.

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

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

A summary of the logged lithologies at Namdini is provided in Table 4.

Table 4: Summary of Namdini geological logging codes and descriptions

Code	Description
LAT	Laterite, ferruginous duricrust developed *in situ*
SPR	Saprock (<20% weatherable minerals altered)
SAP	Saprolite (>20% weatherable minerals altered)
GRA	Granodiorite or tonalite, altered felsic rocks (sericites, muscovite, carbonate and K-feldspar)
DIO	Intermediate rocks, altered (shearing, silicification, chlorite and sericites) and unaltered diorite, quartz diorite speckled with quartz and feldspar
MVO	Mafic rocks, volcaniclastics, altered (sericites, chlorites + silicification)
MSE	Metasedimentary rocks, dominated by quartz-carbonate veining + haematite and chlorite
LTF	Pyroclastic rocks and tuffs
DAC	Dacite, felsic extrusive rock, intermediate in composition between andesite and rhyolite. Often found associated with forms lava flows, volcanic equivalent of granodiorite.
BX	Breccia
QTZ	Quartz

8.0 DEPOSIT TYPES

The Namdini Gold Project appears to be a typical Birimian gold deposit and is hosted in a mixture of altered meta-volcanic sediments, diorite and tonalite. It is associated with quartz-carbonate veins and disseminated pyrite and arsenopyrite in both veins and wall rocks. The mineralisation is strongly structurally controlled and the deposit appears to be located in an oblique, sinistral structure in a regionally extensive deformation zone.

9.0 EXPLORATION

Namdini was discovered in September 2013 by traditional prospecting methods. Follow-up exploration in the region has included aeromagnetic surveying, geological mapping, rock chip sampling and auger drilling.

Savannah subsequently excavated a shallow open pit to expose a westerly dipping gold mineralised zone. Follow up exploration by Cardinal included regional aeromagnetic surveying, regional and prospect-scale geological mapping and rock chip sampling.

Cardinal commenced reverse circulation ("**RC**") percussion and diamond core drilling at Namdini in March 2014 and October 2015 respectively.

All exploration work on the Namdini Gold Project was completed by Cardinal. A field office with core logging and storage facilities was established near the Namdini Gold Project site in Bolgatanga.

The Namdini Gold Project was first discovered in September 2013 by prospecting. A small-scale mining licence was approved in 2014 and RC drilling began shortly thereafter. Cardinal drilled additional RC holes in the same licence area after reviewing initial RC results. At the conclusion of approximately 88 RC holes Cardinal had sufficient confidence in the potential size of the Namdini Gold Project to step out 600 m north along strike and drill a surface diamond drill hole after which the scale and extent of the deposit was established.

A high-resolution, 100 m line-spaced airborne magnetic-radiometric survey was carried out by Terrascan Airborne from August to December 2013 over all of Cardinal's properties in north eastern Ghana.

During 2016, Terratec Geophysical Services completed a ground magnetic survey and induced polarization (IP) survey over the Namdini deposit. The data was processed and interpreted by Southern Geoscience Consultants who generated a suite of digital images and contours, and a litho-structural interpretation at 1:50,000 scale over the area of the survey. This interpretation provided Cardinal with a detailed Project-wide geological and structural map for ongoing exploration target development and assessment activities.

10.0 DRILLING AND SAMPLING

The Namdini Mineral Resource estimate is based on RC and diamond resource drilling information available for Namdini on the 4 February 2019, totalling 326 holes for 87,140 m of drilling. RC and diamond drilling provide around one quarter and three quarters of the estimation dataset respectively.

The resource drilling comprises east-west trending traverses of easterly inclined holes. Hole spacing varies from around 12.5 by 25 m in shallow portions of southern part of the deposit to around 50 by 50 m and broader in the north and at depth.

The RC percussion drilling was either 130 mm (nominally 5¼ inch) or 125 mm in diameter, and drilled to 200 m or less in depth. RC samples were collected over 1 m down-hole intervals using a cyclone, with sub-sampling using a three tier-riffle splitter. Rare un-mineralised intervals were composited over 4 m intervals for analysis.

For drilling prior to approximately April 2016, diamond core was halved for sub-sampling with a diamond saw. From approximately April 2016 to June 2017 core was quartered for assaying. For drilling after June 2017 diamond core was halved for sub-sampling. Sample intervals range from 0.2 to 1.8 m long, with the majority of samples assayed over 1 m intervals.

Collar locations of most resource holes were accurately surveyed by differential GPS techniques. The drilling at Namdini is considered to have been surveyed with sufficient accuracy for Mineral Resource estimation. Most diamond holes and deeper RC holes were down-hole surveyed at generally 30 m intervals. Hole paths have been located with sufficient accuracy for the current estimate.

Geological logging, was undertaken by Cardinal Resources' technical staff and captured on field Toughbook laptops using Maxwell Geoservices (Perth) proprietary Logchief™ software. Structural interpretation and modelling were completed by specialist consultants Orefind, resulting in a three-dimensional model of key lithologies, structures and weathering zones.

11.0 SAMPLE PREPARATION AND ASSAYING

11.1 QAQC

Quality Assurance and Quality Control ("**QAQC**") of the data used for Mineral Resource estimation is described in this Section.

All sample preparation and gold assaying of primary samples from Namdini resource drilling were undertaken by independent commercial laboratories. Analyses by Cardinal were limited to around 87% of the density samples. No employee, officer, director, or associate of Cardinal carried out any sample preparation work on gold-assay samples from the Namdini Gold Project exploration programme.

As part of Cardinal's QAQC programme, a suite of internationally accredited and certified reference materials ('standards') and locally sourced blanks were included in the sample submission sequence. The standards covered gold grade ranges expected at Namdini. Interlaboratory umpire analyses were also conducted. The sampling, sample preparation and analysis processes were found to be appropriate and acceptable for Mineral Resource estimation.

Most primary samples were submitted to SGS Ouagadougou or SGS Tarkwa for analysis by fire-assay with assays from these laboratories contributing around one third and two thirds of the estimation dataset respectively. Samples from several peripheral resource holes analysed by Intertek Tarkwa provide around 0.5% of the estimation dataset.

SGS Tarkwa and Ouagadougou, and Intertek Tarkwa have been accredited 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.

The assay laboratories employed consistent sample preparation and analytical procedures. After sorting and weighing samples oven dried before and crushed to 75% passing 2 mm. A 1.5 kg riffle split sub sample was pulverized to nominally 85% at 75 microns (µm). Samples were fire assayed for gold using a 50 g charge with an AAS finish, with a detection limit of 0.01 g/t. Assays of greater than 100 g/t were re-analysed with a gravimetric finish.

Certified reference material (blanks and standards) were submitted into the sample stream at a frequency rate of 5 % of the samples. Duplicate samples of RC chips were taken at a rate of 5 %.

Average assay results of certified reference standards reasonably reflect expected values supporting the general accuracy of assaying. Several sets of inter-laboratory repeat analyses provide additional support for the primary analyses.

Assays of coarse blanks included in assay batches from before May 2015 and after September 2017 show no indication of significant contamination or sample misallocation. Sample batches submitted between May 2015 and September 2017 included fine blanks of pulverized material. These fine blanks showed no significant sample misallocation.

Diamond core and RC samples were transported from the drill site by a Cardinal vehicle to the secure core yard facility at the Bolgatanga Field Exploration Office.

All samples submitted for assaying were retained in a locked secure shed until collected by laboratory personnel. Retained drill core and RC chips are securely stored in the core storage compound, and pulps are securely stored in the core shed.

11.2 Bulk density

Resource data acquisition included routine water immersion measurements for bulk density determination of representative diamond core samples.

Density measurements available for Namdini comprise 11,047 immersion measurements performed by either Cardinal (9,652) or SGS Tarkwa or Ouagadougou (1,395) on diamond core. Oxidised and porous samples were wax-coated prior to density measurement. Lengths specified for these samples range from 0.01 to 1.4 m and average 0.3 m.

Bulk densities were assigned to the Mineral Resource estimate by rock type and oxidation zone on the basis of the average of the available measurements. Assigned bulk densities vary from 2.00 t/bcm for strongly weathered metavolcanic to 2.82 t/bcm for Fresh diorite and metasediments.

12.0 DATA

Independent verification checks were undertaken to confirm the validity of the database compiled for the Mineral Resource estimate. These checks included internal consistency between and within database tables, comparison of assay values between nearby holes, and comparison of database entries with original source files supplied by Cardinal for collar survey, down-hole surveys and gold assays. The consistency checks showed no significant issues.

13.0 METALLURGY AND MINERAL PROCESSING TESTWORK

13.1 Introduction

Metallurgical testwork continued to focus on the same flowsheet as presented in Cardinal's PFS study (Cardinal, 2018c; Golder, 2018b).

Gold is recovered using crushing, SABC milling, gravity, flotation, concentrate regrind, high shear oxidative pre-treatment, and CIL cyanidation of the flotation concentrate. The milling circuit comprises a SAG mill, ball mill and pebble crushing ("**SABC**").

The metallurgical testwork on Fresh material was carried out by ALS Laboratory in Perth, Australia and at the Maelgwyn Mineral Services Africa ("**MMSA**") Laboratory in Johannesburg, South Africa.

13.2 Results

Key findings from the testwork were:

Mineralogy:

- Native gold is the predominant gold bearing mineral with very low silver content (<2 ppm Ag).
- Pyrite is the dominant sulphide mineral where the majority of the gold is associated.
- The pyrite particle size of 80% passing ("P_{80}") ranges 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 stereomicroscope of the unmounted gravity concentrates. These gold grains are approximately 200 µm in diameter and rounded in appearance. Gravity gold recovery is supported based on the testwork.
- Mineralogy and laboratory testwork results do not indicate the presence of preg-robbing carbonaceous matter. Organic carbon varied from 0.03% to 0.09%; leach kinetic response did not indicate preg-robbing behaviour which was verified by a preg-robbing index ("**PRI**") test ranging from 0.03 to 0.06 PRI.

Comminution:

- Average Bond Ball Mill Work index ("**BBWi**") values for MVO, GRA and DIO ranged from 12.6 to 18.6 kwh/t with Diorite (DIO) reporting the highest work index. Gyratory crusher design has been based on the 85th percentile values, initially 19.8 kwh/t (Starter Pit) reducing to 19.0 kwh/t (LOM).
- JK Drop Weight calibration was performed on PQ drill core samples, supported by SAG mill comminution ("**SMC**") variability testing applied to HQ samples. Analysis of the distribution of separate lithology results supports Comminution circuit design based initially on an A*b value of 31.3 reducing to 28.8 (LOM).
- The BBWi data indicated a range between 14.7 and 19.7 with an average of 16.9 kwh/t. Ball mill circuit design has been based on 85th percentile values, initially 17.3 kwh/t increasing to 18.9 kwh/t (LOM).
- Bond Abrasion Index ranged between 0.03 and 0.29 with Granite (GRA) reporting the highest value. Circuit design is based on a value of 0.285 with an average (blended) value of 0.139 used for the operating cost estimates.
- Pilot plant testing of the Outotec high intensity grinding mill ("**HIGmill**") to establish grind energy signature plots, proved that a regrind (P_{90}) size of 9µm was the most economic for the purpose of design.

Flotation:

- Fast flotation kinetics was observed with most of the gold recovered in less than 8 minutes.
- Gold recovery averaged 95% to concentrate for the majority of composites.
- Gravity recovery improved total gold recovery and mostly eliminated variability in the flotation tails grade.
- Gravity and flotation separation resulted in an average flotation tail grade of 0.08 g/t Au over a total of 72 tests and across all lithologies.
- Flotation mass recovery averaged 7.3% w/w; concentrate grade based on the Starter Pit composite averaged approximately 30 g/t without gravity recovery and approximately 15 g/t Au with prior gravity recovery.

Leach:

- Concentrate leach feed grades based on Starter Pit and separate Life of Mine lithology composites ranged between 6 g/t and 37 g/t, reporting an average at 15.6 g/t Au.
- Leach residues based on standard direct cyanidation leach tests without high shear oxidative pre-treatment averaged 0.21 g/t Au based on an average flotation concentrate mass recovery of 7.6% and a concentrate regrind P_{90} size of 9 µm.

- Maelgwyn Aachen™ shear reactor technology was tested at the MMSA laboratory facility in South Africa with encouraging results, supporting improved leach extraction relative to standard direct cyanidation. At a regrind P_{90} size of 9 µm, leach extraction increased by approximately 4 % relative to the base-case direct cyanidation based on 10-Pass Leachox treatment. The testwork results have been incorporated into the circuit design based on 10-Pass treatment; leach extraction improvement has also been incorporated into recovery values based on a concentrate regrind P_{90} size of 9 µm.
- Prior Leachox treatment also acted to oxidise cyanide-consuming species, indicating potential for reduced leach cyanide consumption and improved operating cost.

All gravity gold, flotation, regrind and leach results were analysed to produce three regression recovery curves, one for each of the key Namdini lithologies. These curves were then applied to the varying head grades of the mine schedule to derive overall recovery.

The metallurgical testwork has also provided variability information characterising the comminution, gravity, flotation and leach response of the main three Namdini lithologies.

Gold mineralisation is mainly associated with pyrite in all three main rock types: Metavolcanic, Granite and Diorite. Bulk samples collected for bench-scale and pilot-scale metallurgical testwork for the key areas of the process plant flowsheet. Sample selection and therefore metallurgical testwork has included high-grade, low-grade, ore body variability and sulphur variability for all ore lithologies.

Metallurgical testwork has proved that the ore is amenable to conventional flotation techniques due to the gold being associated with sulphides. Metallurgical testwork has also confirmed that the ore is amenable to conventional milling and flotation, followed by regrinding, high shear oxidation and cyanide leaching of the flotation concentrate in a carbon-in-leach process.

Previous testwork has shown that a non-flotation conventional gold process can be applied to all Oxide material (less than 3% of the Ore Reserve in terms of tonnes and contained gold) which will be stockpiled and processed at the end of the mine life.

The selected processing route for Namdini ore is crush, primary grind, sulphide flotation followed by regrind, hi-shear oxidative treatment and CIL cyanidation of the flotation concentrate.

Aachen™ is a relatively simple, proven process already being used at gold producing mines globally and specifically in Africa. These operations have consistently demonstrated an uplift in gold recovery with Aachen™. The premise of the process is that high shear contact of slurry particles with oxygen and increased oxygen mass transfer to the slurry results in improved kinetics. Scouring the particle surfaces and elevated dissolved oxygen in slurry accelerates oxidation of the sulphide species. This allows for less residence time and less reagent requirements within the leaching circuit**.** In addition to a potential increase in gold recovery (and therefore a potential uplift to annual gold production rates), there are typically power and reagent (OPEX) savings and power requirements (CAPEX) savings that can be realised.

Cardinal has tested 4,447 kg of material from 47 drill holes (2,048 one metre intervals), comprising 7 pilot scale composites across the entire deposit (Phase I). A further detailed testwork programme (Phase II) was then completed comprising 2,310 kg from 24 drill holes (805 m) as part of an optimisation program.

Aachen testwork on Namdini flotation concentrate indicated the following improvements (Cardinal, 2019c):

- Increased gold recovery (+4% over Base Case, without Leachox treatment)

- Coarser regrind size compared with the PFS flowsheet; potential to operate at a P_{90} size up to 12 µm for certain lithologies
- Reduced power consumption (ie lower operating power requirements and OPEX)
- Improved mass transfer of oxygen, leach kinetics and reactivity of reagents
- Reduced reagent consumption leading to reduced operating costs

Orway Mineral Consultants Pty Ltd ("**OMC**") used the comminution testwork results for comminution circuit selection and mill sizing. A primary crushing and then open circuit SAG mill with recycle pebble crushing followed by closed circuit ball mill/hydro-cyclones ("**SABC**") was selected by OMC using available comminution parameters.

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

- A primary grind size of 80% passing 106 µm was selected for the primary grinding circuit design.
- Incorporation of a gravity concentration circuit given the presence of gravity recoverable gold.
- Flotation testwork indicated fast sulphide flotation kinetics; the circuit comprises six 300 m^3 rougher flotation cells based on kinetic response and recovery.
- The flotation concentrate is reground and subjected to a high shear reactor and pre-aeration before CIL cyanidation.
- Gold recovery will be via a conventional CIL cyanidation with elution circuit, electrowinning and gold smelting to recover the gold from the loaded carbon to produce doré.
- Industry typical design parameters were assumed where testwork is pending.
- Detailed metallurgical testwork is continuing for the Namdini Gold Project under the direction of Cardinal to support the design as part of the continuous improvement program.
- Gold is recovered using crushing, SABC milling, gravity, flotation, concentrate regrind, high shear oxidative pre-treatment, and CIL cyanidation of the flotation concentrate. The milling circuit comprises a SAG mill, ball mill and recycle crushing (SABC).

13.3 Metallurgical testing summary

Key aspects supporting selection of the process flowsheet include:

- Average recovery is dependent on head grade and the ratio of the different lithologies.
- Recovery was calculated by adding the gold recovered by gravity, flotation and leaching gold and allowing for gravity gold loss at scale and CIL carbon and solution loss. This is effectively gravity recovery plus flotation recovery multiplied by leach recovery.
- The Oxide results reported in the PFS were retained. The previous Oxide metallurgical testwork was performed on a whole of ore leach recovery testwork regime which yielded an average of 90% recovery.
- The Transition material at Namdini is approximately 3% of the ore feed. It is only partially weathered (oxidised) and behaves in metallurgical test work similar to the Fresh material, with similar recoveries.

- Metallurgical testwork carried out to date indicates that the Namdini Gold Project can deliver a standard gold recovery process plant design with no unproven technology required.
- The metallurgical process includes 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.

13.4 Conclusions – metallurgy

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 define a technically and economically viable gold mining project.

The Transition material at Namdini is only partially weathered (oxidised) and behaves in metallurgical test work similar to the Fresh material, with similar recoveries. The Transition material is to be processed with the Fresh material as part of the mill feed and thus these are combined in all the mine and mill schedules.

14.0 MINERAL RESOURCE ESTIMATION

Independent mining industry consultant, MPR Geological Consultants Pty Ltd ("**MPR**") was commissioned by Cardinal to estimate the Mineral Resources of the Namdini deposit. To satisfy the Reasonable Prospects For Eventual Economic Extraction ("**RPEEE**") guidelines under the JORC code and CIM standards, the Mineral Resources are reported within an optimised pit shell produced by Golder. The optimisation parameters reflect a large scale conventional open pit operation at a gold price of US$1,950/oz.

The Mineral Resource estimate was reported in accordance with the JORC Code (2012) to the ASX and TSX on 3 April 2019 (Cardinal, 2019a) as shown in the Appendix provided with that release (JORC Code Table 1). The Mineral Resource estimate, summarized in Table 5 and Table 6, on a 100% Project basis shows the Mineral Resources by category and material type (oxidation) at 0.5 g/t Au cut-off. The classification categories of Measured, Indicated and Inferred Mineral Resources under the JORC Code (2012) are equivalent to the CIM categories of the same name (CIM, 2014).

Table 5: Measured and Indicated Mineral Resources at 0.5 g/t Au cut-off 3 April 2019 (Cardinal, 2019a)

Mineral Resource category	Type	Tonnes (Mt)	Gold grade (g/t Au)	Contained gold (Moz)
Measured	Oxide	1.1	1.23	0.04
Measured	Fresh	6.4	1.33	0.27
Measured Resource	**Total**	7.5	1.31	0.32
Indicated	Oxide	3.3	1.08	0.11
Indicated	Fresh	171	1.11	6.10

Mineral Resource category	Type	Tonnes (Mt)	Gold grade (g/t Au)	Contained gold (Moz)
Indicated Resource	**Total**	174	1.11	6.21
Measured and Indicated	**Oxide**	4.40	1.12	0.16
Measured and Indicated	**Fresh**	177	1.12	6.38
Measured and Indicated	**Total**	182	1.12	6.53

Table 6: Namdini Inferred Mineral Resource estimate at 0.5 g/t Au cut-off 3 April 2019 (Cardinal, 2019a)

Mineral Resource category	Type	Tonnes (Mt)	Gold grade (g/t Au)	Contained gold (Moz)
Inferred	Oxide	0.04	1.0	0.001
Inferred	Fresh	12	1.2	0.46
Inferred Resource	**Total**	12	1.2	0.46

Notes on Table 5 and Table 6:

- *Mineral Resource estimates are reported inclusive of those Mineral Resources converted to Ore Reserves as of April 3 2019 (Refer to the announcement released to the ASX and TSX on 3 April 2019 and 18 April 2019).*
- *The Mineral Resources and Ore Reserves are reported in accordance with JORC Code (2012) guidelines and Canadian Institute of Mining, Metallurgy and Petroleum Standards (CIM, 2014).*
- *Mineral Resource estimates follow the ASX Listing Rule LR 5.8.1.*
- *Numbers may not add due to rounding to appropriate significant figures.*

MPR (2019) used the same methods described in the PFS report (Golder, 2018b) to estimate 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 MIK modelling used GS3M™ resource modelling software developed by FSSI Consultants (Australia) Pty Ltd.

