School of Mining Engineering

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

THE EFFECT OF IMPROVED MINERAL RESOURCE MANAGEMENT ON THE NET PRESENT VALUE OF THE CAMUTUE WEST KIMBERLITE DIAMOND DEPOSIT IN ANGOLA

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Johannesburg, 2025

DECLARATION

I have familiarised myself with the University of the Witwatersrand Student Academic Misconduct Policy (SAMP). I hereby declare that the work I am submitting for assessment is my original work. I affirm that I have not plagiarised, misrepresented, or colluded with any other person or source. I have properly acknowledged, cited, and referenced all the sources that I have used in my work. I also declare that I have used artificial intelligence (AI) tools only as a means of guidance. The ideas and arguments presented in my work are my original thoughts and interpretations. I acknowledge that any academic misconduct, such as plagiarism or collusion will result in serious consequences. These consequences may include a reduced grade, a fail mark, or disciplinary action according to the SAMP. The School of Mining Engineering has my consent to investigate any potential academic misconduct in my work. This investigation may include the use of similarity and AI detection software to check the originality of my work. I undertake to abide by the decision of any such investigation.

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“Blessed be the Lord my strength who teaches my hands to fight and my fingers to war”

Psalm 144

ABSTRACT

Angola is rated as a high-risk investor destination, fueling a high cost of equity rate. Bank loans are not easily secured for exploration programs with no proof of return from an established Diamond Resource. The Camutue West kimberlite was mined without a properly developed Diamond Resource model, and no investment was made in exploration drilling. The resource model was extrapolated to avoid capital spending. The exploration drilling program initiated in 2023 provided an opportunity to compare the extrapolated model to the actual result. It provided an opportunity to determine the value of the risk in avoiding capital spending compared to the cost of exploration drilling. Diamond valuation is a unique process that requires the final product to be in high quantities to determine the expected recovery price. Access to such samples could come at a very high cost if not exposed on the surface. This motivated the research to apply open pit optimisation techniques to assist exploration programs in adding value.

Capital spent on the resource estimation, drilling and sampling program has been proven to increase the mine's value compared to the orebody extrapolation method. This proved that there was no replacement for a high-quality resource estimation, drilling and sampling program. Open pit optimisation techniques can be applied to reduce exploration drilling depth, assisting with quality control standards. These techniques also help generate earlier revenue for added value to the mine. Diamond mining companies must investigate the best techniques and drilling equipment to ensure high-quality exploration results. The success in achieving an optimal NPV result is highly dependent on an accurate geological model. Shareholders need to commit to proper exploration programs to achieve the best results for all stake holders involved.

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LIST OF ABBREVIATIONS AND SYMBOLS

Abbreviation	Description
BCM	Bank Cubic Meters
bco	Bottom Cut-Off
CAPM	Capital Asset Pricing Model
CE	Camutue East
CF	Cash Flow
CP	Competent Person
cpht	Carats per hundred tonnes
CRP	Country Risk Premium
CT	Caitondo
CW	Camutue West
CX	Caixepa
DBS	Direct Block Scheduling
DCF	Discounted Cash Flow
DMS	Dense Media Separation
DRC	Democratic Republic of the Congo
EBIT	Earnings Before Interest and Taxes
ERP	Equity Risk Premium
FC	Fixed Cost
FOS	Factor of Safety
GG	Granite gneiss
ha	Hectares
HK	Hypabyssal Kimberlite
IRR	Internal Rate of Return
IFRS	The International Financial Reporting Standards
IRS	Intact Rock Strength
KIM’s	Kimberlitic Indicator Minerals
LDD	Large Diameter Drills
LG	Lerchs-Grossmann
LOM	Life of Mine
mamsl	Metres above mean sea level
MMRPG	Ministry of Mineral Resources, Petroleum and Gas
MRM	Mineral Resource Management
MVK	Massive Volcanoclastic Kimberlite
NPV	Net Present Value
OP	Open Pit
PK	Pyroclastic Kimberlite
RADR	Risk-Adjusted Discount Rate
RC	Reverse Circulation
ROM	Run of Mine
RVK	Resedimented Volcanoclastic Kimberlite

SAMREC	The South African Code for the Reporting of Exploration Results, Mineral Resources and Mineral Reserves
SAP	Saprolite
SFD	Size Frequency Distribution
SOFR	Secured Overnight Financing Rate
SRK	SRK Consulting South Africa
Tecmad	Tecmad Mining Services SARL
TKB	Tuffisitic Kimberlite Breccia
TVM	Time Value of Money
UG	Underground
UVC	Unit Variable Cost
VAT	Value-Added Tax
VK	Volcanoclastic Kimberlite
VKB	Volcanoclastic Kimberlite Breccias
WACC	Weighted Average Cost of Capital
WGG	Weathered granite gneiss

Symbol	**Description**	**Units**
% Debt	percentage financed in debt	%
% Equity	percentage financed from investors	%
b	beta factor for the stock	no
ct	mass of diamonds	ct
f	risk-free rate on return	%
gr	mass of smaller diamonds	grains
GSR	gross sales revenue	USD
i	interest/discount rate	%
it	income tax	USD
Kd	cost of debt	%
Ke	cost of equity	%
m	length	m
m^3	volume	m^3
Mpa	unit of pressure	mpa
MRR	mineral resource royalty	USD
p	price	USD
R	risk-free premium on market return	%
r_e	expected return on the stock	%
RTR	royalty tax rate	USD
T	tax rate	%
t	tonnage	t
TC	total cost	

1 INTRODUCTION

1.1 Research Background and Context

Angola is a country enriched with a wealth of kimberlite pipes with diamond-bearing potential. Kimberlite pipes are found along a northeastern-oriented corridor through the country's middle. The geological structures are divided into two central regions named the Kasai Craton in the northeast of Angola and the Angola Craton, covering a large part of the country, shown in Figure 1. The diamond potential from kimberlites found within the Kasai Craton is expected to be better than the Angola Craton (Ustinov, et al., 2018).

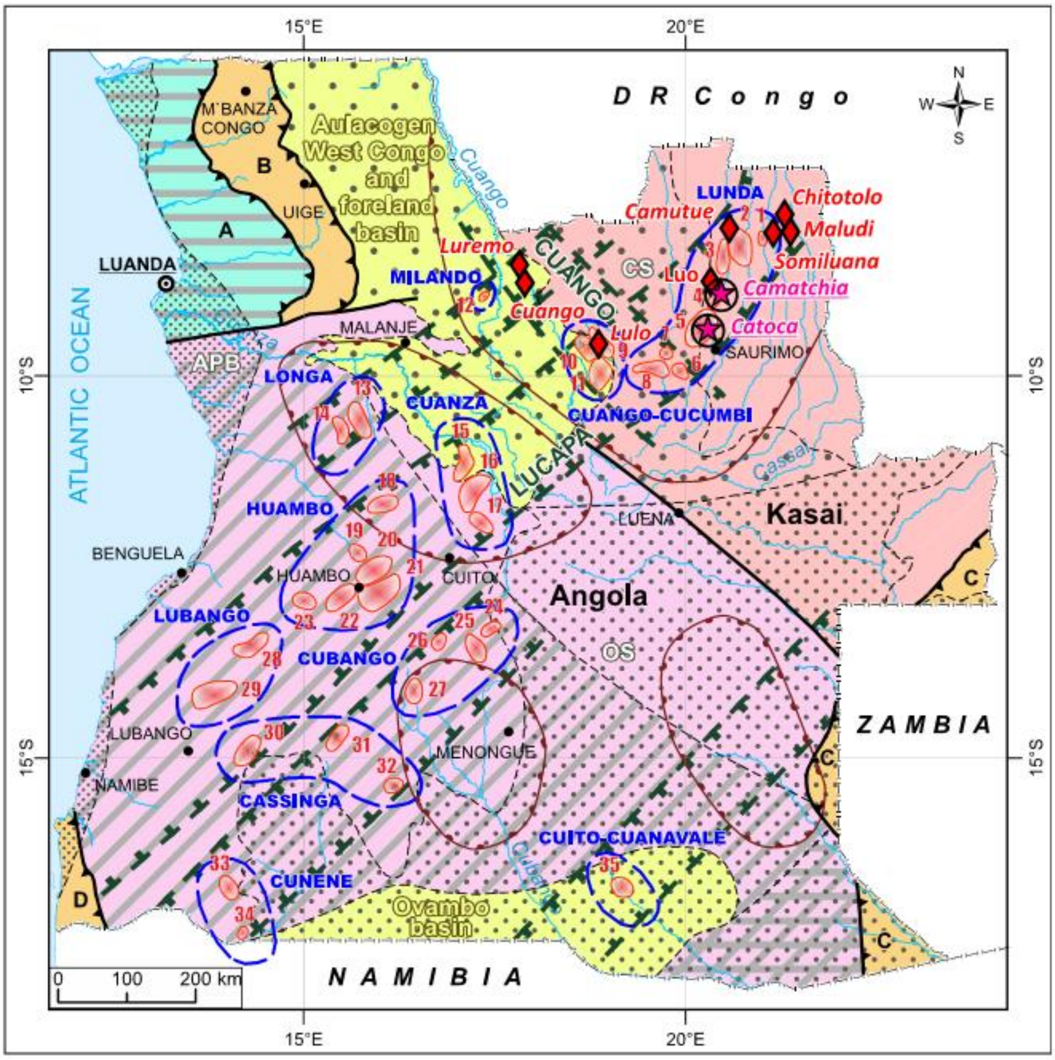


Figure 1 - Angolan kimberlite distribution (Ustinov et al., 2018)

The Camutue concession, within the Kasai Craton in the province of Lunda Norte, is approximately 5km outside Lucapa, illustrated in Figure 2. Twelve kimberlites had been identified on the concession, four proving diamondiferous. Camutue West (CW) kimberlite is the largest and had an original 12 hectares (ha) footprint. The Camutue East (CE) kimberlite is adjacent to CW with a footprint of 9ha. Evaluation of the CE pipe is still ongoing and could not be declared as an economically mineable reserve to date. Caixepa (CX) kimberlite is located 2.4km northeast of CW and had an original footprint of 3ha. The grade of CX is lower than CW, but the diamonds recovered there proved to be high value. Caitondo (CT) kimberlite is situated between CW and CX with a footprint of 0.45ha. The grade of CT is similar compared to CX, and the diamonds recovered from sampling proved to be of an even higher value than CX. Exploration had yet to be done at CT to develop a mineral resource model. Over the past decade, CW and CX have been the primary sources of ore supply for the mine.

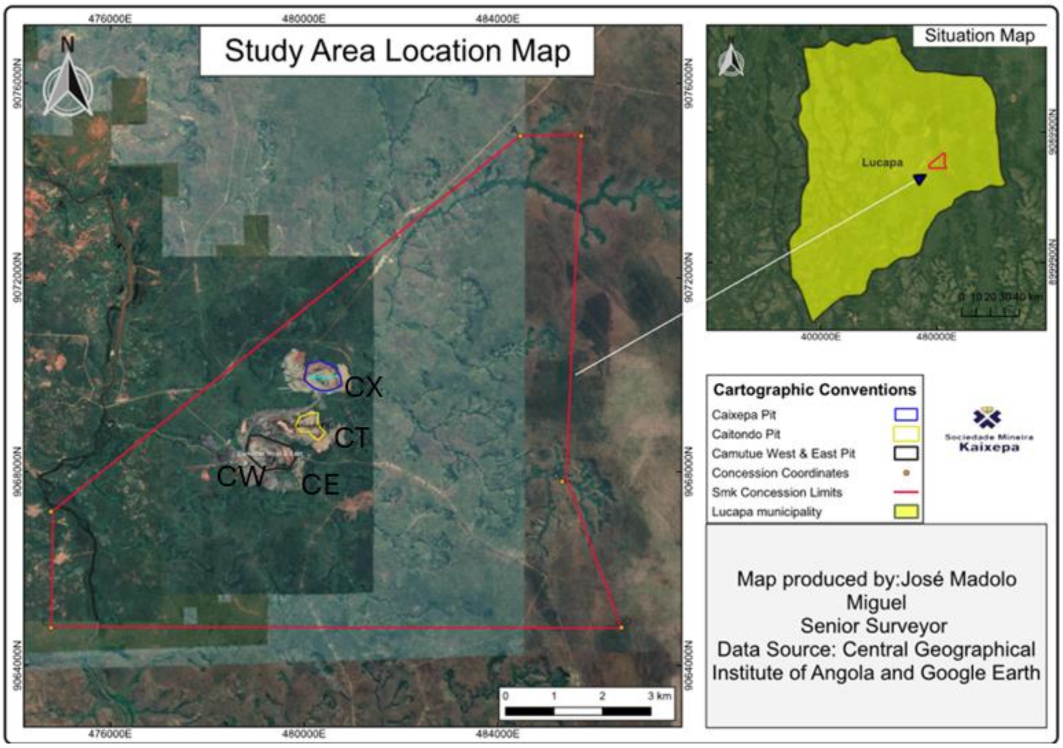


Figure 2 - Camutue Concession Location Map (Madolo, 2023)

The company called Diamang discovered the CW kimberlite in the mid-20th century. Diamang has done exploration drilling at the CW kimberlite, and some production figures were recorded presenting an average grade of nine carats per hundred tonnes (cpht). The Camutue concession was abandoned by the start of the Angolan civil war in 1975 that continued until 2002. Tecmad Mining Services (Tecmad) was awarded a prospecting license in 2007, allowing them to explore and mine alluvial and kimberlite deposits at the Camutue concession. Tecmad started slowly with alluvial mining while re-commissioning and repairing the treatment plants left by Diamang to enable the processing of kimberlite ore. The CW kimberlite was covered in water with minimal open pit development, as shown in Figure 3.

Figure 3 - Camutue West kimberlite 2007 (Heap, 2017)

1.1.1 Historic exploration work

Tecmad initiated a core drilling program designed by the mine geologist employed at the time to generate a mineral resource model to evaluate the potential of the CW-independent kimberlite. Remote Exploration Services was contracted in 2011 as the Competent Person (CP) to assess the progress and further requirements for Diamond Resource classification at Camutue. Remote Exploration Services investigated all geological information available and found the following results:

- Diamang drilled 50 NQ core holes of 1.88 inches in diameter in CW in the 1960s, but the core was not preserved for geological model development;
- Historical results showed that Diamang drilled 36 large-diameter drills (LDD) holes of 12.25 inches per hole, with a reported average grade of 0.23 cts/m^3;
- Documented quality control measures of historical exploration data could not be located, and Remote Exploration Services deemed the information unsuitable for Diamond Resource classification according to the requirements of the South African Code for the Reporting of Exploration Results, Mineral Resources and Mineral Reserves (SAMREC, 2009);
- Remote Exploration Services logged and evaluated 57 NQ core holes drilled by Tecmad, producing 31 pipe margin pierce points for pipe shell development. Drilling reached 200m below the original surface to 580m above mean sea level (mamsl);
- Remote Exploration Services developed a preliminary resource model in 2012 combining kimberlite domains with similar characteristics into a group. The model illustrated in Figure 4 consisted of three groups:
    - Crater Sediments;
    - Resedimented volcanic kimberlite (RVK) and pyroclastic kimberlite (PK) are combined in one domain; and

- Volcanoclastic kimberlite breccias (VKB) is highly diluted with country rock xenoliths.

- For planning purposes, the model grade for the combined RVK and PK domain was based on the average historic plant recovery grade; and
- Remote Exploration Services required additional core drilling and LDD sampling to classify the domains into different rock types and assign grades to each rock type with an acceptable confidence level.

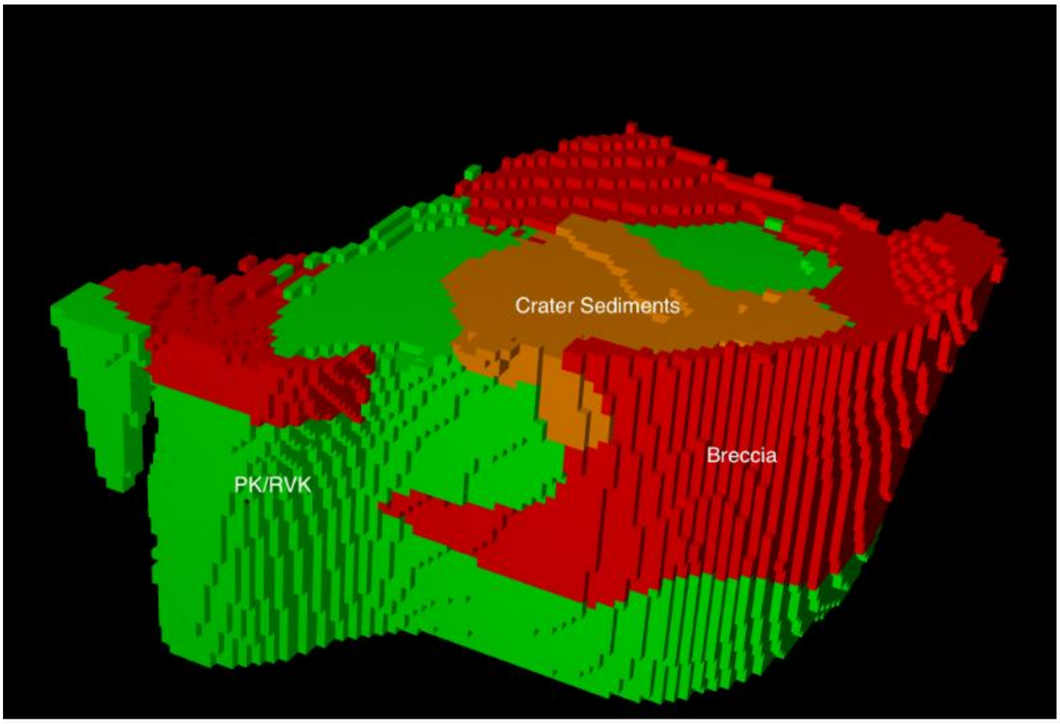


Figure 4 - CW Preliminary resource model 2012 (Hollick, 2016)

Tecmad did not invest any capital into exploration drilling, and all costs had to be covered within the cash flow from revenue recovered from the run of mine (ROM). Lithologies changed as mining progressed to deeper elevations, and mine planning estimates were rarely accurate by assigning one grade to all ore mined. Resource estimation drilling done in conjunction with mining practices in the same area produced challenges in drilling productivity. Blast planning had to be done around the completion of LDD drill holes to avoid damage to the drill rig. Remote Exploration Services planned nine LDD clusters, each cluster containing eight holes. Mining advanced faster than the LDD sampling could keep up with, and some planned drilling sites were within benches in the open pit. The LDD drilling program ended with only four clusters completed, with the pit floor narrowing down, as illustrated in Figure 5. Mining intersected various ore rock types, proving to have grades different from the average grade estimates for the whole kimberlite.

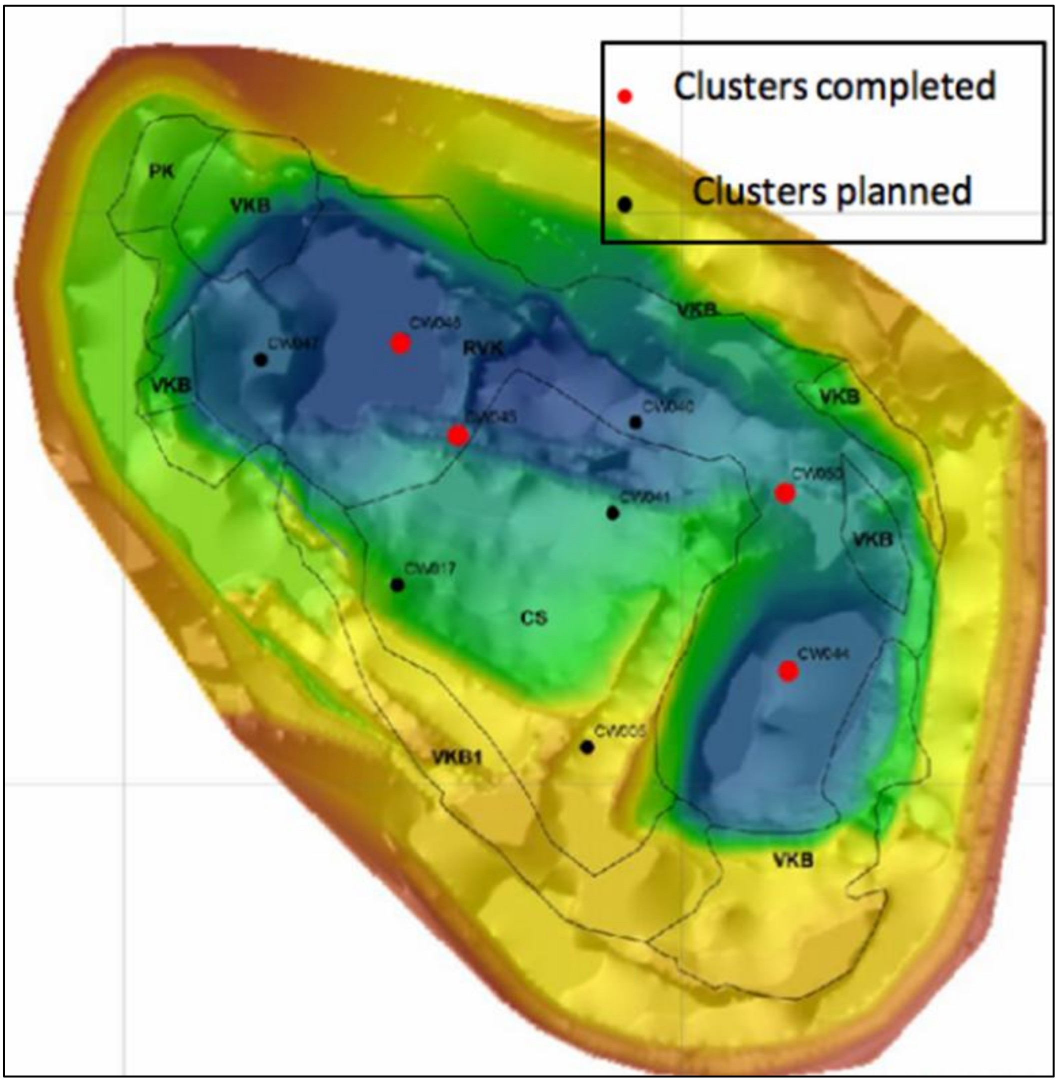


Figure 5 - Completed LDD samples (Hollick, 2016)

Tecmad tasked Remote Exploration Services with providing a solution for more accurate planning practices. Remote Exploration Services stressed that more drilling information is needed but committed to developing an updated resource model in 2016. Table 1 shows the Diamond Resource statement of the updated resource model generated by Remote Exploration Services in 2016. The volume of the facies, grade estimation, total carats, screen bottom cut-off size (BOC), and classification are presented in the table. The valuation was done by an external professional valuator contracted by the mine.

Table 1 - CW Diamond Resource statement 2016 (Hollick, 2016)

Camutue West Diamond Resource Statement 2016						
Facies	**Volume (m^3 '000)**	**Grade (ct/m^3)**	**Carats (ct '000)**	**Value (USD/ct)**	**BOC (mm)**	**Clasifiaction**
Kimberlite 2	77	0.188	14	420.00	2.00	Inferred
Kimberlite 3	786	0.175	138	485.00	2.00	Inferred
Kimberlite 4 & 5	5 929	0.293	1 737	Not valuated	2.00	Inferred
Kimberlite 6	3 910	0.105	411	420.00	2.00	Inferred
Kimberlite 7 & 8	78	0.145	11	550.00	2.00	Inferred
TOTAL	**10 780**	**0.214**	**2 311**	**438.14**	**2.00**	**Inferred**

Figure 6 shows the size-frequency distribution (SFD's) for the various kimbelite facies presented in Table 1.

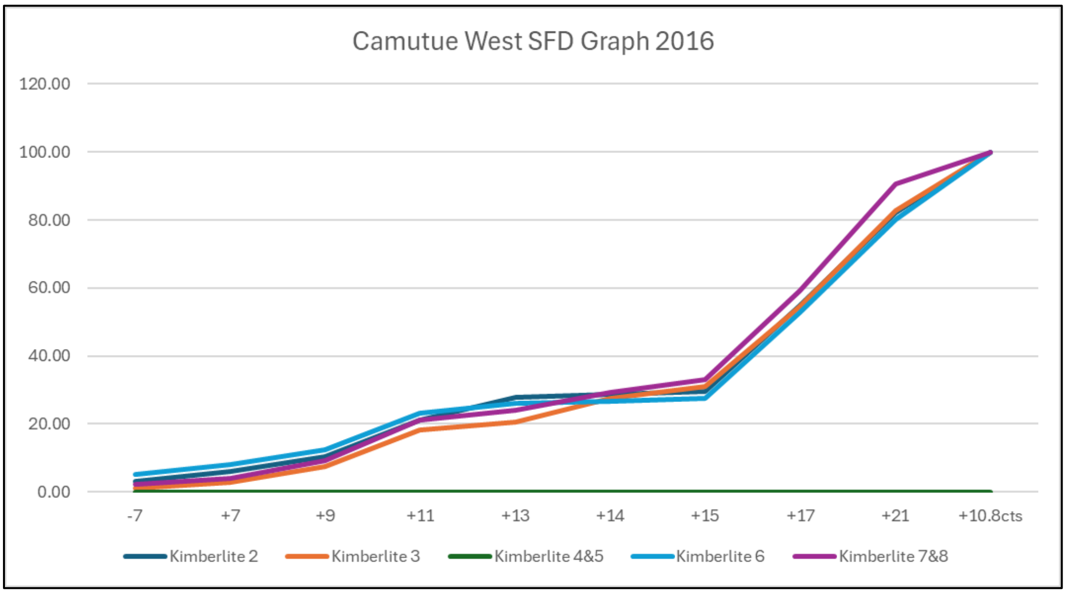


Figure 6 - CW SFD graph 2016 (Sociedade Mineira de Kaixepa Geology Department, 2024)

1.1.2 Historic mine planning background

Tecmad appointed MSG Consulting as the CP to optimise the open pit using the resource model developed by Remote Exploration Services in July 2016. MSG Consulting used Whittle software for the optimisation exercise. SRK Consulting South Africa (SRK) was appointed to produce slope angles based on rock structure mapping around the exposed open pit area. Tecmad's finance department supplied MSG Consulting with cost and revenue inputs for open pit optimisation. The results achieved by the Whittle optimisation give a series of nested pit shells, each with an NPV value. The pit shell with the highest NPV value is the optimal pit shell. Figure 7 shows that Pit Shell 23 is the optimal shell with the highest NPV value rounded-off.

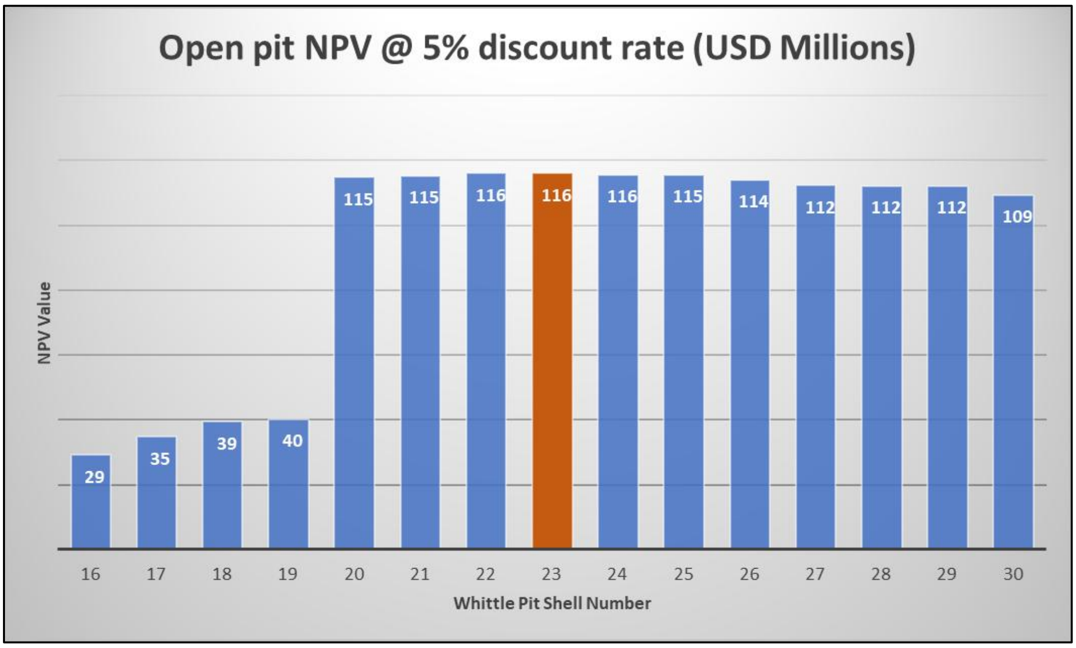


Figure 7 - CW optimisation results (Gallagher, 2016)

The optimisation was done from the actual pit surface, which had a bottom elevation of 670m. The optimal Pit Shell 23 has a bottom elevation of 545m. Figure 8 shows the relation between the current surface and the optimal shell in a north-to-south section view with all applied geotechnical slope angles.

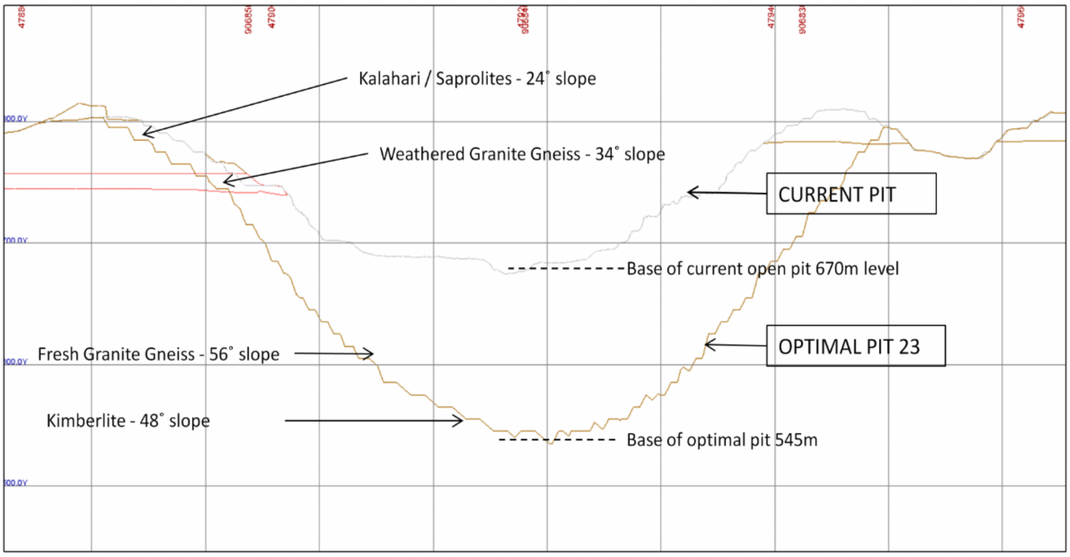


Figure 8 - Optimal Whittle Pit Shell 23 (Gallagher, 2016)

President José Eduardo dos Santos retired as president of Angola in 2017, and President João Lourenço filled his position as the president of the republic of Angola. The change in presidency also changed the diamond trade policy in July 2018. A new decree allowed the state-owned company Sodiam to set a base price for the diamond parcels produced by mining companies. Afterwards, external companies registered at Sodiam are offered an opportunity to tender on parcels. The highest bidder will be allowed to buy the parcel. If the base price Sodiam sets is higher than any external bid, Sodiam will purchase the parcel (Leotaud, 2020). The average price per carat for diamonds produced from the CW kimberlite doubled with the new trade policy. Tecmad realised the increased potential for the business and to fund an exploration drilling program by using operational capital.

Mining progressed to deeper elevations in 2017 and 2018, intersecting the Kimb 4&5 domain (Fig. 8). The pit floor at elevation 660m allowed for a sufficient area of the rock type exposed to allow for a bulk sample to be extracted. The site for the bulk sample was demarcated and thereafter blasted individually as a separate section to produce a volume of 8,577 bank cubic meters (BCM). The treatment plant was sterilised with barren material to ensure no diamonds were present before processing the sample ore. The sample yielded 3,664 carats at a grade of 0.427cts/m^3, including 19 special stones, weighing above the +10.8 ct size fraction. The largest stone weighs 24 carats. The actual grade result from the bulk sample was 46% higher than the grade used in the 2016 optimisation for the Kimb 4&5 domain. This was due to very limited LDD sampling that intersected the domain.

Tecmad realised the mine's development potential. MSG Consulting was tasked with another open pit optimisation in 2019, driven by the increased grade and diamond price. MSG Consulting realised optimisation potential beyond the elevation of the Diamond Resource model. MSG Consulting extrapolated the Kimb 4&5 ore model to elevation 370m. This ensured that the optimal shell had no potential below the geological model. This extrapolation is not in compliance with SAMREC, but MSG Consulting felt the need to demonstrate that there may be increased future potential. The optimisation was done with three risk-adjusted profiles: cautious, mid and optimistic. All three optimal shells in a north-south section view were well beyond the 2016 optimal shell, as shown in Figure 9.

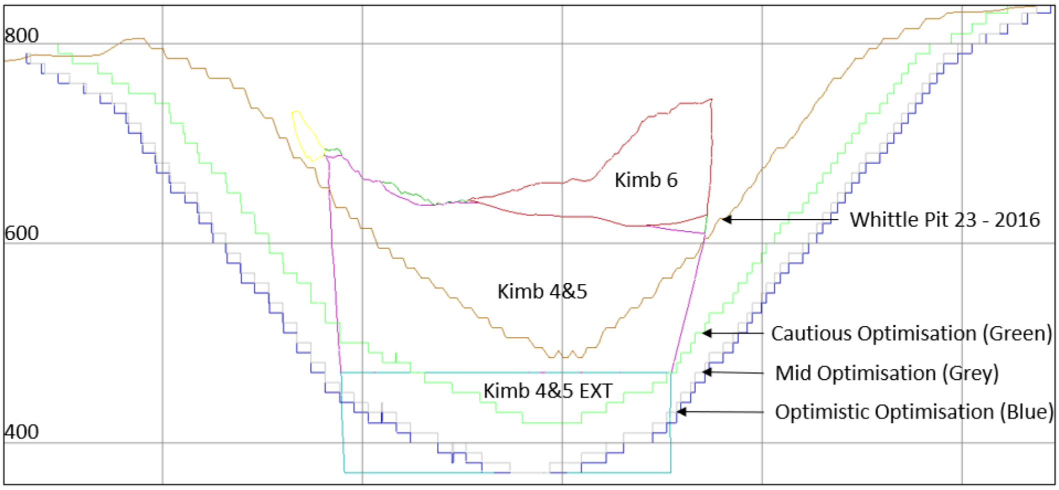


Figure 9 - CW optimisation results (Gallagher, 2019)

Table 2 shows the Diamond Resource statement, which was used for the 2019 Whittle optimisation.

Table 2 - CW Diamond Resource statement 2019 (Gallagher, 2019)

Camutue West Diamond Resource Statement 2019						
Facies	**Volume (m^3 '000)**	**Grade (ct/m^3)**	**Carats (ct '000)**	**Value (USD/ct)**	**BOC (mm)**	**Clasifiaction**
Kimberlite 2	15	0.188	3	635.00	2.00	Inferred
Kimberlite 3	331	0.175	58	700.00	2.00	Inferred
Kimberlite 4 & 5	7 418	0.427	3 168	989.00	2.00	Inferred
Kimberlite 6	238	0.105	25	600.00	2.00	Inferred
Kimberlite 7 & 8	10	0.145	2	900.00	2.00	Inferred
TOTAL	**8 012**	**0.406**	**3 255**	**980.54**	**2.00**	**Inferred**

Figure 10 shows the updated SFD graph with the valuation, including the SFD's from the Kimb 4 & 5 domain as valuated from the bulk sample done.

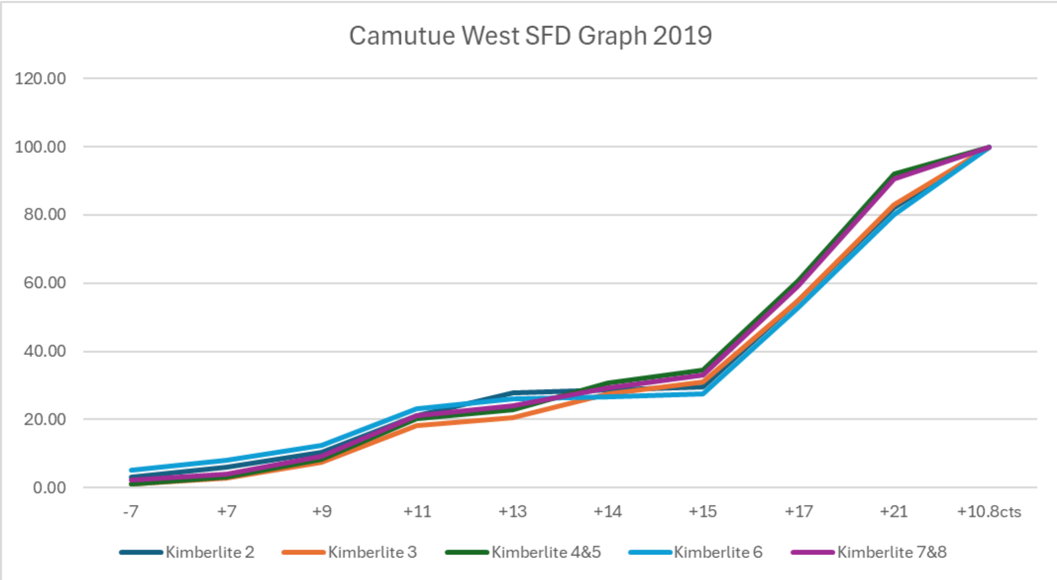


Figure 10 - CW SFD graph 2019 (Sociedade Mineira de Kaixepa Geology Department, 2024)

1.1.3 Camutue concession mining license

The Angola government indicated it intended to change the prospecting and mining license held by Tecmad to a mining association. The shareholders of Tecmad needed clarity on their planned position within the new mining association. Therefore, they were only interested in investing money in a resource estimation, drilling and sampling program once shared positions within the new company were clarified. The formation of the new company was planned to be finalised in 2020. However, with the COVID-19 pandemic, the company formation was not concluded. Tecmad operated on a break-even basis due to minimal production and declined diamond prices due to worldwide COVID-19 restrictions. In May 2021, shareholders of Tecmad were informed that they would not be part of the new mining association and their prospecting and mining licenses were terminated. Sociedade Mineira de Kaixepa was formed by different shareholders who were granted the mining license for the Camutue concession. Sociedade Mineira de Kaixepa took over all Tecmad assets and personnel.

The Sociedade Mineira de Kaixepa board of directors consulted with the mine planning and geology departments to establish the position of the mine in terms of the status of Diamond Resource development. Based on the demonstrated results, it was decided to invest in a resource estimation, drilling and sampling program for the CW pit that will expand to CX and CE later. Sociedade de Mineira de Kaixepa aims to upgrade the Diamond Resources to an acceptable level that could qualify for the application of funding through debt. Sociedade Mineira de Kaixepa contacted Remote Exploration Services, who already had good knowledge of the kimberlites in the concession, to act as the CP in developing Diamond Resource models. Remote Exploration Services generated a design for a core drilling program for CW. SMK bought two core rigs and took over two Prakla RB 40 reverse circulation drill rigs from Tecmad for the required drilling program. Core drilling started in February 2023. Sociedade Mineira de Kaixepa realised that drilling within the kimberlite saturated with seepage water was difficult. It was decided in May 2023 to engage the services of Geoangol, an Angolan exploration drilling contractor, to speed up the process. Sociedade Mineira de Kaixepa also bought two more core rigs to further speed up the drilling program and started drilling at the other kimberlites.

1.2 Problem Statement

Tecmad could not gain investor interest in spending capital on an extended resource estimation drilling program based on the results of the original exploration program and the open pit optimisation done in 2016. Mining intersected the Kimb 4&5 domain and proved a better grade for the kimberlite domain. The high grades of the LDD drill samples intersecting Kimb 4&5 were deemed suspicious of drill hole collapse due to the depth of the domain. The real value of the diamonds was only realised with the bulk sample as no valuation is possible with LDD sampling grinding the diamonds to a finer form. Diamond parcels investigated by a professional valuator revealed that fresh breaks occurred during the LDD sampling process.

Sociedade Mineira de Kaixepa was unwilling to spend capital on another pushback cut for the CW pit without proving that the Kimb 4&5 rock type would continue at deeper elevations. Sociedade Mineira de Kaixepa was interested in spending capital on a resource estimation, drilling, and sampling program fueled by the good results from the Kimb 4&5 bulk sample. The net present value (NPV) calculation of the 2019 optimal shell will be based on the newly defined Diamond Resource model. The result will be compared to the NPV calculation from the optimisation done based on the parameters of the new model. The result will determine whether the capital invested in the exploration program has increased the value of the mine. The significance of an extrapolated model must be measured against the cost of a resource estimation, drilling and sampling program, considering that diamonds can only be evaluated once a representative bulk sample is done.

1.3 Justification for Research

High-value diamonds have been recorded from the CW kimberlite to date. Diamonds are the second largest export product after oil, significantly contributing to Angola's economy. Diamond mining is the most significant source of employment for communities in the Luanda Sul and Luanda Norte provinces of Angola. The Sociedade Mineira de Kaixepa diamond mine contributes to the economy of Angola and employs people living in Lucapa. Proper mineral resource management is required for the CW kimberlite to evaluate the feasibility of further mine expansion. The expansion of the mine will contribute significantly to Angola's economy and the Lucapa community's social welfare. Exploration drilling in kimberlites proved challenging with weak rock formations, especially in contact with water.

Given the high rainfall experienced in the remote location of the CW kimberlite pipe, such challenges contribute to delays in the program and subsequently increase the cost. These challenges call for investigating the application of exploration drilling for kimberlites that could be more cost-effective and, in turn, add value.

Using NPV as a measure of value, we can compare exploration options and approaches to mineral resource management (MRM) of kimberlite pipes. The ability to apply exploration cost over different periods within a cash flow, resulting in a single NPV value for each scenario, makes it a viable option. Exploration options that can enhance the NPV value of kimberlite resources in Angola have the potential to boost future investors' interest significantly. With its positive impact on Angola's economy, further developing kimberlites is a promising prospect and a significant opportunity.

1.4 Research Objectives

The first and crucial objective is to evaluate the mine's current MRM methods based on the extrapolation of the Diamond Resource model. The research will focus on assessing whether kimberlite formation is uniform and maintains the same dip angle at deeper elevations. The advantage of the extrapolation method would be a significant cost saving on exploration drilling. The disadvantage is that there is only proof of the type of kimberlite, grade, and value of the diamonds once mining intersects the lower kimberlite domains currently in the extrapolated section. The level of risk will be very high, with high stripping volumes required without proof that the cost can be recovered. The valuation method uses NPV as a value measure because the concept of the time value of money (TVM) is considered in the calculation. The objective is to identify the effect on the value by enduring the cost and production time delay incurred with a proper exploration drilling program. This value will be weighted against the high-risk option of an extrapolated model.

The second objective is to consider the challenges of resource estimation, drilling and sampling in the weak kimberlite structure. The unique valuation method of diamonds compared to other commodities, which requires increased development to allow for sampling, is fascinating to explore. The consideration is driven by the deep location of the Kimb 4&5 kimberlite body, which would require massive earthmoving costs to obtain a feasible valuation sample. The aim is to consider the feasibility of staged exploration drilling programs allowing for earlier mineral extraction and revenue generation. This is based on open pit optimisation strategies for improved NPV value due to earlier returns. The staged method will be measured against a completed exploration drilling program, considering the time delay in the start of ore processing. The final objective is to determine the highest NPV-valued option using a feasible evaluation method.

1.5 Research Methods

This study will include both qualitative and quantitative research methods.

1.5.1 Qualitative research

The qualitative research method will include a literature review to identify a variety of appropriate methods of kimberlite exploration, given the geo-tectonic and environmental setting of Camutue. The literature review will also focus on open-pit optimisation techniques. The last part of the research will show the steps taken to do a discounted cash flow sheet.

1.5.2 Quantitative research

The quantitative approach will be sourcing the original solids used in the 2016 open pit optimisation. The solids will be validated using mine planning software and clipped against the latest topographic surface. These solids will be combined with the new solids, and the model will be filled with the

CW Kimb 2 orebody until the original surface in 2007. Open pit optimisation practices will be researched to correctly collect cost and revenue data to determine ultimate pit limits. The generation cash flows for NPV calculations will be evaluated to determine the required data collection. Discounted NPV values will be determined to compare the various exploration scenarios.

1.6 Sources of Data

Data will mainly be sourced internally from Sociedade Mineira de Kaixepa. Geological data will be collected from the exploration drilling program through core drilling and LDD sampling. Geological data processing will be outsourced to Remote Exploration Services, providing the geological solids model. The geological model will be transformed into a combined geological and geotechnical block model. Geotechnical parameters will be sourced from SRK. The Sociedade Mineira de Kaixepa's cost-controlling department will make cost data available. Forward-looking diamond price estimates will be sourced from the financial department. Optimal pit limits and designs will be generated using Deswik mine planning and optimisation software packages. Production data for the cash flow will be measured in the block model using the required pit design data. Angolan taxes and diamond royalty rates will be sourced from the internet. Financial data will be sourced from the finance department to calculate the discount rate.

1.7 Research Validation

The research will undergo a rigorous validation process to ensure the credibility and reliability of its findings. This validation will include a comprehensive literature review of all relevant research areas, such as kimberlite geology, open pit optimisation, and financial evaluation. The data source for the research report will be the same data used to produce a technical report suitable for funding in the form of a bank loan. The study aims to enhance the credibility and reliability of its findings, ensuring that the results are well-established and robust. The foundation of existing knowledge and the innovation of different approaches to exploration drilling seek to expand diamond mining in Angola.

1.8 Structure of the Research Report

This thesis consists of six chapters. Chapter 1 is the introduction and covers the background of the research topic, the problem statement, the justification for the research, and the research objectives. The research methodologies followed by this study and the sources of the information are introduced. The research validation criteria, as well as the contribution to knowledge, are discussed.

Chapter 2 contains the literature review. The formation of kimberlites was researched, followed by the exploration methods for kimberlite pipes. NPV, as the use of value measurement for mining projects, and the effects that influence it were evaluated. Open pit optimisation techniques were researched to identify how their application could improve the NPV value. Financial reporting in mining is the next section of the report, which determines all requirements included in a discounted cash flow. The chapter summary includes an overview of the information supplied in the chapter.

Chapter 3 explains the research approach. The first section covers the research design, followed by an overview of the planned data collection. The collected data are separated into sub-chapters, starting with the geological data. All the data inputs required for the open pit optimisation and discounted cash flow calculations follow this. The chapter ends with a chapter summary.

Chapter 4 contains all the data collected for the study. First, all the geological data from the exploration drilling program will be displayed. This is followed by the data collected for the open pit optimisation. Additional data for the discounted cash flow calculations are combined with the survey data collected. The chapter summary concludes all the data collected for the report.

Chapter 5 shows the analysis and findings of the data collected. The exploration drilling results are shown and evaluated first. The results from the updated mineral resource model follow this. The open pit optimisation results are displayed for all the variance scenarios with all the required exploration drilling designs and geological models. The NPV for all scenarios are shown. The chapter is summarised at the end.

Chapter 6 contains all the report's conclusions and recommendations. First, a summary of all the chapters is listed, followed by research observations and contributions. The research limitations and recommendations for future research work form the final section of the chapter.

2 LITERATURE REVIEW

2.1 Introduction

The valuation of diamonds is unique as it is affected by the stone's size, shape, clarity and colour. Revenue expectations for precious metals like gold and platinum can be more easily determined from smaller exploration samples. Kimberlite pipes require a dense exploration drilling grid to increase domain classification and grade determination confidence (Kjarsgaard, et al. 2019). Diamond grades are low and are measured in parts per billion compared to other commodities that are measured in parts per million (Marshall, 2012). Therefore bulk sampling is required for grade estimation. Increased confidence in the mineral resource model will equate to increased exploration drilling costs that could negatively affect the overall NPV of the mine. Exploration drilling samples cannot produce diamond parcels worthy of a valuation. This can only be achieved by a bulk sample excavation treated through a metallurgical plant. In the case of the CW kimberlite, where kimberlite domains are distributed horizontally, a large open pit would be required to achieve a bulk sample at deeper elevations. The risk associated with the cost of such an open pit necessary to prove the feasibility of the deeper kimberlite domains is significantly high. The high risk could lead investors to lose interest and not develop the mine, which could have produced valuable diamonds and developed local communities.

The geological formation of kimberlite pipes was considered to establish similarities that could justify the extrapolation of deeper domains. Similarities between kimberlites found in Angola and other kimberlites worldwide will be investigated. Geological exploration of kimberlite pipes will be reviewed to evaluate all options and constraints for developing an accurate mineral resource model. NPV will be defined and examined to establish its importance in determining the value of mining projects. Factors considered in exploration studies will be evaluated to determine the possibilities of adding value. Financial reporting in the mining industry will be explored, and its importance will be identified. The factors considered for financial reporting in mining will be evaluated, focusing on the NPV method's viability.

The literature review section will investigate the significance of exploration drilling on kimberlite pipes that could contribute to better extrapolation potential. Greater extrapolation can contribute to significant cost savings on exploration if the result could be feasible for optimisation purposes. Optimisation methods for increased NPV will be evaluated to identify potential solutions for the exploration strategy to achieve an increased NPV value for the mine. Financial reporting methods will be applied to the cash flow calculation to achieve the best possible result for each scenario.

The methods of mineral resource management at the CW Kimberlite did not follow industry best practice standards. The elevated kimberlite facies were extrapolated without any drilling backing the continuity of the rock type. The extrapolation methods could prove feasible in approaching kimberlite exploration in a different, more cost-effective way for other potential kimberlite sources in Angola.

2.2 Kimberlite Pipe Formation and Geological Exploration

2.2.1 Kimberlite emplacement methods

The name kimberlite originated from the first discovery of kimberlite material, which was found in Kimberley, South Africa, in the early 1870s. The diamond formation was initially thought to have occurred within the kimberlite magma activity under high-pressure (Stachel & Luth, 2015). Later studies proved that diamonds, referred to as xenocrysts, were formed within the earth’s mantle long before kimberlites were formed (Stachel & Harris, 2008). Diamonds form in the upper earth’s mantle more than 140 kilometres deep in the lithospheric mantle (Tappert & Tappert, 2011). Diamonds are transported from the mantle zones by the eruption of volcanic outbursts carried, in most cases, by kimberlite magma and, on lesser occasions, by lamproite (Smit & Shirey, 2019). The diamond formation is favoured by temperatures and pressures within craton areas characterised by surrounding host rock granites and gneiss, estimated to be 2.5 billion years old (Tappert & Tappert, 2011).

Figure 11 shows the formation of diamonds from the earth's lithospheric mantle transported to the surface by kimberlite eruptions.

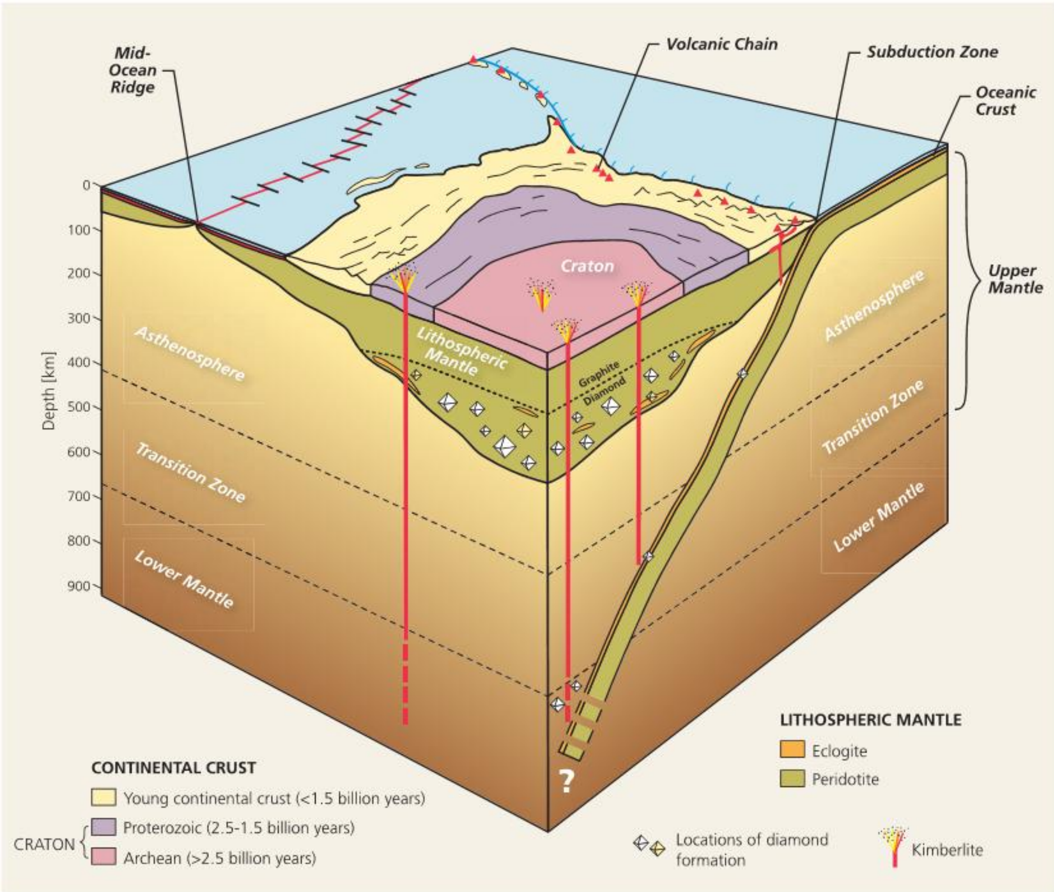


Figure 11 - Diamond formation in the lithospheric mantle (Tappert & Tappert, 2011).

Kimberlite pipes found in Angola are situated in a northeast-to-southwest-oriented corridor that transgresses two cratons. The Kasai Craton in the north extends into the Democratic Republic of the Congo (DRC), and the Angolan Craton from central Angola towards the country's south. Results from operational mines in Angola proved that kimberlites with the highest diamond liberation potential are found on the Kasai Craton (Ustinov et al., 2018). The Camutue concession is the northmost operational kimberlite mine, and the results proved the expected high diamond potential in this part of the country. Figure 12 shows that the primary source of diamonds is shallower in the south, deepening towards the north based on mantle-derived indicator minerals.

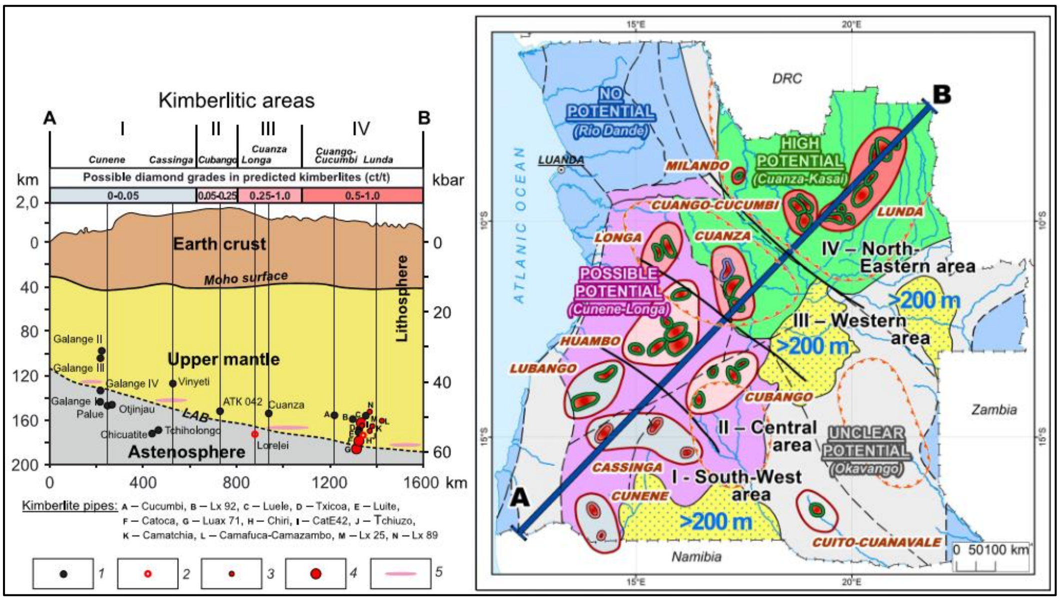


Figure 12 - Angolan kimberlite source identification (Ustinov et al., 2018)

Three types of kimberlite pipe formations have been identified, and pipes found in South Africa and Botswana differ from those found in Canada (Field & Scott Smith, 1999). The class one kimberlite is classified as deep with a steep dip in the orebody divided from top to bottom in a crater, diatreme and root zone (Field & Scott Smith, 1999). The Class One, Kimberly-type, kimberlite pipe is typically found in South Africa. The Class Two, Fort-a-la-Corne, kimberlite shows a flat-angled orebody dip in a saucer-type shape containing only a crater zone (Hetman et al., 2004). Type two kimberlites are found in Siberia, Northeastern Angola and the Canadian Prairies (Skinner & Marsh, 2004). Class Three, resedimented volcanoclastic-type, kimberlites are described as steeply dipping smaller pipes consisting mainly of RVK and, in lesser occurrences, hypabyssal kimberlite (HK) (Field & Scott Smith, 1999). Later findings suggest that Class Three pipes contain tuffisitic kimberlite breccia (TKB) and HK (Scott Smith, 2008). Skinner & Marsh, 2004 confirmed that all three classes of kimberlites are present in northeastern Angola, highlighting the 162ha Camafuca Camazambo pipe as a Class Three pipe close to the Camutue concession (Skinner & Marsh, 2004). The CW kimberlite can be classified as a Class Three pipe as it had a smaller 12ha original top of the orebody surface, dipping steeply. It has to be noted that there is a significant difference between the size of the two pipes mentioned above, questioning the boundary of a smaller pipe. Figure 13 shows a comparison of the three classes of kimberlite pipes.

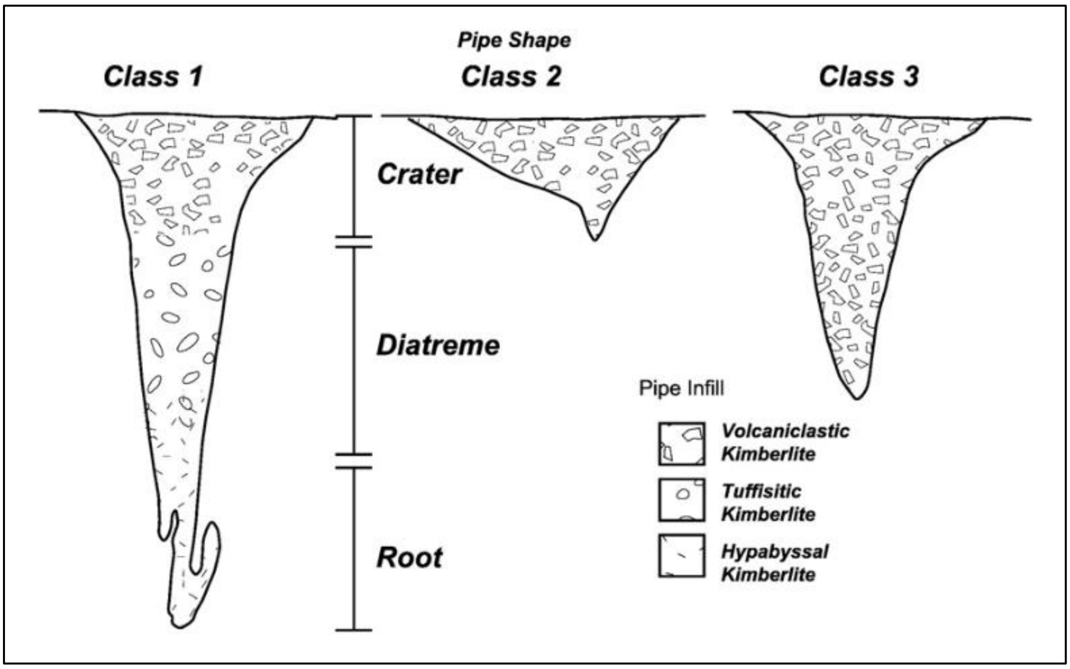


Figure 13 - Kimberlite pipe classes (Cas et al., 2008)

A later study suggested that the Class One pipe of South Africa be divided only into two sections: volcanoclastic kimberlite (VK) and HK. The study suggested the presence of RVK and PK in the upper section and massive volcanoclastic kimberlite (MVK) below, with the root zone containing HK (Kjarsgaard, 2007). Based on this classification of the class one kimberlite, there are similarities to the CW pipe. The model shows predominantly RVK material with some PK material on the sides of the pipe. Below the RVK is a more extensive section of PK, followed by MVK and HK. The CW pipe also contains predominantly RVK with a small portion of PK in Kimb 7&8 at upper elevations, as shown earlier in Fig 4. The pipe is then expected to have a more extensive body of PK in the form of Kimb 4&5. There is no indication of the predicted depth at which the MVK is expected to be compared with the CW pipe. The available core drilling information indicated no MVK presence but could intersect with the CW's planned drilling programClass Three kimberlite pipes are defined as mostly containing variations of RVK and an abundant volume of PK (Skinner & Marsh, 2004). These characteristics are also present in the CW kimberlite, suggesting it could be a Class Three pipe. The findings by Skinner & Marsh (2004) also contradict previous researchers' classifications. The same paper also states that the Camafuca Camazambo pipe’s orebody dip is 45°, suggesting it is a Class Two type. Still, the pipe is identified as a Class Three kimberlite (Skinner & Marsh, 2004). More recent papers have contradictory findings compared to older research. This observation could be related to increased knowledge gained from exploration drilling over the years. Scott Smith, (2008) confirmed that each kimberlite, regardless of the pipe's classification, is unique in geology and will differ from another pipe (Scott Smith, 2008). The statement confirms that the shape, size, and kimberlite classification will differ regardless of the area in which they are situated. Evidence thereof is the comparison between the CW and Camafuca Camazambo pipes, showing complete differences in size and shape.

Kimberlite pipes are expected to start with a small crack that develops more significantly as the eruptions occur. The eruption process is an excavation, taking the volcanoclastics entirely outside of the cone-shaped holder of the host rock. The kimberlite volcanoclastics is then backfilled into the pipe, and the occurrence of this process will determine how the kimberlite domains are structured (Cas et al., 2008). It has been shown that kimberlite pipes with flatter dip angles are situated in weaker host rock areas, flattening the slope during the eruption (Scott Smith, 2008). The presence of VKB in the CW pipe containing massive boulders of country rock could indicate a weaker rock structure. Some of the boulders are expected to have left the pipe during excavation and mixed with the kimberlite volcanoclastics during the backfilling process. Kjarsgaard (2007) confirmed the difference in the shape of kimberlite bodies based on the South African models shown in Figure 14. Figure 15 illustrates the formation of a kimberlite pipe during the volcanic eruption process.