The MIK modelling was based on 2 m down-hole composited gold assay grades from RC and diamond resource drilling. It incorporated a mineralised domain interpreted on the basis of the 2 m down-hole composited gold grades. The mineralised domain captures zones of continuous mineralisation with composite grades of greater than nominally 0.1 g/t Au. This domain trends north-northeast over a strike length of approximately 1,330 m with horizontal widths ranging from around 90 to 400 m and averaging approximately 240 m. The domain dips to the west at around 70°.

The modelling incorporated panels of dimensions 12.5 mE by 25 mN by 5 m elevation reflecting drill hole spacing in the areas of tightest resource drilling. The resource estimates include a variance adjustment to give estimates of recoverable resources at various gold cut off grades. The variance adjustments were applied using the direct lognormal method. The variance adjustment factors are considered by MPR and Cardinal to reflect comparatively large scale, open pit mining consistent with Cardinal's perception of potential mining scenarios.

The variance adjustment factors were estimated from the variogram model for gold grades assuming mining selectivity of 5 m by 10 m by 2.5 m (across strike, along strike, vertical) consistent with high quality grade control sampling on an 8 by 12 by 1.25 m pattern. The variance adjustments 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 by Golder (2019a).

The three progressively more relaxed search criteria used for MIK estimation are presented in Table 7. The search ellipsoids were aligned with the general mineralisation orientation.

Table 7: Estimation search criteria

Search	Radii (m)(x, y, z)	Minimum data	Minimum octants	Maximum 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

The Namdini Mineral Resource has been classified as Measured, Indicated and Inferred 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 classification used the search passes and wire-frames outlining more closely drilled portions of the mineralisation. The classification approach assigns mineralisation tested by generally 50 by 50 m drilling to the Indicated category, with estimates for zones with more closely spaced drilling classified as Measured. Estimates for panels not informed consistently by at least 50 by 50 m drilling are assigned to the Inferred category.

15.0 ORE RESERVE ESTIMATION

The mine design and Ore Reserve estimate are based on the revised Mineral Resource model announced to the ASX and TSX on 3 April 2019 (Cardinal, 2019a).

The Namdini Ore Reserve reported in this FS is a subset of the Measured and Indicated Mineral Resource, which forms the basis of the technically and economically viable Namdini Gold Project.

The Ore Reserve estimation process converted 80% of the Measured and Indicated Mineral Resources to Proved and Probable Ore Reserves.

The Ore Reserve was estimated for the Namdini Gold Project as part of this FS by Golder, which is summarised in Table 8. The total Proved and Probable Ore Reserve is estimated at 138.6 Mt at 1.13 g/t Au with a contained gold content of 5.1 Moz. Of this total, 92% of the contained gold is within the Probable Ore Reserve category.

The Ore Reserve for the Project is reported in accordance with the Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves (JORC, 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 after applying Modifying Factors. All the Proved Ore Reserve is based on the Measured Mineral Resource and all the Probable Ore Reserve estimate is based on the Indicated Mineral Resource. Table 8 presents a summary of the Ore Reserves on a 100% Project basis at a US$1,300/oz gold price.

All Measured Resources within the final pit design were converted to Proved Ore Reserves with the Indicated Mineral Resources within the pit shell converted to Probable Ore Reserves.

Table 8: LOM Ore Reserve estimate, 3 April 2019 (Cardinal, 2019b)

Ore Reserve Category	Type	Tonnes (Mt)	Gold Grade (g/t)	Contained Gold (Moz)
Proved	Oxide	1.0	1.21	0.1
Proved	Fresh	6.4	1.33	0.3
Proved Reserve	**Total**	**7.4**	**1.31**	**0.4**
Probable	Oxide	3.0	1.08	0.1
Probable	Fresh	128.2	1.13	4.6
Probable Ore Reserve	**Total**	**131.2**	**1.12**	**4.7**
Proved and Probable	Oxide	4.1	1.11	0.2
Proved and Probable	Fresh	134.5	1.13	4.9
Proved and Probable	**Total**	**138.6**	**1.13**	**5.1**

Notes on Table 8:

- *The Ore Reserve conforms with and uses JORC Code (2012) and CIM (2014) recommendations*
- *The Ore Reserve was evaluated using a long-term average gold price of US$1,300/oz with the US$1,235/oz optimisation pit shell chosen for the Ore Reserve pit design to maximise the resource base*
- *The Ore Reserve was evaluated and report using an average cut-off grade of 0.5 g/t Au*
- *Dilution was incorporated through the use of an MIK recoverable resource estimation modelling technique, which was demonstrated to incorporate an expected level of equivalent ore loss and dilution for the scale of mining envisaged. This dilution was incorporated at the resource block model stage prior to delivery to Golder*
- *All relevant modifying factors under the ASX Listing Rule LR 5.9.1 guidelines were applied to the Ore Reserve estimate, as described in this JORC Code Table 1 provided as Appendix 1 in the ASX announcements dated 3 and 18 April 2019*
- *All figures are rounded to reflect appropriate levels of confidence. Apparent differences may occur due to rounding.*

16.0 MINING

16.1 Approach

Cardinal commissioned Golder to carry out mine optimisation and design studies and an economic evaluation that led to declaration of the Ore Reserve based on technical work reported by Golder (2019b).

Mining of the Namdini Gold deposit has been planned 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 comprise a conventional hydraulic shovel operation typically using 400 t class excavators in backhoe configuration for mining ore and face-shovel configuration for mining waste. Rigid body Cat 785 (134 t) class dump trucks will be used for hauling ore and waste on designed access roads. An auxiliary mining fleet of dozers, graders, water carts and utility vehicles will support the mining operation.

Mining will be carried out using staged cut-backs with five identified Phases incorporated within the LOM Final Pit. The mining schedule defines movement of ore and waste on 10 m mining benches, by year, for each of the Phases. It is proposed to mine three flitches in the ore (allowing for blast heave), within 10 m benches.

The Mineral Resource model is the basis for the mining model used for the LOM Pit planning and assessment reporting. The resource model has cell dimensions of 12.5 m (east) by 25 m (north) by 5 m (elevation). The MIK variance adjustment allows for a selective mining unit ("**SMU**") of 5 m by 10 m by 2.5 m, which has been applied to Namdini's large-tonnage, disseminated deposit.

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 mining contractors and compared with similar gold projects. Gold grades were supplied with the model as estimated proportional grades using the MIK recoverable resource estimation technique.

Oxide ore will be stockpiled temporarily and batch-fed into the process plant when suitable volumes are available, at the end of the mine life. Waste rock will be stockpiled separately on the western side of the pit.

16.2 Mining factors

Trial open pit optimisations were run in Whittle 4X at a US$1,300/oz gold price, the appropriate gold price at the time of the optimisation runs, to define the base of potentially economic material. Five cut-backs (or Phases) were then selected and full mine designs applied to them.

For selecting the optimum Whittle pit for mine design Golder estimated a mining base surface cost of US$2.86 /t 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 general and administration ("**G&A**") cost were estimated at US$14.30 /t milled plus an additional US$1.50 /t allowance for stockpile reclaim. All costs are based on dry tonnes.

Once the optimum Whittle pit was selected and mine design completed, a detailed mining movement schedule was supplied to five prospective mining contract companies to assist with the provision of a detailed mining cost estimate. Further discussions and negotiations will continue with suitable mining contractors prior to any award of the mining contract.

Metallurgical test work as reported in the Pre-feasibility Study, 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 in each parcel and the gold grade above the cut-off grade were included within the mining model to allow export of the parcelled (ore + waste) blocks for open pit optimisation.

A minimum mining width of 80 m was assumed. Mining dilution and recovery are addressed in the modelling method (MIK with variance adjustment) and the utilisation of flitch mining. No Inferred Mineral Resources have been included within the LOM planning. Mining infrastructure requirements were planned to be provided by the selected mining contractor with the mining performed on an outsourced basis.

Grade control will be based on sampling from RC drilling spaced at approximately 10 m by 15 m with samples taken at 1.5 m intervals down-hole (i.e. 1.25 m vertically). All grade control sampling will be fire assayed at the mine site.

No consideration has been made for underground extensions of the operation in this FS.

16.3 Geotechnical parameters

For the mine design, Golder Ghana (2018) carried out a study of existing geotechnical information, reviewed information on mineral resource estimates, conducted a detailed pit geotechnical drilling campaign, and gathered detailed rotary core logging data from selected drill locations within the 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 defined around the Namdini Pit.

For the final wall, bench stacks will consist of four double-benches (i.e. 80 m high) in Fresh material. These will be separated by either 25 m wide catch-berms or ramps. Some flexibility in height is used where a ramp is close to a catch berm.

16.4 Pit optimisations

Pit optimisations were completed using the Lerchs-Grossman (LG) algorithm in Whittle 4X™ software to calculate the optimal pit at the specified input parameters. A wire-frame 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 pit of approximately 1.2 Moz was chosen as the Starter Pit (Phases 1 and 2) to maximise discounted cash flow and minimise capital payback time.

16.5 Mine scheduling

Mine scheduling was used to maximise value by deferring 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**") targeted shell at around 0.95 RF of US$1,235/oz to maximise cash flow, 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.

The mine scheduling was completed using the Minemax™ Scheduler software in quarterly ("**Qtr**") periods. The mining sequence has been designed to incorporate five mining Phases. The initial mining Phase targets a relatively small initial pit of higher-grade ore with minimal waste stripping requirements (Starter Pit). The overall mining schedule is targeted towards the early generation of cashflow to assist in repayment of the Project capital and to maximise Project discounted value. The Minemax schedule was then used to back-flag the mining model to the quarterly periods mined. Subsequent to the flagging of the period mining sequence in the block model, the model was then used in the Alastri™ Tactical Scheduler ("**ATS**") to identify bottlenecks and to allocate resources for detailed down-stream cost modelling.

The process plant will accommodate an annual feed rate of 9.5 Mtpa as advised by Cardinal over the 15-year life (13 years of direct feed and 2 years of reclaimed stockpiles) including ramp-up. The ramp-up has been assumed to cover a three-month period within the first year. It is planned to treat 90% of annual throughput during that first year of plant operation. An initial pre-strip period has been incorporated within the schedule to allow access to the Fresh ore within the Starter Pit and the stockpiling of the overlying Oxide portion in the Starter Pit.

The schedule was constrained to a maximum vertical sink rate of 80 m per year, with the mining Phases set to honour a minimum bench advance lead of 3 benches during any period.

The schedule targets the ore above the marginal cut-off grade, but uses the maximum recoverable value as a determination of process plant feed. Lower grade material is stockpiled as long as the mill feed requirements for deliverable ore can be met.

The scheduler was set up to maximise Net Present Value (NPV) whilst maintaining a reasonable smoothing of tonnage movement per year. The peak tonnage requirement over the period 2026 to 2033 is maintained at 36 Mtpa to allow mainly medium- and high-grade ore to be directly fed to the process plant, with the low-grade ore being stockpiled for treatment after primary mining has completed.

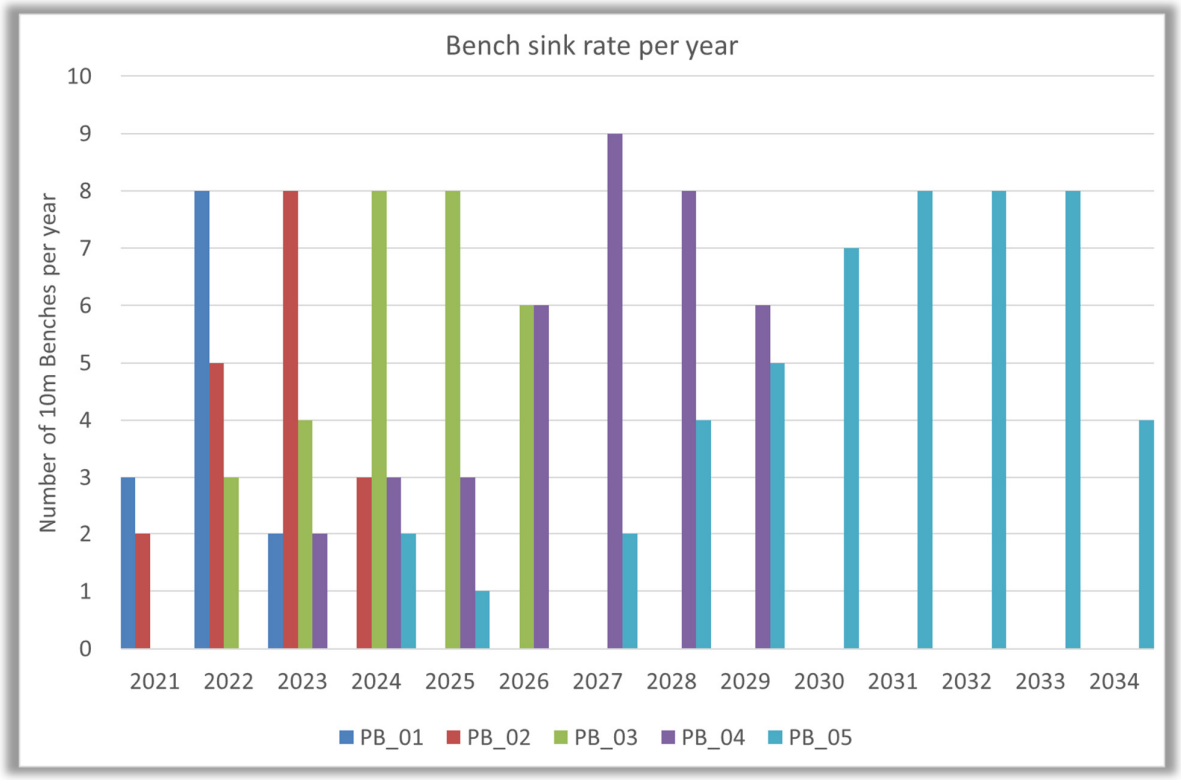


Figure 4: Mining vertical advance rate (source: Cardinal 2019)

16.6 Mine design criteria

The mine design criteria were developed to provide a plant feed rate of 9.5 Mtpa.

The mining sequence at Namdini consists of a relatively short period of higher-grade low strip ratio mining in the Phase 1 and Phase 2 pits. The Oxide ore is removed from most of the mining Phases during the early part of the schedule as this material is stockpiled for processing at the end of life of mine following process plant modifications.

The maximum mining movement has allowed for a strip ratio of up to 3:1 so that the initial optimisations are not 'mining-limited'. The final Life of Mine strip ratio is 1.9:1.

The pit design considered the geotechnical requirements for berms, face angle batter and catch-berms for the lithology within the block model to establish the engineered pit design in which the Ore Reserve is contained.

The pit was designed with five Phases, the first one (the Starter Pit) having two sub-phases with a single common ramp, allowing early access to the higher-grade ore near the surface. The second Phase is largely an expansion of the initial Phase targeting the ore to a greater depth. The Phase designs were created for optimal ore delivery from the first two Phases due to their low strip ratio and waste rock movement. The subsequent Phases contain a greater proportion of waste rock. A minimum mining width of 80 m was established between the Phases.

The Namdini deposit has been described as a largely diffuse orebody with limited pockets of higher-grade zones. An analysis of the grade-tonnage curve for the LOM Pit (Phase 5), indicates that there is a relatively low proportion of higher-grade material above 1.5 g/t Au. This type of grade-tonnage curve with a very flat curve for grades higher than 1.5 g/t Au shows that the ore attainable from selective mining would be minimal compared to the total available ore within the pit. The grade-tonnage profile for the Ore Reserve within the Final Pit design shows that some 86% of the Ore Reserve sits within a gold grade range of 0.5 to 1.5 g/t Au. Of the 138 Mt of ore within the Final Pit design, only 20 Mt of the total is above a gold grade of 1.5 g/t. The nature of the ore lends itself to bulk mining, with minimal edge dilution and ore loss expected at the edges of the demarcated ore zones during mining.

The design work targeted the maximum discounted value pit shell at a US$1,235/oz gold price. The pit optimisation using the Whittle 4X 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 five Phases with the initial two Phases targeting a relatively higher-grade area of ore near surface. Access was allowed to the four Phases by a ramp from the northern edge of the pit as the volume of waste rock in the first four Phases is considered modest. The final fifth Phase 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 Phase has a higher strip ratio than the preceding four Phases. Having the primary access on the western side of the pit reduces waste rock haulage costs and thus improves the overall value.

Design of the pit Phases was largely focused on targeting maximum value change-points within practical mining constraint limits, such as the minimum mining width of 80 m between the Phases.

Table 9 shows the key estimated production results.

Table 9: Key estimated production results

Key Estimated Production Results	Unit	9.5 Mtpa
Gold produced (average for full production years)	(koz/yr)	287
Life of Mine production – gold	(koz)	4,177
Average mine head grade	g/t Au	1.13
Ore Reserve mined at 0.5 g/t Au cut-off grade	Tonnes (Mt)	138.6
Life of Mine strip ratio	W:O	1.9:1
Mine life	years	15

The Final Pit design is shown in Figure 5.

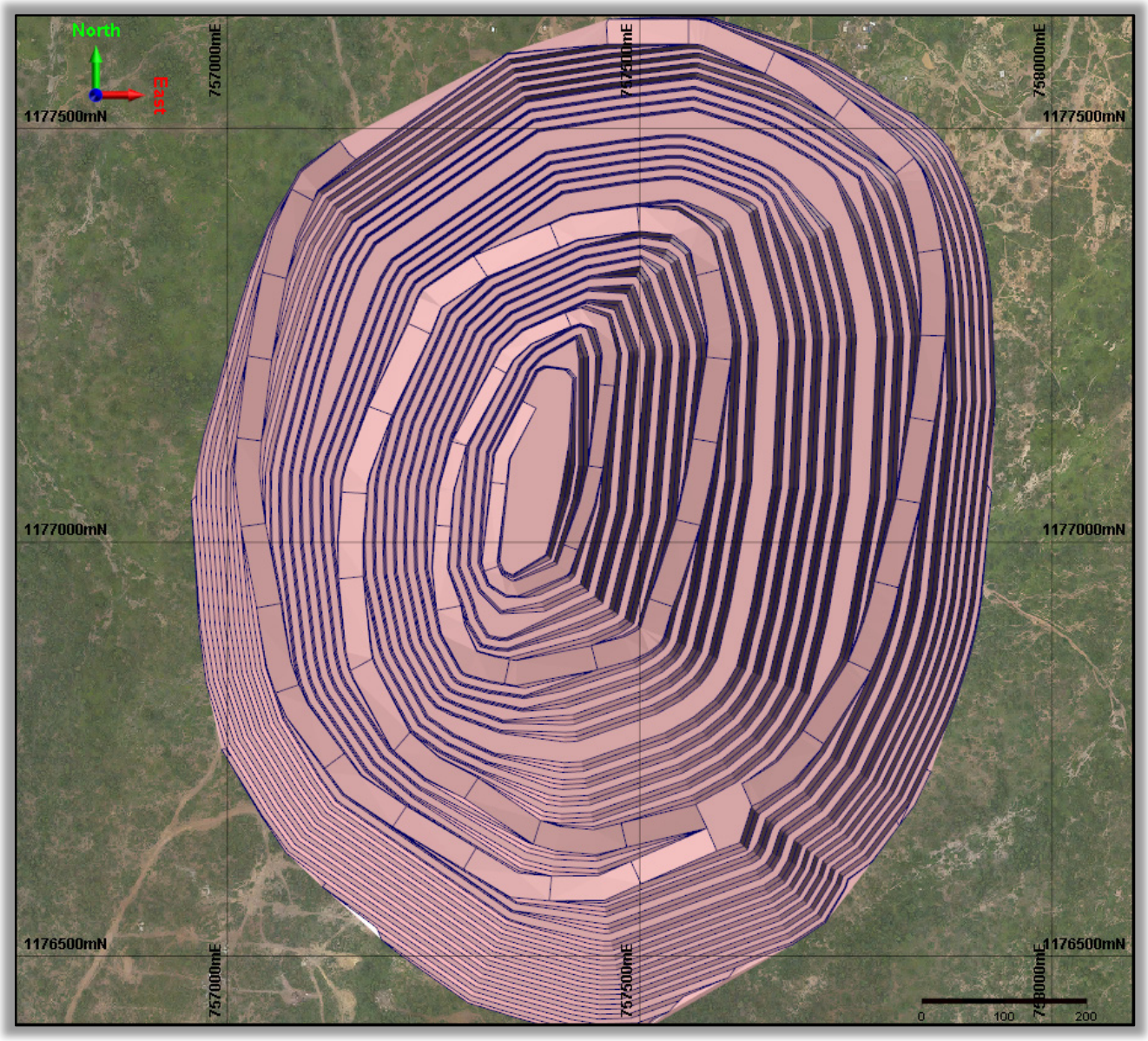


Figure 5: Plan view of the Final Pit design

A typical view in cross section of the Namdini Pit and block model is shown in Figure 7

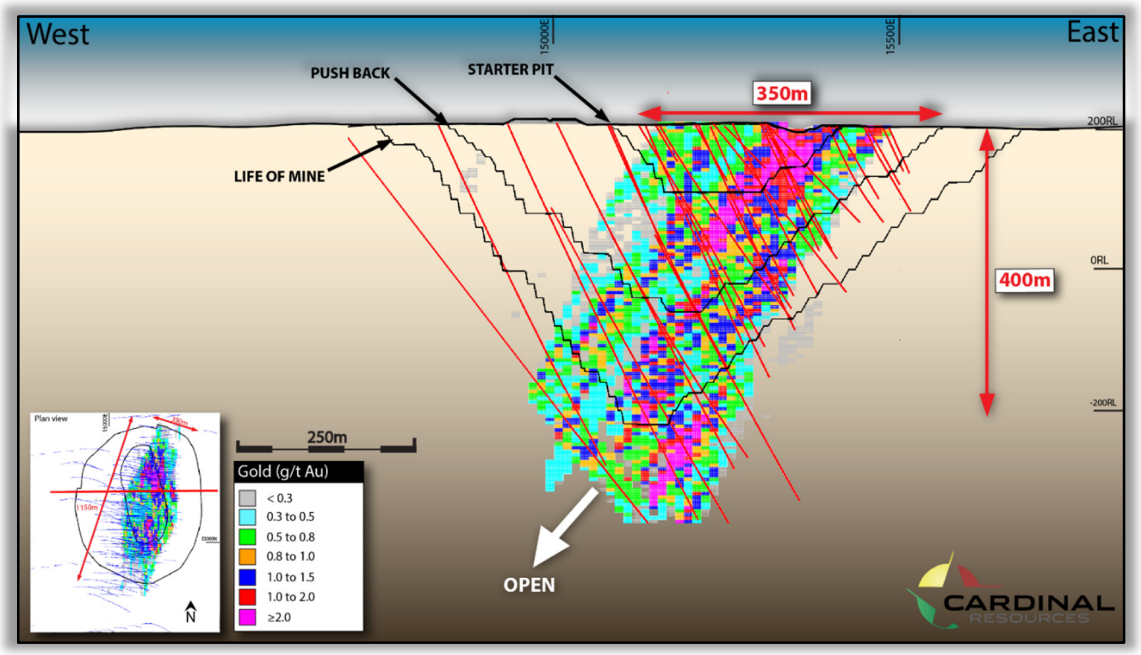


Figure 6: Cross section view of the Final Pit design and block model

A typical view in long section of the Namdini pit and block model is shown in Figure 7.

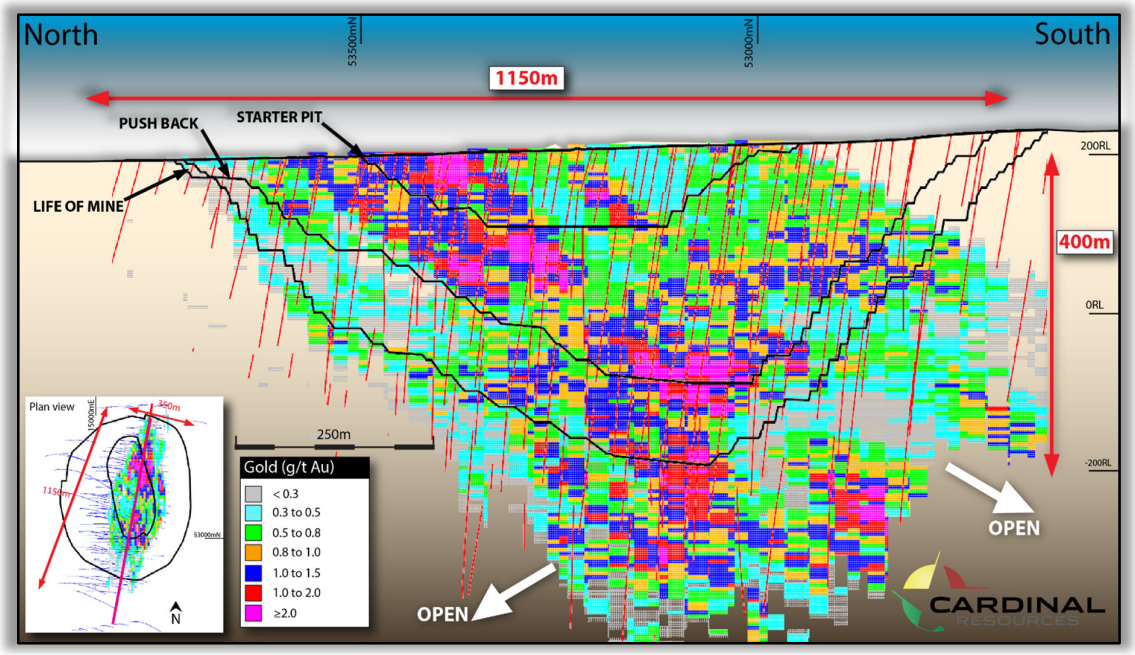


Figure 7: Long section view of the Final Pit design and block model

16.7 Mining cost

The FS 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.

Golder approached five leading mining contractor service providers in Ghana and has received budget estimates for the provision and supply of mining operations at the Namdini Project. The budget estimates have been used to provide project cost estimates for the mining operation over the life of the operation. Ghana currently has a very active mining contractor supply base. Specialist skills and core competencies in the mining contractor companies will be key considerations in the final selection criteria.

In addition to the mining contractor budget estimates, mining costs were also developed from first principles and a profit factor applied to estimate contract mining cost. 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 ("**US$**") basis.

16.8 Cut-off grade parameters

An estimated marginal cut-off grade was established at 0.5 g/t Au using an assumed long-term gold price of US$1,300/oz. The provided Mineral Resource model was validated and used to develop a mining model, as the basis for a 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 $39.67 /g (US$1,234/oz). The input processing cost provided in the ASX and TSX announcement of 18 April 2019 (Cardinal, 2019b) was $14.30/t plus an additional $1.50 /t allowed for stockpile reclaim giving a total of $15.80 /t of mill feed (as dry tonnes). Thus, the marginal cut-off grade ("**COG**") was estimated as: *process cost/(net gold price * process recovery)* giving 0.5 g/t Au (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 grade 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 in CIM (2014) and the JORC Code (2012).

The grade-tonnage curve (Figure 8) for the LOM Pit (Phase 5), indicates that there is a relatively low proportion of higher-grade material above 1.5 g/t Au.

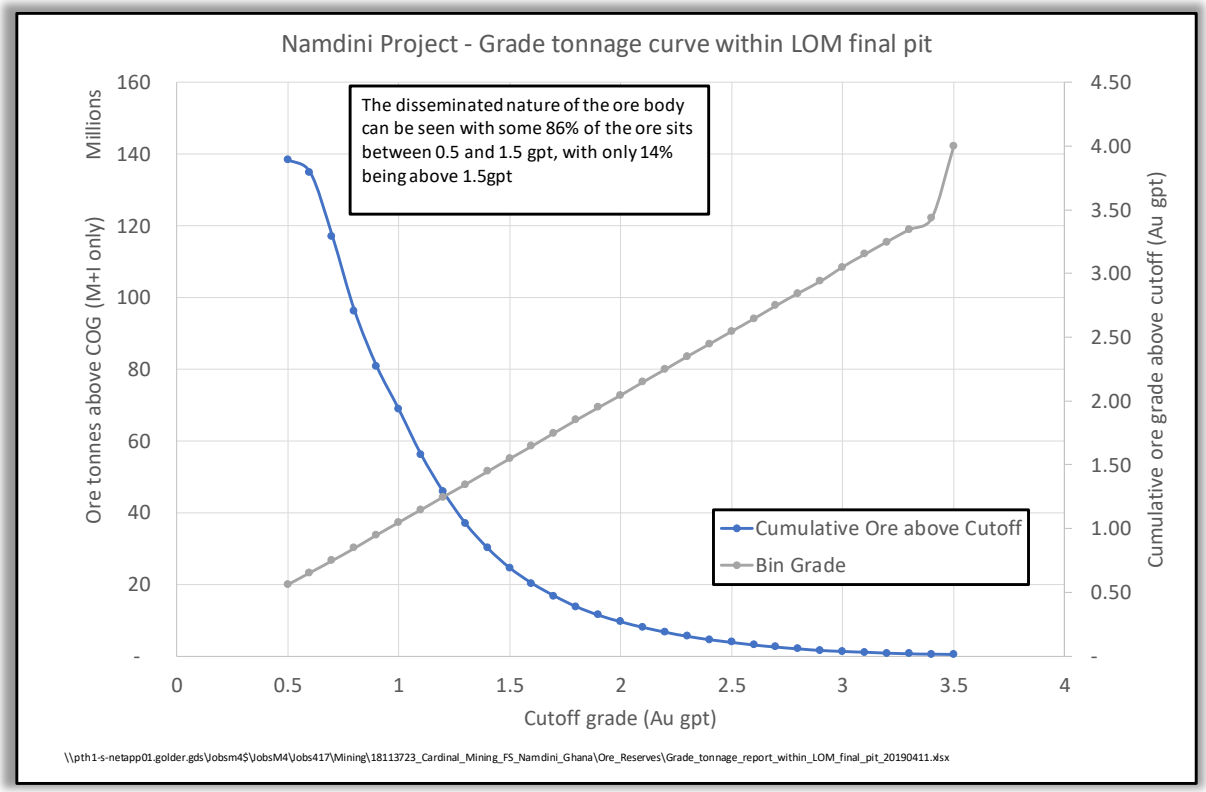


Figure 8: Grade-tonnage curve for Phase 5 Final Pit

16.9 Waste rock geochemical characterisation

To define the Acid and Metalliferous Drainage ("**AMD**") characteristics of the Namdini Project based on the preliminary mine planning, Cardinal requested Golder undertake a geochemical characterisation of the waste rock, low-grade ore and mineralised waste to be produced by mining of the deposit. The main findings (Golder, 2019g) were:

- The bulk of the waste rock materials are Non Acid Forming (NAF), especially Metasediments (MSE), Dacite (DAC) and Pyroclastics and tuffs (LTF).
- The Granite (GRA), Diorite (DIO) and Mafic Volcaniclastics (MVO) are the key lithologies that are consistently characterised as being Potential Acid Forming (PAF) or of uncertain classification (PAF-UC), for 20% of the samples of these lithologies analysed to date. These materials have elevated sulphur mainly associated with reactive sulphides, and insufficient Acid Neutralising Capacity (ANC) to buffer the acidity produced by sulphide oxidation, although results suggest that even samples with elevated sulphidic sulphur may have significant lag times before producing acid leachate.
- Water extractable element testing suggested that there is likely to be minimal immediate mobilisation of trace elements in NAF and PAF materials represented by these samples, other than arsenic.

- MVO samples showed substantial mobilisation of arsenic, with deionised water leachate concentrations above 0.1 mg/L (World Bank Group International Finance Corporation ("**IFC**") mining guidelines and Ghana EPA Akoben mining effluent guidelines) in 90% of samples tested.
- GRA and DIO samples showed some mobilisation of arsenic, with deionised water leachate concentrations above 0.1 mg/L in over 20% of the samples tested, and concentrations above 0.01 mg/L in 67% and 100% of the samples tested respectively.

Based upon the above findings, considering the availability of beneficial oxide zone saprolite (which is non-acid forming and has characteristically low infiltration rates) and laterite (which has the ability to adsorb dissolved arsenic from leachate) it is planned that:

- The waste rock dump and the low-grade ore stockpiles should both be constructed with a basal layer of oxide zone saprolite
- Waste rock materials that are higher risk (PAF, PAF-UC and arsenic-bearing) should be contained within a central cell of the waste rock dump
- Low-risk waste rock materials should be dumped around the outside of the high-risk cell, they could be end-tipped in a doughnut shape, with the high-risk cell at the centre
- The high-risk cell and the low-grade ore stockpile should be constructed with a layer of laterite to manage arsenic in the seepage (above the basal layer of oxide zone saprolite)
- The Tailings Storage Facility (TSF) embankments, which are to be earthfill, should be constructed with oxide zone saprolite, with low-risk waste rock cladding where required (with suitable geotechnical properties).

17.0 PROCESS PLANT

The information presented in this section is derived from Lycopodium (2019a) and Knight Piésold (2019a).

A nominal throughput processing rate of 9.5 Mtpa was selected as part of this FS.

The assessment of the comminution circuit identified that 9.5 Mtpa is the largest throughput that can be achieved with dual pinion mill drives.

The process plant design incorporated the following unit process operations:

- Single stage primary crushing with a gyratory crusher.
- Crushed ore feeding a stockpile with ore reclaim by two apron feeders.
- A SAG mill and ball mill in closed circuit with cyclones with recycle crushing of pebbles from the SAG mill.
- A gravity recovery circuit consisting centrifugal concentrators and an intensive cyanidation leach system.
- Rougher flotation to produce a gold-rich sulphide concentrate.
- Thickening of the flotation tails for water recovery prior to disposal in a separate non-cyanide Tailings Storage Facility ("**TSF**").

- Thickening of flotation concentrate followed by regrind utilizing Outotec HIGmill™ technology.
- Maelgwyn's Aachen high shear oxidation process on the regrind product before CIL.
- A concentrate CIL facility incorporating one pre-leach aeration tank and seven CIL tanks.
- A split AARL elution circuit, electrowinning and smelting to recover gold and silver and produce doré bullion.
- CIL tailings treatment incorporating cyanide destruction.
- Concentrate CIL tailings disposal in a lined tailings storage facility.

The plant is designed to comply with the International Cyanide Management Code (ICMI, 2016) for the manufacture, transport, and use of cyanide in the production of gold.

Figure 9 indicates the overall simplified flowsheet for the Namdini Gold Project.

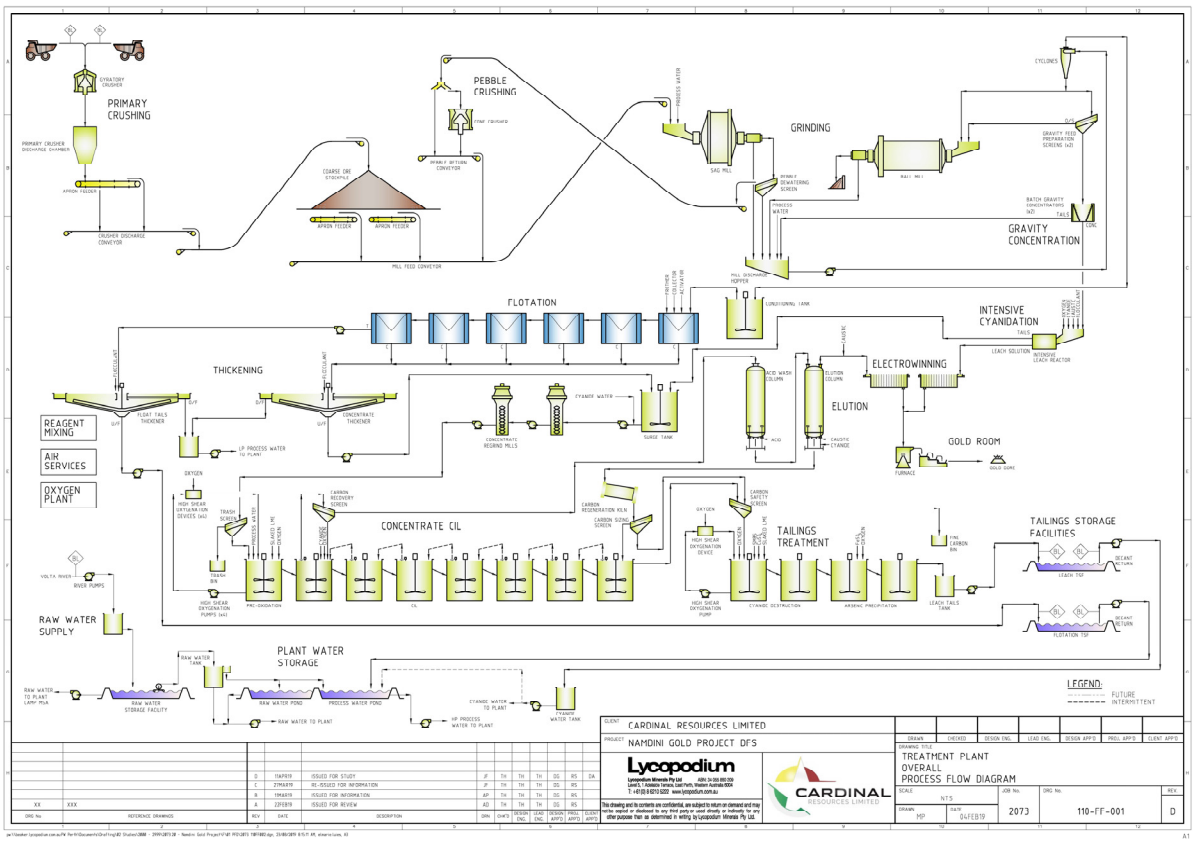


Figure 9: Simplified process flow diagram for the process plant

A summary of the plant design basis and the process plant components follows:

17.1 Process plant

The process plant design was based on a nominal capacity of 9.5 Mtpa. The feed will comprise blended ore from the pit consisting predominantly of three rock types being approximately 56% Metavolcanics, 29% Granite and 15% Diorite over the LOM.

17.2 ROM Pad

The Run of Mine stockpile ("**ROM Pad**") will hold the mill feed ore and be used as a buffer between the pit and the plant. The ROM Pad will allow for some blending of feed stock to help produce a consistent feed type and rate to the plant. A fixed hydraulic rock breaker will be used to break any oversized rocks in the crushing area.

17.3 Comminution selection

Previous comminution testwork started in 2016. This work focused on the main feed lithologies according to a preliminary mining schedule. This only comprises SAG mill power index ("**SPI**") and bond ball mill work index ("**BBWi**") data.

Additional testwork was completed in two campaigns during early and late 2017 and further testwork was completed in June 2018.

As part of optimizing the feed methodology for the Namdini Project, Cardinal geologists identified that the testwork undertaken during early 2017 consisted of material close to the contact zone that would be mined in the latter part of the production schedule.

It was also noted that the November 2017 and 2018 testwork was more representative of the plant start-up blend (effectively operating Year 1 to 5). In terms of identifying the longer-term LOM feed blend, all of the testwork data was considered, including the 2016 and early 2017 data.

The comminution circuit design and throughput predictions reflect this methodology.

A future circuit upgrade is possible, transitioning from a 'primary crush only' fed circuit to a 'secondary crush' fed circuit.

The findings and conclusions were summarised in the mill sizing design report compiled by Orway Mineral Consultants (OMC). The conclusions from the report and results were as follows:

- Test ore had high competencies and work indices with MVO being particularly high. While the initial samples were sourced from one drill hole, the follow up testing showed similar trends with competence (as measured by the SMC A*b drop weight value) varying from 29.9 to 40, placing these ore samples in the hard category.
- A gyratory crusher was selected for primary crushing supported by a fixed rock breaker.
- The SAG mill power efficiency ("**fSAG**") for this ore is low. The fSAG is poor at 1.36 but could be improved by partial crushing.
- Assessment of the comminution circuit identified that 9.5 Mtpa is the largest throughput that can be achieved with dual pinion mill drives.
- Pebble crushing is included to manage build-up of critical size material in the SAG mill.
- The 85th percentile design abrasion index range of 0.090 for Metavolcanics to 0.290 for Granite shows relatively low ore abrasiveness and therefore translates into low and favourable wear liner and steel media consumption.

17.4 Selected comminution circuit

The comminution circuit option selected using the design criteria was a primary gyratory crushing followed by two-stage SAG / ball milling and recycle crushing (SABC). This was selected as it can accommodate competent ore feed and minimises operating cost while still producing the relatively fine product size required.

17.5 Crushing and ore storage

The primary crusher was sized on the basis of achieving 75% utilization. The mine design is based on direct feed to the crusher with minimum rehandle. The crusher will be sized on this basis and to provide capacity for maintenance of the crusher without interrupting mill operation.

Ore will be trucked and direct tipped into the ROM feed pocket for entry into the gyratory crusher. A fixed rock breaker will be used to handle oversize ore. A gyratory crusher was selected to allow direct tipping of ore from

150 t trucks and to achieve the target reduction ratio required for mill feed. As the abrasion index of the ore is moderate no significant wear issues are expected.