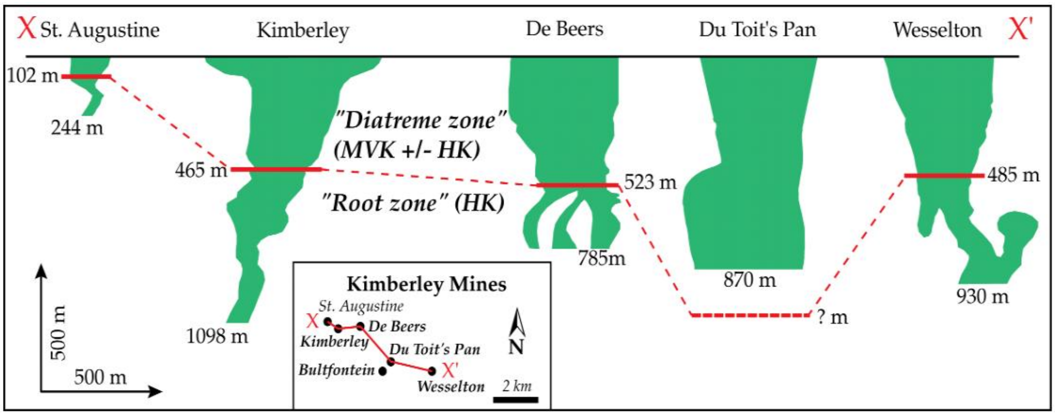


Figure 14 - South African kimberlite pipe models (Kjarsgaard, 2007)

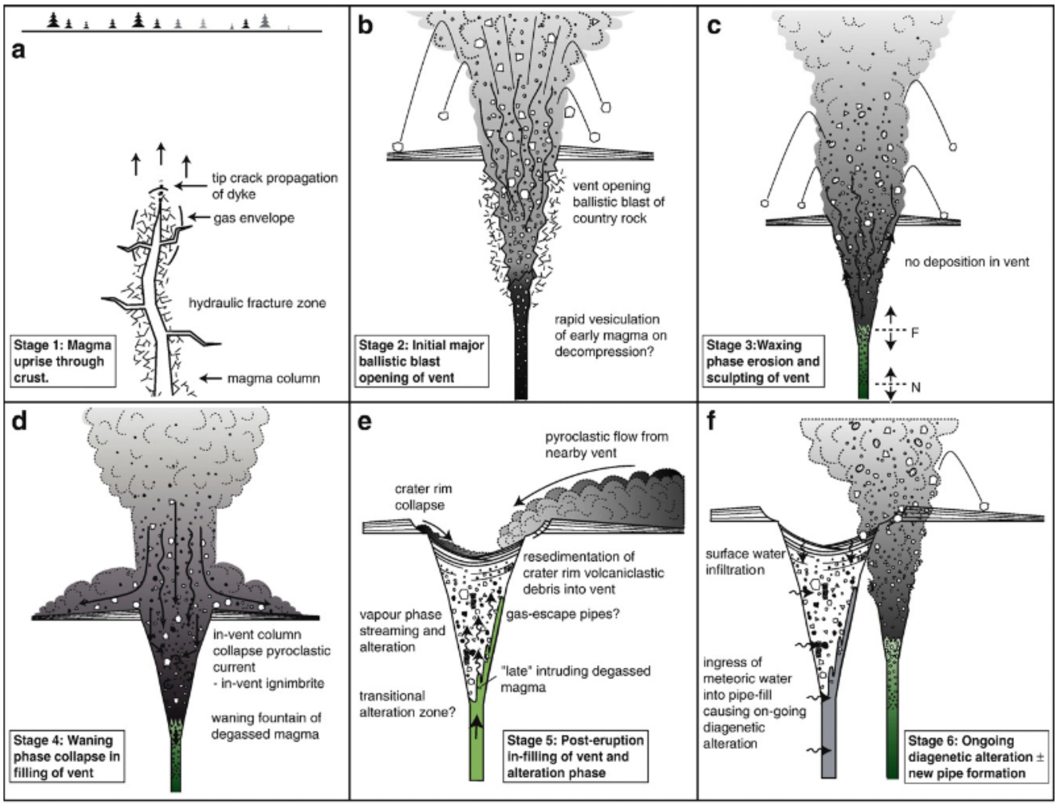


Figure 15 - Kimberlite volcanic eruption process (Cas et al., 2008)

2.2.2 Exploration stages

Mineral exploration is finding deposits of such size, shape, and grade content in an area that can be extracted profitably (Roonwal, 2018). Mineral resources are not renewable; replacement sources must be found to maintain the required mineral supply (Olofsson, 2020). Exploration programs can take years to reach the mining stage, requiring millions of dollars, without proof of ultimate mineral extraction (Marjoribanks, 2010). This identifies the risk of investing in exploration programs, as there is no guaranteed return for the investment. The associated risk often leads to potential mineral assets left unexplored that could, in return, generate wealth for investors. Exploration is done in stages of target generation, target drilling, resource estimation drilling, bulk sampling, and technical studies to mitigate risk and improve the return potential (Marjoribanks, 2010). The aim is to find uneconomic identifiers at the early stages of the program to avoid spending additional money on a deposit that might not prove feasible. The main objective of exploration is to find viable mining deposits quickly at a reasonable level of expenditure. Increased expectations are added to the requirement of sustainable development during exploration projects, with a renewed awareness of environmental effects (Caron et al., 2016). Planning of exploration projects is required to ensure they comply with sustainable development while remaining cost-effective.

Diamond exploration is also done in stages, and the cost increases significantly with the exploration program entering a new stage (Rombouts, 2003). The first step for diamond explorers is to assess maps with cratons and known kimberlites to identify target areas to explore (Kjarsgaard et al., 2019). Desktop studies in target identification are the first significant step in saving costs and avoiding entering areas that could not possibly contain kimberlites. Target identification studies might include regional geological and geophysical maps, aerial photos, and topographic maps (Kaminsky et al., 1995). Due to repeated eruptions, kimberlites in craton zones are often found in areas with high magmatic penetrability (Kaminsky et al., 1995). After exploration target areas have been identified, soil or stream sampling for indicator minerals and geophysical surveys are applied. This is to determine the presence of kimberlites. The mineral chemistry of the indicators will assist in assessing the kimberlite's grade potential (Kjarsgaard et al., 2019).

2.2.3 Geophysical studies on kimberlites

Geophysical studies involve an aerial magnetic survyes and kimberlites have unique magnetic fields in circular forms (Bournas et al., 2018). Using aerial magnetic surveys has proved feasible in northeastern Angola, with dense vegetation and some kimberlites buried under thick overburden layers. The CE kimberlite is adjacent to the CW pipe and is covered with 40m of Kalahari sand. An example of such a survey was a magnetic and electromagnetic aerial survey at the Alto Cuilo concession in northeastern Angola. The survey proved the existence of some large anomolies, some exposed to erosion and others buried under 10m to 70m of overburden (Pettit, 2009). Electromagnetic surveys is another geophysical method that can be used, for instance at Alto Cuilo shown in Figure 16. Figure 17 shows the cone-shaped formation of the area in section view.

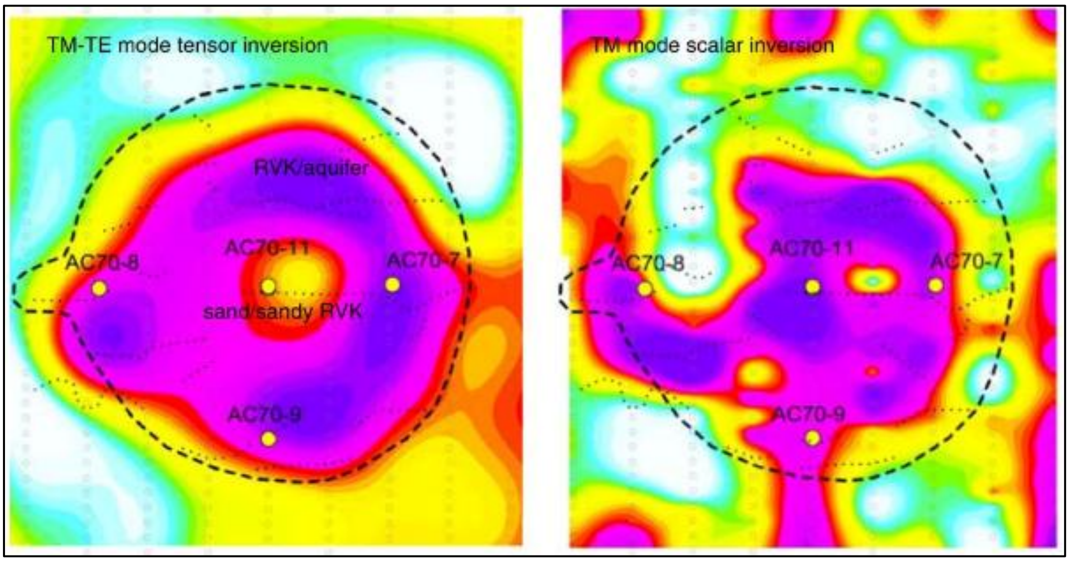


Figure 16 - Alo Cuilo electromagnetic survey results plan view (Pettit, 2009)

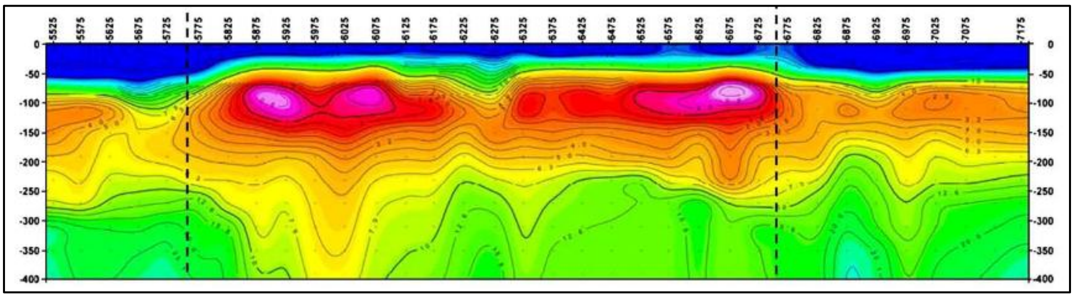


Figure 17 - Alto Cuilo electromagnetic survey results section view (Pettit, 2009)

2.2.4 Exploration core drilling

The next step is to drill the geophysical anomalies to confirm the existence of kimberlite. Once kimberlite is confirmed some additional target holes might be drilled to confirm a rough outline. Once kimberlite is found, the secondary aim is to determine whether the kimberlite is diamondiferous or not. Explorers examine kimberlite cores to identify mineralogy coming from the lithospheric mantle (Kjarsgaard et al., 2019). Three main rock types have been identified from the lithosphere: lherzolite, harzburgite, and eclogite, which contain indicating minerals (Rombouts, 2003). These rock types are rich in chrome and magnetite content. Three groups of kimberlitic indicator minerals (KIM's), are identified. The first group comprise mantle xenoliths containing pyrope garnet, chrome spinel, olivine and chrome diopside. The second group, megacryst suite minerals, contains magnetite ilmenite and chrome diopside. The third group is identified as phenocryst minerals, including olivine and spinel (Kjarsgaard et al., 2004). A general rule, but not fully proved, is the higher the content of indicator minerals found in the kimberlite core, the higher the possibility of the kimberlite containing diamonds. A chemical analysis of the are done to determine the diamond potential. Micro-diamond analysis is another method used to identify the existence of diamonds and grade estimation in the core, but is a very expensive method. Kimberlite cores are crushed and disolved after which the micro-daimonds are extracted or are scanned using X-ray technology to determine the presence of diamonds (Schena et al., 2005). Figure 18 shows a rounded olivine macrocryst viewed under a microscope in a kimberlite core from the Colossus kimberlite in Zimbabwe.

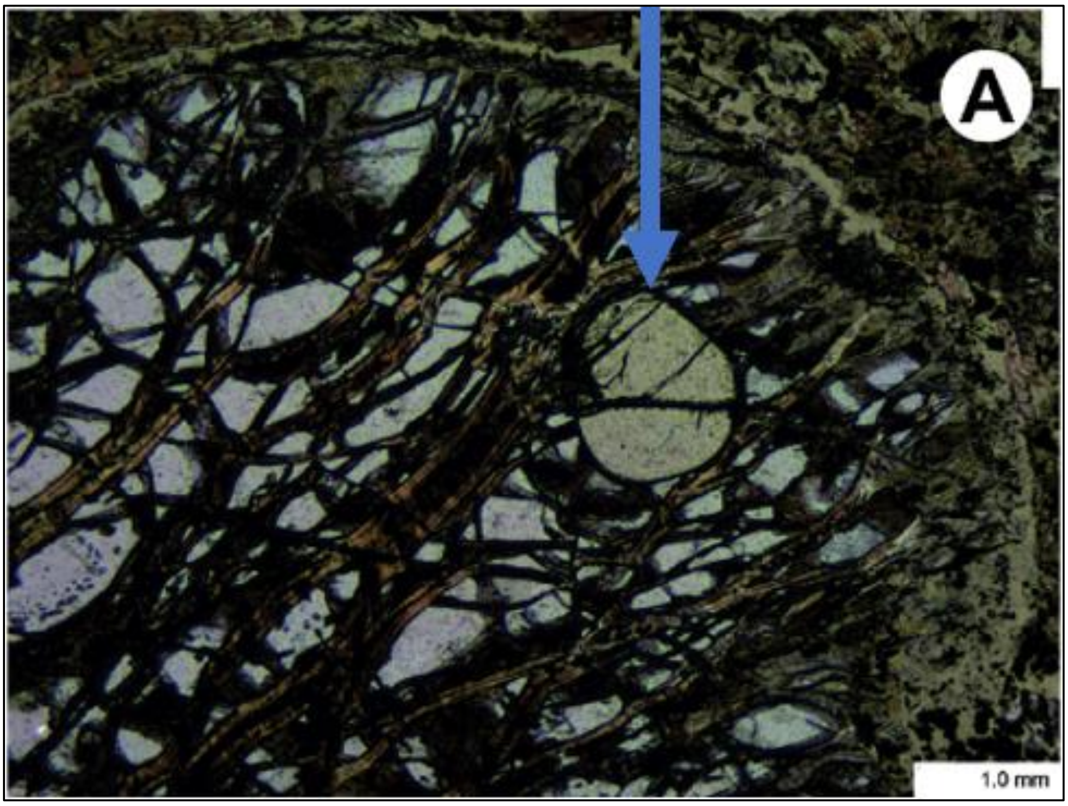


Figure 18 - Olivne macrocryst in kimberlite core (Moore et al., 2021)

The evaluation of indicator minerals and the presence of diamonds within the core will indicate the requirement for a more advanced core drilling program. The shapes and sized of kimberlite pipes are different requiring sufficient drilling data to determine the pipe geometry (Jakubec, 2004). Inclined holes are drilled for pipe delineation into the host rock to determine the point of intersection. Vertical holes drilled into the kimberlite body are usually designed in a systematic grid. These holes confirm the pipe's extent at depth and differentiate between various kimberlite domains within the pipe. The different kimberlite lithologies are classified by their distinct characteristics (Scott Smith et al., 2013). Facies is formed by a separate volcanic eruption following each other in sequence (Scott Smith et al., 2013).

2.2.5 Diamond grade estimation

The next step in kimberlite evaluation is the grade determination of each kimberlite domain. Micro-diamond analyses are used to determine grade but are deemed less accurate compared to bulk sampling and LDD sampling (Chapman & Boxer, 2004). The micro-diamond content is plotted on a lognormal graph using the logarithmic mean and variance to predict the micro-diamond grade (Rombouts, 2003). The most commonly accepted method of determining diamond grade is bulk sampling. LDD drill sampling is used to collect relatively large samples from deeper kimberlite domains. LDD sampling is done using the reverse circulation drilling (RC) method. RC drilling uses a double barrel system with high-pressured air flowing between the inner and outer rods. The drill bits are open at the bottom to transport drill chips up the centre of the inner rod to the surface (Sarath & Manuel, 2010). RC holes are planned in a grid pattern around vertical core holes. This is done to map the LDD sample grade against the lithology identified within the core hole. The number of holes in the LDD cluster depends on the drill bit's diameter. The larger the drill bit, the more sample volume is collected within one hole. A drill bit with a smaller diameter requires more holes to be drilled for the same sample volume. Figure 19 illustrates the process of RC drilling.

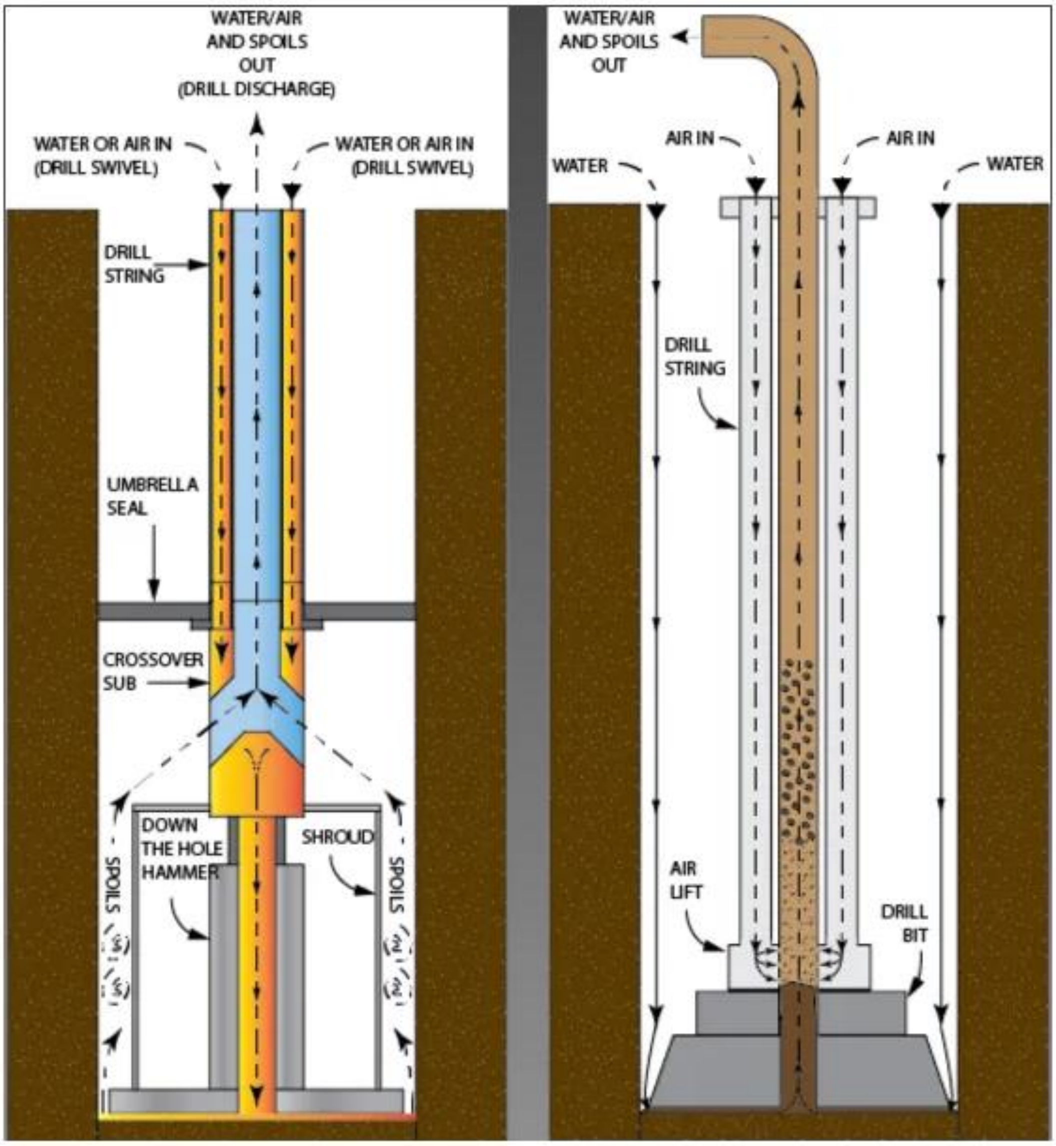


Figure 19 - Reverse circulation drilling illustration (Newatia, 2024)

Sample rock cuttings are collected into sampling bags at the required intervals. These bags are tagged according to the hole ID and sample interval depth. Survey callipers improve quality control of volume measurement down the RC holes. Kimberlite rock strength is mainly classified as weak or moderately strong and becomes weaker with exposure to water (Jakubec, 2004). The downhole survey method aims to identify hole collapse in weaker areas to calculate the correct sampling volume (Harrison et al., 2009). Hole collapse in weaker kimberlite lithologies is experienced with core drilling as well. Drilling deep holes is impossible in areas with high moisture content. Samples collected are processed in a small bulk sampling plant to extract the diamonds for grade estimation. RC drilling can grind diamonds, especially the larger ones, into smaller particles, and the recovery usually contains mostly smaller cuttings of larger diamonds. (Kleingeld & Nicholas, 2007).

The final stage of diamond exploration is not just a step but a crucial one. It is marked by a controlled bulk sample done by trenching or a small sample pit. This can only be done if the kimberlite is exposed and not for those that are buried. This stage represents the culmination of the exploration process, where the distribution of diamonds and the impact of stone size on their value are carefully assessed. At this stage, the diamond deposit's true potential is revealed, making it a pivotal point in the exploration (Kleingeld & Nicholas, 2007). The valuation of diamonds requires a substantial sample size, typically comprising at least 2,000 to 3,000 carats. This large sample size is not just a preference but a necessity to allow for a more reliable USD per carat estimation (Rombouts, 2003). Diamond quality and size distribution may vary significantly between kimberlite domains within a kimberlite pipe. This variability directly and significantly impacts the cost of obtaining a bulk sample, particularly from domains at deeper elevations. The cost can be extremely high due to the high mining volume required to intersect these domains.

There are some 1,000 kimberlites and lamproites around the world containing diamonds of which 67 have been mined economically (De Wit et al., 2016). Only 61 diamond mines have developed from some 7,000 intrusions based on grades and diamond value (Kjarsgaard et al., 2019). Kimberlites in Southern Africa are considered well-explored and have limited future potential, except for the Angolan pipes. Angolan kimberlites were not explored during the prolonged period of civil war and are seen as the diamond exploration destination of Southern Africa (McKechnie, 2019).

2.3 Net Present Value

2.3.1 Definition of net present value

NPV is a financial tool to evaluate the success and demand of investments with a different opportunity, time frame, or anticipated cash flow (Žižlavský, 2014). It is expressed as the variance in the current value of cash inflows and outflows measured over some time (Gaspars-Wieloch, 2019). Future cashflows are discounted to the present value by a specified discount rate (Jones & Smith, 1982). The result of a positive NPV value for a project indicates that the project can be accepted as a good investment. A negative NPV value will be deemed unprofitable and rejected as an investment opportunity (Gaspars-Wieloch, 2019). NPV evaluation is a standard method for evaluating investments across various forms of finance, accounting, and economic platforms.

2.3.2 Importance of net present value in mining projects

The mining industry is regarded as a high-risk business. Exploiting minerals is capital-intensive and requires long-term production for any investment returns (Frolova et al., 2021). Mining risks are divided into internal and external risks. Internal risks include orebody uncertainty, production rate, and ground stability. Consumer inflation, market supply and demand, and social, environmental, and governmental factors affect external risks (Mirakovski et al., 2009). The cash flow for the NPV calculation is discounted based on a rate calculated to account for the cost of capital for the mining investment (Cui et al., 2022). The advantage of using an NPV calculation for investments is that a risk-adjusted rate can be applied to the NPV calculation (Gallagher & Ryan, 2017). This raises the hurdle for accepting a project and so can account for unforeseen costs and delays.

The NPV method takes into account time value of money (TVM) (Shou, 2022). The TVM principle states that the value of money is worth more today than what the exact amount will be worth at a future date (Irena & Mariana, 2017). Money earned today can be invested and earn interest to have more value in the future. The interest rate and the number of compounding periods drive this (Saif Alzaabi, 2022). Earlier positive cash inflows will positively affect the NPV value due to the TVM concept (Fontes et al., 2020).

The effect on the NPV value can be used as a management tool for projects. Capital decisions spent on ramping up production during certain project stages can be quickly evaluated based on the NPV result (Shou, 2022). In the case of mining projects, this tool will be advantageous when investigating the possibility of capital spending to increase plant production. An increasing commodity price outlook will typically drive this. Companies with various projects of similar scopes can use NPV as a comparison value to rank the best projects (Shou, 2022). Mining projects are rarely similar due to orebody differences for even the same commodity. Companies can still use NPV scenario comparisons based on innovations to identify optimal value. A typical example of such innovation is the Venetia mine in the Limpopo province of South Africa. A slope failure in the southern section of the open pit caused the slope angles to be reduced. The increased waste required to be stripped with the flattened angles made continuing the open pit method economically unfeasible (Hummel, 2001). The concept of a split shell was introduced to advance mining of the northern section, leaving the southern section to be mined later (Gallagher & Kear, 2001). The innovation of increased ore production and reduced waste stripping increased the NPV. The split shell concept made the third mining cut at Venitia feasible before the transition to underground mining would be necessary based on NPV valuation instead of using average grade (Hummel, 2001). Figure 20 compares the concentric open pit method versus the split shell concept.

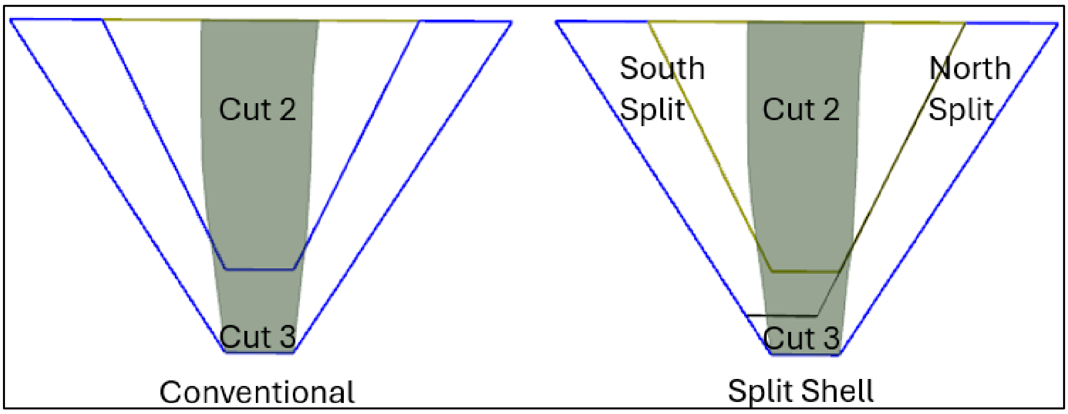


Figure 20 - Conventional method vs split shell method (Gallagher & Kear, 2001)

The De Beers company owns many kimberlite diamond mines, and such innovation can be measured at other mines to identify the effect on NPV value there. The split-shell concept gave rise to the idea of conducting vertically layered kimberlite exploration drilling in stages. The idea is for exploration drilling to do wide-spaced drilling for pipe area and rock type identification at depth initially. This will allow for mineral chemistry evaluation to determine the feasibility of further drilling. The second phase of drilling will then concentrate on the section of the pit showing the best potential of drilling and doing LDD sampling to a shallower depth. This would ensure better quality control in the weaker kimberlite rock strength and reduce geology uncertainty risk. When the economic feasibility of the first section is determined, mining could commence in the form of a split shell. Exploration drilling and sampling can continue on the opposite section with a denser grid for improved quality control. The process can be repeated once mining has reached the bottom of the first identified reserve swopping areas with the exploration drilling program. The concept of continuous exploration drilling in conjunction with mining is expected to increase the NPV value of the mine based on the following theories:

- Capital spent on exploration drilling in the early stages will be significantly reduced, providing reassurance about the project's cost-effectiveness and the potential for high returns;

- An earlier start of production will create earlier returns and will benefit the NPV based on the TVM concept;
- Another significant advantage of the proposed strategy is developing a more robust geological model at shallower elevations. This will help avoid hole sloughing and instil better confidence in the geological model, thereby reducing risk and enhancing the project's overall viability;
- Increased confidence in the geological model will significantly reduce investor risk and lessen the risk-adjusted rate applied to the discounted cash flow, providing security about the project's risk management;
- Advance mining towards one side of the open pit will allow bulk sampling of kimberlite facies at deeper elevations. This will allow for the extraction of diamond parcels with a sufficient number of carats for value determination; and
- The split shell mining going deeper at an increased rate will allow for better geotechnical analysis that could determine adjustments required for future pushback designs. This will reduce the risk of slope failures.

The NPV method is the most widely used method to value mineral assets (Domingo et al., 2007). NPV is an unambiguous way of measuring potential wealth generation in current value (Huang et al., 2022). NPV uses a simplistic method of calculating the viability of the investment, making it easier for investors to make decisions (Huang et al., 2022).

2.3.3 Factors that affect net present value

The discount rate determination is a significant factor in determining NPV. The discount percentage value is usually determined by someone with high authority based on the organisation's risk appetite (Ovalle, 2020). An increased discount rate will negatively affect the NPV value. Two methods are used to calculate the discount rate for mining investments. The first method is calculated based on the company’s cost of capital, which combines the cost of debt and the cost of equity. The process is the weighted average cost of capital (WACC) (Lilford et al., 2018). The formula to calculate WACC is shown in Equation 1 (Ovalle, 2020).

Weighted Average Cost of Capital ($WACC$)

$$WACC = \%Debt\ x\ Kd\ x\ (1 - T)\ +\ \%Equity\ x\ Ke \qquad \text{Equation 1.}$$

Where: $\%Debt$ is the percentage of projects financed with debt, Kd is the cost of debt, T is the tax rate, $\%Equity$ is the percentage of projects financed with investors capital, and Ke is the cost of equity.

The part of the formula referring to the cost of equity is based on the capital asset pricing model (CAPM). The CAPM formula is illustrated in Equation 2 below (Lilford et al., 2018).

Capital Asset Pricing Model ($CAPM$)

$$CAPM = \mathrm{r_e}\ =\ \mathrm{f}\ +\ \mathrm{Rb} \qquad \text{Equation 2.}$$

Where: $\mathrm{r_e}$ is the expected return on stock, f is the risk-free rate on the return, R is the risk premium of market returns, and b is the beta factor for the stocks.

Beta refers to a measure of risk calculation compared to the stock market, and the higher the value, the higher the risk of the investment. A beta value of one equals the stock market risk, and a value higher than one is considered more volatile (Kenton, 2022). The preferred method used to calculate the discount rate in the mineral industry is the WACC (Lilford et al., 2018).

The elements considered are subject to the author's evaluation of the rate and the risks (Taheri, 2009). Considering all relevant data and risks is essential to calculating an accurate discount rate. The discount rate must not be too low, producing a high NPV value that would be over-ambiguous and could lead to investor losses. Mining remains a high-risk investment, so the discount rate must not be too high, dropping the NPV value. This will lead to investors losing interest in a mineral asset that could have produced wealth. A discount rate with the correct balance is required, but investors must be informed of all investment portfolio risks.

A risk-adjusted discount rate (RADR) was considered to allow for risk considerations and would be higher than the rate achieved by the WACC (Lilford et al., 2018). Risks in calculating the discount rate are directly related to uncertainty, and various stages of the project have different levels of uncertainty (Taheri, 2009). The Monte Carlo simulation method is computer-based software produced by companies like Crystal Ball, @Risk, and others. It allows the simulation of uncertain value inputs at their expected periods to provide a mean and standard deviation for the value output (Betterton and Karagiannidis, 2014). The simulation will provide a probable result for all risks, providing an RADR rate. This rate would offer more comfort for investors, knowing that the risk was considered in the NPV calculation. Figure 21 shows an example of a result run through a Monte Carlo simulation, suggesting that the discount rate should be 7.7% for the scenario used.