Crushed ore will feed a 12-hour live capacity stockpile. The live coarse ore stockpile was selected to ensure adequate surge capacity in the event of a crusher breakdown. Crushed ore will be reclaimed by two apron feeders, each capable of providing 100% of the mill feed.

17.6 Milling and classification

The milling circuit was sized to reduce the crusher product to the nominal P_{80} size of 106 µm. The SABC facility provides a more uniform product while minimizing operating cost. Pebble crushing was included to reduce any critical size build-up. The SAG mill will be equipped with a variable speed drive allowing a range of mill speed with a nominal design of 75% of critical speed. The ball mill will also be variable speed. The variability in ore competence can be addressed by varying the speed of the mills.

A gravity circuit was included as some of the ore types tested, in the Starter Pit samples in particular, appear to have a gravity recoverable gold component.

17.7 Flotation concentrate thickening

Inclusion of a flotation concentrate thickener before the regrind facility will achieve a higher regrind feed slurry solids content. Thickening also recycles water that is not cyanide-bearing for reuse in the grinding and flotation sections of the process plant.

The higher regrind feed slurry solids allows the CIL tailings decant to be used for process water dilution to meet the regrind mill vendor's requirements for limiting the mill feed slurry solids content without compromising the plant water balance.

The thickener was sized to allow for potential froth management.

A surge tank is installed to store concentrate thickener underflow slurry prior to delivery to the regrind circuit. This allows the primary grinding and flotation circuit to remain operational in the event of a short-term maintenance stoppage or breakdown in the regrind area.

17.8 Flotation

Testwork on samples of the ore has indicated that a high gold recovery can be achieved by flotation, with a design point of 7.5% mass recovery from the feed selected by Cardinal for design.

The testwork indicated a simple roughing circuit with a residence time of 30 minutes was adequate without a cleaning stage. Given the significant slurry flow from the grinding facility at 35% solids, tank cells were selected with six cells each with individual level control. All flotation concentrate will report to a single concentrate hopper and be pumped to the concentrate thickener before transfer to the regrind circuit.

17.9 Concentrate Regrind

Leach testwork indicated that regrinding of flotation concentrate would be necessary to improve leach extraction. An optimisation study indicated that a regrind to P_{90} grind size of 9 µm should be targeted, with the opportunity to grind to 12 µm for certain lithologies.

Two high intensity grinding mills (the HIGmill) in series were selected for the regrind duty. This equipment minimizes footprint, provides internal classification and has minimal overgrind issues, while providing suitable

access for maintenance. The mill was sized based on testwork carried out by the vendor (Outotec) on behalf of Cardinal.

The reground concentrate will be pumped to the trash screen ahead of the Aachen process and CIL circuit.

17.10 Pre-leach Shear and Oxidation

The Aachen process has proved at pilot scale to enhance leach kinetics and gold extraction for all the ore types fed to the process. The process uses a pipe shear device designed to improve oxidation of slurries using oxygen fed into an aerator. The aerator has an engineered slot (200 µm) to introduce micron-sized (2 µm) oxygen bubbles into the slurry and sub sonic velocity. The device has several tubes separated by an orifice plate creating a highly efficient contact of oxygen to the slurry. The equipment is especially efficient for high-rate oxidation of sulphides which is ideal for Namdini's ore since the gold is particulate and occurs as free gold, in fractures in pyrite or in pyrite grains.

17.11 Leach and adsorption circuit

Metallurgical testwork indicated that pre-oxidation improved both the gold leaching kinetics and overall dissolution. As a result, a pre-aeration tank was included in the design. Cardinal nominated a leach residence time of 48 hours for design.

A configuration of one pre-aeration tank and seven CIL tanks was selected. The pre-leach and CIL tanks will be the same size. As well as the pre-aeration tank oxygen addition facility, extra oxygen may be added to all CIL tanks to oxidise any cyanicides and maintain an adequate dissolved oxygen level.

17.12 Elution and gold room

The average daily movement of carbon was calculated based on the design feed grade and maximum gold and silver extraction. On this basis a 4.5 t capacity split AARL elution circuit was selected requiring just under seven strips per week. The AARL circuit also offers the flexibility to run more than one elution per day if needed.

17.13 Flotation tails thickening

Tails from the flotation circuit will be dewatered in a high rate thickener to recover cyanide-free process water for re-use in the grinding and flotation circuits.

17.14 Cyanide destruction

Concentrate leach generally requires a higher cyanide concentration to achieve efficient extraction. As a result, tailings from the CIL circuit may have high weak acid dissociable cyanide (CN_{WAD}) levels. A cyanide destruction facility incorporating sodium metabisulphite and oxygen was included to reduce the levels of CN_{WAD}, compliant with the International Cyanide Management Code (ICMI, 2016) limits.

17.15 Arsenic precipitation

Testwork has indicated that elevated levels of arsenic can occur in leach solutions. The arsenic levels in CIL tailings solution can be reduced by the addition of iron sulphate. This process has been included in the design.

The design of the arsenic precipitation circuit has two agitated tanks, the same size as the cyanide destruction tanks. This provides additional residence time. One tank is designed for use as either a cyanide destruction or arsenic precipitation tank to provide additional cyanide destruction capacity if required.

17.16 Tailings disposal

Two separate tailings streams will be produced. CIL tailings from the cyanide destruction circuit will be pumped to a plastic-lined tailings storage facility. Tailings from the flotation circuit will be pumped to a separate storage facility without a plastic lining. This will allow the two decant water streams to be recycled separately.

17.17 Water and air services

Three water systems will be used:

- Process water recovered from the flotation tails thickener and tailings storage facility will be recycled in the grinding and flotation areas.
- Cyanide water recovered from the cyanide tailings storage facility will be used in the CIL circuit.
- Raw water sourced from the White Volta River via a raw water storage dam will be used for reagent mixing, cooling water make-up, pump gland seal water and will feed a water treatment plant for elution water and potable water plant feed.

Three air systems will be used:

- Low pressure air will be used in the flotation cells.
- Oxygen will be used in the CIL circuit and cyanide destruction and arsenic precipitation areas.
- Compressed air will be used for instruments and plant services.

18.0 INFRASTRUCTURE

The information presented in this Section is derived from Lycopodium (2019b) and Knight Piésold (2019a).

18.1 Location and layout

The site is located approximately 20 km outside Bolgatanga and 180 km 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.

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.

Cardinal has sufficient area available on its Mining Leases to cater for all its planned infrastructure requirements.

Lycopodium and Knight Piésold completed FS level analyses covering all related aspects of the infrastructure requirement including power, water, road access and waste management.

The site infrastructure layout has been developed and is shown in Figure 10.

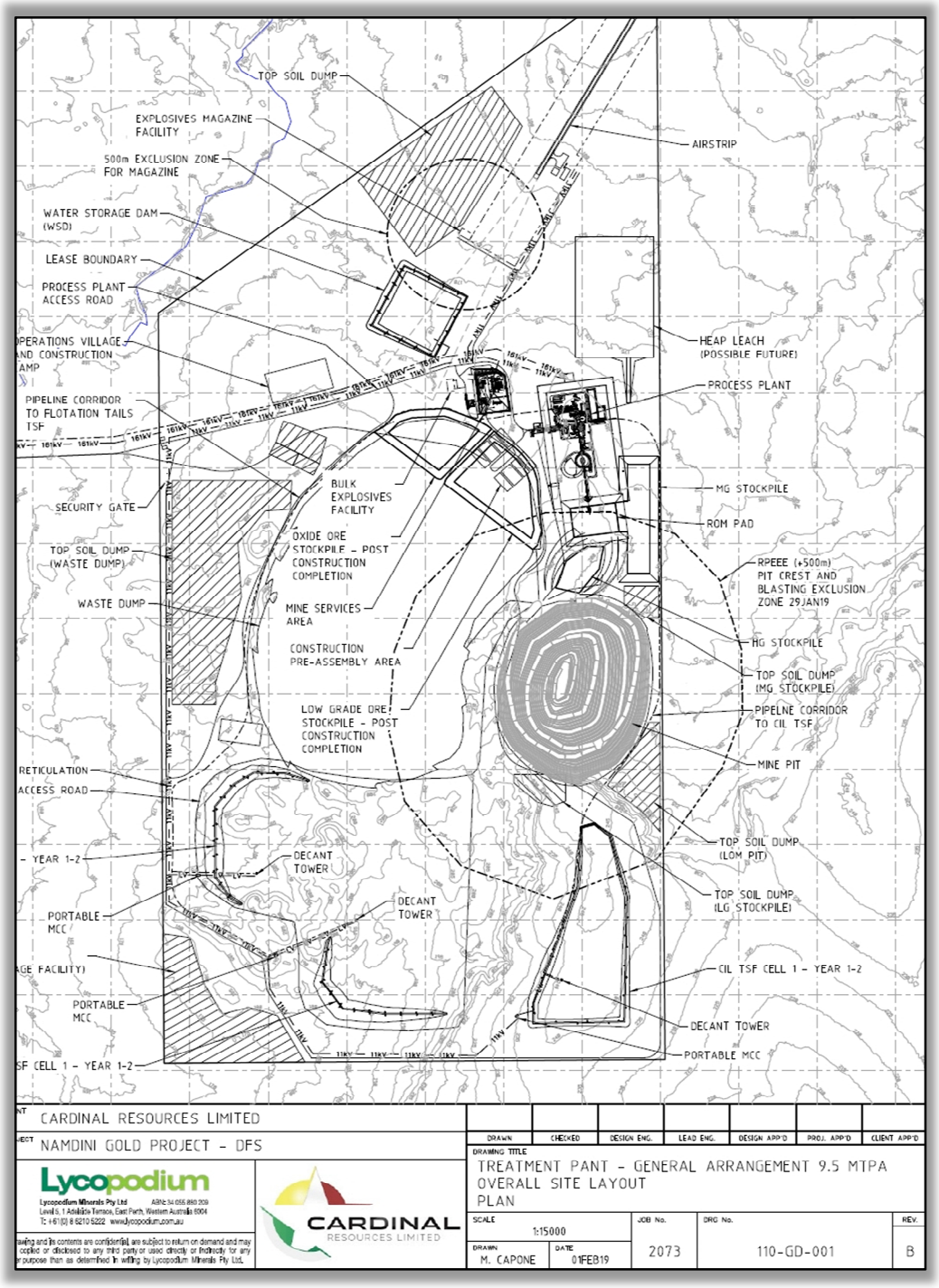


Figure 10: Project site infrastructure layout

The site layout was developed based on the following information:

- Total available ore tonnage for the Life of Mine is 138.6 Mt
- Process throughput is 9.5 Mtpa.
- Flotation tail/concentrate split is 92.5% : 7.5%
- Tailings to flotation TSF is 128.2 Mt
- Tailings to CIL TSF is 10.4 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.

Infrastructure costing includes the following dedicated elements:

- Unsealed access road
- High voltage power supply line to the process plant
- Water supply pipeline from the White Volta River
- Raw water storage facility
- Airstrip
- Accommodation village
- Mine service area including heavy vehicle workshops
- Fuel depot.

Approximately 260 Mt (95 Mm^3) 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.

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.

For the FS, the TSF designs have been further optimised using locations defined in the PFS and incorporating more recent topography for the site area together with the updated design parameters.

A hydrogeological fieldwork programme was undertaken comprising a hydro-census of surrounding properties to identify groundwater users. 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.

Further geotechnical investigations of the flotation TSF, CIL TSF and process plant sites were carried out by Knight Piésold as part of the Feasibility Study to investigate the sub-surface conditions and to provide final geotechnical parameters for design. A geotechnical investigation of the site access road, water storage facility, airstrip and potential borrow sources was carried out as part of the FS.

The power design is based on establishing a grid power supply to the process plant. This will be achieved by constructing a new GRIDCo switchyard near the process plant to step-down the incoming 161 kV supply to 11 kV for plant power distribution. The grid supply is seen to be reliable, based on a HV supply monitoring study previously carried out by Cardinal. Construction power and emergency power for process plant essential drives and facilities during grid power supply outages is provided for.

A water management model was developed 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 to calculate process water shortfall and quantify the volume of water required from external sources. Results indicate the CIL plant will only require 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 will require some additional water make up, some of which may be sourced from an abstraction tower on the northern bank of the White Volta River approximately 8.5 km to the west 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.

Waste will be treated or stored appropriately. Grey water and effluent from all water fixtures will drain to gravity sewerage systems at the camp and plant site. Effluent will be treated in a sewage treatment plant located adjacent to the camp. Solid waste will be sorted and reused or recycled as far as the limited access to recycling facilities allows. Waste lubricating oils will be returned to the supplier for recycling.

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 in terms of percent water release, but at a slower rate. Ultimate settled density (air dried) was 1.47 t/m^3 for CIL tails and 1.67 t/m^3 for flotation tails. Geochemical testing has been carried out to define mined materials as acid consuming or potentially acid forming. On the basis of the multi-element results, both the flotation and CIL TSFs will be designed to prevent the loss of solids. 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 TSF design incorporates an underdrainage system comprising a network of branch and collector drains in each cell. The underdrainage system will drain by gravity to a collection sump located at the lowest point in each cell. 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 earth fill perimeter embankments and will be lined with compacted soil liner overlain by a synthetic HDPE geomembrane. 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 as required

Construction and permanent accommodation camps have been allowed for. 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.

Requirements for site communications, IT services, mobile phone, radio and satellite TV connections have been estimated. Diesel fuel and explosives storage and handling have been considered.

Site security is based on concentric lines of fencing and control. 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 and exit will be via a single monitored security post and will be strictly controlled. Access to the gold room within the plant will be restricted and strictly controlled.

Site facilities, buildings and the airstrip have all been allowed for in the design and costings. An administration office, site warehouse and clinic combined with the emergency response facility will be located together.

An airstrip will be constructed 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.

18.2 Tailings Storage Facilities

18.2.1 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 in terms of percent water release, but at a slower rate. Ultimate settled density (air dried) was 1.47 t/m^3 for CIL tails and 1.67 t/m^3 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 pH values. Therefore, the Diorite and Metavolcanics flotation tailings are classified as acid consuming ("**AC**") and the Granite rougher tailings as non-acid forming ("**NAF**") following the AMIRA (2002) classification.
- The CIL tailings sample recorded a positive NAPP and a low net acid generation pH, resulting in a classification of potentially acid forming ("**PAF**").
- On the basis of the multi-element results, both the flotation and CIL TSFs will 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 a compacted soil liner with overlying HDPE liner and underdrainage system.

18.2.2 Design of the 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 474 Ha and is designed to accommodate 139 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.

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 *in situ* material (assumed 70%) or imported Zone A (30%) material.

The TSF design incorporates an under-drainage system comprising a network of branch and collector drains in each cell. The system will drain 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 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.

18.2.3 Design of the 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 earth fill 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 (Knight Piésold, 2019b) to a final elevation of 266.0 mRL.

The TSF basin area will be cleared, grubbed and topsoil stripped, and a 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 smooth HDPE geomembrane liner.

The TSF design incorporates an underdrainage system comprising a network of branch and collector drains. The underdrainage system will drain 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 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 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.

19.0 MARKET STUDIES AND CONTRACTS

No formal marketing studies have been completed. Gold is a readily traded commodity and a specific market study was not required.

Gold doré bars will be transported from the Project site to an accredited gold refiner for smelting and refining into an LME grade gold bar on a regular basis, and the refined product credited to the Company's revenue account.

Advice regarding the forward-looking gold price was provided by Cardinal and the Project assumes US$1,350/oz for the purposes of the financial model at the date of this FS.

20.0 ENVIRONMENT

20.1 Studies

Cardinal engaged NEMAS Consult Ltd ("**NEMAS**") as an independent consultant to undertake the Environmental Impact Assessment ("**EIA**") study for the Project (NEMAS, 2017). This culminated in preparation and submission of an Environmental Impact Statement ("**EIS**") report (NEMAS, 2018) to the Ghanaian Environmental Protection Agency ("**EPA**") on 26 October 2018 to satisfy the Environmental Protection Agency

Act 1994 (EPA Act 490) and the Environmental Assessment Regulations 1999 (LI 1652). The EIS Report is still in Draft form pending approval from the EPA.

Cardinal has also registered the Tailings Storage Facility ("**TSF**") portion of the Project with the EPA as a standalone project. This enables a TSF specific EIA to be conducted to ultimately obtain an environmental permit for the construction, operation and closure of the TSF. Therefore, Cardinal engaged Geosystems Consulting Limited ("**Geosystems**") to prepare a Draft TSF Scoping Report (Geosystems, 2019), which precedes the EIA specifically for the TSF. The Draft TSF Scoping Report sets out the scope and extent of the EIAs to be carried out and includes the draft terms of reference to be addressed in the EIS during the EIA process.

This Technical Summary provides a high-level summary of the environmental and social baseline conditions with a focus on key findings from the baseline studies conducted to date for the Project. Numerous desktop and field studies and assessments were undertaken to support the EIA Study and EIS, including examination of stakeholder engagement, flora, fauna, aquatic biology, hydrology, soils, environmental quality, archaeology and culture.

There are four main sub-basins within the Volta catchment, consisting of the Black Volta River, White Volta River, Oti-Pendjari River and the Lower Volta River. The sub-basins, excluding the Lower Volta system, flow to the Volta Lake which was created by the construction of Aksombo Dam in 1964.

The White Volta River first flows south on entering Ghana, turns west to be joined by the Red Volta River, continues westwards through the Upper East Region and then turns south, where it is joined by several tributaries, including the Kulpawn/Sissili and Nasia Rivers. The Project area is located approximately 7 km north of the White Volta River (Figure 11).

A small ephemeral stream, the Zoan Buliga, is the only visible source of surface water that traverses the Project area and passes through the northern boundary before joining the White Volta. The Zoan Buliga stream flows from a few days to weeks during the months of heavy rainfall, typically between May and October.

Stagnant ponds of water are a result of rainfall collecting in pits left by illegal mining.

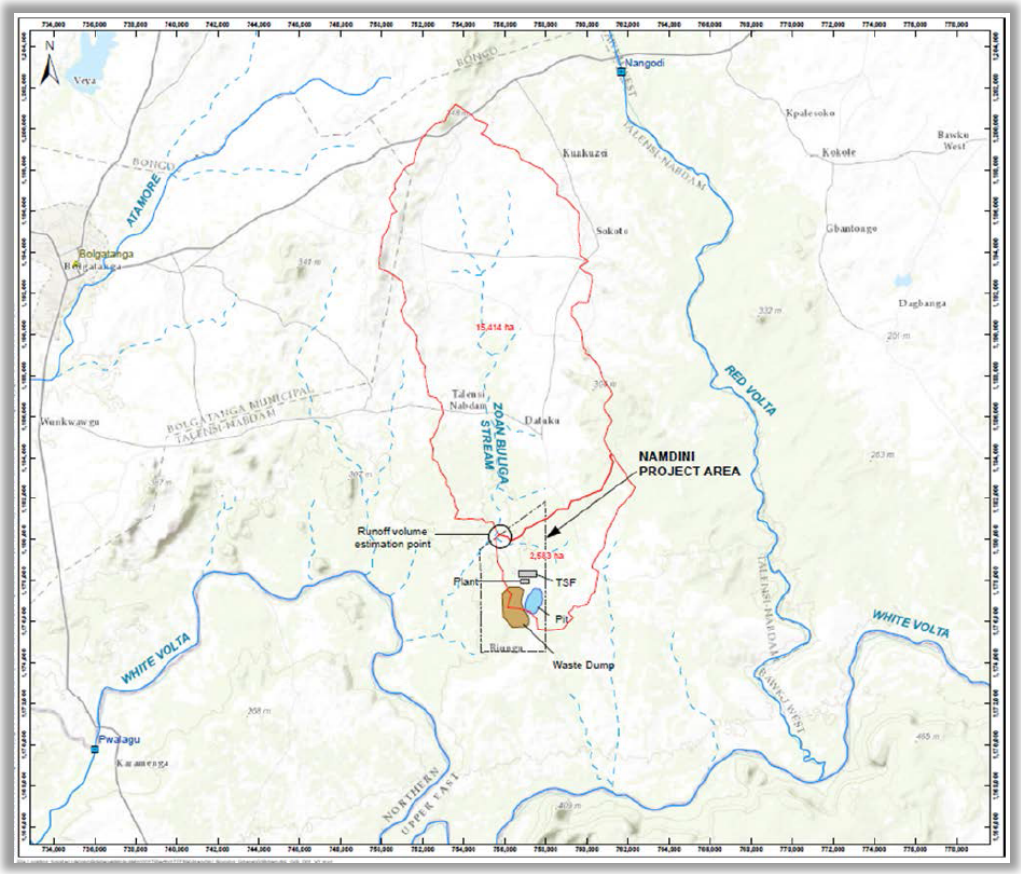


Figure 11: Location of the Project area in relation to nearby rivers

The broader hydrogeological aspects of the region and the impacts on community use of groundwater are discussed in more detail in the FS documentation, as is the hydrology and the results of water quality sampling.

20.2 Social setting

A social baseline study was conducted as part of the EIA Study to outline the socio-economic and cultural settings of the host communities for a reference against which to measure impacts (positive and negative) of the Project on the host communities.

The host communities affected by Cardinal's 19.5 km^2 Project area are the Biung (Bingo) and Datoko which also captures Wankala and Zangore.

The dominant tribe is the Talensi which forms about 90% of the local population with some migrants from Southern Ghana and neighbouring countries. The area is under the Nabdam Traditional Council and is male dominated, both in terms of demography and cultural practices. The people are mostly traditionalist and/or Christians with Muslims forming the minority.

Fifteen heritage resources, two archaeological settlement sites and 13 shrines were identified and documented at Biung. Three shrines and 14 archaeological settlement sites were identified and documented at Datoko.

Most residents either have no formal education or are without any employable skills. The local economy is based on subsistence farming. Illegal artisanal gold mining has dominated economic activity particularly within the Project area over the past 20 years. Concerns regarding loss of access to land and therefore loss of this economic activity due to Project development is a key concern for these communities.

As part of the EIA Study and to support the EIS, Cardinal identified approximately 29 key stakeholders for the Project, including Government regulatory agencies, Government institutions, traditional and political authorities, Project communities and leaders, and non-Government authorities.

Extensive social consultations and stakeholder engagements have been held with key stakeholders.

All key stakeholders consulted expressed their support for the Project. Key concerns raised related to security, Social Corporate Responsibility, payment of royalties, and protection of juveniles from engaging in artisanal mining activities. Stakeholders advised Cardinal to operate an 'open door' policy based on mutual respect.

20.3 EIS

As noted above, Cardinal has recently completed an Environmental Impact Statement ("**EIS**") 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.

The FS environmental studies included active engagement with local and state regulatory bodies and local stakeholders. Cardinal has an excellent relationship with neighbours and the granted leases cover all the required mining and processing areas. There are no title claims pending.

20.4 Tailings Storage Facilities

Reclamation and subsequent closure of the proposed TSFs will be completed in accordance with the provisions of LI 2182 and with the conditions of the environmental permit and EPA guidelines so that water leaving the Project site meets regulatory requirements.

The proposed TSFs will be rehabilitated to promote long term stability, minimise erosion, and provide a discharge water quality that meets the baseline quality of the receiving environment or the EPA guidelines for discharge into waterbodies. Rehabilitation of the TSF would begin when process plant operation ceases and tailings are no longer generated with initial measures taken to stabilise the tailings surface. This is a key issue that will be appropriately addressed during the EIA to ensure compliance with the legislation and result in long term environmental sustainability.

Decommissioning and rehabilitation of the TSF will be linked to the general rehabilitation of the mine site and the permitting conditions for the mining lease.

20.5 Potential environmental and social impacts, and mitigation

The Project shall interact both positively and negatively with the biophysical and socioeconomic resources and/or receptors within and beyond the Project area. The key potential positive impacts and opportunities, and key potential adverse impacts from Project construction, operation, and decommissioning/closure identified in

the draft Project EIS (NEMAS, 2018), and draft Scoping Report for the TSF (Geosystems, 2019) are summarised in this Report.

20.6 Resettlement

All issues related to relocation and/or resettlement shall come under a Resettlement Action Plan ("**RAP**") to be produced as a standalone report for the Project. The handling of relocation and/or settlement will consider the following principles:

- Fair and adequate compensation
- Compensation based on negotiation
- Payment before destruction
- Maintenance and/or betterment of facilities to pre-project condition
- Regards to traditional and spiritual needs of the people
- Grievance redress mechanism.

Cardinal will liaise with relevant stakeholders as provided in the RAP to establish the Relocation and Compensation Negotiation Committee ("**RCNC**") within the Project approval phase prior to commencement of construction. The RCNC will approve or agree on compensation rates for affected properties/assets, livelihood restoration programmes for project affected persons and deprivation of use of land/surface rights issues as provided in the *Minerals and Mining Act 2006* and the Minerals and Mining (Compensation and Resettlement) Regulations, 2012 (LI 2175).

Potential compensation amounts cannot be predicted at this stage.

20.7 Environmental management and monitoring

A provisional Environmental Management Plan ("**EMP**") has been developed for the Project which captures Cardinal's corporate policies on environment, health and safety with clear policy objectives and targets as well as establishing a comprehensive Environmental Management Structure.

Cardinal is committed to financing the environmental aspects of the Project from its annual operating budget for the Mine and will make provisions for financial allocations during budget preparations for the implementation of all environmental management actions, including monitoring. The detailed cost estimates will be calculated prior to the construction and operational phases.

A detailed EMP will be prepared and submitted to the Ghana EPA within 18 months of commencement of operations under Regulation 24 of LI 1652. Cardinal will update the EMP every three years throughout the life of the Project.

Environmental monitoring programmes will be implemented to confirm the extent and magnitude of predicted impacts and to ensure effectiveness of the proposed mitigation measures as well as to confirm any residual impacts, which are expected with the development of such Projects. The proposed monitoring programme will cover meteorology, ambient air quality and noise levels, blast vibration, water resources and the socio-economic environment.

20.8 Closure, decommissioning and reclamation

The Project's Mining Lease was issued for 15 years, renewable for a further 30 years. The current projected mine life is 15 years (including ramp-up and mine closure) based on a 9.5 Mtpa processing plant throughput.

Within two years of commencement of operation Cardinal is required to prepare and submit a detailed Reclamation and Decommissioning Plan for the Project to guide the reclamation security agreement to be signed by Cardinal and the Ghanaian EPA. The Plan shall address land stabilisation and erosion, sediment control among other issues associated with the Project. The Plan will serve as the basis for concurrent reclamation during the Project's life. A final Reclamation and Decommissioning Plan is required to be submitted to the EPA two years before closure of the Project.

Cardinal's aim of reclamation is to achieve a socially acceptable balance between mining and the biophysical and social environment, and to ensure that internationally accepted standards of health, safety and environmental protection are observed during and after active mine life.

The short-term reclamation approach will be to stabilise all areas heavily impacted during mining operation as well as its immediate areas not disturbed from any land degradation, either by erosion, sediment transport or deposition.

The long-term reclamation approach will be to ensure complete site stabilisation and re-establish a productive floristic heterogeneous community capable of supporting and sustaining a healthy faunal population. The post-mining decommissioning is also to ensure public safety within the mine sites and its immediate areas of influence and establish and regenerate the sites to acceptable land use that conforms to the pre-mining land use or land use that enhances land utilisation.

The post-mining land use objectives will be determined through stakeholder engagement during the operational phase, and the final land use will be compatible with community expectations and needs.

A comprehensive monitoring programme is required to be prepared and shall include physical observation and assessment of reclaimed sites. Closure and post-closure monitoring shall aim to ensure that the mine area after closure does not suffer from residual mine effect and to satisfy statutory authorities on both environmental and public safety of areas decommissioned.

Cardinal proposes to finance the closure, decommissioning and reclamation of the Project from the annual operations budget which is included as part of sustaining capital expenditure in Cardinal's financial model.

21.0 COST ESTIMATES

The information presented in this Section is derived from Lycopodium (2019c), Golder (2019b) and Cardinal.

21.1 Capital costs

The capital cost ("**Capex**") estimate for the Namdini Gold Project has been compiled by Lycopodium with input from Knight Piésold on water infrastructure and the tailings storage facility.

The FS capital cost estimate was completed to an accuracy of +15% to -5% for both Plant and Infrastructure Capital Costs, based on open pit mining of the Ore Reserve.

The proposed plant comprises crushing, SABC milling, gravity, flotation, concentrate regrind, high shear oxidative pre-treatment, and CIL cyanidation of the flotation concentrate.

Cardinal has elected to compile project specific portions of Mining and Owner's costs. The mining establishment cost was based on information provided by in-country mining contractors. The mining equipment is identified in Section 16.0. The capital costs include Owner's costs and contingency as calculated by Lycopodium.

The capital cost estimate is summarised in Table 10 for which the detail is available separately to Cardinal.

Table 10: Capital estimate summary (US$, 1Q19, +15/-5%)

Main area	US$'000
Construction distributables	41,699
Treatment plant costs	149,727
Reagents and Plant services	28,562
Infrastructure	60,138
Mining Services	6,253
Management costs	36,313
Owner's Project costs	25,207
Subtotal – Process Facility & Infrastructure	**347,911**
Contingency	42,196
Taxes & duties	*
Escalation	Excl.
TOTAL PLANT DEVELOPMENT	**390,107**

* Estimated Taxes during construction of $37M, are excluded and are subject to negotiation and or deferment under a Development Agreement.

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 including 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 requests 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 infrastructure items that were subsequently costed by Lycopodium.

The Capex estimate includes:

- Direct costs of the Project development including infrastructure
- 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
- Operating spares and 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
- HV Powerline to the process facility and switchyard
- Taxes and duties (subject to Development Agreement)

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

21.2 Operating costs

The operating costs ("**Opex**") have been developed by:

- Lycopodium – Processing and General and Administration costs
- Golder – Mining costs
- Cardinal – Owner's costs.

Operating costs have been determined for a single throughput rate of 9.5 Mt/a operating 24 hours per day, 365 days per year at a primary grind size of P_{80} 130 µm and a flotation concentrate regrind size of P_{90} 9 µm.

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

- OMC modelling for crushing and grinding energy and consumables, based on comminution testwork
- The LOM expected mass recovery to flotation concentrate is 7.5% based on testwork managed by Cardinal
- Flotation reagent consumption based on testwork managed by Cardinal
- CIL reagent consumption based on based on testwork managed by Cardinal
- Calculated reagent usage for cyanide destruction and arsenic precipitation prior to testwork
- Typical industry data from equipment vendors
- Budget pricing from Vendors or Lycopodium's database of unit prices for consumables
- Lycopodium's database of costs for similar sized operations
- Mining costs were solicited from five 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 increases in the depth of mining in line with standard mining cost principles.

21.3 Processing and G&A costs

Estimated process operating costs per tonne of ore processed (138.6 Mt of ore) at a throughput of 9.5 Mtpa are shown in Table 11.

Table 11: Processing operating cost estimate summary (+/-15%,1Q19)

Opex – Process costs	US$ M/y	US$/t	% of cost
Power	49.5	5.21	45%
Operating consumables	48.0	5.06	44%
Maintenance	8.0	0.84	7%
Laboratory	1.9	0.20	2%
Process & maintenance labour	2.7	0.28	2%
Total Processing	**110.1**	**11.59**	**100%**
Administration labour	7.7	0.82	50%
General & administration costs	7.2	0.76	47%
Camp power	0.4	0.05	3%
Total G&A	**15.4**	**1.62**	**100%**
TOTAL – Process	**125.4**	**13.21**	

Note: Costs and totals are rounded.

21.4 Contract mining costs

Contract mining costs per tonne of ore processed (138.6 Mt of ore) at a throughput of 9.5 Mtpa are shown in Table 12.

Table 12: Contract mining costs

Item	Cost/t milled (US$)
Variable mining cost – Waste	5.08
Variable mining cost – Ore	3.53
Management fees	1.68
Services	0.30
Total	**10.59**

21.5 Owner's costs

Owner's costs per tonne of ore processed (138.6 Mt of ore) at a throughput of 9.5 Mtpa are shown in Table 13.

Table 13: Owner's costs

Opex – Owner's costs	US$/t
Grade control	0.76
10% ROM rehandle	0.07
Owner's G & A	0.60
TOTAL	**1.43**

21.6 Sustaining capital costs

Sustaining capital costs provided by consultants and Cardinal were compiled from a variety of sources and compared against existing and planned operations elsewhere in Ghana. These costs include rehabilitation and mine closure.

Sustaining capital costs per tonne of ore processed (138.6 Mt of ore) at a throughput of 9.5 Mtpa are shown in Table 14.

Table 14: Sustaining costs

Sustaining capital cost	US$ '000	US$/t
Flotation TSF sustaining capital	102,696	0.74
CIL TSF sustaining capital factor	20,910	0.15
Vehicles & equipment sustaining capital	6,678	0.05
TSF sustaining costs - mining waste to TSF	27,513	0.20
Mine closure cost	23,789	0.17
TOTAL	**181,586**	**1.31**

22.0 ECONOMIC ANALYSIS

22.1 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 mineralised 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.

22.2 Methodology

The economic assessment was carried out pre-tax and has assumed a total allowance for royalties of 5% of the gross gold price.

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 5 % discount rate applied is appropriate to the specific project and depends on many factors, including the type of commodity and the level of project risks (market risk,

technical risk and political risk). The discounted, present values of the annual 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 are 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.

The Free Cash Flow calculation is the total revenue generated, minus total costs. The calculation therefore is total recovered ounces (4.177 Moz), multiplied by the gold price selected (US$1,350/oz), minus the total cost per ounce (US$/oz). The Pre-Tax cash flow is before tax is deducted, while the Post-Tax cash flow is after tax is deducted.

22.3 Financial summary

22.3.1 Key economic results

The key economic results at a gold price of US$1,350/oz are provided in Table 15.

Table 15 Key economic results

KEY ECONOMIC RESULTS		UNIT	FEASIBILITY STUDY
Capital cost *(including 11% contingency)*		US$ M	390
All-in Sustaining Cost *(AISC)*[1]	*Starter Pit*	US$/oz	585
	Life of Mine	US$/oz	895
Total Project payback		Months	21
Pre-Tax NPV US$ *(5% discount rate)*		US$ M	914
Post-Tax NPV US$ *(5% discount rate)*		US$ M	590
Pre-Tax IRR		%	43
Post-Tax IRR		%	33

Notes:

[1] Cash Costs + Royalties + Levies + Life of Mine Sustaining Capital Costs (World Gold Council Standard)
Royalties calculated at a rate of 5.5% and a corporate tax rate of 32.5%; both subject to negotiation, and expected to be finalised over coming months.

22.3.2 Production summary – Starter Pit and Life of Mine

A summary of the expected production is provided in Table 16 for the Starter Pit and in Table 17 for the Life of Mine (including the Starter Pit).

Table 16 Starter Pit proposed production summary

KEY ESTIMATED PRODUCTION RESULTS	UNIT	FEASIBILITY STUDY
Gold price	US$/oz	1,350
Gold produced *(average for full production years)*	(koz/yr)	361
Gold head grade *(Starter Pit, Ore Reserve)*	g/t Au	1.41
Gold recovery *(Starter Pit)*	%	85
Strip ratio *(Starter Pit)*	W:O	0.9 : 1
Ore mined *(0.5 g/t cut-off grade)*	Tonnes (Mt)	47
Waste mined	Tonnes (Mt)	43
Starter Pit life *(including ramp-up)*	Months	27
Total Project payback	Months	21

Table 17 LOM proposed production summary, including the Starter Pit

KEY ESTIMATED PRODUCTION RESULTS	UNIT	FEASIBILITY STUDY
Gold price	US$/oz	1,350
Gold produced *(average for LOM full production years)*	(koz/yr)	287
Gold produced *(LOM)*	(Moz)	4.2
Gold head grade *(LOM, Ore Reserve)*	g/t Au	1.13
Gold recovery *(LOM)*	%	83
Strip ratio *(LOM)*	W:O	1.9 : 1
Ore mined *(0.5 g/t cut-off grade)*	Tonnes (Mt)	138.6
Waste mined	Tonnes (Mt)	263
Mine life *(Including ramp-up and mine closure)*	years	15
Capital cost *(including 11% contingency)*	US$ M	390
Total Project payback	Months	21

22.4 Economic sensitivity studies

Based upon Life of Mine production and cost parameters, the Post-Tax NPV sensitivities are shown for the 9.5 Mtpa throughput in Table 18.

Table 18 Post-Tax NPV (in US$ M) and gold price sensitivity for the 9.5 Mtpa throughput

POST TAX REAL DISCOUNT RATE (%)	GOLD PRICE (US$/oz)				
	US$1,150	US$1,250	US$1,350	US$1,450	US$1,550
0	441	720	980	1,257	1,527
5	228	411	590	769	950
10	105	233	355	486	614

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

Bar charts in Figure 12 to Figure 15 show the expected Pre-Tax and Post-Tax economic sensitivities for the 9.5 Mtpa throughput at a gold price of US$1,350/oz.

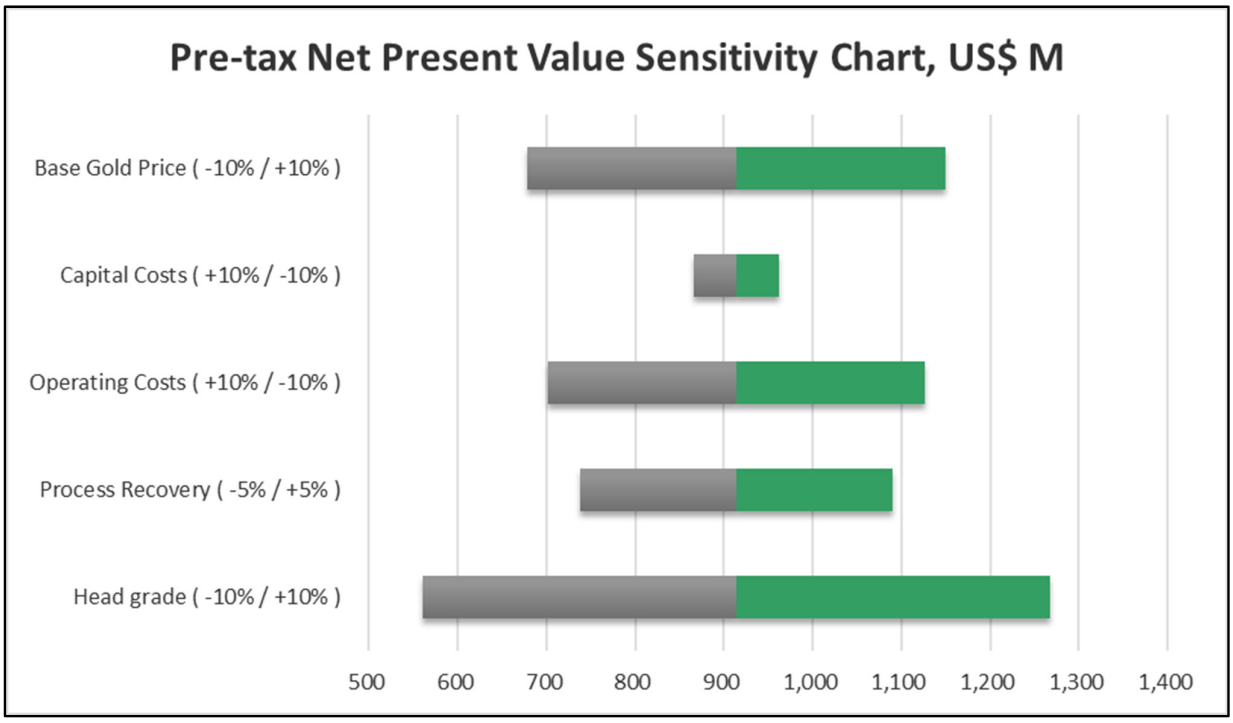


Figure 12: Pre-Tax NPV sensitivity at 5% discount (US$ M) for the 9.5 MTPA throughput