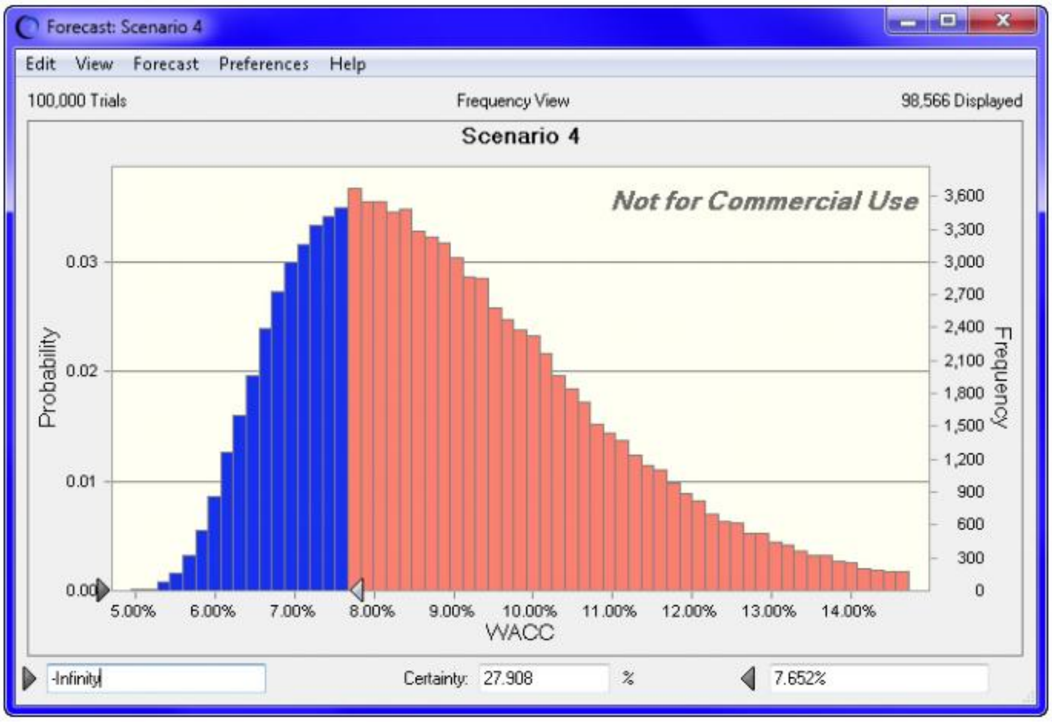


Figure 21 - Monte Carlo simulation example (Betterton & Karagiannidis, 2014)

Commodity price estimations can severely impact the NPV calculation of a mine. Price fluctuations must be considered when making decisions regarding mining investments (Rahmanpour & Osanloo, 2016). The effects of price fluctuations in iron ore mining can have such an impact on NPV that it could reduce the ultimate size of the open pit (Kim et al., 2022). This can also impact diamond mining in a similar manner, particularly given the diamond market's collapse in 2023. If a mine were already stripping the final pit limit, it would mean that all waste stripped would be at a cost. There will be no future revenue return for the waste stripped outside of the newly adjusted pit limit based on the price adjustment. Commodity price fluctuations can be investigated by following historical trends to identify price drop scenarios and their reasons. The diamond market differs from the metal markets and cannot follow a specific price trend (Rombouts, 2003). Diamond evaluations are mine-specific based on the stones' quality, size, and shape. The diamond market trends are predicted by a diamond trading company named Rapaport. The company is named after owner and qualified diamond valuator Martin Rapaport. Diamond companies and valuators use the paid registration option to access diamond market information on the Rapaport website. The registration allows access to tables of diamond values based on cut, clarity, colour, and carat weight, referred to as the four C's of diamond valuation.

A professional diamond valuator will examine the rough diamonds and classify them according to the category to which they belong. The expected loss on the stones due to cutting and polishing will be determined to achieve the expected polished weight and cut of the diamond. The diamonds are then classed based on table values to determine each diamond's actual value and the whole diamond parcel. The USD value per carat of the parcel is established by the total value of the parcel divided by the total weight of the parcel measured in carats. The Rapaport website does offer a free subscription with limited information. Daily news reports are provided with information regarding the diamond trade, which includes a graph showing the diamond trade based on the previous year. Based on historical data, it is possible to estimate the value of a parcel based on the stone size distribution compared to historical prices achieved. If you have a parcel of three-carat stones and earned $100 per carat a year ago, you can expect to earn, on average, $70 per carat if the market is down by 30%. Figure 22 shows a graph per the Rapaport news report for the 14th of November, 2023.

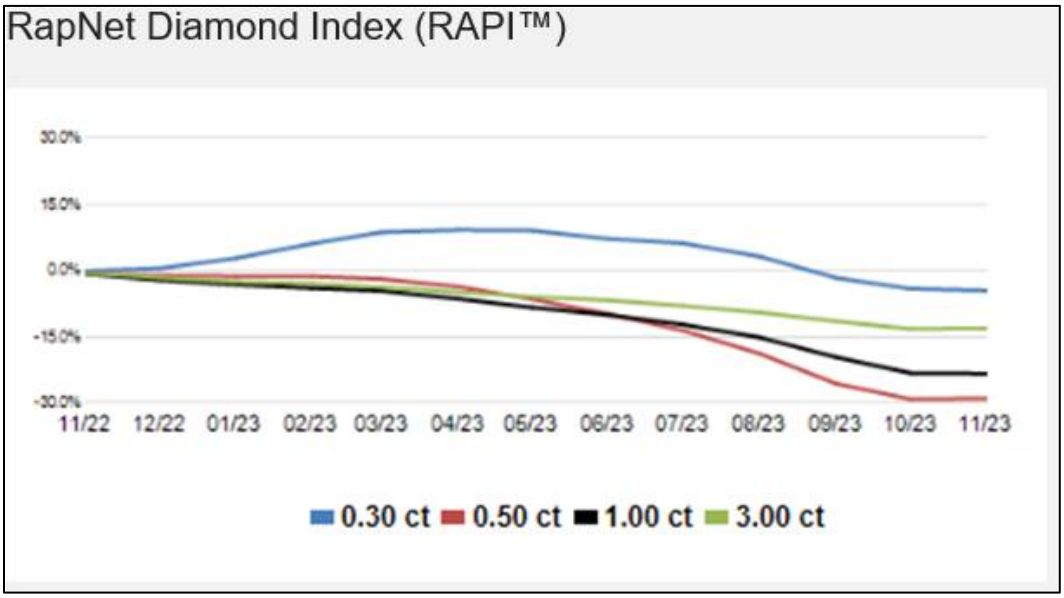


Figure 22 - Rapaport diamond market index (Rapaport, 2015)

The diamond market is mainly influenced by supply and demand needs. De Beers and the Russian company Alrosa are the most significant contributors to the diamond market. It has been noted that the two major companies are controlling the diamond market. Companies are not pressured to sell diamonds for revenue generation; they can store diamonds for an extended period while waiting for the price to increase (Rapaport, 2015). These market dynamics, under the strategic control of De Beers and Alrosa, also allow these companies to flood the market, leading to a decrease in the rough diamond market and posing a survival challenge for smaller diamond miners. The introduction of lab-grown diamonds, a disruptive force of significant magnitude, has further unsettled the market, contributing significantly to the diamond market crash in 2023. Compared to their natural counterparts, the cost-effective production of these diamonds has not just altered but reshaped the market landscape (Sojitra, 2023). One of the significant benefits of lab-grown diamonds is their affordability, making them a more accessible option for many consumers. These diamonds allow consumers to purchase engagement rings at a fraction of the cost of natural diamonds, democratising the luxury of diamond ownership (Sojitra, 2023).

Geological uncertainty can significantly impact the NPV by affecting future cash flows (Koushavand et al., 2009). The effect on the NPV result is realised when various scenarios of geological outcomes are compared (Kuckartz & Peroni, 2019). Geostatistical methods such as the Kriging approach are applied to geological models to accommodate for areas of uncertainty (Koushavand et al., 2009). A risk analysis approach to grade variability within the model to understand the effect on the NPV result proved feasible for gold deposits. This method was applied to determine the transition elevation from the open pit (OP) to underground mining (UG) (MacNeil & Dimitrakopoulos, 2017). Variability in grade distribution in kimberlite pipes is very high due to the nature of the formation of the pipe through volcanic eruption (Harrison et al., 2009). The high variability in grade distribution for diamond deposits makes the risk analysis approach less effective compared to gold deposits. A high level of geological grade information from exploration drilling is required to achieve a suitable model for NPV calculations (Jakubec, 2004). Geotechnical uncertainty can also significantly impact the NPV result of a mine. Slope failures can cause open pit mining cuts to become economically unfeasible, which would, in turn, reduce the overall NPV value of the mine (Gallagher & Kear, 2001). The contact zone between the kimberlite and the host rock of the pipe shell is very smooth and causes slope failures with the sliding of the contact. Determining contact areas with core drilling is essential to avoid benches and ramps intersecting such zones. Benches must be either outside the contact zone or within the orebody to prevent failures. This could lead to additional waste stripping at an increased cost or an ore loss at reduced revenue, negatively impacting the NPV result. Figure 23 shows the kimberlite contact zone with a heavily fractured country rock pipe shell.

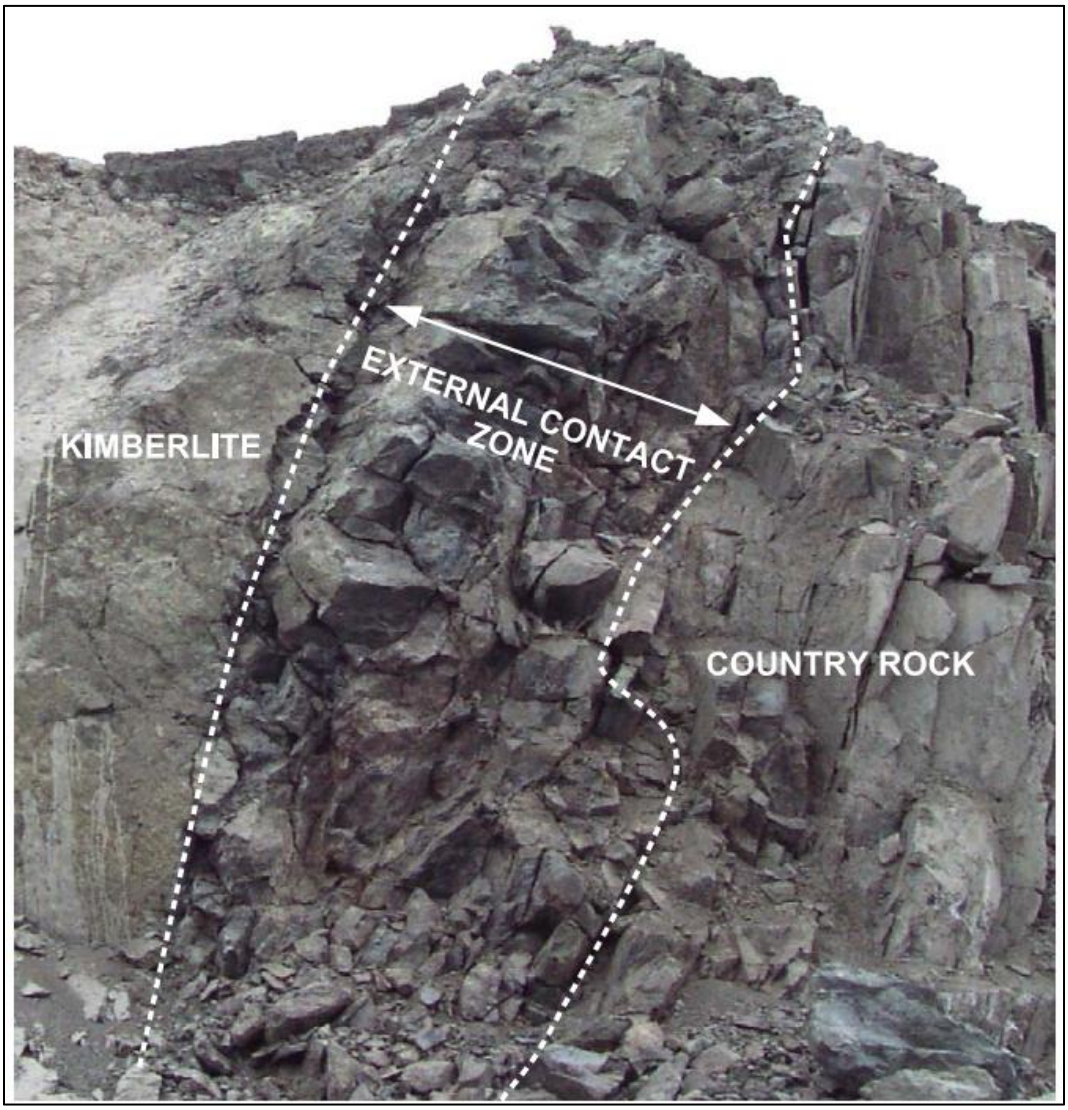


Figure 23 - Kimberlite contact to country rock pipe shell (Jakubec, 2004)

Social and environmental impacts can affect the NPV value of a mine. Open Pit (OP) mining consists of significant vegetation and overburden removal to execute the mining activity (Coffey, 2022). Waste material stripped around the orebody is discarded around the open pit area and affects the vegetation, impacting the environment. Other considerations that impact the environment are air pollution, noise, and water extraction. Rehabilitation work is required to close the mine, increasing its cost profile. The cost associated with environmental impacts needs to be quantified and included in the mine cash flow model to determine the effect thereof on the NPV. Social conflict in mining can be a very costly aspect of mining companies.

Mining concessions in Africa are situated mostly in remote areas inhabited by local communities. The cost of accommodating social responsibility by mining companies is essential. This cost must be factored into the cash flow to ensure that sufficient funds are available for compliance. Non compliance to social resposiblities could lead to industrial actions that could cost the mine more in future. In some areas where social unrest is expected, mining companies applied a risk factor to the cash flow to allow periods without production (Teschner & Holley, 2021). The Koidu Kimberlite Project in Sierra Leone had to adjust from conventional OP mining to doing a vertical pit using a hoist. Local communities are situated within 250m² around the open pit area, making a pushback design impossible. The vertical pit method was more costly than the OP method but allowed for revenue generation during the development stages of the UG mine (Terbrugge & Armstrong, 2017). The increased cost of the vertical pit method negatively affected the NPV, which was a response to the consideration of the mining project's social responsibility.

2.4 Open Pit Optimisation Techniques for Improved Net Present Value Results

2.4.1 Overview of open pit optimisation

The open pit optimisation process is done to find the ultimate pit limit that is technically and economically feasible to mine safely (Mwangi et al., 2020). Various data inputs are required in the open optimisation to find the best open pit solution with the highest NPV value. In the open pit environment, every block of waste stripped must represent a block of ore producing sufficient profit to justify the cost of the waste block stripped. Various computer software programs are available to assist in making the final decision of which blocks to mine optimally and which blocks to leave in situ. The most commonly used solution is the Lerchs-Grossmann (LG) algorithm built into software programs (Mwangi et al., 2020). The floating cone (FC) algorithm is another method used and is known to be a fast, easy-to-use solution (Arez et al., 2012). The newest method developed by the Deswik software company uses direct block scheduling (DBS) based on the Bienstock-Zuckerberg algorithm (Mortimer & McHale, 2022). The advantage of the DBS method is that it considers TVM capable of doing block extraction sequencing during the optimisation process (Mortimer & McHale, 2022).

The result of all mathematical algorithms depends on the accuracy of the economic block model used. The economic block model is generated based on the geological grade model, which includes rock type delineation, density, and grade of each block (Paithankar et al., 2021). Estimates of cost and revenue are allocated to each ore block, and estimations of extraction costs are made for waste blocks (Mwangi et al., 2020). The optimisation algorithms use the economic parameters assigned to the blocks to solve the ultimate pit limit that will achieve the highest NPV value. The confidence level of the geological model has a significant impact on the open pit optimisation process. A geological model with a low confidence level due to inadequate exploration data could incorrectly assign rock types to blocks in the model. This could lead to overestimation or underestimation during the optimisation. The quality of the data input into an open pit optimisation is crucial to avoid a garbage in-garbage out scenario. This is a common term used by software developers, explaining that the software's capability is highly dependent on the accuracy of the data input (Ozminkowski, 2021).

2.4.2 Data inputs in open pit optimisation

Economic factors are applied to the geological block model to assign cost and revenue expectations to each block based on the geological classification. Blocks in the model containing ore material with an assigned grade above the cut-off grade form part of the revenue model (Djilani, 1997). The blocks containing mineral content below the cut-off grade are also referred to as mineralised waste and are not considered in the revenue model. Mineralised waste materials are, in most cases, stockpiled and remain available for future treatment considerations in the event of an increased commodity price. Determining an optimal cut-off grade is crucial for material destination decisions and avoiding material that could be treated profitably but instead discarded (Paithankar et al., 2021).

Cut-off grade calculations significantly impact the optimisation of metal commodities like iron ore. Portugal's Cabeco de Mua iron ore deposit case study increased profitability by optimising the cut-off grade (Da Gama, 2013). Global domain grades are assigned to the various kimberlite lithologies due to the significant variability in diamond grade distribution (Kleingeld & Nicholas, 2007).

The value of the diamonds has a more significant impact on the revenue model than the grade. Low-grade kimberlite domains can have diamonds of such great value that they could be more profitable than a mine with double the grade. De Beers deemed the AK 6 kimberlite in Botswana uneconomical due to the low-grade results of the exploration drilling and sampling (Campbell & Jooste, 2017). Lucara Diamonds proved that the quality and stone size of the diamonds outperformed the grade by producing four diamonds weighing above 1,000 carats in 2015 (Arnoldi, 2023). Figure 24 shows the latest large diamond recovery by Lucara Diamonds, the 2,492ct diamond, which was recovered in 2024.

Figure 24 - 2,492ct diamond (Jamasmie, 2024)

The massive diamonds mined at Karowe mine can significantly increase the revenue model of a kimberlite deposit. These types of diamonds are sold for millions of dollars and are usually bought by wealthy individuals. Block size selection in the development of the block model can impact the estimation of kimberlite deposit revenue. Larger blocks around the margin between ore and waste could increase error margins in percentage discrimination and miscalculations in expected volumes (Jara et al., 2006). The block size selection within the ore model for kimberlite pipes will also affect the contact zone areas between domain types, each containing diamonds of potentially different values. The margin of error in the percentage allocation of blocks with shared rock types might be low and considered insignificant. This will, however, impact the revenue expectation when considered over thousands of blocks.

Diamond price forecasts are mainly sourced from specialist diamond valuation consultants. Diamond valuation is a specialised skill requiring experts with access to the correct forums to determine future diamond price estimates. Commodity price estimations and market analysis are done by the company’s financial departments or external consultants with expertise in commodity market predictions (Whittle & Cahill, 2001). Expected commodity prices and accurate growth forecasts are sourced from the financial section and applied to blocks classified with sufficient geological potential to be processed through the plant. The open pit optimisation software will consider these blocks as revenue-generating blocks when calculating the optimal pit shell.

Cost parameters must be added to all the blocks in the model based on their geological classification. Cost inputs are applied based on the removal strategy and destination of the blocks from the model. Destination policies significantly impact the mining cost of the material, with increased hauling distances increasing the cost (Paithankar et al., 2021). The cost parameters of mining blocks are separated into loading, hauling, and drill blast costs, dependent on the rock strength of the material. The cost applied to the blocks considers loading, hauling, dumping, dump and stockpile maintenance and fuel (Arez et al., 2012). Mining costs are determined as a unit cost of USD per BCM or USD per tonne mined. The cost of ore treatment must be calculated, including handling, crushing, milling, and processing until the final recovery. This unit cost per tonne might include administrative costs (Arez et al., 2012). Overhead costs that include all administrative costs, head office costs, and salaries of personnel not directly involved in the mining production or ore processing must be sourced. The costs are combined and divided by the plant capacity to achieve a USD per tonne treated value. Whittle argued that the overhead costs must be divided between mining and processing costs to avoid having a misleading final pit shell (Whittle, 1989). The plant processing capacity directly impacts the required mining rate, and the input parameter is required for the open pit optimisation. The stripping rate is determined by the monthly volume of ore extracted for plant processing. Costs, inputs, and plant processing capacities for brownfield projects are sourced from within the company. In most cases, mining companies have a cost-controlling department that allocates costs to each department and section of work. The costs available from the cost controllers are site-specific and, therefore, represent accurate figures. Cost inputs for greenfield projects are sourced from other projects mining the same commodity. Online software packages contain datasets of mines' actual costs for various commodities. An example of that is the Costmine software, which is a paid subscription (Costmine.com, 2024). Software like this would benefit companies doing technical studies for new mining ventures.

Geotechnical parameters assigned to each rock type within the block model are required to ensure that the pit will comply with an acceptable Factor of Safety (FOS) (Madowe, 2013). The hydrogeological model must also be incorporated into the slope design of kimberlite mines. Water around the contact zones between kimberlite and waste rock could cause weakness and instability (Jakubec, 2008). The weaker the rock strength and the more complex the geotechnical zone, the flatter the overall slope angle of the pit will be. An overall flatter slope angle will increase the required stripping volume for the same volume of ore mining. This usually produces a smaller optimal pit shell than areas with improved geotechnical parameters.

Advanced software packages like Whittle 4D and Deswik GO will allow running extraction rate scenarios. The result will provide recommended shells to be mined in sequence to achieve the highest NPV based on the TVM concept (Madowe, 2013). The production sequencing allows the capital cost calculation to be applied to the open pit optimisation. Capital for additional mining fleets can be used based on the pushback shells in the correct time frame, allowing for a more accurate NPV calculation. Table 3 shows the required data input parameters for an open pit optimisation.

Table 3 - Open pit optimisation data inputs (Sociedade Mineira de Kaixepa Mine Planning Department, 2024)

Open Pit Optimisation Data Inputs		
Geological Inputs		
Description	**Unit of Measure**	**Source**
Orebody Solids	Software File Format	Geological CP
Waste Rock Solids	Software File Format	Geotechnical CP
Surface Topography	Software File Format	Survey CP
Surface Infrastructure	Software File Format	Survey CP
Block Model Data		
Lithologies	Rock Type Description	MRM Manager
Density	t/m^3	MRM Manager
Block Grade	Grade/t	MRM Manager
Cutt-off grade	Grade/t	MRM Manager
Block Size	m	MRM Manager
Block Percentages	%	MRM Manager
Block Classification	Inferred, Indicated or Measured	MRM Manager
Revenue Inputs		
Selling Price	$ per ct/t/oz	Financial Department
Escalation	% (Increase per year)	Financial Department
Marketing Cost	% (Deduction)	Financial Department
Sales Tax	% (Deduction)	Financial Department
Royalties	% (Deduction)	Financial Department
Cost Inputs		
Load & Haul	$ per t (Mined)	Cost Controller
Drill & Blast	$ per t (Mined)	Cost Controller
Ore processing	$ per t (Treated)	Cost Controller
Overhead	$ per t (Treated)	Cost Controller
Operational Inputs		
Pit Slope Design	Slope angle per rock type	Geotechnical CP
Mining Dilution	%	Survey CP
Mining Recovery	%	Survey CP
Process Capacity	t/year	Metallurgy CP
Process Recovery	%	Metallurgy CP

2.4.3 Open pit optimisation strategies

Mining of smaller consecutive nested pits within the optimal pit areas targeting the highest valued ore initially proved to increase the NPV value of mines (Ünal et al., 2001). The NPV value increases based on the time value of the money principle, producing more revenue during earlier stages of the production cycle. Initially, smaller mining cuts require less capital on mining equipment and lower production volumes. This allows for an earlier payback period on capital spent. The safe work and necessary mining equipment area must be considered to generate pushback designs. Pushback designs that would enable too little working space can be counterproductive and can, in return, affect the NPV value negatively (Araya et al., 2020). The split shell concept discussed earlier in this report works on the same principle, targeting higher-valued ore towards one side of the pit. Gallagher & Kear (2001) recommended that optimisation software packages like Whittle consider applying the split shell concept to compare NPV results to the concentric pushback designs. To date, no software package has considered the option, and it is questionable whether the concept only applies to kimberlite mines. No evidence of other commodities was found using the split shell concept. Whether the strategy targeted higher-grade ore or allowed seepage water to accumulate at lower elevations to be pumped out is still being determined. Figure 25 shows the kimberlite mined in advance towards one side of the open pit with the stripping of a pushback cut around the outside.

Figure 25 - Karowe diamond mine in Botswana (Friedman, 2020)

Ramping up the processing plant's production rate can increase the mine's NPV value. Increased plant feed will generate more revenue and reduce the unit variable cost of production for the mine, improving the overall NPV. In open-pit mining, it is crucial to consider the additional volume of waste that needs to be mined to maintain the increased ore supply (Akishev et al., 2017). Additional waste stripping will also increase the capital required for mining equipment or extra costs for a mining contractor. It is essential to run various plant capacity scenarios, adding the various capital profiles to the open pit optimisation. This will help find the optimal feed rate that will return the best NPV value. All mines are subject to price fluctuations due to the volume of the minerals within the market supply chain (Minnitt, 2007). The diamond market is susceptible to oversupply, and great care must be taken when deciding on the planned yearly diamond production. Diamond mining companies that do not have the financial capacity to stock diamonds during periods of market crashes are more susceptible to complete failure.

The option of steepening the overall slope angle of open-pit mines can be evaluated, particulary from a safety point of view. This will reduce the volume of waste to be stripped, which could significantly improve the mine's NPV with the reduced cost of stripping (Madowe, 2016). Proper geotechnical assessments can be made once the first cut of the open pit has been mined. This will allow the geotechnical personnel to determine the feasibility of safely steepening the slope angles. Significant consideration needs to be taken when considering the steepening of slope angles. Slope failures can be so substantial that they cannot be recovered economically, which could lead to mine closure (Kolapo et al., 2022). Figure 26 shows the significant open pit slope failure at the Kennecott Utah Copper's Bingham Canyon Mine in the United States of America.

Figure 26 - Slope failure at Kennecott Utah Copper's Bingham Canyon mine (Kolapo et al., 2022)

2.5 Financial Reporting in the Mining Industry

2.5.1 Overview of financial reporting in the mining industry

The International Financial Reporting Standards (IFRS) control financial reporting in mining (Price Waterhouse Cooper, 2012). The mining industry has three main stages of financial reporting: exploration, project development, and production (Baurens, 2010). The mining industry has unique challenges due to uncertainty in geological content and specific risks associated with the exploitation of minerals (Price Waterhouse Cooper, 2012). Reporting codes for mineral resources and reserves have been generated worldwide to achieve reporting standards. The set reporting standard was developed so that investors would have clarity regarding the position of the project concerning the level of geological knowledge (SAMREC, 2016). The confidence level in the resource models is reported based on the amount of geological knowledge gained from resource estimation, drilling and sampling. Mineral Resources are classified as Inferred, Indicated or Measured. Each level of resource reporting requires more robust geoscientific confidence signed off by the competent person (CP). The reporting of diamond resources and reserves is specified separately within reporting codes due to the commodity's distinct value measurement nature (SAMREC, 2016).

Resources are converted to reserves by applying the modifying factors to ensure that all considerations have been taken into account during the optimisation of the mine. The reserve statement is the portion of the Mineral Resource classified as economically feasible to mine. Based on the increasing confidence level in the data, mineral reserves are separated into two parts: Probable and Proved. It is scarce if ever, that diamond resources reach the level of a Measured Resource or Proved Reserve due to the high variability in estimating the diamond content. Financial reporting is a requirement at certain stages of mineral asset development. Investors need to understand the asset's potential and the motivation to spend additional capital for improved resource confidence. Various reporting codes worldwide have been developed to protect investors and the public against fraud (Henley & Allington, 2013). Exploration and mining companies listed on the stock exchanges must adhere to the relevant reporting code from which they disclose the information. Figure 27 shows the SAMREC classification of resources and reserves based on their confidence level adopted by the reporting standards.

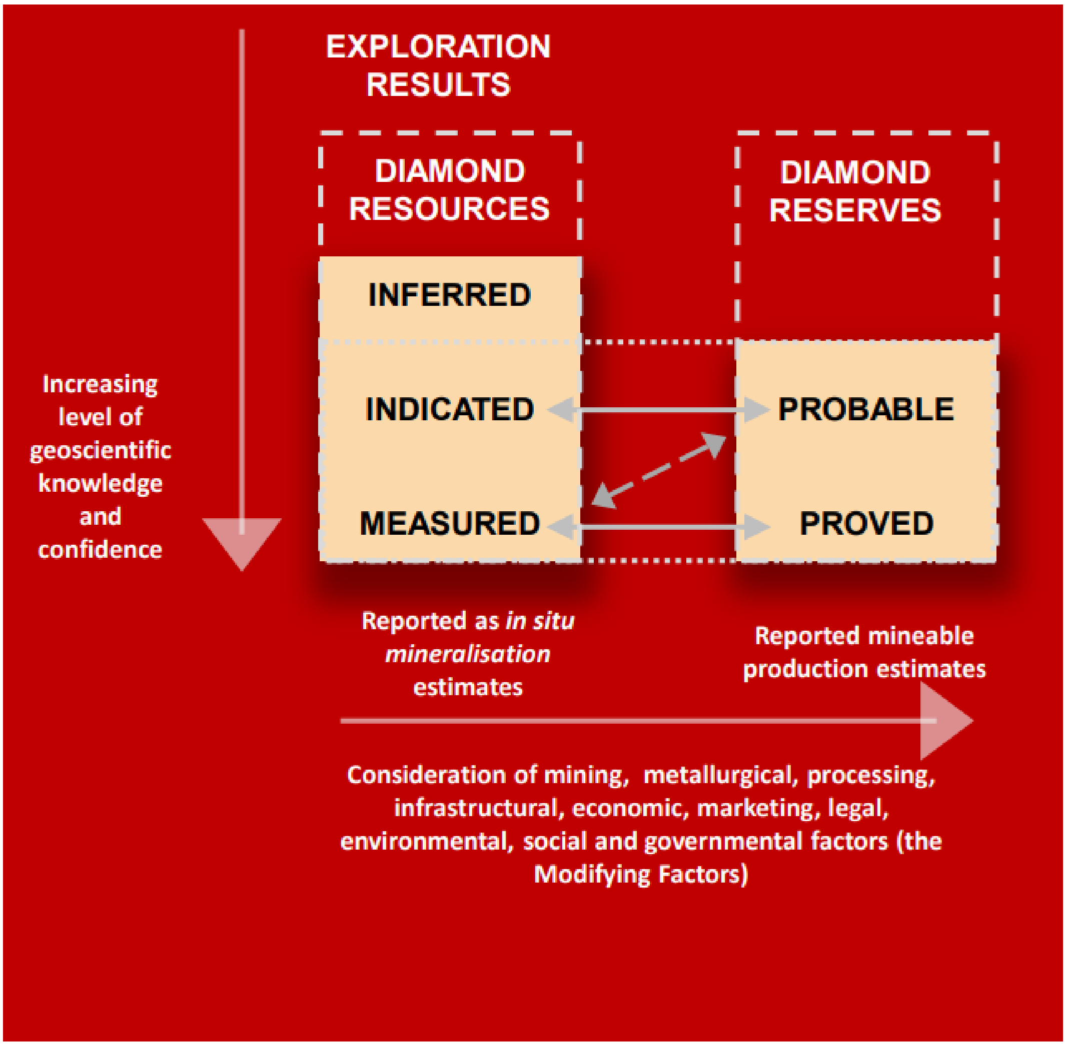


Figure 27 - Diamond resource and reserve conversions (SAMREC, 2016)

Financial reporting codes also accompany mineral asset reporting codes to ensure that the same level of compliance is adhered to when reporting financial figures. Valuation of mineral resources and reserves follows three approaches: the income approach, the market approach, and the cost approach (SAMVAL, 2016). The approach used for mineral asset valuations depends on the mineral asset's development stage. The preferred valuation methods of financial calculations differ based on the confidence level in the mineral asset, as shown in Figure 28.