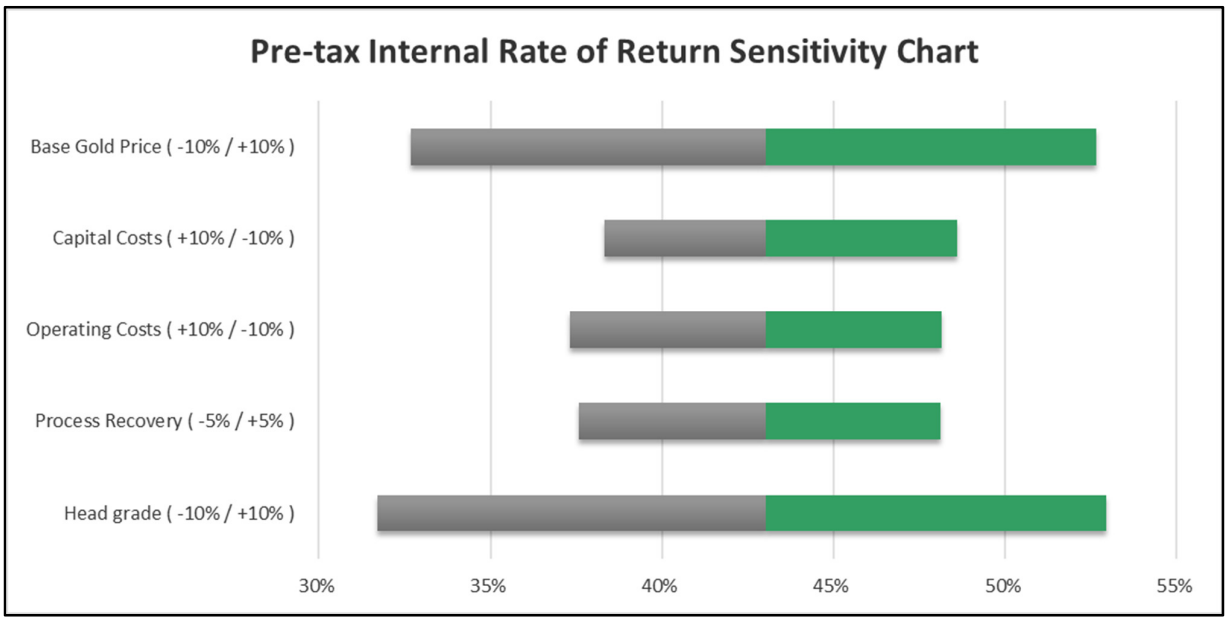


Figure 13: Pre-Tax IRR (%) sensitivity for the 9.5 Mtpa throughput

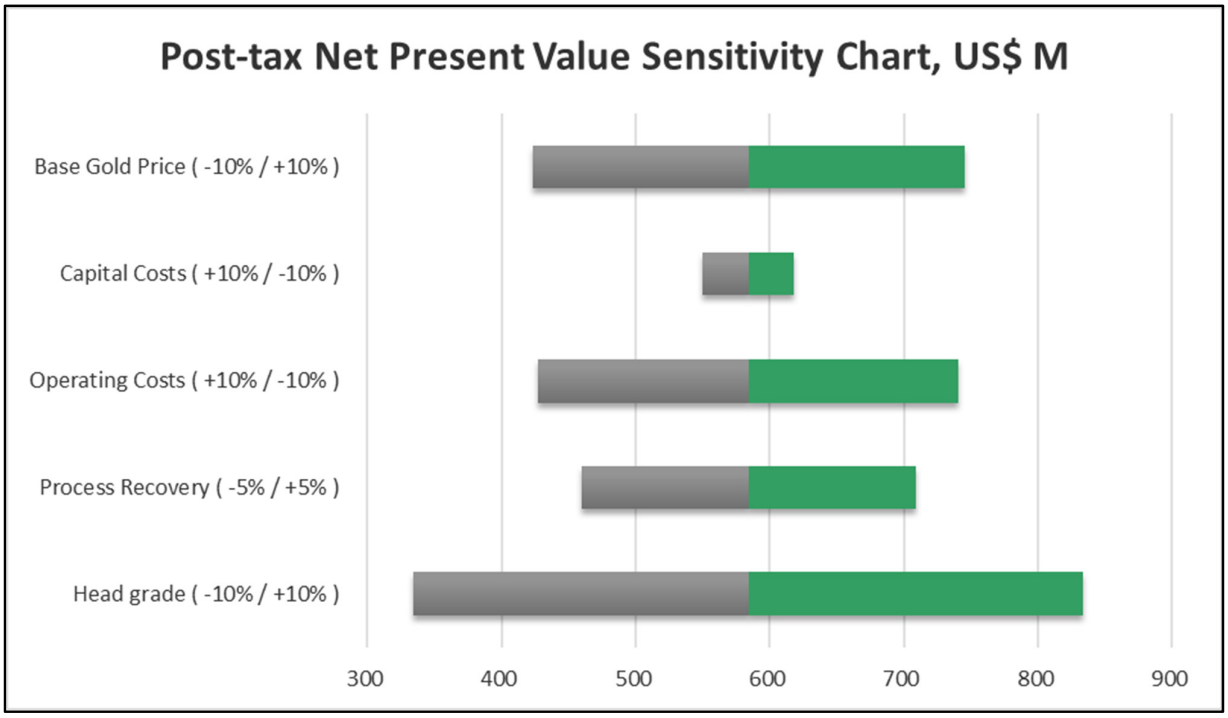


Figure 14: Post-Tax NPV sensitivity at 5% discount (US$ M) for the 9.5 MTPA throughput

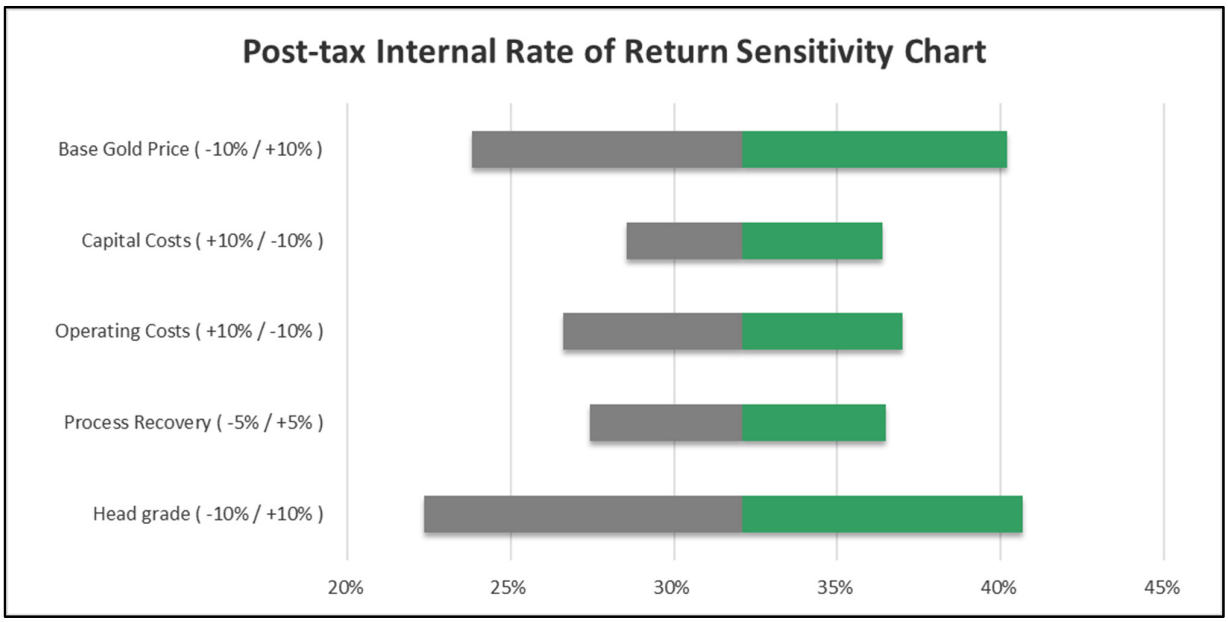


Figure 15: Post-Tax IRR (%) sensitivity for the 9.5 MTPA throughput

Figure 16 shows the annual gold production against the accumulative post tax cash flow for the 9.5 Mtpa throughput at a gold price of US$1,350/oz.

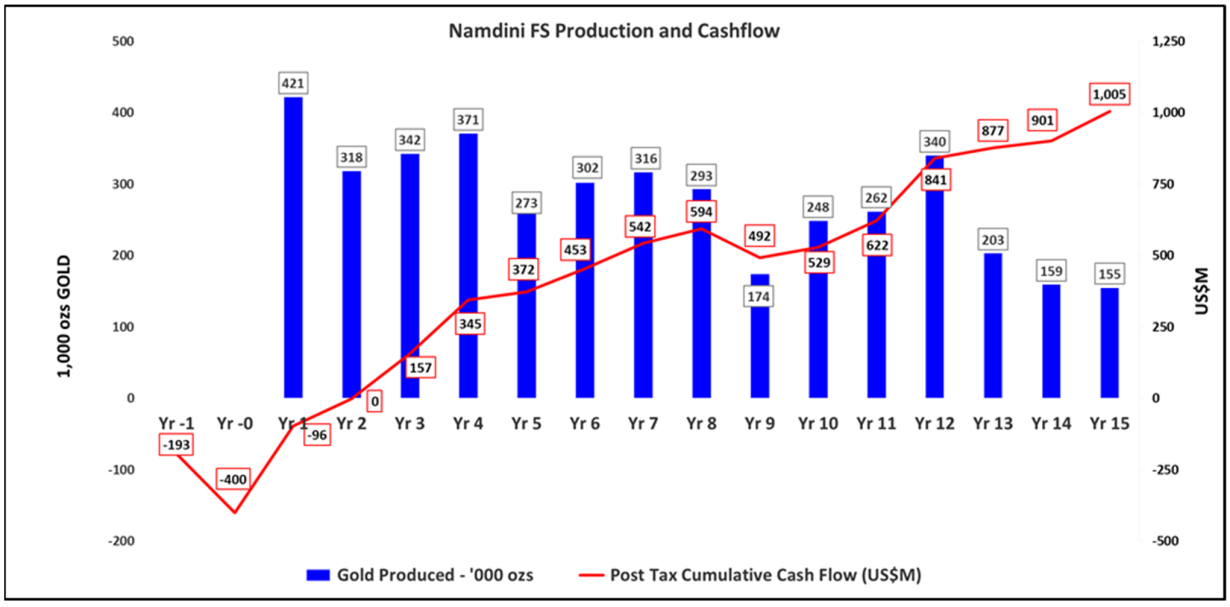


Figure 16: Namdini FS ounce production and net cash flow (100%)

Figure 17 shows the annual gold production against the All-in Sustaining Cost (AISC) in US$/oz for the 9.5 Mtpa throughput.

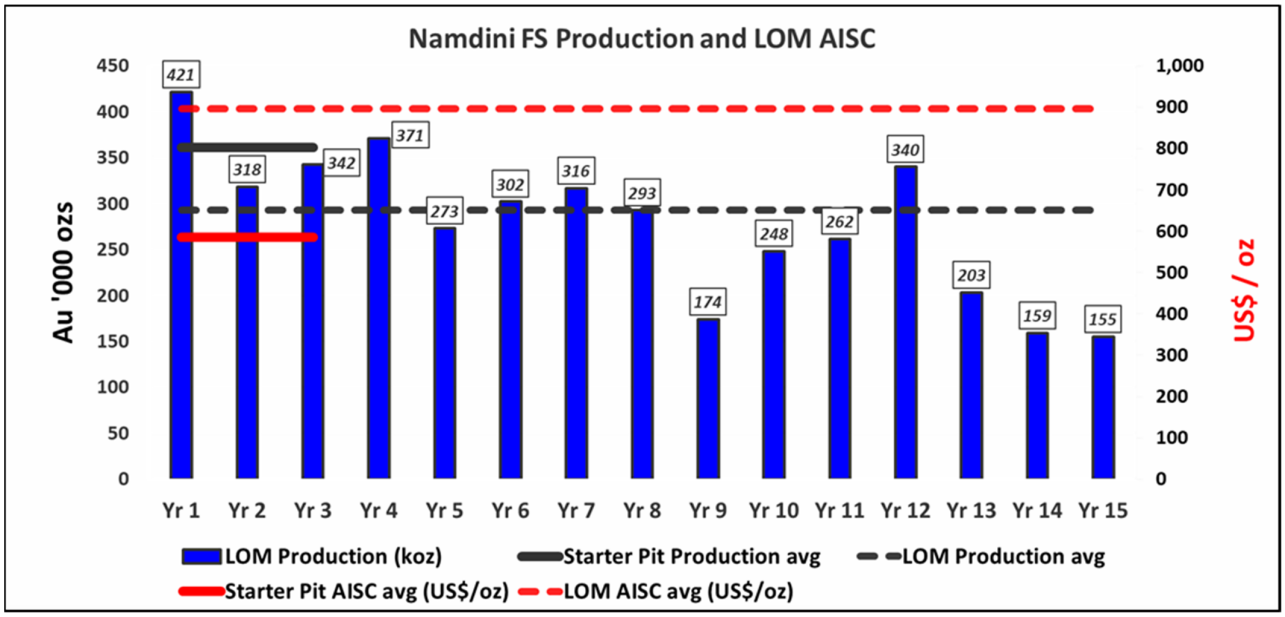


Figure 17: Namdini FS ounce production & All-in Sustaining Cost (100%)

22.5 Funding

Cardinal's Board has approved this Feasibility Study and recommends progressing the Project to construction pending successful completion of financing activities.

- The gold price is currently trading at approximately US$1,500/oz which compares favourably to the Project's financial assumption of US$1,350/oz.
- The Company has been actively working with its debt advisor Cutfield Freeman to secure Project finance on competitive terms and to ensure that Project finance can be secured in a timely manner following completion of the Feasibility Study. A number of leading financial institutions are involved in the process which is well advanced and is continuing. Cardinal looks forward to providing more details in the future.
- In addition to traditional financing solutions, the Company is concurrently evaluating alternatives to bring the project into production with a view to maximising economic outcomes for Cardinal shareholders.
- The strong production and economic outcomes delivered in the Namdini FS are considered by Cardinal's Board to be sufficiently robust to provide confidence in the Company's ability to secure project funding.
- A final financing decision will be made at a time assessed as the most appropriate and beneficial to the Company.
- In the meantime, the Company remains in a strong financial position with cash reserves of approximately A $27 million.

23.0 ADJACENT PROPERTIES

The Namdini Gold Project site is located approximately 6 km southeast of the operating Shaanxi underground mine, which uses grid power.

24.0 OTHER RELEVANT INFORMATION

In the opinion of the Authors, all relevant and material information is provided in this Technical Summary based on the Feasibility Study documentation.

25.0 NEXT STAGES

Based on the positive FS outcome, the Cardinal Board has approved initiatives which will further de-risk the project. These include immediate advancement of the Namdini Gold Project to the FEED and Early Works Construction stages, plus advancement of the Relocation Action Plan subject to final project finance.

The Project development schedule is shown in Table 19 and a Project Gantt Chart is provided as Figure 18. This is subject to available funding based on the positive outcome of this FS and to favourable timelines for permitting, contracting and procurement.

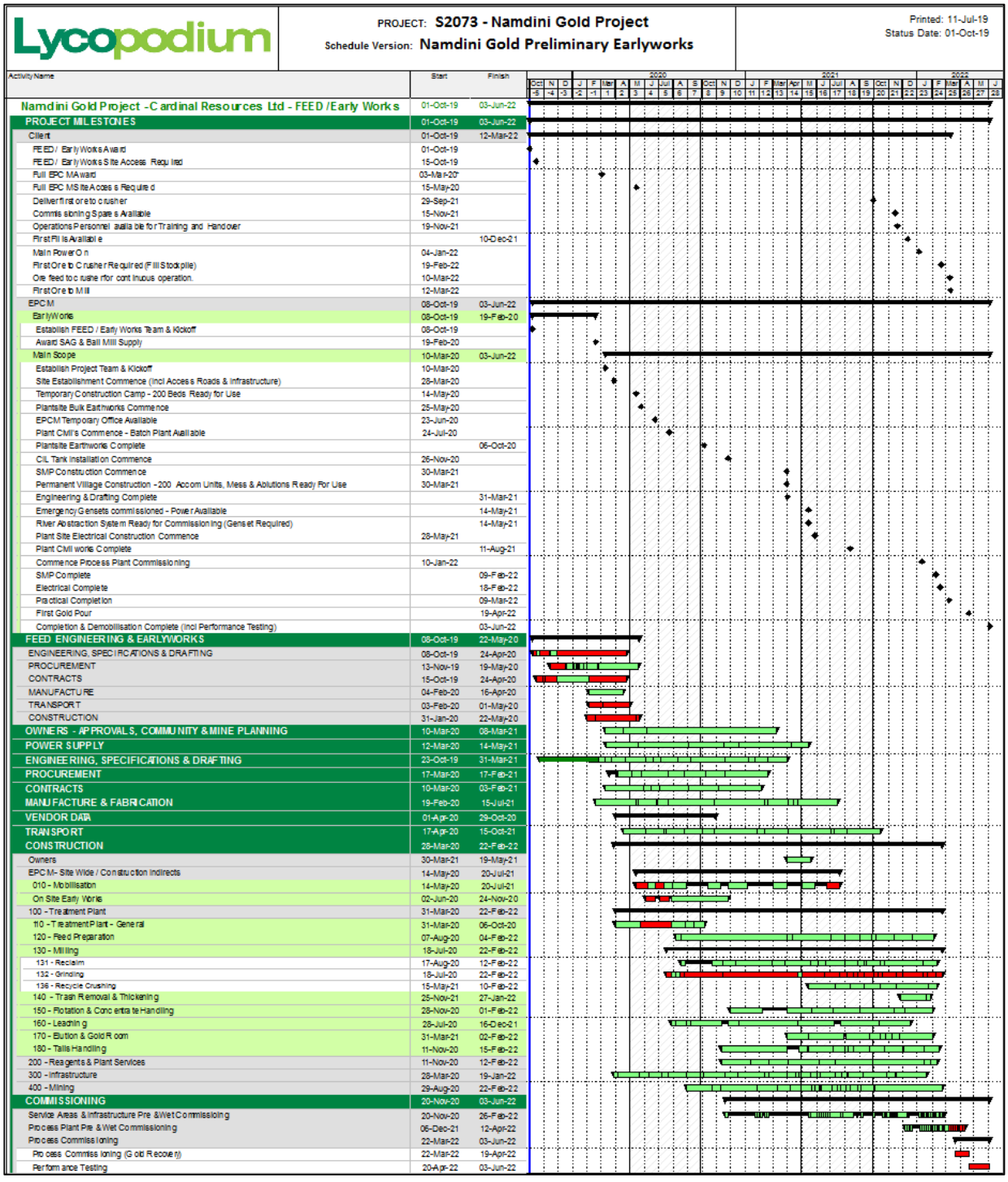
Table 19: Project schedule

Proposed Project development schedule (Subject to Financing*).

Milestone	Target timeline
Commence Front End Engineering and Design ("FEED")	Q4 2019
Advance Relocation Action Plan to completion	H1 2020
Target production commencement	H2 2022

**The Company's proposed project development schedule assumes that the Company is fully funded to proceed throughout and beyond the FEED process, into early works and full construction. Whilst the Company is currently engaged in the financing process as described in this release, the actual development schedule will depend upon the manner and timing of the Company's financing plans. Dates are therefore indicative only.*

Figure 18: Project schedule Gantt timeline (source: Lycopodium 2019d)



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26.2 Abbreviations and acronyms

AARL	gold elution circuit (developed by Anglo American Research Laboratory)
AC	acid consuming
AEP	annual exceedance probability (for rainfall events)
AIF	Annual Information Form (company report to the TSX)
AISC	All-in Sustaining Cost
ATS	Alastri Tactical Scheduler

ASX	ASX Group Ltd (the Australian Securities Exchange)
Authors	Cardinal, Lycopodium, Golder, and other consultants who have contributed to this Report
BBWi	Bond ball mill work index
BDO	BDO Advisory Pty Ltd
BW	berm width (for open pit design)
C.Eng	Chartered Mining Engineer
Capex	Capital expenditure
Cardinal	Cardinal Resources Limited
Cardinal Namdini	Cardinal Namdini Mining Limited a wholly owned subsidiary of Cardinal
CIL	carbon-in-leach
CN_{WAD}	weak acid dissociable cyanide
COG	cut-off grade (in g/t Au)
CSV	comma separated value computer format
DGPS	differential GPS
EIA	Environmental (and Social) Impact Assessment
EIS	Environmental Impact Statement (a comprehensive public report)
EPA	Ghana Environmental Protection Agency
EPCM	Engineering, Procurement, Construction & Management (construction management)
Eur.Ing.FEANI	Registered European Mining Engineer
fSAG	SAG mill power efficiency
FS	the Namdini Gold Project Feasibility Study (the basis of this Report)
G&A	General and Administration (cost category)
Ga	Billion years (giga annum)
Golder Africa	Golder Associates Africa (Pty) Ltd
Golder Ghana	Golder Associates Ghana Limited
Golder	Golder Associates Pty Ltd
GPS	global positioning system
HDPE	High-density Polyethylene
HIGmill	High Intensity Grinding mill
IFC	World Bank Group International Finance Corporation
IMO	Independent Metallurgical Operations Pty Ltd
IRA	inter-ramp angle (for open pit design)
IRR	Internal Rate of Return
Knight Piésold	Knight Piésold Consulting Pty Ltd
LG	Lerchs-Grossmann (algorithm used in pit optimisation)
LOM	Life of Mine
LV	low voltage
Lycopodium	Lycopodium Minerals Pty Ltd
M+I	Measured plus Indicated Mineral Resource categories
MIK	Multiple Indicator Kriging
MMSA	Maelgwyn Mineral Services Africa Pty Ltd

MPR	MPR Geological Consultants Pty Ltd
MSA	mine services area
NAF	non-acid forming
NAPP	net acid producing potential
Namdini	Namdini Gold Project (or the Project)
NAPP	net acid producing potential
NEMAS	Nemas Consult Ltd
NI 43-101	National Instrument 43-101
NPV_5	Net Present Value at a discount rate of 5%
OK	Ordinary Kriging
OMC	Orway Mineral Consultants Pty Ltd (for comminution and milling)
Opex	Operating expenditure
Orefind	Orefind Pty Ltd
OSA	overall slope angle (for open pit design)
P_{80}	product size of 80% passing
PAF	potentially acid forming
PB	pushback, stage or Phase of development of the open pit mine design
PEA	Preliminary Economic Assessment (first stage of study under NI 43-101), see Golder (2018a)
PFS	Pre-feasibility Study (second stage of study under NI 43-101), see Golder (2018b)
PM_{10}	particulate matter less than 10 microns
PPE	personal protective equipment
PRI	preg-robbing index (for evaluation of metallurgical processing of the ore)
QAQC	Quality assurance and control
QP(s)	Qualified Person(s) under NI 43-101
Qtr	quarter (quarterly period)
RAP	Resettlement Action Plan
RC	reverse circulation (drilling)
RF	revenue factor (for Whittle optimisation) RF1300 is based on a gold price of US$1,300/oz.
ROM (Pad)	Run of Mine mill feed (stockpile)
RPEEE	reasonable prospect for eventual economic extraction (for Mineral Resource reporting)
SABC	open circuit SAG mill with recycle pebble crushing followed by closed circuit ball mill/hydro-cyclones
SAG	semi-autogenous grinding (mill)
SANAS	South African National Accreditation System
Savannah	Savannah Mining Ghana Limited
SGI	Sebbag Group International Pty Ltd
Shaanxi	Shaanxi Mining Company Limited (nearby mine)
SMC	SAG mill comminution (test)
SPI	SAG mill power index
TSF	Tailings Storage Facility
TSX	Toronto Stock Exchange

WC	Whittle Consulting Pty Ltd

26.3 Units

Many of these units are combined in measurement, e.g. kWh is thousand-Watt hours

µ	millionth (as in µm for micron or micro-metre)
bcm	banked cubic metre (volume of in situ material)
g	gram
g/t Au	gold grade in grams per tonne
Ga	Billion years (*giga annum*)
h	hour
Ha	hectare
k	thousand (as in koz or kWh)
km	kilometre
km^2	square kilometre
l or L	litre
l/sec	litres a second (flow rate)
lcm	loose cubic metre (volume of disturbed material)
m	metre
M	million
m^3	cubic metre
m^3/day	cubic metres a day (flow rate)
mg	milligram (thousandth of g)
mm	millimetre
Mtpa	million tonnes a year
pH	measure of acidity
t	tonne
t/m^3	tonnes per cubic metre (for *in situ* dry bulk density)
tph	tonnes per hour
US$	United States dollars
V	volt
w/w	weight for weight (e.g. for slurry density)
y or a	year (a for *annum*)

26.4 Trademarks

Aachen™ shear reactor technology by Maelgwyn Laboratories South Africa for ore processing

Alastri™ Tactical Scheduler software for mine planning

Datashed™ database software from Maxwell Geoservices (Perth)

GS3M™ geostatistical estimation software from FSSI Consultants (Australia) Pty Ltd

HIGmill™ High Intensity Grinding mill for ore processing by Outotec

Logchief™ geological logging software from Maxwell Geoservices (Perth)

Micromine™ geological modelling software

Minemax™ Scheduler software for mine planning

Vulcan™ software by Maptek for geological modelling and mine planning

Whittle 4X™ software for mine planning

APPENDIX – TABLE 1 (JORC,2012)

Section 1 – Sampling Technique and Data

Criteria	JORC Code Explanation	Commentary
Sampling techniques	*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.*	Resource drilling comprises 175 diamond core holes and 151 reverse circulation (RC) drill holes totalling 87,140 m. Diamond core sampling includes half-core and quarter-core samples of HQ core size. RC drilling utilised face-sampling hammers of nominally 127 to 140 mm diameter, with samples collected by riffle splitting. Additional drilling including exploration and sterilisation drilling outside the resource area, and 10 by 15 m spaced trial RC grade control drilling was not included in the Mineral Resource estimation dataset.
	Include reference to measures taken to ensure sample representivity and the appropriate calibration of any measurement tools or systems used.	Field sampling followed Cardinal Namdini protocols including industry standard quality control procedures. Sample representativity is ensured by: RC samples: Collecting 1 m samples from a cyclone, passing them through a 3-tier riffle splitter, and taking duplicate samples every 20th sample. Diamond Core: For drilling prior to approximately April 2016 core was halved for sub-sampling with a diamond saw. From approximately April 2016 to June 2017 core was quartered for assaying. For drilling after June 2017 diamond core was halved for sub-sampling. Sample intervals range from 0.2 to 1.8 m in length, with the majority of samples assayed over 1 m intervals.
	Aspects of the determination of mineralisation that are Material to the Public Report. *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*	After oven drying diamond core samples were crushed using a jaw crusher, with core and RC samples crushed to a -2 mm size using an RSD Boyd crusher. Riffle split sub-samples were pulverised to nominally 85% passing 75 µm. Pulverised samples were analysed for gold using fire assay technique with a 50 g charge, with an AAS finish, with a detection limit of 0.01 g/t Au. Assays of greater than 100 g/t Au were re-analysed with a gravimetric finish.

Criteria	JORC Code Explanation	Commentary
	commodities or mineralisation types (e.g. submarine nodules) may warrant disclosure of detailed information.	
	Selection of Composites for Aachen metallurgical test work.	A selection of representative 1 m samples from 47 drill holes were sent to Maelgwyn Laboratories South Africa for Aachen Metallurgical testwork. The drill hole samples selected were from different representative lithologies within the planned Starter Pit and Life of Mine pit. The samples were sent as competent HQ quarter core and crushed material rejects from SGS assay laboratories.
Drilling techniques	*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.).*	Diamond core drilling is completed with core size of HQ with triple tube drilling through surficial saprolite and standard tubes for deeper drilling. Core was orientated using a digital Reflex ACT II RD orientation tool. RC drilling utilised face sampling hammers of nominal 127 to 140 mm diameter. The resource drilling comprises east-west trending traverses of holes inclined towards the east at generally 45^0 to 65^0 approximately perpendicular to mineralisation. Most drill collars are surveyed using a differential GPS with most diamond holes and deeper RC holes down-hole surveyed at intervals of generally around 30 m using electronic multi-shot and gyroscopic equipment.
Drill sample recovery	*Method of recording and assessing core and chip sample recoveries and results assessed.*	Recovered core lengths were measured for 98% of the diamond resource drilling, showing generally very high recoveries, which average 99.8% for mineralised domain samples. RC sample recoveries were assessed by weighing recovered sample weights for 1 m intervals. For the combined dataset estimated recoveries average 85% which is considered acceptable.
	Measures taken to maximise sample recovery and ensure representative nature of the samples.	All drilling activities were supervised by company geologists. Measures taken to maximise diamond core recovery included use of HQ core size with triple tube drilling through the saprolite zone, and having a geologist onsite to examine core and core metres marked and

Criteria	JORC Code Explanation	Commentary
		orientated to check against the driller's blocks and ensuring that all core loss is considered. RC sample recovery was maximised by utilising drilling rigs with sufficient compressor capacity, including auxiliary compressors to provide dry, high recovery samples. In cases where the RC rig was unable to maintain dry samples the hole was continued by diamond core drilling. RC sample condition was routinely logged by field geologists with less than 0.2% of resource RC samples logged as moist or wet.
	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.	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 generally high sample recoveries obtained by both drilling methods employed.
Logging	*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.*	All drill holes were geologically logged, and selected diamond core was geotechnically 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 Maxwell LogChief™ software. The geological and geotechnical logging is of appropriate detail to support the Mineral Resource estimation, and mining and metallurgical studies.
	Whether logging is qualitative or quantitative in nature. Core (or costean, channel, etc.) photography.	Logging was both qualitative and quantitative depending on the field being logged. RC chips in trays and HQ core were photographed both in dry and wet form.
	The total length and percentage of the relevant intersections logged.	Geological logs are available for 86,728 m (99.5%) of the resource drilling
Sub-sampling techniques and sample preparation	*If core, whether cut or sawn and whether quarter, half or all core taken.*	For sampling, diamond core was either quartered or halved with these sample types providing 36% and 64% of mineralised domain core samples, respectively.
	If non-core, whether riffled, tube sampled, rotary split, etc. and whether sampled wet or dry.	RC samples were split using a three-tier riffle splitter. Rare wet samples were air dried prior to riffle splitting.

Criteria	JORC Code Explanation	Commentary
	For all sample types, the nature, quality and appropriateness of the sample preparation technique.	Sample preparation and gold assaying were undertaken by independent commercial laboratories. Most primary samples were submitted to SGS Ouagadougou or SGS Tarkwa for analysis by fire-assay with assays from these laboratories contributing around one third and two thirds of the estimation dataset respectively. Samples analysed by Intertek Tarkwa provide around 0.5% of the estimation dataset. After oven drying diamond core samples were crushed using a jaw crusher, with core and RC samples crushed to minus 2 mm using an RSD Boyd crusher. Riffle split sub-samples were pulverised to nominally 85% passing 75 µm in an LM2 pulveriser. The sample preparation is of appropriately high quality for Mineral Resource estimation.
	Quality control procedures adopted for all sub-sampling stages to maximise representivity of samples.	Procedures adopted to maximise representivity of samples include crushing and pulverising of samples prior to further sub-sampling by appropriate splitting techniques. Sample preparation equipment was routinely cleaned with crushers and pulveriser flushed with barren material at the start of every batch.
	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.	Measures taken to ensure sample representivity include the use of appropriate sub-sampling methods, including riffle splitting for RC samples and halving, or quartering diamond core with a diamond saw. RC field duplicates were routinely collected, and selected samples were resubmitted for inter-laboratory check assaying.
	Whether sample sizes are appropriate to the grain size of the material being sampled.	Sample sizes are appropriate for the grain size of the sampled material.
Quality of Assay data and laboratory tests	*The nature, quality and appropriateness of the assaying and laboratory procedures used and whether the technique is considered partial or total.*	Samples were analysed for gold by fire assay with a 50 g charge with AAS finish; the assay charge was fused with the litharge-based flux, cupelled and prill dissolved in aqua regia and gold tenor determined by flame AAS with a detection limit of 0.01 g/t Au. Assays of greater than 100 g/t Au were re-analysed with a gravimetric finish. The quality of the fire assay and laboratory procedures are considered to be appropriate for this deposit type. The analytical method is considered appropriate for this mineralisation style and is of industry standard.

Criteria	JORC Code Explanation	Commentary
		The fire assay analytical method represents total analysis and is considered appropriate for the style of mineralisation.
	For geophysical tools, spectrometers, handheld XRF instruments, etc., the parameters used in determining the analysis including instrument make and model, reading times, calibrations factors applied and their derivation, etc.	No hand-held geophysical tools were used.
	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.	Monitoring of sample preparation and analysis included industry standard methods comprising routine submission of certified reference standards, coarse and fine blanks, umpire checks, check samples and check assays. These procedures have confirmed the reliability and accuracy of the sample preparation and analysis with sufficient confidence for the Mineral Resource estimation. Acceptable levels of accuracy and precision have been established.
	Aachen metallurgical test work	Each metallurgical composite sample received at the Maelgwyn Laboratory was staged crushed by jaw and cone crusher to 100% passing 1.7 mm. The material was then split into 20 kg portions using cone and quartering. Each of the 20 kg samples was split into 1 kg portions using a rotary splitter, for purposes of chemical head assays, grind establishment and bench scale testwork. The Aachen testwork was performed in accordance with South African National Accreditation System (SANAS) industry standards.
Verification of sampling and assaying	*The verification of significant intersections by either independent or alternative company personnel.*	No individual drill hole results are reported in this announcement. Several small phases of independent core-sampling and assaying have been conducted.
	The use of twinned holes.	None of the drill holes in this report are twinned.
	Documentation of primary data, data entry procedures, data verification, data storage (physical and electronic) protocols.	Primary data were captured on field tough book laptops using LogChief™ software. The software has validation routines and data was then imported onto a secured central SQL database.
	Discuss any adjustment to assay data.	No adjustments were made to assays.
Location of data points	*Accuracy and quality of surveys used to locate drill holes (collar and down-*	Most drill collars are surveyed using a differential GPS (±10 mm of accuracy) with most diamond holes and

Criteria	JORC Code Explanation	Commentary
	hole surveys), trenches, mine workings and other locations used in Mineral Resource estimation.	deeper RC holes down-hole surveyed at intervals of generally around 30 m using electronic multi-shot and gyroscopic equipment.
	Specification of the grid system used.	Coordinates and azimuths are reported in UTM WGS84 Zone 30 North.
	Quality and adequacy of topographic control.	Topographic control was established from aerial photography using 12 surveyed control points. A 1 m ground resolution DTM was produced by Sahara Mining Services from a UAV survey using a DJI Inspire 1 UAV at an altitude of 100 m. Topographic control is adequate for estimation of Mineral Resources and Ore Reserve.
Data spacing and distribution	*Data spacing for reporting of Exploration Results.*	Hole spacing varies from around 12.5 by 25 m in shallow portions of the southern part of the deposit to around 50 by 50 m and broader in the north and at depth.
	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.	Drill data spacing and distribution are sufficient to establish geological and grade continuity for the Mineral Resource and Ore Reserve classifications were applied utilising this information. Mineralisation tested by generally 50 by 50 m and closer spaced drilling is assigned to the Indicated category, with estimates for zones with more closely spaced drilling classified as Measured. Estimates for panels not informed consistently 50 by 50 m drilling are assigned to the Inferred category.
Orientation of data in relation to geological structure	*Whether sample compositing has been applied.*	Drill hole assays were composited to 2 m down-hole intervals for resource estimation.
	Whether the orientation of sampling achieves unbiased sampling of possible structures and the extent to which this is known, considering the deposit type. *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.*	Most resource drilling was inclined at around 45^0 to 60^o to the east, providing un-biased sampling of the mineralisation.
Sample security	*The measures taken to ensure sample security.*	Diamond core and RC samples were transported from the drill site by Cardinal vehicle to a secure storage at the Bolgatanga field exploration office. Core yard technicians, field technicians and geologists ensured

Criteria	JORC Code Explanation	Commentary
		samples were logged, prepared and securely stored until collected for transportation to the assay laboratories by personnel employed by the assay laboratory. All samples submitted for assaying were retained in a locked secure shed until collected by laboratory personnel for transport to the assay laboratory. Retained drill core and RC chips were securely stored in the core storage compound, and pulps were securely stored in the core shed A sign-off process between Cardinal and the laboratory truck driver ensured samples and paperwork correspond. Samples were then transported to the laboratory where they were receipted against dispatch documents. The assay laboratories are responsible for samples from the time of collection from the exploration office.
Audits or reviews	*The results of any audits or reviews of sampling techniques and data.*	The sampling techniques and data collection processes are of industry standard and have been subjected to multiple internal and external reviews. The most recent audit of the SQL database was completed by Maxwell Geoservices (Perth) and found the database to be consistent with industry standards.

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	*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.*	The Mining Licence LVB14619/09 covering Cardinal's Namdini Project over an area of approximately 19.54 km^2 is located in the Northeast region of Ghana. 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. The application by Savannah for a Large-Scale Mining Licence over an area of approximately 19.54 km^2 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.

Criteria	JORC Code Explanation	Commentary
		Savannah applied for the assignment of this Large-Scale Mining Licence to Cardinal Namdini Mining Limited (Cardinal Namdini), a wholly owned Subsidiary of Cardinal. The assignment has been granted by the Minister of Lands and Natural Resources of Ghana.
	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.	All tenements are current and in good standing. The Mining Lease for Namdini was granted for an initial 15 years which is renewable.
Exploration Done by Other Parties	*Acknowledgment and appraisal of exploration by other parties.*	Aside from Cardinal there has been no recent systematic exploration undertaken on the Namdini Project.
Geology	*Deposit type, geological setting and style of mineralisation*	The deposit type comprises gold mineralisation within sheared and highly altered rocks containing sulphides; mainly pyrite with minor arsenopyrite. The geological setting is a Paleoproterozoic Greenstone Belt comprising Birimian metavolcanics, volcaniclastics and metasediments located in close proximity to a major 30 km ~N-S regional shear zone with splays. The style of mineralisation is hydrothermal alteration containing disseminated gold-bearing sulphides.
Drill hole information	*A summary of all information material to the understanding of the exploration results including tabulation of the following information for all Material drill holes:* • *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* *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.*	No individual drill hole results are reported in this announcement. There has been no exclusion of information.

Criteria	JORC Code Explanation	Commentary
Data aggregation methods	*In reporting Exploration Results, weighting averaging techniques, maximum and/or minimum grade truncations (e.g. cutting of high grades) and cut-off grades are usually Material and should be stated.*	No individual drill hole results are reported in this announcement.
	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.	No individual drill hole results are reported in this announcement.
	The assumptions used for any reporting of metal equivalent values should be clearly stated.	
Relationship between mineralisation widths and intercept lengths	*These relationships are particularly important in the reporting of exploration results.*	The resource drilling comprises east-west trending traverses of holes inclined towards the east at generally 45^0 to 65^o approximately perpendicular to mineralisation.
	If the geometry of the mineralisation with respect to the drill hole angle is known, its nature should be reported.	
	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').	
Diagrams	*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.*	Appropriate maps with scale are included within the body of the announcement
Balanced Reporting	*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.*	No individual drill hole results are reported in this announcement.
Other substantive exploration data	*Other exploration data, if meaningful and material, should be reported including (but not limited to): geological observation; geophysical survey results; geochemical survey*	Other exploration data collected is not considered material to this document at this stage.

Criteria	JORC Code Explanation	Commentary
	results; bulk samples – size and method of treatment; metallurgical test results; bulk density, groundwater, geotechnical and rock characteristics; potential deleterious or contaminating substances.	
Further Work	*The nature and scale of planned further work (e.g. tests for lateral extensions or depth extensions or large – scale step – out drilling).* *Diagrams clearly highlighting the areas of possible extensions, including the main geological interpretations and future drilling areas, provided this information is not commercially sensitive.*	Exploration drilling will continue to target projected lateral and depth extensions of the mineralisation along with infill drilling designed to increase confidence in Mineral Resource estimates.
	Aachen metallurgical test work.	A set of additional samples have been selected and sent for the next phase of Aachen testwork at the Maelgwyn Laboratory in South Africa (805 one metre samples with a total mass of 2,310 kg). The total mass of sample available for Aachen testwork will be 3,120 kg.

Section 3 – Estimation and Reporting of Mineral Resources

Criteria	JORC Code Explanation	Commentary
Database integrity	*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.*	Cardinal has an SQL central data storage system using Maxwell Geoservices' DataShed™ drill hole management software. Validation checks were conducted using SQL relational database standards. All geological and field data is entered using data-loggers and Maxwell GeoServices' LogChief™ software, that includes lookup tables, fixed formatting, and the Cardinal geological code system. Data is then loaded to the SQL database. 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. Independent checks of database validity included checking for internal consistency between, and within database tables and comparison of database entries with original source files. These checks, which included 99% of primary assays, 53% of down-hole surveys, and all collar surveys for the resource drilling showed no significant inconsistencies. The checks were conducted on the database compiled for resource estimation and in addition to checking Cardinal's master database also checked for data-compilation errors.
	Data validation procedures used.	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 recording of holes checked, errors found, corrections made and the date of database update.
Site visits	*Comment on any site visits undertaken by the Competent Person and the outcome of those visits.* *If no site visits have been undertaken indicate why this is the case.*	Mr. Nicolas Johnson of MPR Geological Consultants Pty Ltd (MPR) visited the Namdini Gold Project in January 2017. Mr Johnson inspected drill core, mineralisation exposures and drilling and sampling activities and had detailed discussions with Cardinal geologists gaining an improved understanding of the geological setting and mineralisation controls, and the resource sampling activities. Both Mr. Richard Bray and Mr. Ekow Taylor are full-time employees of Cardinal and undertake regular site visits.