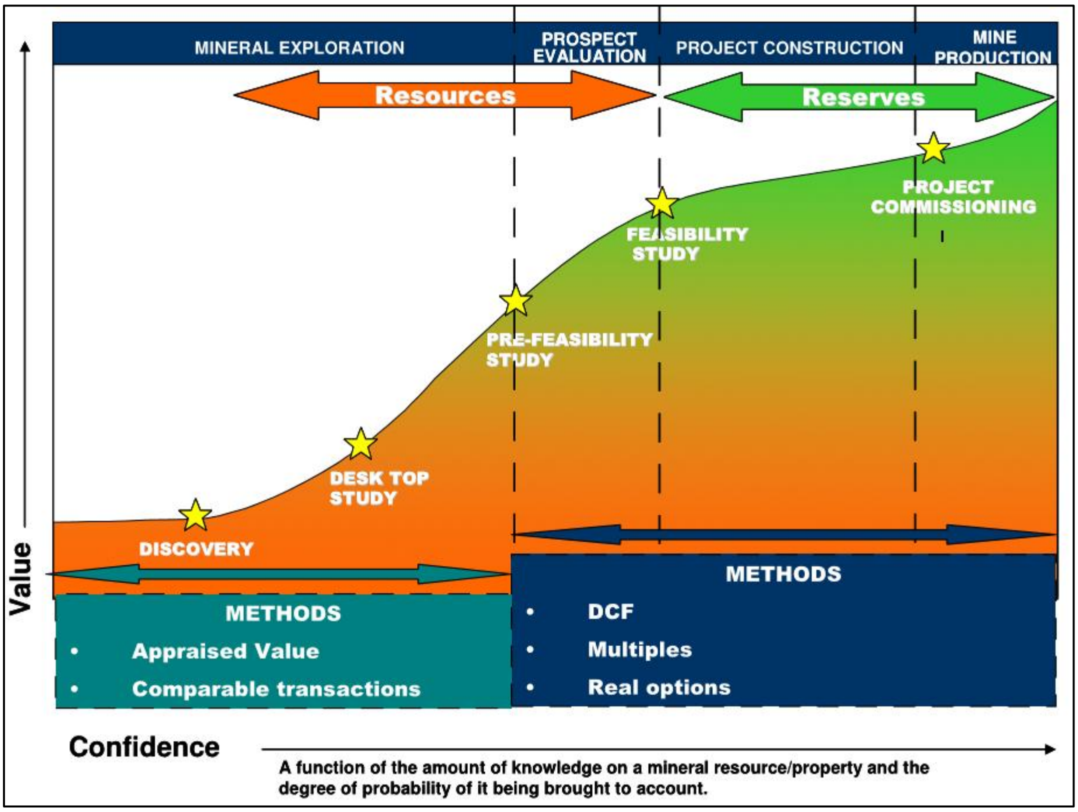


Figure 28 - Valuation methods based on the stage of development (Baurens, 2010)

2.5.2 Discounted cashflow method

The preferred method for evaluating operating mines and projects at advanced stages is the discounted cash flow method (DCF) to achieve an NPV result (Eves, 2013). The confidence level in the mineral reserve is expected to be high with the availability of actual production results in operating mines. The high level of confidence is favourable for using the DCF method. The DCF method was selected to evaluate the CW kimberlite since the mine is already operational and has actual production figures available. Data required for the DCF calculations will be acquired after the completion of the resource model and open pit optimisation.

The DCF method takes a range of future cash inflows and discounts it to the present value over some time (Gardner, 2015). The discount rate represents uncertainty and risks considered (Eves, 2013). The variance between the present value of future income and the expected cost presents the NPV value (Gardner, 2015). The DCF's inputs are separated by cost and revenue inputs based on the planned production parameters sourced from the mineral reserve.

Production plans are generated within the mineral reserve limits following the guidance of open pit optimisation. The LOM plan is generated first based on the final pit limits, guided by open pit optimisation. The LOM plan is then divided into long, medium, and short-term plans, with increasing detail for the shorter-term plans. Yearly plans present production figures for the DCF. The revenue calculation is based on the planned annual saleable product multiplied by the forecasted commodity price estimated by the company's financial department.

The cost parameters of the DCF for a mining financial valuation are commonly separated into three parts: operating costs, capital costs and taxes and royalties (Baurens, 2010). The operational costs are also separated into mining, milling (processing) and general and administration costs (Curry et al., 2014). The general and administrative costs are combined into a fixed cost line item within the DFC calculation. Fixed costs are not dependent on the production rate and remain the same regardless of the amount of volume treated through the processing plant (Mohutsiwa & Musingwini, 2015). Fixed costs consist of head office costs, mine administration, salaries of personnel not directly involved in the mining or processing production, and all other general costs incurred at the mine that are not production-related. Variable costs are cost directly involved with the production process. Costs like electricity, fuel, explosives, maintenance parts, and labour wages are directly engaged in production (Mohutsiwa & Musingwini, 2015). Variable costs will go up once the output of the mine increases. Fixed and variable costs are added to the DCF table to present a total operational unit cost per ton. The variable cost of a mine is usually the higher contributor to the total unit cost. The total unit cost can be reduced by increasing production due to the constant fixed cost (Tholana et al., 2013). Increased production has generally proven to decrease the total unit cost for the mine in the past, and investors are using mining industry cost curves for this information. The mining cost curve shows a column chart comparing mines and mining companies mining the same commodity. The y-axis of the cost curve shows the cost per ton milled, and the x-axis shows the milling production for the measurement period. Evaluation of a mining cost curve is a good indicator for investors to determine the ability of mines to survive during commodity price fluctuations. It is evident that mines with a lower unit cost per once milled are usually found on the left side of the cost curve and are higher-producing mines. Mines on the left with low production are usually mines with higher grades. Figure 29 shows a mining cost curve comparing platinum mines.

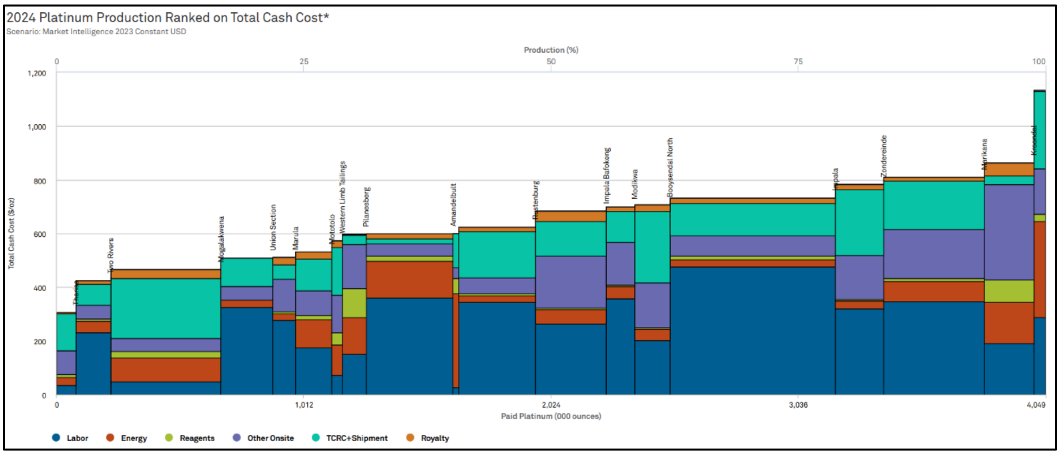


Figure 29 - Cost curve of South African platinum mines (S&P Capital IQ, 2024)

Capital costs can be divided into two sections: start-up capital and stay-in-business capital (Mohutsiwa & Musingwini, 2015). Start-up capital costs are fixed and are mostly related to mine infrastructure, the processing plant, and equipment to access the orebody (Nourali & Osanloo, 2019). The highest capital cost for open mining is usually for mining equipment and can significantly impact the NPV for a new mining project (Guo et al., 2021). Stay-in-business capital costs in open pit mines are primarily incurred in replacing mining equipment and during the commencement of consecutive pushback designs. Exploration programs are also costed under the capital section to increase the company's mineral assets (Price Waterhouse Cooper, 2012). High capital values spent during earlier stages of the mining project will hurt the cash flow, resulting in a reduced NPV value (Nourali & Osanloo, 2019). Exploring exploration drilling in stages would reduce the initial capital on drilling equipment. If the quality control of the exploration program is maintained, this could increase the mine's NPV value.

The variance between revenue and operational cost is reported in the DCF as earnings before interest and taxes (EBIT). Capital costs are added to the DCF after EBIT. Mining royalty taxes are usually applied on a revenue or profit basis dictated by the country's mining tax law (Castillo, 2021). In countries with a profit-based royalty tax system, the mining company has the benefit of not paying any royalty taxes until capital is redeemed. A revenue-based royalty tax system will require the company to pay a fixed percentage of all revenue generated at the mine. In some countries, mining royalties are applied to the estimated value of ore extracted, ready to be shipped (Bouterige et al., 2018). Researching and understanding the royalty rates in the country where the mine is located is essential. The rates applied for royalties are usually high and will significantly impact the NPV value of the mine. Special mining taxes are also applied to mining companies on top of other company taxes, such as value-added tax (VAT) and tax on salaries and labour wages (Otto et al., 2006). Like royalty taxes, mining taxes are country-specific. Sometimes, tax rates are applied differently based on the commodity being mined. In South Africa, gold has a different mining tax rate and is calculated differently than other commodities. South Africa also provides a tax break for mining companies using debt-fed capital (Benning, 2000). Mining companies benefit from not paying tax until the capital is wholly redeemed when funded with a bank loan. Understanding the tax law in the country where the mine is operational for the commodity being mined is crucial for strategic decision-making. This will allow us to realise possible benefits of reduced tax payment that can, in turn, increase the NPV value of the mine.

Royalty and mining tax payments are deducted from the EBIT value to the cashflow value line item in DCF. The company discount rate is applied to the cash flow values of each year based on the cost of capital calculation. The discounted cash flow values are added together to achieve the NPV value for the mine. The internal rate of return (IRR) value can also be calculated from the cash flow values to indicate to investors at what rate the NPV value of the mine will be zero. Table 4 presents a simplified example of a discounted cash flow.

Table 4 - Simplified discounted cashflow example (Baurens, 2010)

Simplified Discounted Cashflow Example (All units in thousands)					
	Year 0	**Year 1**	**Year 2**	**Year 3**	**TOTAL**
Gold produced		200	250	280	730
Gold price		500	500	500	500
Sales Revenue		**100 000**	**125 000**	**140 000**	**365 000**
Less: Site Operating Cost		55 000	70 000	70 000	195 000
Refining		1 500	1 700	1 700	4 900
Operating Profit		**43 500**	**53 300**	**68 300**	**165 100**
Less: Income Tax		5 000	9 000	11 000	25 000
Capital Expenditure	80 000	640	1 600	9 600	91 840
Net Cash Flow	**(80 000)**	**37 860**	**42 700**	**47 700**	**48 260**
Discount Factor (13%)		0.885	0.783	0.693	2.000
Net Present Value		**33 504**	**33 440**	**33 058**	**20 003**
Total Net Present Value ($ millions)		**20 003**			

2.6 Chapter Summary

Existing kimberlite pipes were formed millions of years ago by volcanic eruptions. Diamonds are formed in the lithospheric mantle of the earth's crust and are present in kimberlites where the volcanic eruption intersects the diamond-bearing lithosphere. Based on their formation, there are three distinct kimberlite classes. During geological times, kimberlites may be buried beneath younger lithologies and can be located through the application of airborne and ground geophysical techniques, as well as detailed soil sampling. Exploration core drilling is done in kimberlite pipes for pipe delineation and rock-type identification to create a geological model with defined kimberlite domains. Kimberlite cores are examined to identify the presence of indicator minerals coming from the lithospheric mantle zone. Indicator minerals are analysed for first stage interest rating. Microdiamond analyses are also carried out on the core for early-stage grade determination. Core drilling is challenging in kimberlite due to weak rock strength and disintegration characteristics when in contact with water, making it difficult to drill deep holes. RC drilling is done in a cluster of holes to obtain samples and processed at a sampling plant for domain grade determination. RC drilling also experiences the same challenges as core drilling, and hole sloughing can occur at deeper levels, which could cause inaccurate grade estimates. RC drilling grinds diamonds to a finer form, and the finer fractions cannot be used for valuation. A diamond valuation can only be done when 2,000 to 3,000 carats can be produced from a controlled bulk sample. If kimberlite domains are horizontally layered, an open pit excavation will be required to reach deeper domains for a bulk sample.

NPV is the most widely used valuation method for calculating mineral asset value. The main factors affecting the NPV value of a mine are revenue estimation, cost estimation, capital cost and the discount rate used. The discount rate is calculated based on the company's cost of capital, with a risk rate applied to ensure investors' confidence. Open pit optimisations are done to determine what volume of ore and waste could be mined optimally to achieve the highest NPV value for the mine. Advanced optimisation software packages like Geovia-Whittle and Deswik-GO allow for various optimisation options. A robust geological model is required to achieve accurate optimisation results. Various plant production rates can be evaluated to achieve the highest NPV result for the mine. Optimisation methods such as pushback designs, split shell designs and steepening of slope angles can all contribute to an increased NPV. These methods need to be applied with an acceptable level of risk management. The DCF method is used to calculate the NPV value.

Production rates calculated from the open pit optimisation determine revenue and cost parameters. The forecasted commodity market price is estimated by the financial department and is multiplied by the planned recovery to achieve the expected revenue. Operational cost parameters are separated in the DCF as fixed and variable costs. Fixed costs are summarised as general and administrative costs, whereas variable costs are only directly related to production. The concept of increased processing capacity for increased NPV is directly related to the constant fixed cost, with only variable costs increasing with increased production. This will result in a reduction in total unit cost with increased revenue, increasing NPV value. High start-up capital will negatively impact the NPV value and can be reduced by mining feasible pushback designs. Royalty and tax rates applied to the DCF depend on the mining tax law of the mineral asset. The correct understanding and application of the tax law are essential to realising opportunities for tax breaks that could increase the NPV value. The discount rate is applied to the cash flow results for each year after all required costs are deducted from the forecasted revenue. The sum of the discounted cash flow value will produce the final NPV for the mine.

3 RESEARCH APPROACH

3.1 Introduction

The research topic focuses on the effect of improved mineral resource management on the NPV of the CW kimberlite diamond deposit in Angola. The research aims to analyse the cost impact of an exploration drilling program done on a kimberlite pipe to achieve an improved mineral resource model. The research approach chapter will provide a detailed plan for conducting the study. Data collected will be outlined, describing its relevance to the study outcome. The validity of the data collected will be presented, describing the quality control measures taken to ensure good-quality data. The data analysis approach will present all considerations in data processing. It will outline how the data will be applied to achieve an outcome for the research report.

3.2 Research Design

The research design is structured around the challenging conditions of conducting exploration drilling in the weakly formed kimberlite material. It will be evaluated based on the exploration program results compared to the designed plan. Quality control measures and time delays associated with difficulty drilling holes at deeper elevations will be recorded. The NQ-type core drilling program was designed by Remote Exploration Services consultants acting as competent persons for the development of the mineral resource model. Vertical core holes are intended to be drilled in a square grid, 20 metres apart, to a depth of 250 metres. Based on the facie distribution of the kimberlite pipe, the drill grid is dense enough to achieve a viable Indicated Diamond Resource that could then be converted into a Probable Diamond Reserve. A denser drill grid will contribute to high costs without adding the same benefit level due to the variability in diamond distribution within kimberlites. Two inclined holes will be drilled at each vertical hole situated on the outer perimeter of the designed grid. The inclination of the holes is designed as pierce points at the intersection between the contact point of the kimberlite pipe and the host rock. The different angles of the holes are intended to represent the pipe limits at various elevations. The design angles are based on the best-expected representation of the pipe outline as expected by the competent person. The pierce points will be used for pipe delineation in developing the kimberlite pipe shell. LDD sampling is planned to be done on all vertical holes. RD drilling will be done with a Prakla RB 40 drill rig using a twelve-and-a-quarter-inch bit. A cluster of eight holes spaced at a four-meter square grid will be drilled around the core hole. Samples collected will be placed in sampling bags and processed at the bulk sample plant facility on the mine. Samples will be processed in ten-meter increments. Sampling results will determine the grade assigned to each classified kimberlite rock type.

Actual kimberlite rock type classification based on the newly developed solids model from the core drilling information will be compared to the extrapolated model. The result will determine the level of accuracy of the extrapolation done at deeper elevations of the CW kimberlite. The solids model will be developed into a geological block model separating the various kimberlite lithologies with an assigned grade for each ore rock type. The block model will be used for an open pit optimisation to determine the optimal pit shell for the CW kimberlite. The optimisation will be conducted using the Deswik GO software package licenced under Sociedade Mineira de Kaixepa.

The optimal shell produced from the optimisation will measure the available reserve to be mined from the block model. A production profile will be calculated for the cash flow inputs. Ore volume mined and treated will be based on the plant capacity with a 8mm cut-off size, and the required stripping volume per year will be calculated to maintain positive ore feed for the LOM period. Production figures will be applied at the start of year three of the cash flow, with years one and two allocated to exploration drilling. Cost and revenue will be calculated based on the production profile per year. The cost of exploration drilling will be accumulated and divided into the first two years and allocated to capital costs. Mining taxes and royalties will be applied to achieve cash flow value for each year. The calculated discount rate will be applied to the cash flow to achieve the discounted NPV value. The cash flow profile will be used to calculate the NPV using the production profile of the 2019 optimal shell. There will be no capital cost as no exploration drilling was done for the extrapolated model, and the production will start in year one. The comparison of the two results will determine the effect of exploration costs on the NPV value of the CW kimberlite.

The CW solids model of 2016 will be clipped against the topographic surface used to develop the updated solids model based on the exploration drilling results. A drill program will be created using the current design's same drill grid. The drill program will calculate the timeframe to complete two scenarios based on the production rate achieved with the current drill program. The first scenario will be calculated based on all drilling done before production starts. The second scenario will divide the drilling program proportionally based on the concept of split shell mining. Drilling of shorter holes will be planned, allowing mining production to be initiated earlier on one side of the pit. During that cycle, exploration drilling will continue on the opposite side. Open pit optimisations for each scenario will be done to determine the ultimate pit limits. The production profile for the first scenario will be based on the best pushback design sequence. The second scenario will have a production profile based on the split shell concept, allowing exploration drilling to continue. Exploration drilling cost will be applied as capital for the first years of Scenario One, and production will commence after the expected completion of the exploration drilling program. Capital costs for Scenario Two will spread over the time frame of the planned exploration drilling in conjunction with mining production. Mining production of Scenario Two will start on the completion of the first stage of the planned exploration program. The exact cost, revenue, taxes, and royalty inputs will be applied to the cash flow table for the initial two NPV calculations. The initial discount rate will be used to calculate the discounted NPV value. The same inputs are used for all cash flow calculations to ensure that the comparison between the results is unbiased. All calculated NPV values will be evaluated to determine the most appropriate exploration method that will produce the best value for the mine.

3.3 Data Collection Process

3.3.1 Geological data collection

The core will be collected from the core drilling program and kept in core trays at the drilling sites. Core trays are marked with the planned hole identification. Core sections extracted are measured and are separated with yellow bocks indicating the measurement of the core section. Core trays are packed and transported to the mine’s core shed, where they are stored for evaluation purposes. LDD samples from the RC drilling process are screened with a shaker plant over 2mm panels and collected in 1,000kg polypropylene bags with handles. The handles help hang onto the shaker when collecting the samples. The handles are also useful during the lifting process of the bags to be transported and treated at the bulk sampling plant. Each bag consists of a sample collected for 10 metres of drilling for each planned hole in the cluster. Sample bags are transported to the laydown area at the bulk sampling plant and packed together per sample interval in sequence for processing. Each of the eight bags in the 10 metres sampling interval is weighted with an electronic hanging scale, and data is recorded by senior geological personnel. The eight bags are processed through the bulk sampling plant, crushing it down to the 8mm size fraction and using a dense media separation (DMS) system to generate concentrate. The bottom cut-off (bco) is 2mm. The DMS concentrate is processed through an X-ray recovery system to improve the identification of diamonds. Diamonds picked from each sampling interval are weighted and kept separated in the picking safe for grade estimation purposes.

3.3.2 Open pit optimisation data collection

Remote Exploration Services will provide the solids model after processing and analysing all geological data. The solids model will be processed into a geological block model using Deswik CAD software. Recommended slope angles for each geotechnical zone of CW will be sourced from SRK Consulting, acting as the competent person for the geotechnical part of the resource development process. Geotechnical slope angles will be applied in the Whittle optimisation. The mine's cost-controlling department allocates costs for each department utilising Primavera software. All allocated costs for the production year 2023 will be collected from the cost-controlling department. Departmental costs will be assigned to production areas and weighted against the production produced during 2023 to determine unit costs of mining and ore processing. Costs non-related to production parameters will be allocated as overhead costs for the optimisation. Yearly ore production estimates will be based on the actual reconciled processed volume for 2023. Diamond price inputs and accurate growth estimates for the open pit optimisation will be sourced from Sociedade Mineira de Kaixepa's financial department.

3.3.3 Discounted cashflow data collection

Production volumes will be calculated using the optimal pit shells. Production volume will be allocated yearly until the end of LOM. The cash flow calculation will use the same cost and revenue data for the open pit optimisation. The capital cost data for the exploration drilling program will be sourced from the Primavera software and allocated to the geology department. Angola's mining tax and royalty rates will be sourced from the Internet based on the latest laws in practice. The discount rate will be calculated based on the WACC formula. The required data will be sourced from the Internet and Sociedade Mineira de Kaixepa's financial department. The cash flow will be calculated using an Excel spreadsheet. The main components are:

- Production Volumes;

- Revenue;
- Costs;
- EBIT;
- Capital costs;
- Mineral resource royalties;
- Income tax;
- Cash flow; and
- DCF.

Production

Production for each scenario used in the cashflows is calculated based on the bench depletion volumes produced by the Deswik CAD software. The volumes are separated into the various rock types as measured from the block model. The carats produced at each period are calculated using an Excel spreadsheet. The carats produced for the cash flow are determined using Equation 3.

Carats produced (ct):

$$ct = \mathrm{BCM} \times \mathrm{g} \qquad \text{Equation 3.}$$

Where: BCM is the in-situ ore volume measured from the block model, and g is the grade representing the carats per m^3 with a bco of 2mm for the respective ore rock types.

Revenue

The diamond price for this study is presented as USD per carat. The revenue is calculated based on the carat production for each production year of the cash flows. Equation 4 presents the formula used for revenue calculation.

Gross sales revenue (GSR):

$$GSR = ct \text{ x p} \quad \text{Equation 4.}$$

Where: ct is the carats produced, and p is the diamond price.

Costs

Costs are separated between fixed costs (FC) and unit variable costs (UVC). FC remains constant each year in the cash flow calculations based on the actual fixed cost of 2023. The UVC cost for each year of the cash flow scenarios is separated between mining and ore processing costs. Mining costs are divided based on the rock types mined with the specific USD cost per m^3 multiplied by the BCM mined. Processing costs are calculated by multiplying the BCM treated at the plant with the USD cost per m^3.

Earning before interest and tax

EBIT is calculated using the gross sales revenue minus the total costs, shown in Equation 5.

EBIT (USD):

$$EBIT = (\text{GSR} - \text{TC}) \quad \text{Equation 5.}$$

Where: GSR is the gross sales revenue, and TC is total costs in USD.

Capital costs

The exploration drilling costs for the duration of the exploration program are applied as the capital cost in the cash flows. The duration of exploration drilling for the various cash flow scenarios is calculated based on the actual production rate achieved. The capital cost of the exploration program done by Sociedade Mineira de Kaixepa is divided into the exploration drilling months to get the exact monthly cost. The duration of the planned exploration programs for the other scenarios is multiplied by the actual monthly exploration cost. This produced the total capital cost for each scenario cash flow.

Mineral resource royalties

Mineral resource royalties in Angola are charged a fixed rate of 5% of the revenue (Podowski et al., 2022). Equation 6 shows the calculation for mineral resource royalties.

Mineral resource royalties (MRR):

$$MRR = \quad (\mathrm{GSR} \times \mathrm{RTR}) \qquad \text{Equation 6.}$$

Where: GSR is the gross sales revenue, and RTR is the royalty tax rate as a value in USD.

Income tax

The Angolan law states that a fixed tax rate of 25% is payable on the yearly profit of the mining company (Podowski et al., 2022). The tax amount calculation is shown in Equation 7.

Income tax (it):

$$it = \quad (\mathrm{EBIT} \times \mathrm{T}) \qquad \text{Equation 7.}$$

Where: EBIT is the earnings before interest and taxes, and T is the income tax rate.

Cash flow

The cash flow of each production year is calculated based on the formula in Equation 8.

Cash flow (CF):

$$CF = \ (\mathrm{EBIT} - \ \mathrm{MRR} - \mathrm{it}) \qquad \text{Equation 8.}$$

Where: EBIT is the earnings before interest and taxes, MRR is the mineral resource royalty, and it is the income tax in USD.

Discounted cash flow

The cash flow value is discounted using a discount rate to get the present value of the expected future cash flow (Gardner, 2015). The discount rate is calculated based on the company's WACC calculation, presented in Chapter 2 (Equation 1). The company's equity cost, which forms part of the WACC calculation, is calculated based on the CAPM presented in Chapter 2 (Equation 2). The formula used to calculate the DCF is shown in Equation 9.

Discounted cash flow (DCF):

$$DCF = (\mathrm{CF_1}/(1+\mathrm{i})) + (\mathrm{CF_2}/(1+\mathrm{i}^2)) + (\mathrm{CF_n}/(1+\mathrm{i}^n)) \qquad \text{Equation 9.}$$

Where: DCF is the discounted cash flow (USD), $\mathrm{CF_1}$ is the first year’s cash flow, $\mathrm{CF_2}$ is the second year’s cashflow, $\mathrm{CF_n}$ is the cash flow for the remaining years, and i is the discount rate (%) (Fernando, 2024).

3.4 Data Validation Process

The geology department continuously monitors the core drilling process to ensure that the correct quality control measures are in place during the drilling process. Geologists are present when the core is extracted from the core barrels and are responsible for measuring the core and marking the measurement blocks. The appointed representative of Remote Exploration Services does site visits every quarter. During site visits, the drilling process is evaluated to ensure that correct measures are in place. Core logging on completed holes is done by the Remote Exploration Services representative in the core shed. Photos of each drill hole logged are taken as evidence of the logging process and for future verification purposes. Like the core drilling, the exact quality control measures apply to the RD drilling. No caliper measurements were done as the management of SMK deemed it to be too expensive. This could lead to a fatal error in grade estimation due to the collapse of the LDD holes, resulting in an additional sample volume. Geologists are divided into shifts, controlling the process to ensure that samples are separated correctly without any contamination. Senior geologists and metallurgy personnel control the treatment of samples. The bulk sampling plant is purged with waste material before each cluster is sampled to ensure the plant is entirely sterile. This process ensures that no diamonds are stuck in the system, which could affect the results of the following sample. The geologist on duty controls the weighing of the bags and ensures that the correct selection of bags is treated. The metallurgist on shift ensures the plant functions optimally during the treatment process. Tracer tests are conducted to ensure the plant is in good working order. Diamonds are picked from the Flow Sort double-pass X-ray system by the geologist, who is supervised by industrial and national security personnel. The results of each cluster are sent to Remote Exploration Services for verification and grade calculation purposes.

The geological solids model will be validated using the functionality of the software packages. This is to ensure that there is no overlapping of kimberlite domains where solids are connected, which could affect the accuracy of the block model. Block models between the available mine planning and optimisation software packages will be verified. Volume measurement tests will be compared between the software packages to ensure they meet acceptable standards. The cost and revenue data will be specific to the actual results from the mine and will not be estimated based on data taken from other operations. This will ensure the validity of the data as it will consider the remote location of the mine in terms of logistical difficulties that increase costs. Production figures for unit cost calculations are also specific, considering the delays caused by the high rainfall in the area. The finance department will source diamond price estimates from a professional diamond valuator. He is responsible for evaluating the mine's diamond parcels before each sale; therefore, he is well acquainted with the diamonds produced from the mine. Capital costs will also be sourced from actual mine costs incurred during the exploration drilling process and will not be estimated based on other similar projects.

3.5 Data Analysis Approach

The core extracted from the core drilling program will be analysed for classification into kimberlite rock types. Each drill hole will be surveyed on completion to ensure that the actual drill position and elevation are recorded. The core will be measured to indicate the exact distances between intersections of rock types, and elevations will be applied to each intersection point. The assay data will be stored in a spreadsheet format to be loaded into the software and utilised for the solid model generation. Sections of the core of each rock type will be weighed to determine the density of each rock type. Densities will be applied to the conversion of the weighted LDD sampling bags to determine the exact volume processed. The representative of Remote Exploration Services will analyse core segments under a microscope to investigate the presence and type of lithospheric mantle indicator minerals. Remote Exploration Services will also indicate portions of the core representing the various kimberlite rock types identified to be sent to Canada for mineral chemistry analysis. The cost of the mineral chemistry sampling are included in the capital budget for the exploration program.

Core logging data will be evaluated to determine the rock type of each section of the LDD samples to be processed. LDD sample volumes weighed per treatment section will be converted to volume using the density measurements taken from the core. The weight of the diamonds recovered from the section treated will be divided into the volume measured to determine the grade and recorded as carats per cubic metre. The result will be recorded as the actual grade. Caliper logging will not be done after drilling due to the additional capital output required. A calculated factor will be applied to the exact grade to account for the possibility of the hole collapsing, thereby producing a theoretical grade. The theoretical volume is the actual volume of the sample calculated using the cylinder volume formula. This is done due to the lack of caliper logging equipment for proper volume calculation. The theoretical grade will be more conservative and used for the open pit optimisation to ensure the result is not overly ambitious.

Geological and geotechnical data will be analysed to ensure the correct slope angles are applied to the specific rock type classification. Data will be used for the block model before loading into the Deswik GO optimisation software. Cost data per department sourced for 2023 will be analysed based on the department's contribution towards the specific production input sections. The cost will be allocated to each appropriate production section as the Deswik GO software input section requires. The cost will be divided by the actual production figures in 2023 to generate unit variable costs. Unit variable costs will be separated into various rock types mined per cubic meter. A separate cost item of ore processing per cubic meter will also be treated. Costs from the geology department will be combined as the capital cost input. Geology cost will also be divided by the production meters achieved to determine a drill cost per meter for core and LDD drilling.

The information will be used for capital cost estimation when evaluating the options of a complete exploration program compared to the exploration program done in stages. The production rate of the drilling will also be analysed to determine the time frames for the comparison between the exploration drilling approaches. Costs not directly related to production will be allocated as overhead costs. Diamond prices sourced from the financial department will be analysed to determine a real growth expectation for optimisation. A drone, with a vertical accuracy of 30mm, will survey the actual topography of CW, and a surface will be generated as a starting base for the optimisation. The surface will be analysed and validated using the available software programs. The Deswik GO software program will produce a set of mineable pit shells. The shells will be analysed to determine which will be optimal for CW and deliver the highest NPV value.