Criteria	JORC Code Explanation	Commentary
Geological interpretation	*Confidence in (or conversely, the uncertainty of) the geological interpretation of the mineral deposit.*	Gold mineralisation is widespread within the metavolcanic, granite and dioritic units which can be interpreted and modelled with a high degree of confidence. There is a sharp mineralisation boundary with the metasediments in the footwall while the hanging wall contact exhibits a more diffuse mineralisation boundary. Higher-grade mineralisation (>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 interpretation.
	Nature of the data used and of any assumptions made.	The deposit's geological setting has been confidently established from drill hole logging and surface mapping.
	The effect, if any, of alternative interpretations on Mineral Resource estimation.	Geological setting of the Namdini mineralisation has been confidently established.
	The use of geology in guiding and controlling Mineral Resource estimation.	Logging, interpretation and modelling is undertaken by Cardinal's technical staff and specialist structural consultants Orefind Pty Ltd who produced a three-dimensional model of key rock types, structures and oxidation zones. These wire-frames were used for flagging of the resource composites into Oxide, Transition and Fresh subdomains, and assigning rock types and oxidation zones to the block model for density assignment and partitioning final resources by oxidation type. Depth to the interpreted base of complete oxidation ranges averages approximately 10 m. Interpreted depth to Fresh rock averages approximately 18 m. Resource modelling included a broad mineralised domain capturing drill hole intercepts of greater than 0.1 g/t Au. Domain interpretation included reference to geological logging, and is consistent with geological understanding. The mineralised domain trends north-northeast over approximately 1.3 km with horizontal widths ranging from around 90 to 400 m and averaging approximately 250 m. The domain dips to the west at around 60^{o} and is interpreted to around 860 m depth, well below the base of drilling.
	The factors affecting continuity both of grade and geology.	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 mineralisation is interpreted.

Criteria	JORC Code Explanation	Commentary
		Geological setting and mineralisation controls have been established with sufficient confidence for the current estimates.
Dimensions	*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.*	The mineralised domain trends extend over 1.3 km of strike with an average horizontal width of approximately 250 m. Mineral Resources are constrained within an optimal pit and extend from natural surface to the bit base at around 580 m depth.
Estimation and modelling techniques	*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.*	Mineral Resources were estimated by Multiple Indicator Kriging (MIK) with block support adjustment. The modelling included a broad mineralised domain capturing drill hole intercepts of greater than 0.1 g/t Au, and oxidation domains outlining Oxide, Transition and Fresh zones. Grade continuity characterised by indicator variograms modelled at 14 indicator thresholds. All class grades were derived from class mean grades, with the exception of upper bin grades, which were generally derived from bin medians, or for the case of Fresh mineralised domain bin means inclusive of a 50 g/t Au upper cut. The modelling used a three-pass octant-based search strategy giving estimates extrapolated to a maximum of 92.5 m from composite locations. Estimated resources include a variance adjustment to give estimates of recoverable resources for selective mining unit dimensions of 5 m east by 10 m north by 2.5 m in elevation. The variance adjustments were applied using the direct lognormal method. Data viewing, compositing and wire-framing was performed using Micromine™ software. Exploratory data analysis, variogram analysis and modelling, and Mineral Resource estimation utilised GS3M™ software from FSSI Consultants (Australia) Pty Ltd. The modelling technique is considered appropriate for the mineralisation style, and potential mining method.
	The availability of check estimates, previous estimates and/or mine production records and whether the Mineral Resource estimate takes appropriate account of such data.	Independent reviews were conducted by Golder Associates Pty Ltd.
	The assumptions made regarding recovery of by-products.	There is no assumption made regarding the recovery of any by-product.

Criteria	JORC Code Explanation	Commentary
	Estimation of deleterious elements or other non-grade variables of economic significance (eg sulphur for acid mine drainage characterisation).	Block modelling included estimation of sulphur and arsenic. These attributes are not reported in the Mineral Resource and have no bearing on the cut-off grade or economics of the Project.
	In the case of block model interpolation, the block size in relation to the average sample spacing and the search employed.	Block dimensions used were 12.5 mE by 25 mN by 5 mRL and chosen due to this dimension approximating the average resource drill spacing in the areas of tightest resource drilling. The modelling includes a three-pass octant search strategy with search ellipsoids aligned with the average domain orientations. Search radii and minimum data requirements are: Search 1: 65 by 65 by 15 m (16 data), Search 2: 97.5 by 97.5 by 22.5 m (16 data), Search 3: 97.5 by 97.5 by 22.5 (8 data).
	Any assumptions behind modelling of selective mining units.	Estimated resources include a variance adjustment to give estimates of recoverable resources for selective mining unit dimensions of 5 m east by 10 m north by 2.5 m in elevation with grade control sampling on an 8 by 12 by 1.25 m pattern. The variance adjustments were applied using the direct lognormal method.
	Any assumptions about correlation between variables. *Description of how the geological interpretation was used to control the resource estimates.*	The modelling did not include any specific assumptions about correlation between variables. Interpretation of the mineralised domain used for resource modelling included reference to geological logging, and the domain is consistent with geological understanding. A three-dimensional model of key rock types and oxidation zones was used for density assignment and partitioning final resources by oxidation type.
	Discussion of basis for using or not using grade cutting or capping.	Statistical analysis showed the gold population in the mineralised domains to be highly skewed and generally having moderate to high coefficient of variation. All class grades were derived from class mean grades, with the exception of upper bin grades, which were generally derived from bin medians, or for the case of Fresh mineralised domain bin means inclusive of a 50 g/t Au upper cut.
	The process of validation, the checking process used, the comparison of model data to drill hole data, and use of reconciliation data if available.	Model validation included visual comparison of model estimates and composite grades, and review of swath plots. Additional checking included comparison of model estimates with independent conditional simulation grade control models produced from the trial GC drill data, which

Criteria	JORC Code Explanation	Commentary
		showed close agreement.
Moisture	*Whether the tonnages are estimated on a dry basis or with natural moisture, and the method of determination of the moisture content.*	Tonnages are estimated on a dry basis.
Cut-off parameters	*The basis of the adopted cut-off grade(s) or quality parameters applied.*	The cut-off grade of 0.5 g/t Au used for Mineral Resource reporting reflects Cardinal's interpretation of the potential range of gold prices and process plant recoveries and operating costs for a potential operation.
Mining factors or assumptions	*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.*	Estimated resources include a variance adjustment to give estimates of recoverable resources for selective mining unit dimensions of 5 m east by 10 m north by 2.5 m in elevation with grade control sampling on an 8 by 12 by 1.25 m pattern. The variance adjustments were applied using the direct lognormal method. The Mineral Resource is constrained within an optimal pit shell based on a long-term gold price of US$1,950 /oz using factors relevant to location and proposed processing and mining method, comprising conventional drill, blast, load and haul unit operations.
Metallurgical factors or assumptions	*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 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.*	Gold mineralisation is mainly associated with pyrite in all three main rock types being metavolcanic, granite and diorite. Metallurgical testwork has proved that due to the gold being associated with sulphides, the ore is highly amenable to efficient flotation techniques. Metallurgical testwork has also confirmed that the ore is amenable to conventional milling and flotation, followed by regrinding and cyanide leaching of the flotation concentrate in a carbon-in-leach process. Metallurgical testwork has been completed indicating that a non-flotation conventional gold process can be applied to the Oxide material (less than 3% of the Ore Reserve as both tonnes and contained gold). Bulk samples have been taken for bench-scale and pilot-scale metallurgical testwork for the key areas of the flowsheet. Sample selection and therefore metallurgical testwork has included high-grade, low-grade, ore body variability and sulphur variability for all ore lithologies.

Criteria	JORC Code Explanation	Commentary
		Metallurgical testing using industry standard gold techniques has demonstrated an average LOM gold recovery rate of 83%. A conventional grind-flotation-regrind-CIL flowsheet continues to be the preferred process option. No deleterious elements have been identified in the testwork that could affect the saleability or price of the gold doré produced.
Environmental factors or assumptions	*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.*	Cardinal's exploration activities are undertaken such that any potential emissions and effects associated with exploration activities, which could include habitat modification and associated visual effects, are kept to a minimum. NEMAS Consult Ltd (NEMAS), of Accra, Ghana, has been contracted by Cardinal to undertake the Environmental Impact Assessment (EIA) 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 (EPA) procedures for the EIA. The Environmental Impact Statement (EIS) has recently been completed and filed with the EPA in accordance with Regulations 15(1b) and (1c) of the Environmental Assessment Regulations, 1999 (LI 1652) and Ghana's Environmental Impact Assessment Procedures. The EPA has issued a public notification on the proposed Namdini Gold Mining Project. Further detailed environmental studies are continuing including development of an Environmental Management Plan (EMP). Cardinal believes that there are unlikely to be any specific environmental issues that would preclude eventual economic extraction.
Bulk density	*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.* *The bulk density for bulk material must have been measured by methods that*	Resource data acquisition included routine immersion measurements of bulk densities for samples of diamond core. The bulk density database for the Mineral Resource estimate comprises 11,047 measurements. Oxidised and porous samples were wax-coated prior to density measurement. Lengths specified for these samples range from 0.01 to 1.4 m and average 0.3 m.

Criteria	JORC Code Explanation	Commentary
	adequately account for void spaces (vugs, porosity, etc), moisture and differences between rock and alteration zones within the deposit.	
	Discuss assumptions for bulk density estimates used in the evaluation process of the different materials.	Bulk densities were assigned to the estimate by rock type and weathering zone. The assigned values were derived from the average of the available measurements for each zone. Assigned densities vary from 2.00 for strongly weathered metavolcanic to 2.82 t/m^3 for Fresh diorite and metasediments.
Classification	*The basis for the classification of the Mineral Resources into varying confidence categories.*	Resource model blocks were classified as Measured, Indicated or Inferred on the basis of search pass and three wire-frames outlining more closely drilled portions of the mineralisation. The classification approach assigns estimates of mineralisation tested by generally 50 by 50 m and closer spaced drilling to the Indicated category, with estimates for more zones with closely spaced drilling classified as Measured. Estimates for panels not informed consistently 50 by 50 m drilling are assigned to the Inferred category. Classification of the area of Grade Control sampling as Measured is warranted by the close agreement between resource and Grade Control estimates.
	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). *Whether the result appropriately reflects the Competent Person's view of the deposit.*	The resource classification accounts for all relevant factors and reflect the competent person's views of the deposit.
Audits or reviews	*The results of any audits or reviews of Mineral Resource estimates.*	Mineral Resource reviews including comparative modelling have previously been undertaken by independent external consultants.
Discussion of relative accuracy/ confidence	*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*	Confidence in the accuracy of the estimates is reflected by their classification as Measured, Indicated and Inferred.

Criteria	JORC Code Explanation	Commentary
	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. *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.* *These statements of relative accuracy and confidence of the estimate should be compared with production data, where available.*	The Mineral Resource has been classified as Measured, Indicated and Inferred with the Measured and Indicated Resource considered to be of sufficient confidence to allow mine planning studies to be completed. The geostatistical techniques applied to estimate the Namdini deposit are deemed appropriate for the anticipated bulk mining method proposed.

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 Ore Reserves	*Description of the Mineral Resource estimate used as a basis for the conversion to an Ore Reserve.* *Clear statement as to whether the Mineral Resources are reported additional to, or inclusive of, the Ore Reserves.*	The Mineral Resource model used as input to the mining model was the MIK model supplied by MPR (February 2019) using parent cell sizes of 12.5x25x5 m (X, Y, Z). The Mineral Resource includes the Ore Reserve for the Namdini Gold Project.
Site visits	*Comment on any site visits undertaken by the Competent Person and the outcome of those visits.* *If no site visits have been undertaken indicate why this is the case.*	The Competent Person (Ore Reserves) visited the Namdini Project site in Ghana on 14 and 15 December 2017. The site has road access and is readily accessible for power, water and additional infrastructure requirements.
Study status	*The type and level of study undertaken to enable Mineral Resources to be converted to Ore Reserves.*	A Preliminary Feasibility Study has been completed and a NI43-101 Technical Report for the TSX was submitted in October 2018.

Criteria	JORC Code Explanation	Commentary
	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.	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.

Class	Ore tonnes (Mt)	Contained ounces (Moz)	Grade (Au g/t)
Proved Oxide	1.0	0.1	1.21
Probable Oxide	3.0	0.1	1.08
Proved Fresh	6.4	0.3	1.33
Probable Fresh	131.2	4.6	1.13
Total Proved and Probable	**138.6**	**5.1**	**1.13**

Apparent differences may occur due to rounding.

Cut-off parameters	*The basis of the cut-off grade(s) or quality parameters applied.*	A marginal cut-off grade (COG) was estimated for gold using a gross long-term gold price of US$1,300/oz. Input processing costs of $14.30/t plus $1.50/t stockpile reclaim using an estimated 82% metallurgical recovery. A marginal COG was estimated as: *process cost / (net gold price * process recovery)* i.e. COG = ($14.30 + $1.50) / ($39.67 * 82%) 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 (ore + waste) blocks were exported for open pit optimisation.
Mining factors or assumptions	*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).* *The choice, nature and appropriateness*	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 most material requiring drilling and blasting. Mining will be carried out using cut-backs with five

Criteria	JORC Code Explanation	Commentary
	of the selected mining method(s) and other mining parameters including associated design issues such as pre-strip, access, etc. *The assumptions made regarding geotechnical parameters (eg pit slopes, stope sizes, etc), grade control and pre-production drilling.* *The major assumptions made and Mineral Resource model used for pit and stope optimisation (if appropriate).* *The mining dilution factors used.* *The mining recovery factors used.* *Any minimum mining widths used.* *The manner in which Inferred Mineral Resources are utilised in mining studies and the sensitivity of the outcome to their inclusion.* *The infrastructure requirements of the selected mining methods.*	identified Phases being incorporated into the LOM Final Pit. Oxide ore will be stockpiled temporarily and treated separately within the process plant as a batch process at the end of life of mine. Waste rock will be dumped separately with the waste rock piles on the western side of the pit. 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°, Slope angles in the fresh rock have been determined in accordance to the lithology type, and zone within the pit in accordance with the prescribed geotechnical parameters. Grade control drilling will precede ore identification and ore mark-out on a bench basis. 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 technique (MIK with post-processing of variance adjustment and change of support). Moderate bulk mining (minimal selectivity) will be used with 400 t excavators loading Cat 785 (134 t) class rigid body haul trucks. The ore will be mined in a series of three flitches within a 10 m bench and the waste rock will be mined in 10 m benches where practicable. A minimum mining width of 80 m was assumed. Inferred Mineral Resources have been considered as waste material. There is minimal Inferred Resource material within the Final Pit design. Mining infrastructure requirements will be provided by the selected mining contractor with the mining performed on an outsourced basis.
Metallurgical factors or assumptions	*The metallurgical process proposed and the appropriateness of that process to the style of mineralisation.* *Whether the metallurgical process is well-tested technology or novel in nature.* *The nature, amount and representativeness of metallurgical test work undertaken, the nature of the metallurgical domaining applied and the corresponding metallurgical*	Metallurgical process recoveries have been defined on various samples for Oxide and Fresh ore. Metallurgical testwork was carried out by ALS Laboratories Perth, Australia and Maelgwyn Mineral Service Laboratory, Johannesburg, South Africa. An average estimated 90% for the Oxide ore and 82% recovery for the Fresh ore was applied in the LOM plan and the pit optimisation process. Testwork is ongoing. The process plant will be a conventional crush, grind, flotation, regrind (of flotation concentrate), Carbon-In-

Criteria	JORC Code Explanation	Commentary
	recovery factors applied. *Any assumptions or allowances made for deleterious elements.* *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.* *For minerals that are defined by a specification, has the ore reserve estimation been based on the appropriate mineralogy to meet the specifications?*	Leach with elution circuit, electrowinning and gold smelting to recover the gold from the loaded carbon to produce doré. Aachen shear reactor technology was tested at their laboratory testing facility in South Africa. These results have been incorporated into the recovery figures used in the updated Ore Reserve estimates. The regrind size has been selected as a P_{90} of 9 µm. No deleterious elements have been identified in the testwork that could affect the saleability or price of the gold doré produced. Testwork carried out to date indicates that the Namdini Gold Project can use a conventional gold recovery process plant with fine regrind circuit and existing proven process. Namdini will produce a readily saleable gold doré which will be exported for refining.
Environmental	*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.*	NEMAS on behalf of Cardinal submitted its Environmental Impact Statement (EIS) report in October 2018 to the Environmental Protection Agency (EPA) for approval. The report covers all regulatory requirements for environmental impacts, mitigation plans and monitoring programmes. The EPA has issued a public notification on the proposed Namdini Gold Mining Project and the approval process is nearing completion. A provisional Environmental Management Plan (EMP) has also been developed for the Project
Infrastructure	*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.*	Lycopodium completed FS level study of the infrastructure requirements including power, water, road access, and waste management. The site will be accessed by a new ~25 km gravel road linking the site to the existing national road N10 between Pwalagu 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 north of Pwalagu.
Costs	*The derivation of, or assumptions made, regarding projected capital costs in the study.* *The methodology used to estimate*	Costs were provided by Lycopodium to a FS level. Capital and operating costs were estimated for the proposed 9.5 Mtpa processing operation. Operating costs were compiled from quotations,

Criteria	JORC Code Explanation	Commentary
	operating costs.	database and a variety of sources and compared against existing and planned gold mining operations elsewhere in Ghana.
	Allowances made for the content of deleterious elements.	
	The derivation of assumptions made of metal or commodity price(s), for the principal minerals and co- products.	Mining costs built up from first principles by Golder using vendor quotations and current databases to derive contractor equivalent rates. These rates were to previous 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 increase with depth to account for increased haulage costs.
	The source of exchange rates used in the study.	
	Derivation of transportation charges.	
	The basis for forecasting or source of treatment and refining charges, penalties for failure to meet specification, etc.	
	The allowances made for royalties payable, both Government and private.	All costs were determined on a US dollar (US$) basis.
Revenue factors	*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.*	An allowance for 5% royalties was used in the pit optimisations and financial modelling associated with the LOM planning assessment. An additional $1.10 per ounce of doré bar has been allowed for as TC/RC costs.
	The derivation of assumptions made of metal or commodity price(s), for the principal metals, minerals and co-products.	Gold will be the single product commodity from the Namdini Gold Project with the gold product being exported as doré.
Market assessment	*The demand, supply and stock situation for the particular commodity, consumption trends and factors likely to affect supply and demand into the future.*	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.
	A customer and competitor analysis along with the identification of likely market windows for the product.	No projected or oversupply of gold is envisaged which could affect the product market pricing.
	Price and volume forecasts and the basis for these forecasts.	The long-term price of gold has been assumed to be US$1,350 for the financial model evaluation metrics
	For industrial minerals the customer specification, testing and acceptance requirements prior to a supply contract.	The gold will be sold as doré.
Economic	*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.*	A detailed economic evaluation as part of the FS indicates that the Project is economically viable using a discount rate of 5%. The Project's sensitivity has been tested against the value drivers of gold price, discount rate, Capex, Opex, process recovery and head grade.
	NPV ranges and sensitivity to variations in the significant assumptions and	

Criteria	JORC Code Explanation	Commentary
	inputs.	
Social	*The status of agreements with key stakeholders and matters leading to social licence to operate.*	A feasibility level social study and relocation action plan is currently being carried out by NEMAS and MKM Social Limited respectively, including active engagement of local and state regulatory bodies.
Other	*To the extent relevant, the impact of the following on the project and/or on the estimation and classification of the Ore Reserves:* *Any identified material naturally occurring risks.* *The status of material legal agreements and marketing arrangements.* *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.*	There are no known current impediments to the progression of the Project or foreseen encumbrances to the granting of a licence to operate. Continued discussions with the regulatory authorities and submission of the mine plan and closure plan to the Ghanaian authorities are continuing as part of the Feasibility study. Under the supervision of Ghana Government Ministries, EPA and The Minerals Commission, Cardinal has conducted public hearings for the Namdini Gold project in relation to the current and future support of the Namdini Project proceeding into mine development. There are no objections or obstructions to the Namdini Project proceeding.
Classification	*The basis for the classification of the Ore Reserves into varying confidence categories.* *Whether the result appropriately reflects the Competent Person's view of the deposit.* *The proportion of Probable Ore Reserves that have been derived from Measured Mineral Resources (if any).*	Probable and Proved Ore Reserves are declared for the Namdini Gold Project. Measured and Indicated Resources within the Final Pit design that have been scheduled for processing have been converted to Ore Reserves after application of the Modifying Factors.
Audits or reviews	*The results of any audits or reviews of Ore Reserve estimates.*	The Feasibility and Prefeasibility Study outputs have been the subject of internal review by the contributing parties and external review by other consultants. No fatal flaws were identified by external consultants
Discussion of relative accuracy/	*Where appropriate a statement of the relative accuracy and confidence level in the Ore Reserve estimate using an*	Ore Reserves have been classified as Proved by conversion of Measured Resource material above the 0.5 g/t Au cut-off grade within the Final Pit design. While

Criteria	JORC Code Explanation	Commentary
confidence	*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.* *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.* *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.* *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.*	Probable Ore Reserves have been estimated by the conversion of Indicated Resource material above the 0.5 g/t Au cut-off grade within the Final Pit design. 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 Measured and Indicated Mineral Resources. 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. The proposed mine plan is technically achievable. All technical proposals made for the operational phase involve the application of conventional process that is widely utilised in the gold industry. The key factors that are likely to affect the accuracy and confidence in the Ore Reserves are: • Changes in gold prices and sales agreements • Accuracy of the underlying Resource Block Models • Changes in metallurgical recovery • Mining loss and dilution