The exact cost and revenue models will be used to optimise the combined solids model containing the newly developed solids with the old solids. The original survey data of CW will be sourced to create a topographic surface for optimisation. Optimisation results will be analysed to find the optimal shells. Open pit designs of split shells for the staged exploration drilling option will be generated. Volumes for the two options will be measured against the original topographic surface generated. The estimated volumes will be analysed to ensure a continuous supply of ore based on the current capacity of the processing plant.

Production inputs measured from the optimisations will be used for the cash flow calculations. Costs will be separated into fixed and variable costs. The overhead costs will also be used as a fixed cost in the cash flow calculation. Capital costs will be evaluated based on the drilling period and applied accordingly to the periods in the cash flow. The cash flow calculation will use tax and royalty rates for diamonds in Angola. The finance department will approve the calculated discount rate before discounting the cash flow results. Each scenario's discounted cash flow results will be tabulated to be compared. The comparison results will be analysed to conclude that the exploration strategy is driven towards the highest NPV value.

3.6 Chapter Summary

The research aims to analyse the cost impact of an exploration drilling program on a kimberlite pipe to improve the mineral resource model. The chapter outlines the detailed plan for the study, emphasising data collection relevance, data validity, and the approach to data analysis. The research design is tailored to challenging conditions in weakly formed kimberlite material. Exploration drilling is strategically planned, involving vertical and inclined holes to delineate the kimberlite pipe. Sampling methods and equipment specifications are outlined, focusing on obtaining accurate geological information. Geological data collection involves core drilling and sampling, while open pit optimisation and discounted cash flow data collection rely on various software programs. Detailed procedures for collecting geological and open pit optimisation data, including geological and geotechnical considerations, are provided. Continuous monitoring and quality control measures are applied during core and RD drilling. The geological solids model is validated to ensure accuracy, and actual mine data is used to determine costs, enhancing data validity.

The core extracted is analysed for rock type classification and density determination. Various analyses include lithospheric mantle indicator minerals, mineral chemistry analysis, and data verification through multiple software packages. Cost analysis involves unit variable costs, capital cost estimation, and overhead cost allocation. The chapter details the process of open pit optimisation, including pit shell generation, slope angle application, and the comparison of different scenarios. The feasibility of alternative approaches in conducting exploration drilling based on model extrapolation and open pit optimisation techniques will be determined. NPV results based on the different exploration approaches will be weighed against each other to decide on the best option for kimberlite exploration programs.

4 DATA FOR THE STUDY

4.1 Introduction

The chapter will present all the data collected relevant to this research report. This data will include the geological data required for developing the mineral resource model. It will also show the core shed's quality control systems and the core logging process. The process of doing the RC drilling and processing of the LDD samples will be illustrated.

The drill holes within the pipe shell will show the pierce points into the shell. Solids models created from the geological drilling information will be presented. The combined solids model generated from historical and updated data will be presented. This will be followed by the drill designs to determine the capital required for the exploration drilling based on the original model. The geotechnical evaluation and recommendations made by SRK that will be applied to the open pit optimisation will be presented.

The financial parameters of the cost and revenue inputs needed for the open pit optimisation studies will be given. The discount rate will be calculated and illustrated to generate cash flows. Tax and royalty data will also be described. The various pit shells generated for each comparison scenario will be illustrated, followed by the reserve volumes calculated. The last section of the data will present the survey methods with the surface generated for the open pit optimisation. The chapter summary will follow this.

4.2 Geological Data

4.2.1 Core drilling data

Two second-hand core rigs, a Boyles and an Atlas Copco, were sourced locally to speed up the start of the exploration drilling program in January 2023. Sociedade Mineira de Kaixepa bought another two core rigs from Reger Finley in South Africa that had to be manufactured. The LY 44 drills were delivered to the mine in May 2023. The second-hand rigs' initial drilling progress was slower due to numerous mechanical failures. Drilling performance increased when the new rigs were commissioned, and the drilling of the inclined holes was also initiated. The latest drill rigs had a much more stable platform, anchoring it to the ground for the planned inclined holes. This prevents the rig from shifting from the setup position to maintain the correct drilling angle. The main aim of the inclined holes is to determine the extent of the kimberlite pipe margin; therefore, the correct angle must be maintained. Figure 30 shows the two second-hand core rigs sourced in Angola from previously abandoned exploration drilling programs.

Figure 30 - Second-hand Boyles and Atlas Copco core rigs (Sociedade Mineira de Kaixepa Geology Department, 2024)

Figure 31 shows one of the new Reger Finley LY 38 drills, drilling an inlined hole.

Figure 31 - New Reger Finley core rig (Sociedade Mineira de Kaixepa Geology Department, 2024)

The NQ-type core extracted during drilling was washed and packed into core trays. The trays were kept safe at the drilling site and covered by a tarp to prevent weather elements from damaging the recovered core. Sections of the core were measured, and plastic blocks indicating the measurement were placed in between the core for guidance during the logging process. The structural weakness of the kimberlite is evident, as shown in Figure 32, with the core broken into many smaller sections when extracted from the core barrels.

Figure 32 - Kimberlite core packed in core boxes (Sociedade Mineira de Kaixepa Geology Department, 2024)

The core drilling program experienced some challenging conditions due to the weak formation of the kimberlite structure. Exceptionally high rainfall figures in this area of Angola worsened the drilling conditions. High volumes of seepage water entered through the shear zones of the country rock mass, causing the kimberlite to swell and weaken at deeper elevations. Saturated kimberlite zones are prone to collapse, causing the drill rods to get stuck in the holes. Due to the weaker, moist kimberlite formation, most vertical holes had not reached the desired drill depth. Table 5 shows the comparison between the planned and actual vertical core holes.

Table 5 - Vertical core drilling production statistics (Sociedade Mineira de Kaixepa Geology Department, 2024)

Camutue West Vertical Core Drilling Comparison					
Hole ID	**Angle(°)**	**Planned Depth(m)**	**Actual Depth(m)**	**Variance Depth(m)**	**Comments**
CW2-14	-90	231	201	-30	Hole Collapsed. Drill String Stuck
CW2-07	-90	232	196	-36	Hole Collapsed. Drill String Stuck
CW2-45	-90	239	197	-42	Hole Collapsed. Drill String Stuck
CW2-06	-90	234	178	-56	Hole Collapsed. Drill String Stuck
CW2-10A	-90	237	237	0	Completed successfully
CW2-3	-90	239	191	-48	Hole Collapsed. Drill String Stuck
CW2-13	-90	234	234	0	Completed Successfully
CW2-18	-90	228	156	-72	Hole Collapsed. Drill String Stuck
CW2-23	-90	233	225	-8	Hole Collapsed. Drill String Stuck
CW2-15	-90	229	229	0	Completed Successfully
CW2-22	-90	217	139	-78	Hole Collapsed. Drill String Stuck
CW2-42	-90	216	216	0	Completed Successfully
CW2-29	-90	247	222	-25	Hole Collapsed. Drill String Stuck
CW2-36	-90	136	136	0	Completed Successfully
CW2-33	-90	214	67	-147	Hole Collapsed. Drill String Stuck
CW2-21	-90	172	172	0	Completed Successfully
Total	**-90**	**3 538**	**2 996**	**-542**	**85% Completed Successfully**

The depth of the inclined core drilling holes was planned according to the extrapolated solid model. A double set of inclined holes was added to each planned vertical hole closest to the edge of the orebody perimeter. The angle of the first inclined hole would be shallower to intersect the pipe shell midway through the planned vertical hole depth. The second inclined hole was drilled steeper to intersect the pipe at a deeper elevation. This method allows the connection of the orebody contact on the surface to the pipe shell mid-point and further down to the bottom pierce point. Table 6 compares the planned and actual inclined core drilling holes.

Table 6 – Inclined core drilling production statistics (Sociedade Mineira de Kaixepa Geology Department, 2024)

Camutue West Inclined Core Drilling Comparison					
Hole ID	**Angle(°)**	**Planned Depth(m)**	**Actual Depth(m)**	**Variance Depth(m)**	**Comments**
CW2-34	-80	75	49	-26	Completed. Pierce Point at 38m
CW2-17	-83	189	103	-86	Completed. Pierce Point at 91m
CW2-31	-74	76	25	-51	Completed. Pierce Point at 16m
CW2-19	-67	82	39	-43	Completed. Pierce Point at 30m
CW2-48	-65	129	55	-74	Completed. Pierce Point at 46m
CW2-49	-82	177	137.4	-40	Completed. Pierce Point at 127m
CW2-24	-60	109	73	-36	Completed. Pierce Point at 61m
CW2-25	-80	201	114	-87	Completed. Pierce Point at 104m
CW2-1	-69	105	88	-17	Completed. Pierce Point at 76m
CW2-2	-85	200	165	-35	Completed. Pierce Point at 142m
CW2-4	-50	157	98	-59	Completed. Pierce Point at 98m
CW2-5	-74	201	151	-50	Completed. Pierce Point at 137m
CW2-12	-79	198	225	27	Completed. Pierce Point at 220m
CW2-11	-71	151	180	29	Completed. Pierce Point at 167m
CW2-44	-80	201	161	-40	Completed. Pierce Point at 141m
CW2-43	-55	156	96	-60	Completed. Pierce Point at 76m
CW2-47	-79	200	240	40	Completed. Pierce Point at 228m
CW2-46	-55	157	123	-34	Completed. Pierce Point at 122m
CW2-9	-83	199	243	44	Completed. Pierce Point at 235m
CW2-8	-60	109	108	-1	Completed. Pierce Point at 98m
CW2-16	-66	94	80	-14	Completed. Pierce Point at 59m
CW2-41	-64	193	110	-83	Completed. Pierce Point at 103m
CW2-28	-78	208	105	-103	Completed. Pierce Point at 94m
CW2-27	-60	112	75	-37	Completed. Pierce Point at 64m
Total		**3 679**	**2 843**	**-836**	

Core boxes were packed at the core shed to separate the completed drill holes from each other. The CP appointed by Remote Exploration Services visited the mine every quarter to evaluate the quality control measures of the drilling program. During each visit, the CP also did core logging and microscopic analysis. Based on the analysis findings, the CP determined which core sections should be shipped to Canada for mineral chemistry analysis. Appendix A tabulates the core logging done per hole. Figure 33 shows the core trays packed out in sequence from the top to the bottom of the hole, ready to be logged in the core shed.

Figure 33 - Core trays arranged in the core shed (Sociedade Mineira de Kaixepa Geology Department, 2024)

Figure 34 shows the CP appointed by Remote Exploration Services doing microscopic core analysis.

Figure 34 - Microscopic core analysis (Sociedade Mineira de Kaixepa Geology Department, 2024)

4.2.2 LDD sampling

RC drilling was done with a Prakla RB40 drill rig. Sampling material was screened and collected into polypropylene bags at five-meter intervals. The bags were tagged and secured before being transported to the sampling plant facility. Eight holes, each 12.25 inches in diameter, were drilled within a cluster. Figure 35 illustrates the RC drilling process, showing the drill rig, shaker screen, and telescopic handler for lifting the bags.

Figure 35 - RD drilling process (Sociedade Mineira de Kaixepa Geology Department, 2024)

LDD sampling bags were packed in sequence from the start to the end of each hole. Samples were processed at 10m intervals, combining all eight holes drilled in the cluster. That totalled 16 sampling bags per sampling interval with an average weight of 8.5 tons. Each sample was weighed before being fed into the sampling plant for volume calculation. Samples were processed through a scrubber, screening unit and DMS cyclone system, and the concentrate generated was processed through the X-ray machine, whereafter the diamonds were picked. LDD sampling was planned for each vertical core drill hole position. RC drilling was done for all scheduled positions. Figure 36 shows the 30-tonne-an-hour sampling plant.

Figure 36 - Bulk sampling plant (Sociedade Mineira de Kaixepa Geology Department, 2024)

The CP evaluated all sampled results based on the volume conversions from the weighted results. Due to slime loss, the volumes measured are less than those calculated based on the hole diameter and depth, referred to as the theoretical volume. The higher theoretical volume will decrease the grade compared to the weighted volume. No down-the-hole survey callipers were available for this sampling process. The theoretical volume approach was deemed more cautious when calculating the sampled grade for the open pit optimisation. Each kimberlite facies grade results were combined and divided by the total volume to achieve a global average sample grade per domain. The LDD sampled grades are tabulated in Table 7.

Table 7 - CW LDD sampling grade results (Hollick, 2024)

Camutue West LDD Sample Grades		
Rock Type	**Sampled Grade (ct/m³)**	**Theoretical Grade (ct/m³)**
Kimb 3	0.242	0.185
Kimb 4	0.463	0.428
Kimb 5	0.453	0.417
Kimb 6	0.129	0.118

4.2.3 Geological solids model

Geological core logging at the mine was completed in May 2024. Remote Exploration Services processed the core logging data using GOCAD software. The imported drill holes indicated the separation of the kimberlite domains. The drilling was done at a sufficient density to separate the Kimb 4 and Kimb 5 facies domains. There were also enough pierce points into the host rock around the kimberlite pipe to develop an accurate pipe shell. Solids were generated based on the core logging data, separating each ore rock type within the pipe shell. Figure 37 shows the core logging data within the kimberlite pipe shell generated.

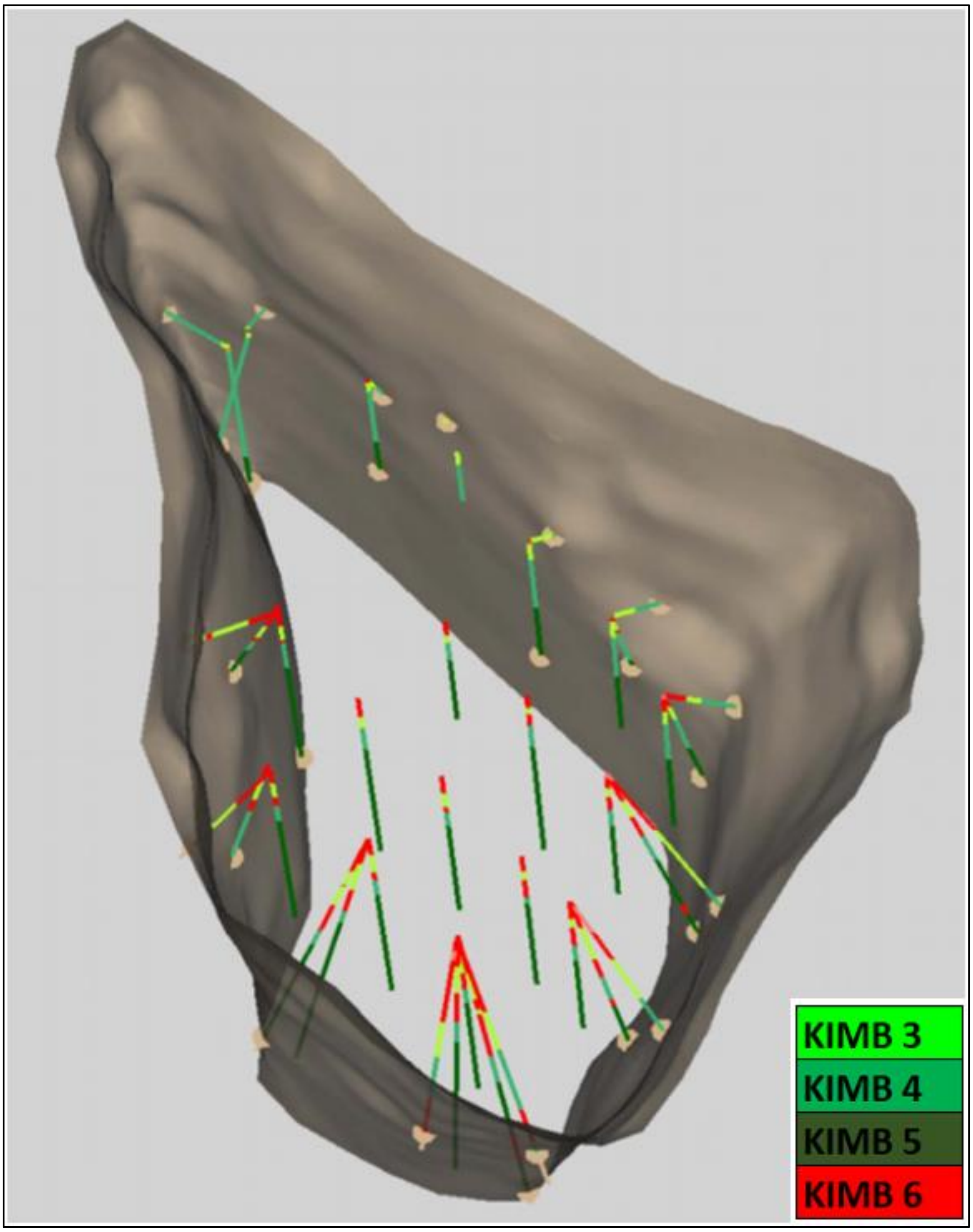


Figure 37 – CW Core logging data processing (Hollick, 2024)

Figure 38 shows the solids model generated from the processed core logging data.

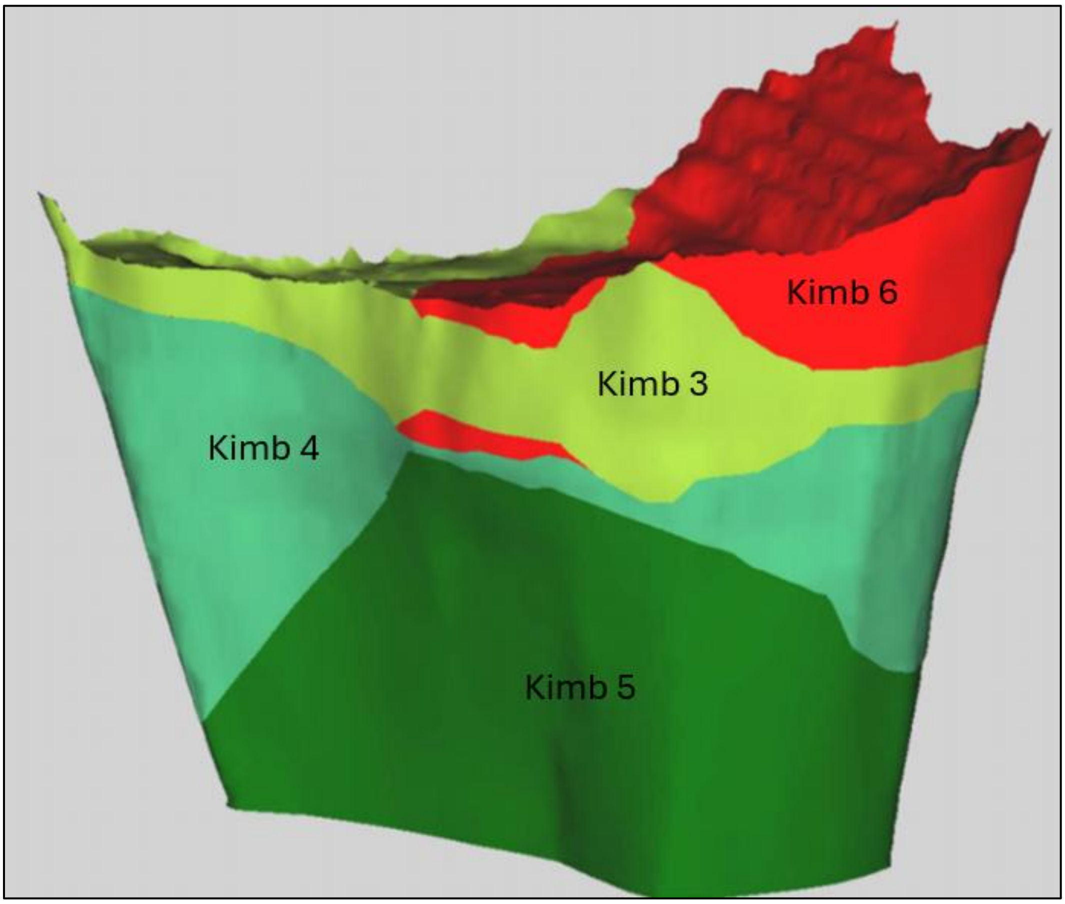


Figure 38 - CW geological solids model to elevation 420 (Hollick, 2024)

4.2.4 Combined geological volume model

Historically, Remote Exploration Services created three sets of solids models. The original model had the highest elevation of 790m. In 2016, the model was updated to separate facies rock types. This model was again updated later based on the geological mapping done in the pit by the end of 2018. This was also the extrapolated model used for the 2019 optimisation. All models were clipped against the actual pit surfaces at creation time. The last set of solids used was the developed solids done by Remote Exploration Services in 2024, which replaced the extrapolated section completely. All these solids were imported and evaluated using the Deswik CAD software. Clear intersection points between the same rock types from the various models were identified. All the similar rock types were clipped against each other and merged to generate one solid per ore rock type. Figure 39 shows the combined solids model generated.

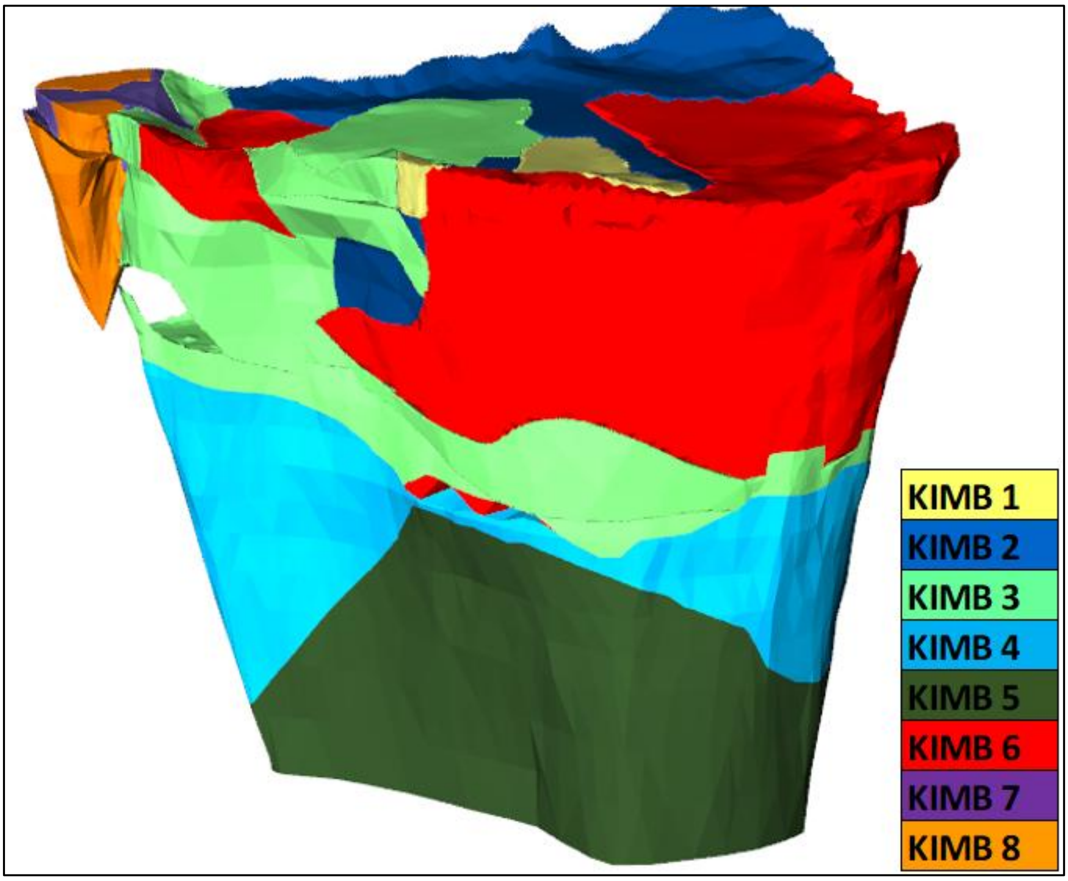


Figure 39 - Combined solids model (Sociedade Mineira de Kaixepa Mine Planning Department, 2024)

The facies solids generated for the combined solids model were joined to create one kimberlite pipe solid. This solid was used to generate the waste rock model and as a guideline for a core drilling design. The vertical core holes were designed with a 40-meter grid spacing. The holes outside the pipe solid deeper down were clipped, allowing for a two-meter intersection of waste rock. The inclined holes were designed from the vertical holes around the pipe margin to allow pierce points into the waste rock model. Two inclined holes were created at each position to intersect the pipe at one-third and two-thirds of the total depth of the pipe solid. The drill design aimed to use the same parameters of the exploration program to determine the required drilling meters. The vertical and inclined production parameters are tabulated in Appendix A of the report. Figure 40 shows the drill design within the pipe solid.

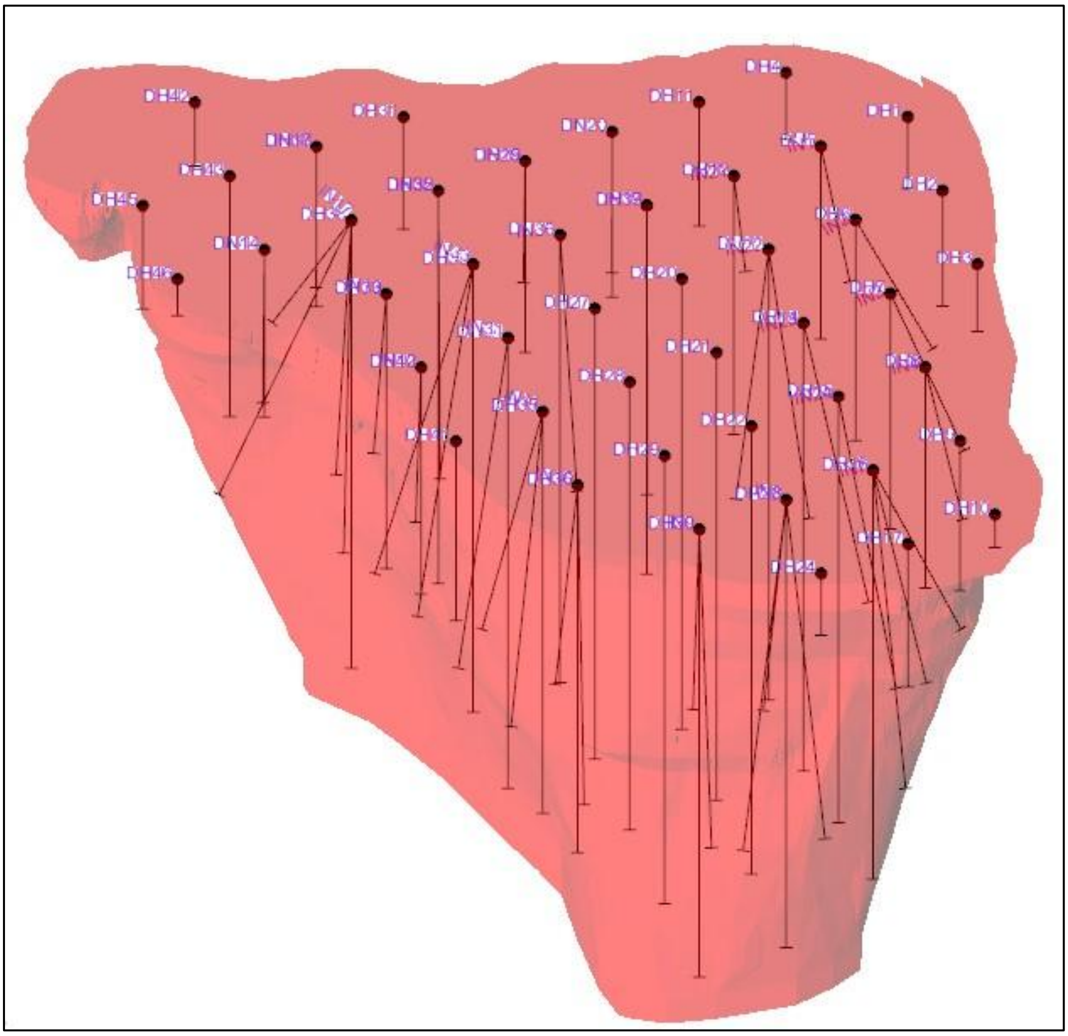


Figure 40 - Complete exploration program drill design (Sociedade Mineira de Kaixepa Mine Planning Department, 2024)

4.2.5 Phased exploration geological model

The combined solids model parameter was used for the phased exploration drilling option. A complete drill design was planned for elevation 790 to 605, the middle elevation of the model. This will allow for an optimisation to guide the first split shell design. Then, another drill design will be done from elevation 605 to 420, the end of the model. This design will be separated into two parts based on the floor surface of the split shell design. It was realised that the split shell design could only reach elevation 690. Due to the size of the pipe, the ramps intersected the remaining half of the pit at that elevation. The phased exploration drill design had to be revised to elevation 790 to 690 for the first phase. The next phase had to be designed from 690 to 420. The orebody was found to be too small to do the second phase in shallower intervals. The vertical and inclined production parameters for all phases of drilling are tabulated in Appendix B of the report. Figure 41 shows the first phase of the drill design.

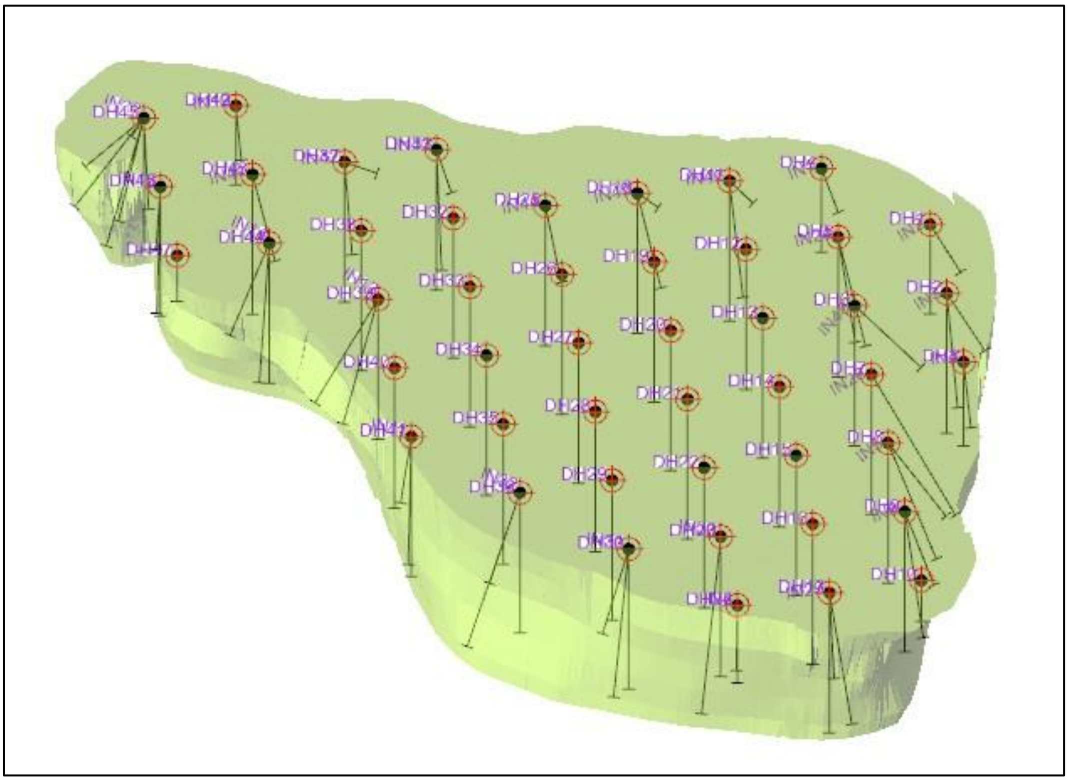


Figure 41 - First phase exploration drill design to elevation 605 (Sociedade Mineira de Kaixepa Mine Planning Department, 2024)

The combined solids model was sliced at elevation 790, keeping all geological information above that elevation. All required optimisation data was added to the generated block model. The optimisation produced an optimal shell to ensure the first split shell design did not go outside that perimeter. The second phase of drilling would be planned in two sections.

The first section will be drilled after the first split shell design. The second section will be drilled once the second half of the first design is mined to elevation 690. Figure 42 shows the second-phase drill design.

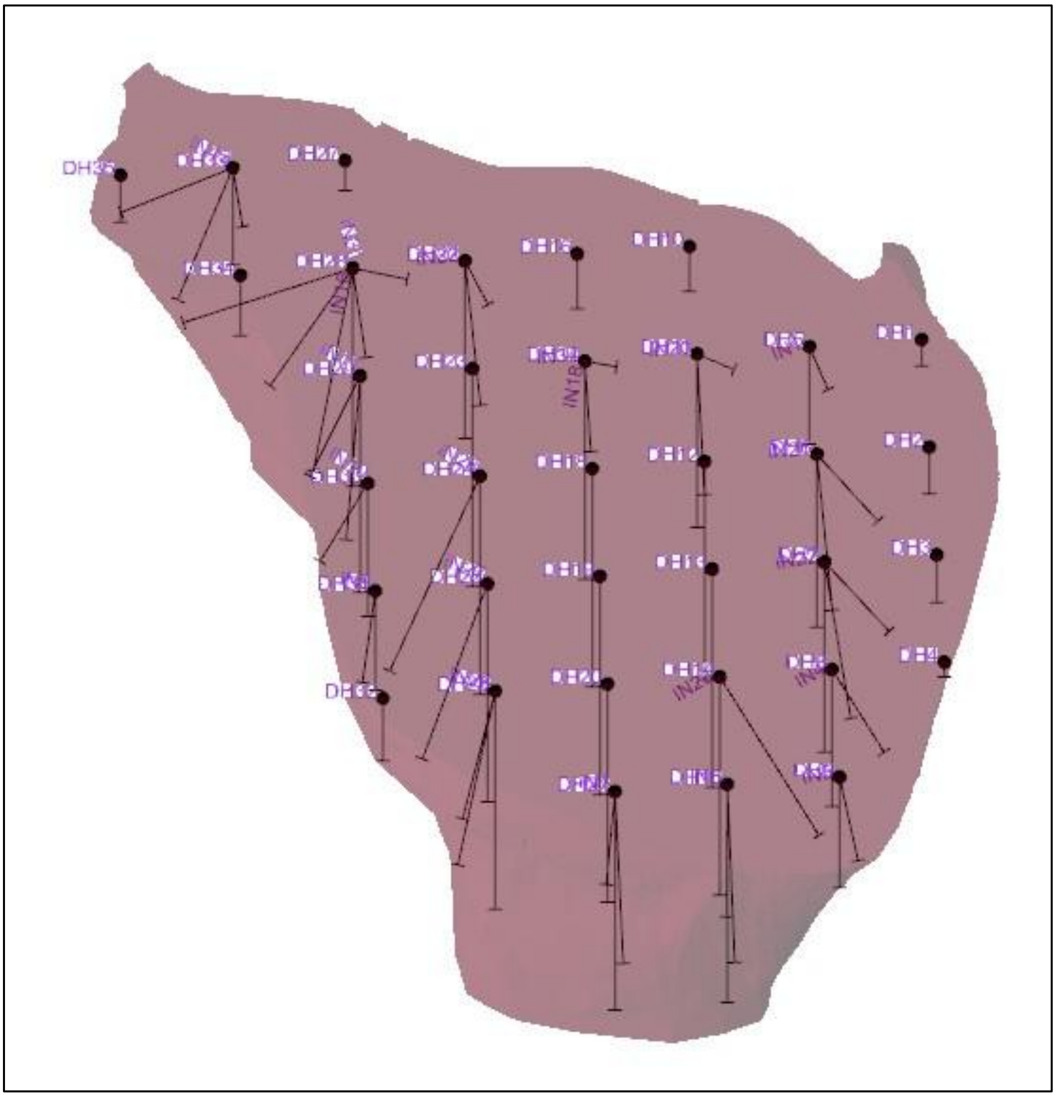


Figure 42 - Second phase exploration drill design to elevation 420 (Sociedade Mineira de Kaixepa Mine Planning Department, 2024)

Figure 43 shows the solids model after the first half of the second phase drilling is completed from two different angles.

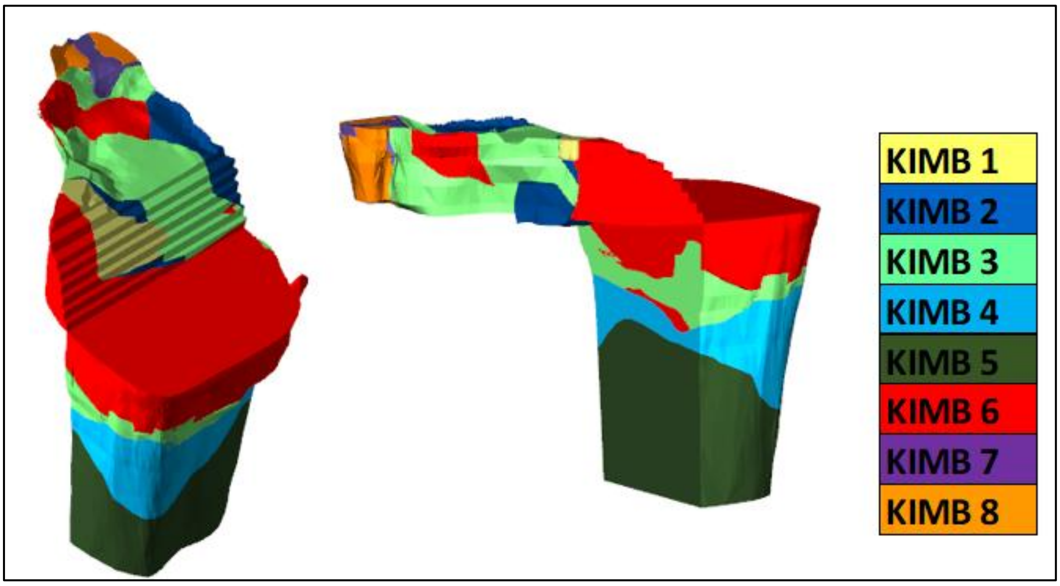


Figure 43 - Facies solids clipped based on phased exploration drilling to elevation 605 (Sociedade Mineira de Kaixepa Mine Planning Department, 2024)

4.3 Geotechnical Data

SRK evaluated the current slope condition of the CW open pit during a mine visit presented by their CP. They assessed the available core recovered from the inclined drilling that went beyond the orebody into the country rock. SRK requested that samples be sent to South Africa for laboratory testing to determine the compressive strength of the various rock types. Based on the compressive strength test results, the intact rock strength (IRS) is displayed in Table 8.

Table 8 – CW Rock strength summary (Armstrong & Terbrugge, 2018)

Camutue West Rock Strength Summary				
IRS Class Code	**IRS Class**	**Class Description**	**USC Range (Mpa)**	**CW Rock Types**
R1	Very Soft Rock	Peeled with a knife, it crumbles under firm blows with a geo-pick	1 - 5	Saprolite (SAP) and highly weathered gneiss (WGG)
R2	Soft Rock	Shallow indents with geo pick, knife peels with difficulty	5 - 25	Kimb 1, Kimb 2, Kimb 3, Kimb 4, Kimb 5
R3	Medium Strong	It cannot be scraped with a knife. Fractures with a firm blow of the hammer	25 - 50	Kimb 6 (VKB)
R4	Strong Rock	Fractures with more than one firm blow of the hammer	50 - 100	None
R5	Very Strong Rock	Fractures with many blows of the hammer.	100 - 250	Kimb 8 and granite gneiss (GG)

The results shown in Table 8 indicated a very weak rock strength for the kimberlite rock types. SRK agreed to maintain the slope design that they recommended in 2018 but cautioned about the areas where the ore and waste contacts are. Such areas must be avoided where haulage ramps are located as much as possible, as failures could be fatal. SRK also recommended additional future drilling outside the final pit perimeter to develop a hydrogeological model. The model would advise the positioning of dewatering wells around the pit area to decrease the volume of seepage water through the shear zones. Figure 44 shows the designed slope angles for the Saprolite and Weathered Granite Gneiss zones.

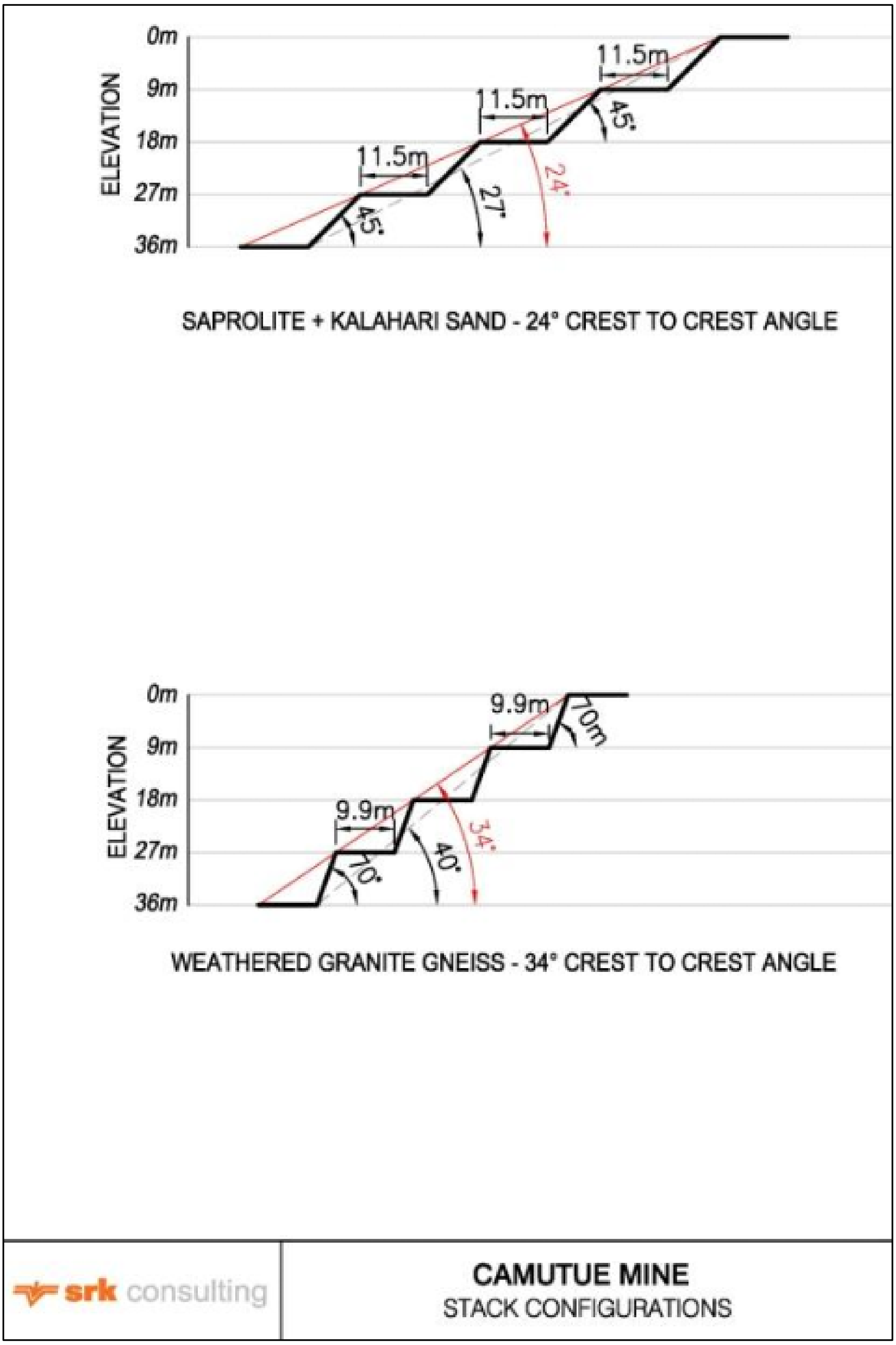


Figure 44 - CW SAP and WGG slope angles (Armstrong & Terbrugge, 2018)

Figure 45 shows the slope design for Granite Gneiss and kimberlite zones.

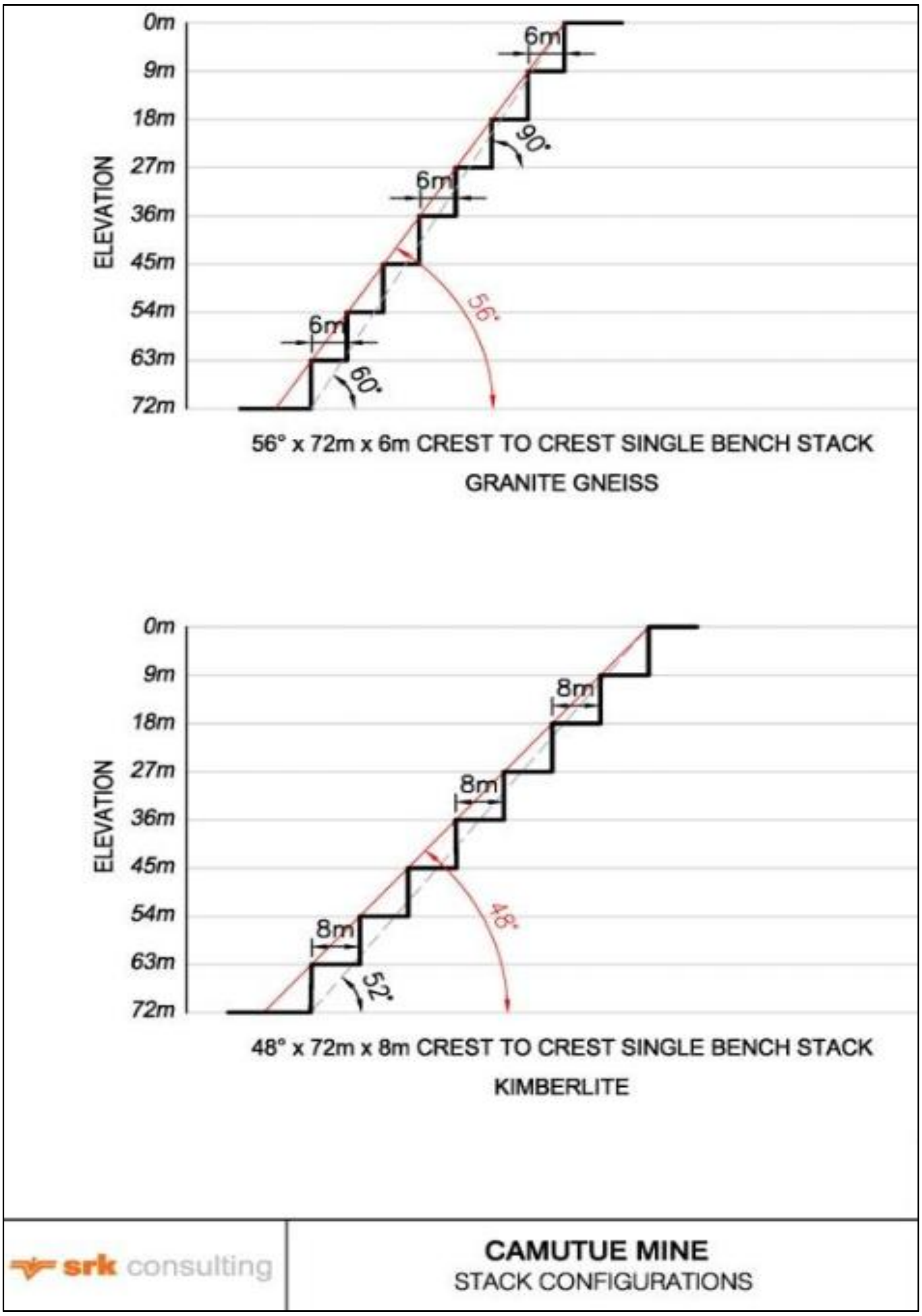


Figure 45 - CW GG and kimberlite slope angles (Armstrong & Terbrugge, 2018)

4.4 Financial Data

4.4.1 Cost data

The cost-controlling department sourced cost data for the open pit optimisation and financial evaluation for the production year 2023. The department uses Primavera computer software to process financial and procurement data. The software is set up so that costs are allocated to the various departments within the company. Mining and ore processing production figures were calculated based on the reconciliation of the monthly topographic survey. Various mine development processes occurred during 2023. This included the construction of a new tailings disposal facility and excavating for bulk sampling access of smaller satellite kimberlites. The production volume accounted for a significant amount, and the cost had to be separated to achieve accurate unit variable costs from the open pit areas.

Mine development costs are normally allocated to capital costs for mining companies. The cost-controlling system combined all costs for the earthmoving fleet under the mining department. Mining fleet hours utilised for production within the open pit areas were accurately recorded by the mine planning department to calculate efficiencies for future planning. The total combined earthmoving fleet hours were sourced from the Komatsu Comtrax system installed on equipment items. The open pit production hours were weighted against the total hours to get a percentage split between production and mine development. The total cost of the company's earthmoving operations was separated by the percentage split applied. Table 9 shows the percentage of split calculation based on the recorded production hours.

Table 9 - Mining fleet production hour split (Sociedade Mineira de Kaixepa Mine Planning Department, 2024)

Mining Fleet Production Hour Split			
Year Total Hours	**Open Production Hours**	**Percentage Pit Production**	**Percentage Mine Development**
152 581	88 586	58%	42%

The total cost of each department was sourced from the Primavera system. Costs at each department were evaluated and allocated on a percentage basis to the various required fixed or unit variable cost sections. The fixed costs were applied as overhead costs per cubic meter of ore treated through the plant. The cost was allocated to the overhead cost section to ensure all company costs were included in the open pit optimisation. The total overhead costs used during the open pit optimisation will be allocated as fixed costs per year for the DCF calculation. All costs associated with exploration drilling were combined and will be applied as capital costs in the open pit optimisation and the DCF calculation. Table 10 shows the cost evaluation per department.

Table 10 – Sociedade Mineira de Kaixepa cost allocation year 2023 (Sociedade Mineira de Kaixepa Mine Planning Department, 2024)

SMK Cost Allocation – Year 2023						
Department	**Total Cost (USD'000)**	**Load & Haul**	**Drill & Blast**	**Plant**	**Overhead Cost**	**Capital Cost**
Mine Admin	3 500	0%	0%	0%	100%	0%
Camp	2 000	0%	0%	0%	100%	0%
Drilling & Blasting	7 292	0%	100%	0%	0%	0%
Engineering	4 468	60%	20%	20%	0%	0%
Exploration Drilling	1 979	0%	0%	0%	0%	100%
Geology	242	50%	0%	50%	0%	0%
Human Resources	21	0%	0%	0%	100%	0%
Health & Safety	201	0%	0%	0%	100%	0%
Logistics	2 289	40%	10%	40%	0%	0%
Head Office	3 983	0%	0%	0%	100%	0%
Metallurgy	9 931	0%	0%	100%	0%	0%
Mine Planning	62	50%	50%	0%	0%	0%
Mining	24 374	100%	0%	0%	0%	0%
Plant Maintenance	3 290	0%	0%	100%	0%	0%
Security	2 101	0%	0%	0%	100%	0%
Survey	12	50%	50%	0%	0%	0%

The mining cost was separated based on the calculation done in Table 10. The reconciled mining, drilling for blasting, and ore processing production figures are weighted against the total cost allocation for each unit variable cost. Table 11 shows all combined cost and production figures with the unit variable costs calculated for each area of production required for the open pit optimisation.

Table 11 - Unit variable cost calculation (Sociedade Mineira de Kaixepa Mine Planning Department, 2024)

Combined Costs - Allocated Production Areas	
Cost Allocation Area	**Total Cost (USD '000)**
Load & Haul - Pit Production	16 331
Load & Haul - Mine Development	11 798
Drill & Blast	8 451
Ore Processing	15 030
Fixed Cost	11 805
The reconciled Year 2023 Production Parameters	
Production Parameters	**Production Achieved ('000)**
Pit Production (m^3)	2 781
Mine Development (m^3)	2 099
Drilling for Blasting (m)	222
Blasted Volume (m^3)	2 781
Ore Processed (m^3)	576
Combined Costs - Allocated Production Areas	
Production Parameters	**Unit Variable Cost (USD/m^3)**
Drill & Blast (m^3/blasted)	3.04
Mining SAP (m^3/mined)	5.87
Mining WGG (m^3/blasted & mined)	7.39
Mining GG (m^3/blasted & mined)	8.91
Mining Kimberlite (m^3/blasted & mined)	8.91
Ore Processing (m^3/proccessed)	26.10
Fixed Cost (m^3/proccessed)	20.50

4.4.2 Revenue data

The CW open pit profile did not allow the mining operation to proceed to elevations deeper than the original pit bottom of the second cut. Stripping of the CW Cut 3 benches was delayed to ensure less interference with the exploration drilling program. Sociedade Mineira de Kaixepa decided it would be best to use the diamond parcel from the surface bulk sample done in 2018. The same professional evaluator who valued the sample of 2018 is still doing the valuations for the mine and was tasked to re-evaluate the parcel. He re-visited the photos and data used previously and determined that the current value per carat is 15% higher than what was evaluated in 2018. Table 12 summarises the data used for the diamond parcel valuation.

Table 12 - CW diamond valuation (Sociedade Mineira de Kaixepa Mine Planning Department, 2024)

Camutue West Diamond Parcel Valuation - 2018			
Description	**Carats**	**Average Price/ct (USD '000)**	**Value (USD'000)**
Special Stones	290	2.6	738
10ct	0	0.0	0
9ct	0	0.0	0
8ct	0	0.0	0
7ct	0	0.0	0
6ct	1092	1.6	1 748
5ct	0	0.0	0
4ct	0	0.0	0
3ct	0	0.0	0
10gr	847	0.7	606
8gr	0	0.0	0
+13	423	0.2	116
+11	377	0.2	34
+9	175	0.1	12
+7	51	0.1	3
+5	39	0.2	2
-5	0	0.0	0
TOTALS			
Description	**Unit**	**Value**	
Carat	**ct**	**3 294**	
Value	**USD**	**3 259 384**	
2018 Price per Carat	**USD/ct**	**989**	
15% Market Adjustment	**USD/ct**	**148**	
2024 Price per Carat	**USD/ct**	**1 138**	

4.4.3 Royalties and Taxes

Angola's royalty rate is set at 5% of the value of the Mineral Resource for strategic minerals, including industrial diamonds, precious metals and precious stones. The value of the Diamond Resource is determined based on the total sales per year. The corporate tax rate is set at 25% of the profit, including that of exploration and mining companies. The government of Angola has been investigating the possibility of tax breaks for mining companies on capital spending since 2022. No official tax break laws have been approved so far. The Angolan mining law states that companies may apply for tax discounts from the Ministry of Mineral Resources, Petroleum and Gas (MMRPG) (Podowski et al., 2022).

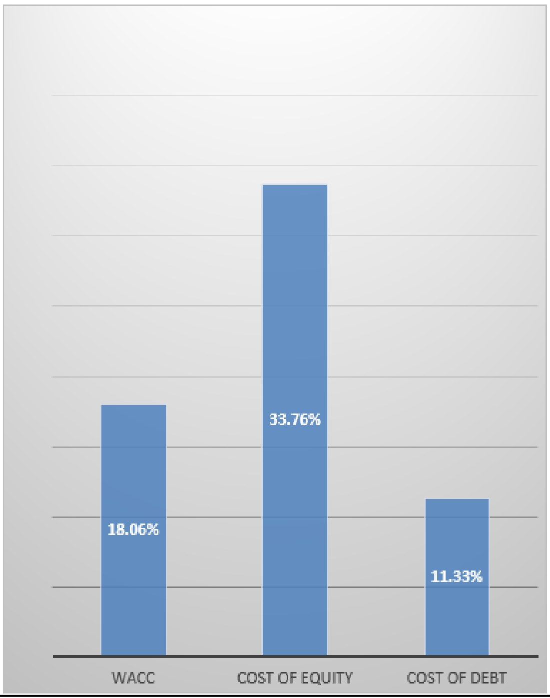
4.4.4 Discount rate

The exploration drilling program was funded by both equity and debt. The shareholders of Sociedade Miniera de Kaixepa financed the purchasing of drilling equipment and consumables. The operational cost of the exploration drilling program was funded with a bank loan from a local bank in Angola. The financial department supplied the interest rate charged by the bank. The rate of return for the equity finance was calculated based on the capital asset pricing model. Added to the model was the country-specific rate of return consideration to ensure that risks associated with Angola have been considered. The finance department provided a beta value of 1.1 due to the added risk incurred because of the remote location of the mine. The equity risk premium of Angola was sourced from the internet, updated in January 2024 (Damodaran, 2024). The cost of equity calculation is tabulated in Table 13.

Table 13 - Cost of equity calculation (Sociedade Mineira de Kaixepa Mine Planning Department, 2024)

Country Risk Premium - Cost of Equity Calculation	
Capital Asset Pricing Model	
Description	**Rate**
Risk-Free Rate (rf)	8.73%
(+) Beta (β)	1.1
(×) Equity Risk Premium (ERP)	14.11%
(+) Country Risk Premium (CRP)	9.51%
Cost of Equity (ke)	**33.76%**

Sociedade Mineira de Kaixepa secured a bank loan, with interest charged at the Secured Overnight Financing Rate (SOFR) with an added 6% spread. When the loan was secured, the 30-day rate used for the discount rate was 5.33%. The spread of 6% was added to the rate to achieve a debt financing rate of 11.33%, a direct cost to the company charged for the loan. The primary shareholders have signed for surety if Sociedade Mineira de Kaixepa cannot comply with the loan's obligations. The bank required this because the Diamond Resource had yet to be developed to a stage that could justify funding with debt. The values funded from equity and debt were weighted against each other to determine the percentage contribution of each part. This was used in the WACC calculation to determine the company's discount rate. The discount rate will be applied to the open pit optimisation and the DCF calculations. Figure 46 shows that the WACC calculation is done.



Weight %	
Equity	30.00%
Debt	70.00%
Total	**100.00%**

Cost of Equity & Debt	
Cost of Equity	**33.76%**
Cost of Debt	**11.33%**

Weighted Average Cost of Capital Calculation	
Cost of Equity	33.76%
(x) Equity % Weight	30.00%
(+) Cost of Debt	11.33%
(x) Debt % Weight	70.00%
WACC	**18.06%**

Figure 46 – Sociedade Miniera de Kaixepa WACC calculation (Sociedade Mineira de Kaixepa Mine Planning Department, 2024)

4.5 Survey Data

Survey data required for developing the geological block model was collected using a Wingtra Gen II drone. The outer limits of the block model were determined based on the widest pit shell achieved with the 2019 Whittle optimisation. The block outline was expanded beyond the optimal shell to ensure sufficient space around all areas if even wider pit shells could be achieved. The block limit was extended in Google Earth software to ensure that the drone flight covers the block perimeter's extent. The flight area was exported as a .kml file and imported into the Samsung Tablet used for the drone's flight plan. The survey department processed the drone flight data using Agisoft software to generate a point cloud. The point cloud was clipped to the limit of the block perimeter for surface generation. Figure 47 shows the drone ready for takeoff to do the survey.

Figure 47 - Wingtra Gen II drone (Sociedade Mineira de Kaixepa Mine Planning Department, 2024)

Figure 48 shows the flight plan generated.

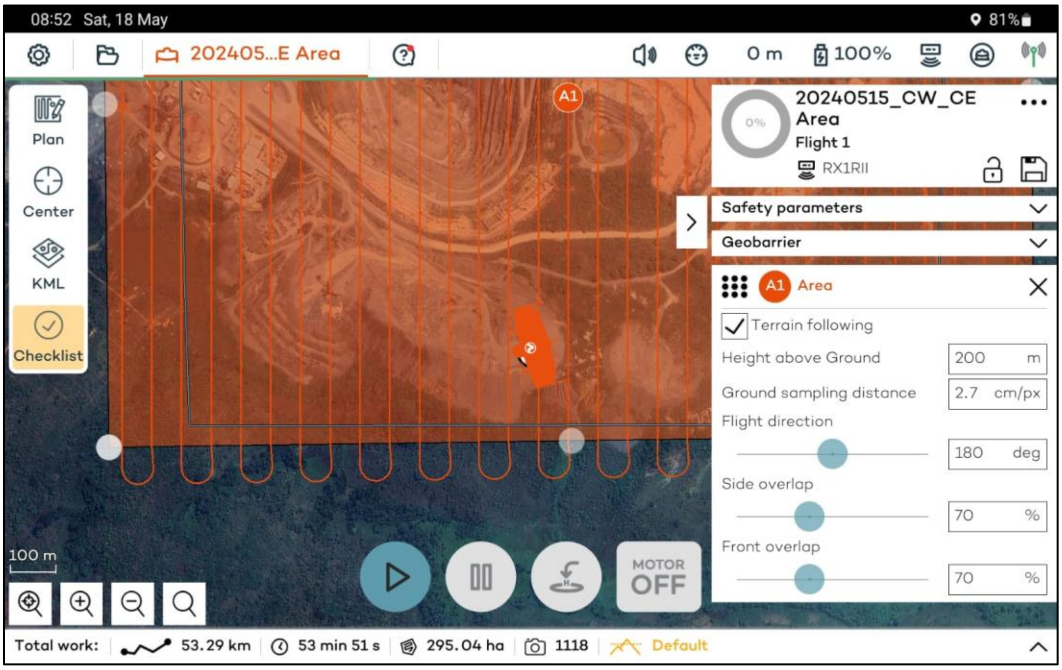


Figure 48 - Drone survey flight plan (Sociedade Mineira de Kaixepa Mine Planning Department, 2024)

Figure 49 shows the processed photogrammetry data, which shows the block area of survey data collected with the drone.

Figure 49 - Drone survey data image (Sociedade Mineira de Kaixepa Mine Planning Department, 2024)

Figure 50 shows the surface clipped to the required block model perimeter generated with the Deswik CAD software program.

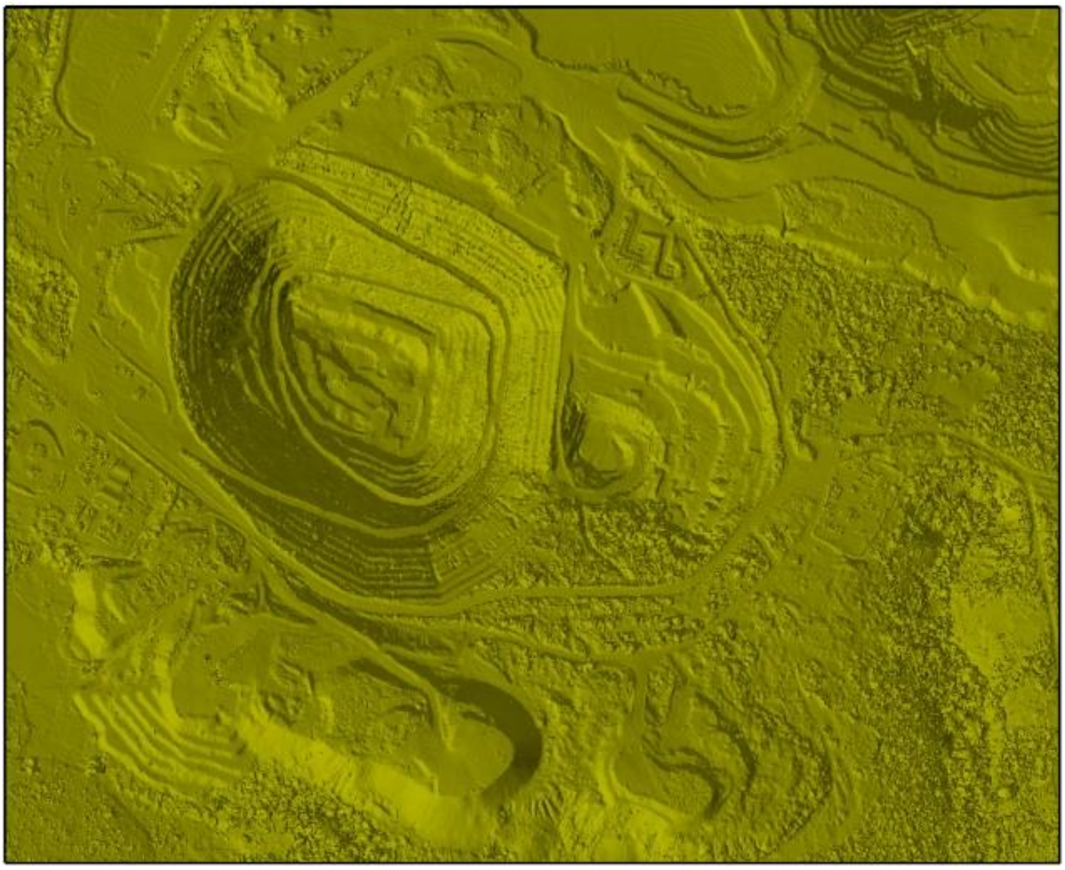


Figure 50 - CW block model perimeter surface September 2024 (Deswik CAD, 2024)

4.6 Chapter Summary

This chapter contains all the data required to run the open pit optimisation. The core drilling production figures for the drilled vertical and inclined holes are summarised in the chapter's first section. Photos showed how the core from Remote Exploration Services was handled and evaluated. The LLD sampling methods and quality-controlled measures are illustrated, including the processing methods used through the bulk sampling plant. The grade results achieved from the LDD sampling process were evaluated by the CP and presented. The core login information processed by the CP is illustrated in a three-dimensional (3D) format using GOCAD software. Based on the evaluation of the core logging, the CP generated a solids model with the grade content applied to each solid. The rock strength of the various waste and ore rock types in the CW open pit is summarised from the information obtained from SRK. Recommended slope angles designed by SRK are illustrated for each rock mass. These slope angles will be applied to the open pit optimisation.

The cost data from the Sociedade Miniera de Kaixepa cost-controlling department are summarised. The various allocations of the different types of costs are explained and separated into the sections required for the open pit optimisation. The Sociedade Miniers de Kaixepa professional evaluator revisited the 2019 bulk sample information and provided a price per carat for the current real value. This price will be used for the optimisation process to calculate the cash flow revenue. Angola's royalty and tax laws were researched using the internet and presented to be applied to the cash flow. The cost of equity for Sociedade Miniera de Kaixepa was calculated using the CAPM formula. The cost of equity value was combined with the cost of debt within the WACC formula to get the correct discount rate. The discount rate will be applied to discount the final result in the various cash flow scenarios.

The drone survey is illustrated, and the surface is generated from the extracted survey data. The surface will be clipped to the exact perimeter required to create the geological block model, which will be the data source containing all relevant information needed for the open pit optimisations.

5 ANALYSIS AND FINDINGS

5.1 Introduction

The data required and used for the optimisation will be analysed to determine its effect on the results. All geological data will be evaluated and compared to the 2019 geological model to determine the extrapolation method's accuracy. Exploration drilling production parameters will be assessed to determine the required capital application for each scenario. This will analyse the opportunity of staged exploration drilling compared to a complete exploration program before mining starts. Financial data will be compared to the data used in the 2019 optimisation to determine variances that might affect the results.

The results from the various open pit optimisations will be presented. The analysis is based on the pit shells produced by the Deswik GO software package. Production volumes measured from the block models within the pit shells will be presented and analysed. The expected effect of the variances in the size of the shells on the cash flow results will be evaluated. The cash flow results for each scenario will be presented and analysed to determine the cause for the variances for each scenario.

5.2 Geological Analysis

5.2.1 Exploration drilling results

The actual core drilling metres was less than that achieved in the planned program. The core drilling program produced 836 meters for the vertical holes and 542 meters for the inclined, less than planned. This is a total of 1 378 meters less than what was intended. There were two factors mainly influencing the vertical holes. The first finding was that some holes planned closer to the edge of the kimberlite pipe intersected the host rock. This is an indication of a shallower-than-expected dip in the orebody. The second finding was that some planned holes, more in the centre of the orebody, collapsed. The weak compressive strength of the kimberlite and seepage water at deeper elevations contributed to the collapse of holes. The design of the exploration program was done based on the extrapolated model from 2019.

The reduced inclined core drilling metres was due to an earlier intersection with the host rock. This was an early indication that the orebody was smaller than previously estimated with the extrapolated model before the solids model could be generated. A reduced ore volume would lead to unnecessary costs that would have been considered mineable ore with the 2019 optimisation. The core drilling confirmed the continuity of the Kimb 4 and Kimb 5 rock types down to elevation 420, the end of the geological model. The only difference now was that the two kimberlite domains could be separated. An interrogation model was generated using Deswik CAD software to compare the ore volumes of the 2024 geological model to the 2019 geological model. The 2024 model proved to be significantly smaller than the 2019 model. The volume of the Kimb 4 and Kimb 5 domains measured from the 2024 model was combined for comparison purposes illustrated in Table 14.

Table 14 - Mineral resource volume comparison (Deswik CAD, 2024)

Mineral Resource Volume Comparison			
	2019 Model	**2024 Model**	**Variance**
Rock Type	**Volume m³ ('000)**	**Volume m³ ('000)**	**Volume m³ ('000)**
Kimb 2	19	0	-19
Kimb 3	355	1 102	746
Kimb 4&5	7 710	5 748	-1 962
Kimb 6	1 266	1 129	-137
Kimb 8	15	0	-15
TOTAL	**9 365**	**7 978**	**-1 386**

The LLD sampled grades correlated to the Kimb 4 bulk sample processed in 2018. Both the Kimb 4 and Kimb 5 domain's grade results were near the combined Kimb 4&5 bulk sample results from historical data. The Kimb 3 and Kimb 6 grades also correlated well with the historic ore processing grades achieved. It was decided to use the 2019 ore domain grades for the optimisation. This was due to their proximity in grade estimation results and equal bco, allowing for an unbiased comparison between the exploration drilling program and the extrapolated model. Table 15 shows the variance between the 2019 and LDD sampled grades from 2024.

Table 15 - CW Grade Comparison (Sociedade Mineira de Kaixepa Geology Department, 2024)

Camutue West 2024 LDD Grades - 2019 Optimisation Grades			
Rock Type	**LDD Grade (ct/m³)**	**2019 Grade (ct/m³)**	**Variance ct/m³**
Kimb 1	Mined out	0.000	Not applicable
Kimb 2	Mined out	0.188	Not applicable
Kimb 3	0.185	0.175	0.010
Kimb 4	0.428	0.417	0.011
Kimb 5	0.417	0.417	0.000
Kimb 6	0.118	0.105	0.013
Kimb 7	Mined out	Mined out	Not applicable
Kimb 8	Mined out	0.145	Not applicable

5.2.2 Waste rock model

Sociedade Mineira de Kaixepa only contracted Remote Exploration Services to generate an ore solids model. The Deswik CAD software program had to be used to create the waste rock model. A complete solid model of the required perimeter of the block model was made, and the ore model was clipped out of that. The waste rock solid was then further sliced, representing the various waste rock types identified by the geotechnical evaluation. This was required to ensure the prescribed slope design was honoured within each geotechnical zone. SRK maintained the slope design as specified in 2018, following the evaluation done in 2024. The slope angles, therefore, will not affect the comparison of the cash flows in any way. Figure 51 shows the waste rock model developed.

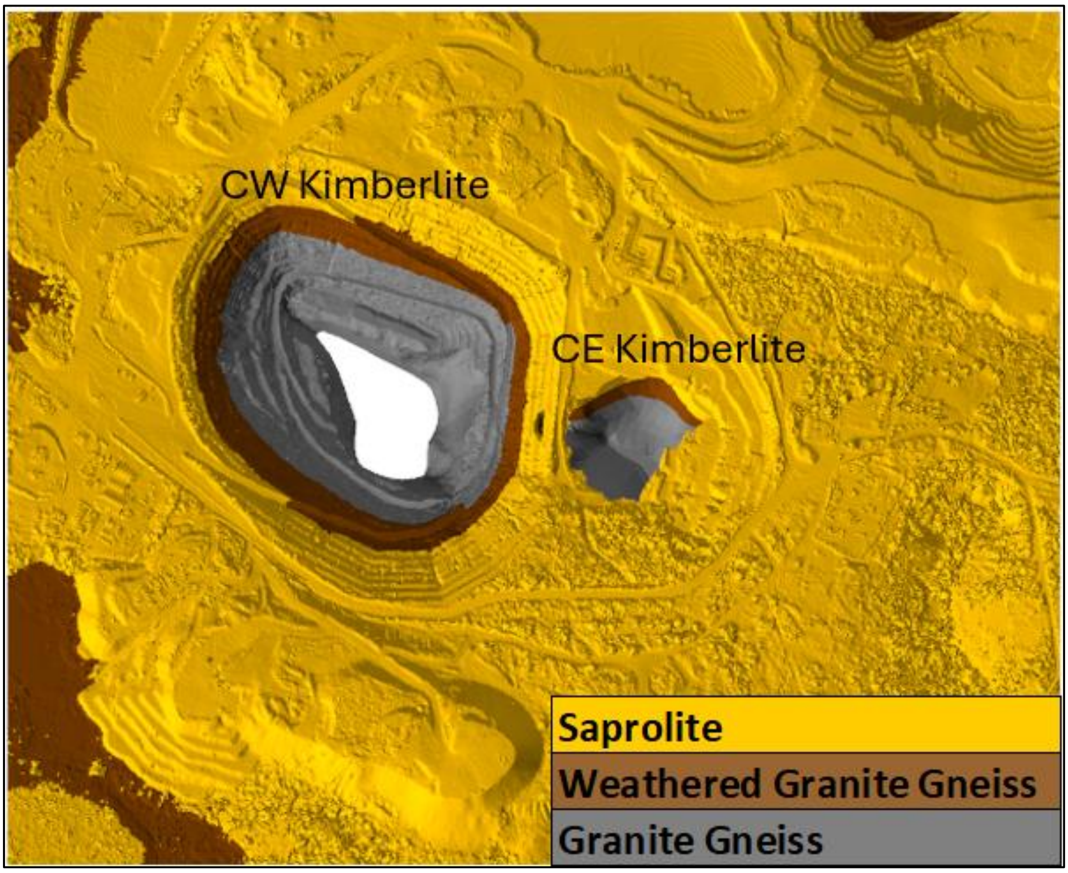


Figure 51 - CW waste rock model (Sociedade Mineira de Kaixepa Mine Planning Department, 2024)

5.3 Financial Data Analysis

5.3.1 Cost data

The 2023 cost data from the financial department were near the cost data inputs into the 2019 optimisation. The variance in costs for the optimisation inputs was evaluated to ensure no significant difference. Great variances in the unit cost inputs into the optimisation would have impacted the NPV results from the cash flow. It would have also made the optimal pit shell of the 2024 model either much bigger or smaller. This would have defeated the purpose of comparing various exploration methods and the impact thereof on the overall NPV value of the mine. The comparison showed that the mining costs in 2023 were lower, but the processing cost was higher. The COVID-19 pandemic had a significant impact on the supply of plant parts to the mine, resulting in damage to major components. Frequent stoppages due to breakdowns are decreasing production and, consequently, increasing the unit variable cost. There was an insignificant difference between the fixed costs. After consideration, it was found that the actual 2024 costs could be used for the optimisation. The mining volume is much more than the processing volume, balancing out the bigger variance in processing cost. Table 16 compares the unit cost inputs of the 2019 Whittle optimisation compared to the 2024 Deswik GO optimisation.

Table 16 - Optimisation unit cost comparison (Sociedade Mineira de Kaixepa Mine Planning Department, 2024)

Optimisation Unit Cost Input **Comparison**				
		2019 Cost	**2024 Cost**	**Variance**
Input Parameters	**Unit of measure**	**USD/m³**	**USD/m³**	**USD/m³**
Drill & Blast	m³/blasted	\$3.04	\$3.86	\$0.82
Mining Saprolite	m³/mined	\$5.87	\$6.17	\$0.30
Mining FGG	m³/mined	\$7.39	\$8.10	\$0.71
Mining GG	m³/mined	\$8.91	\$10.03	\$1.12
Mining Kimberlite	m³/mined	\$8.91	\$10.03	\$1.12
Ore Processing	m³/processed	\$26.10	\$16.78	-\$9.32
Fixed Cost	m³/processed	\$20.50	\$20.09	-\$0.41

5.3.2 Revenue data

The diamond valuator contractor by Sociedade Mineira de Kaixepa estimated a price of USD 1 138 per carat based on the re-evaluation of the bulk sample done in 2018. The 2019 Whittle optimisation used the valued price of USD 989 per carat. A five per cent real growth percentage was applied to the price for the first three years and then maintained at that level. A price of USD 1 202 per carat was used for the 2019 optimisation, slightly higher than the 2024 price. It was decided to use the price provided by the valuator for the 2024 optimisation. No growth percentage was added to the price based on the condition of the diamond market in 2024.

The variance in the diamond market between the first valuation in 2018 and the set price of 2024 had to be evaluated. This was to determine whether the revenue input into the optimisation was a realistic value. Due to the privacy in diamond market reporting, it was difficult to find such an analysis. All sources of diamond market reporting were found to be paid sites with high yearly subscription rates. Zimnisky's website was found on the internet, which provided a diamond price graph that was useful to analyse the market position over the indicated period. The trend on the diamond price graph was analysed, and it was found that the price for optimisation correlated with the diamond market.

Figure 52 shows the diamond market graph supplied by Zimnisky.

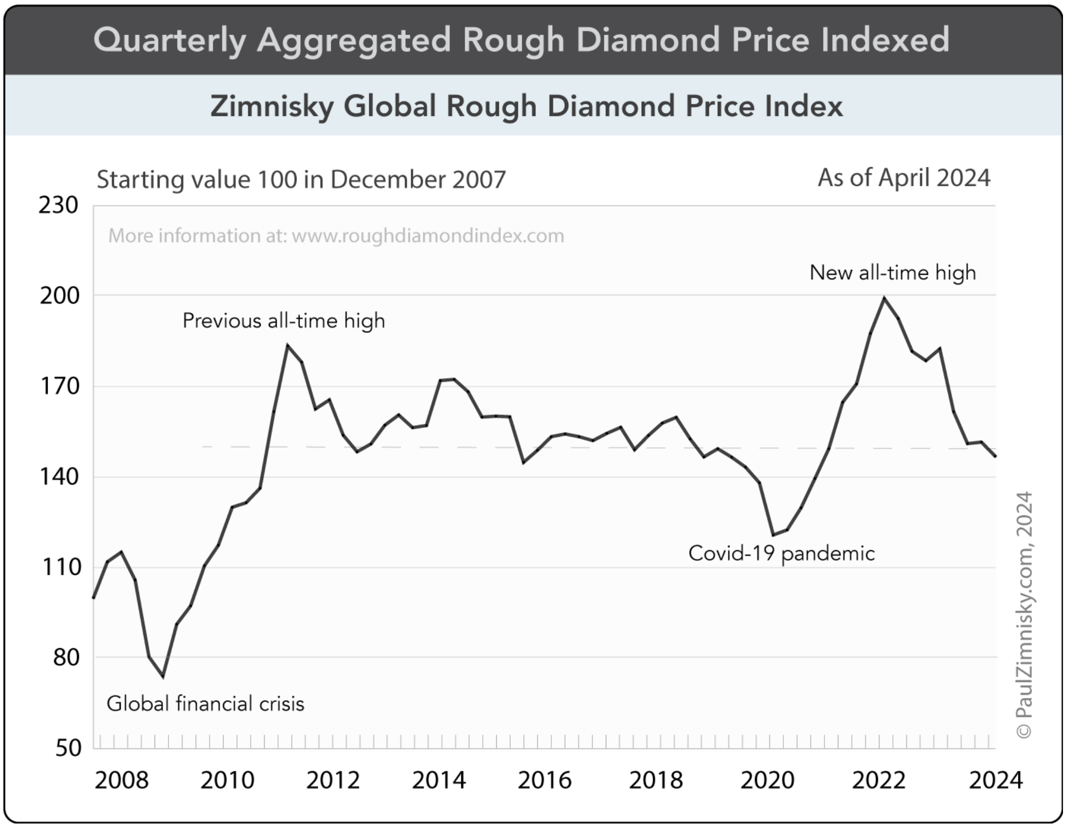


Figure 52 - Diamond price index (Zimnisky, 2024)

5.3.3 Capital cost

The actual cost of the 18-month exploration drilling program was applied as capital cost for the 2024 optimisation. The cost included all drilling equipment purchased, operational costs, and Remote Exploration Services's evaluation. The cost and production rate of the exploration program were used as a baseline for calculating the capital cost and timeframe for the other scenarios. This was applied to the complete and phased exploration drilling programs. The cash flow for the extrapolated model had no capital included, as no exploration was being done. The core drilling program quantities were broken down into drilling costs per meter and drilling meters per month. These values were applied to the drilling designs for the different scenarios to determine the capital cost and exploration drilling time. Table 17 shows the breakdown of the production figures.

Table 17 - Exploration drilling program breakdown (Sociedade Mineira de Kaixepa Mine Planning Department, 2024)

Exploration Drilling Program Breakdown		
Description	Unit	Quantity
Vertical drilling	m	2 996
Inclined drilling	m	2 843
Total drilling	m	5 839
Total drilling months	no	18
Average drilling per month	m	324
Total exploration drilling cost	USD	2 969
Cost per month	USD	165
Cost per year	USD	1 979

The production figure breakdown was applied to the complete drill design to calculate the cost of capital and drilling time, as shown in Table 18.

Table 18 – Complete NQ core drill design estimations (Sociedade Mineira de Kaixepa Mine Planning Department, 2024)

Complete Drill Design Estimations		
Description	Unit	Quantity
Vertical drilling	m	10 082
Inclined drilling	m	6 645
Total drilling	m	16 727
Meters per month	m	324
Total Months	no	52
Cost per month	$	165
Cost per year	$	1 979
Cost for four months.	$	660

Table 19 shows the same calculations for the first phase drill design based on the split shell option.

Table 19 - First-phase NQ core drill design estimations (Sociedade Mineira de Kaixepa Mine Planning Department, 2024)

First Phase Drill Design Estimations		
Description	Unit	Quantity
Vertical drilling	m	5 071
Inclined drilling	m	2 975
Total drilling	m	8 046
Meters per month	m	324
Total Months	no	25
Cost per month	$	165
Cost per year	$	1 979
Cost for one month.	$	165

Table 20 summarises the drilling estimations for the first portion of the split shell design at 690 elevation.

Table 20 - Second phase first half NQ core drill design estimations (Sociedade Mineira de Kaixepa Mine Planning Department, 2024)

Second Phase First Half Drill Design Estimations		
Description	Unit	Quantity
Vertical drilling	m	3 497
Inclined drilling	m	1 846
Total drilling	m	5 343
Meters per month	m	324
Total Months	no	16
Cost per month	$	165
Cost per year	$	1 979
Cost for four months.	$	660

Table 21 summarises the final drilling phase in the last portion of the split shell design.

Table 21 - Second phase last half NQ core drill design estimations (Sociedade Mineira de Kaixepa Mine Planning Department, 2024)

Second Phase Last Half Drill Design Estimations		
Description	Unit	Quantity
Vertical drilling	m	2 848
Inclined drilling	m	2 528
Total drilling	m	5 376
Meters per month	m	324
Total Months	no	17
Cost per month	$	165
Cost per year	$	1 979
Cost for five months.	$	825

5.4 Open Pit Optimisation Results

5.4.1 Optimisation results – 2024 geological model

Open pit optimisation was done with the Deswik GO software package. The software used the direct block scheduling method to process the optimisation. The optimisation produced a mineable optimal pit shell with a positive NPV value.

The optimal shell of the 2024 optimisation was visually compared using the Deswik CAD software. The two shells were evaluated in section view to visualise their differences. It was found that the optimal shell of 2019 was much bigger compared to the 2024 model. The updated geological solids model was super-imposed in the section view to evaluate if the 2019 shell gained substantially more ore. The 2019 optimal shell included significantly more stripping volume and was well below the updated geological model. Figure 53 compares the 2024 Deswik GO optimal shell and the 2019 optimal Whittle shell within the updated geological model.

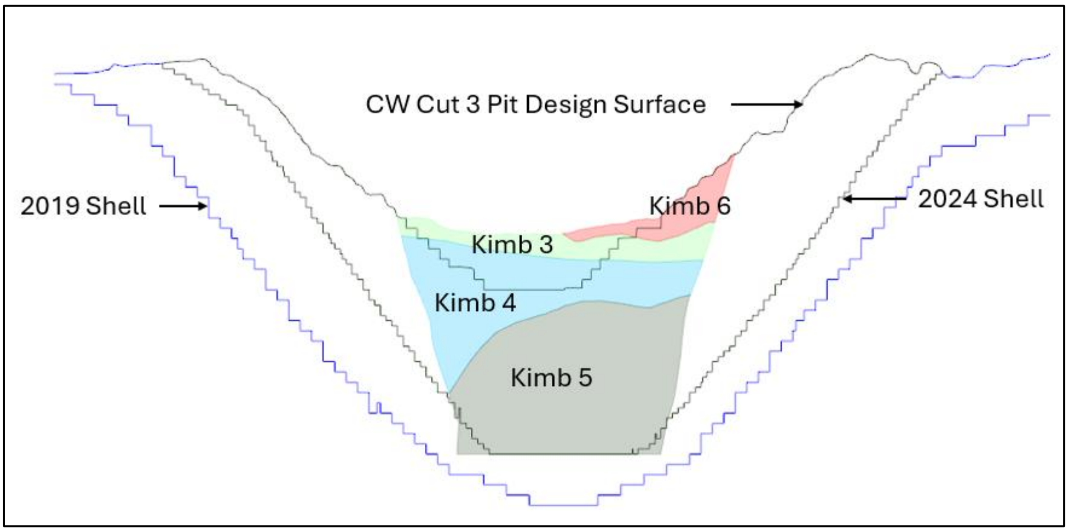


Figure 53 - Optimal pit shell comparison (Deswik CAD, 2024)

Table 22 shows the Diamond Resource statement for the 2024 model.

Table 22 - CW Diamond Resource statement 2024 (Sociedade Mineira de Kaixepa Mine Planning Department, 2024)

Camutue West Diamond Resource Statement 2024						
Facies	**Volume (m^3 '000)**	**Grade (ct/m^3)**	**Carats (ct '000)**	**Value (USD/ct)**	**BOC (mm)**	**Clasifiaction**
Kimberlite 3	1 113	0.175	195	700.00	2.00	Indicated
Kimberlite 4	1 756	0.427	750	989.00	2.00	Indicated
Kimberlite 5	3 992	0.427	1 705	1 138.00	2.00	Indicated
Kimberlite 6	957	0.105	101	600.00	2.00	Indicated
TOTAL	**7 818**	**0.352**	**2 750**	**1 046.69**	**2.00**	**Indicated**

Figure 54 shows the updated SFD graph for CW.

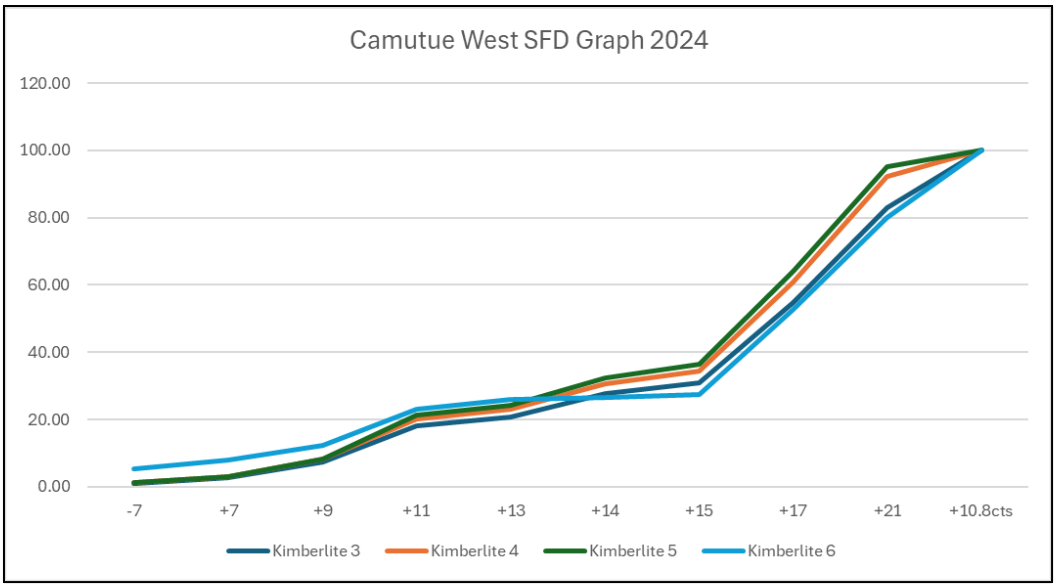


Figure 54 - CW SFD graph 2024 (Sociedade Mineira de Kaixepa Geology Department, 2024)

The optimisation inputs were very similar except for the geological models. The 2019 extrapolated model contained more ore than the model created from the exploration drilling program, which showed a major risk of incurring additional stripping costs using the extrapolation method. The additional cost of stripping would also negatively impact the mine's NPV value. The volumes from each optimal shell were interrogated with the Deswik CAD software measured from the 2024 updated geological model. It was found that the total ore volume for the optimal shells was near each other, but the stripping volume was completely the opposite. Table 23 summarises the variance in the volumes measured between the pit shells.

Table 23 - Optimal pit shell volume comparison (Deswik CAD, 2024)

Optimal Pit Shell Volume Comparison				
Rock Type	Unit	2019 Optimal Shell	2024 Optimal Shell	Variance
Kimberlite	m^3 ('000)	8 193	7 884	308
Saprolite	m^3 ('000)	11 155	8 561	2 594
Weathered Granite Gneiss	m^3 ('000)	10 698	5 660	5 038
Granite Gneiss	m^3 ('000)	50 485	26 172	24 313
Total Ore	**m^3 ('000)**	**8 193**	**7 884**	**308**
Total Stripping	**m^3 ('000)**	**72 338**	**40 394**	**31 945**

5.4.2 Combined geological model optimisation

The same cost and revenue factors were applied to the combined geological model's optimisation. Historic grades were applied to rock types that had previously been depleted. The grades of the ore upper ore domains were much lower than the Kimb 4 and 5 domains. The bigger ore model was expected to produce a bigger optimal pit shell with the added revenue from upper domains. The optimal shell from the 2024 model was evaluated in section view against the shell from the combined optimisation model. It was found that they are almost the same. This indicated that the lower-grade ore at higher elevations did not add value to the optimisation. The direct block scheduling process in Dewik GO predominantly considered the Kimb 4 and Kimb 5 domains to add value to the NPV. Figure 55 compares the two optimal shells within the combined geological model.

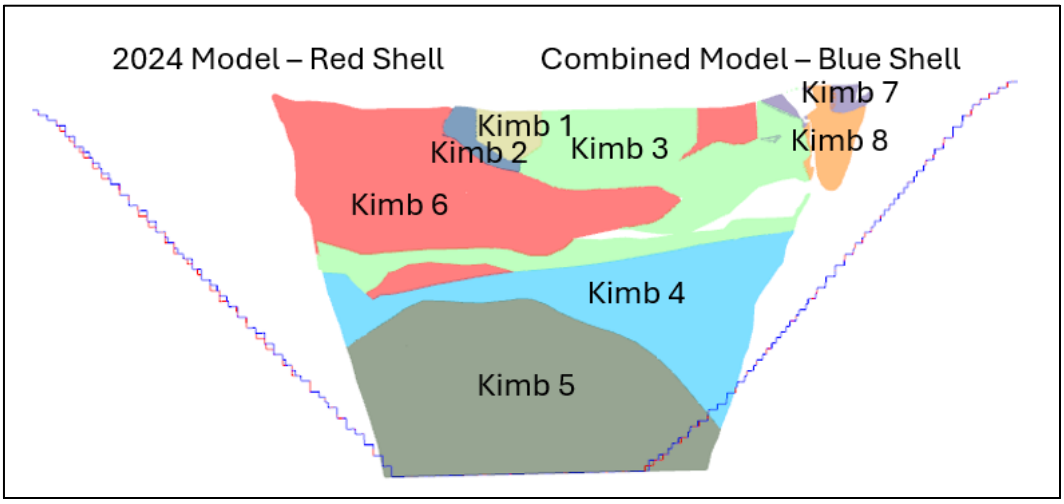


Figure 55 - Combined model optimal shell comparison (Deswik CAD, 2024)

The original pit surface profile was evaluated against the optimal pit shell. It was established that three evenly sized mining cuts can be done with feasible space for equipment movement. This optimisation approach aimed to determine if the first cut could reach sufficient depth to intersect the higher-grade ore. This would have allowed a bulk sample to prove the ore domains' diamond value at deeper elevations. Three pit designs were done using the Deswik CAD software package, with the first cut intersecting the Kimb 4 domain. The second cut intersected the Kimb 5 domain, which would also provide valuable diamond value information before the final cut is concluded. The three designs within the combined geolgical model are shown in Figure 56.

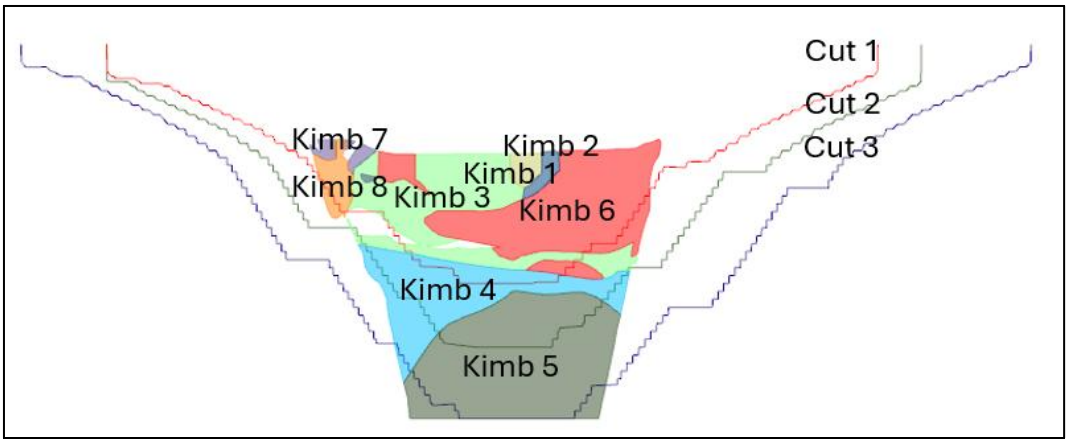


Figure 56 - Concentric pushback designs (Deswik CAD, 2024)

5.4.3 Phased exploration model optimisation

The first optimisation was done with the combined solids model sliced at elevation 690. It resulted in an optimal pit shell that considered all ore mineable until the end of the model. The pit shell was a guideline for a full first-cut pit design. The pit design was modified to advance mining towards the southeastern side of the orebody to form the first split shell design. Bench access to the ramps has to be carefully planned to allow the full design to be mined after the first split shell cut. It was noticed in this design that the access ramps can only proceed until the 690 elevation. At this point, it intersects the benches left for the second mining phase. Figure 57 shows the design lines of the first split shell.

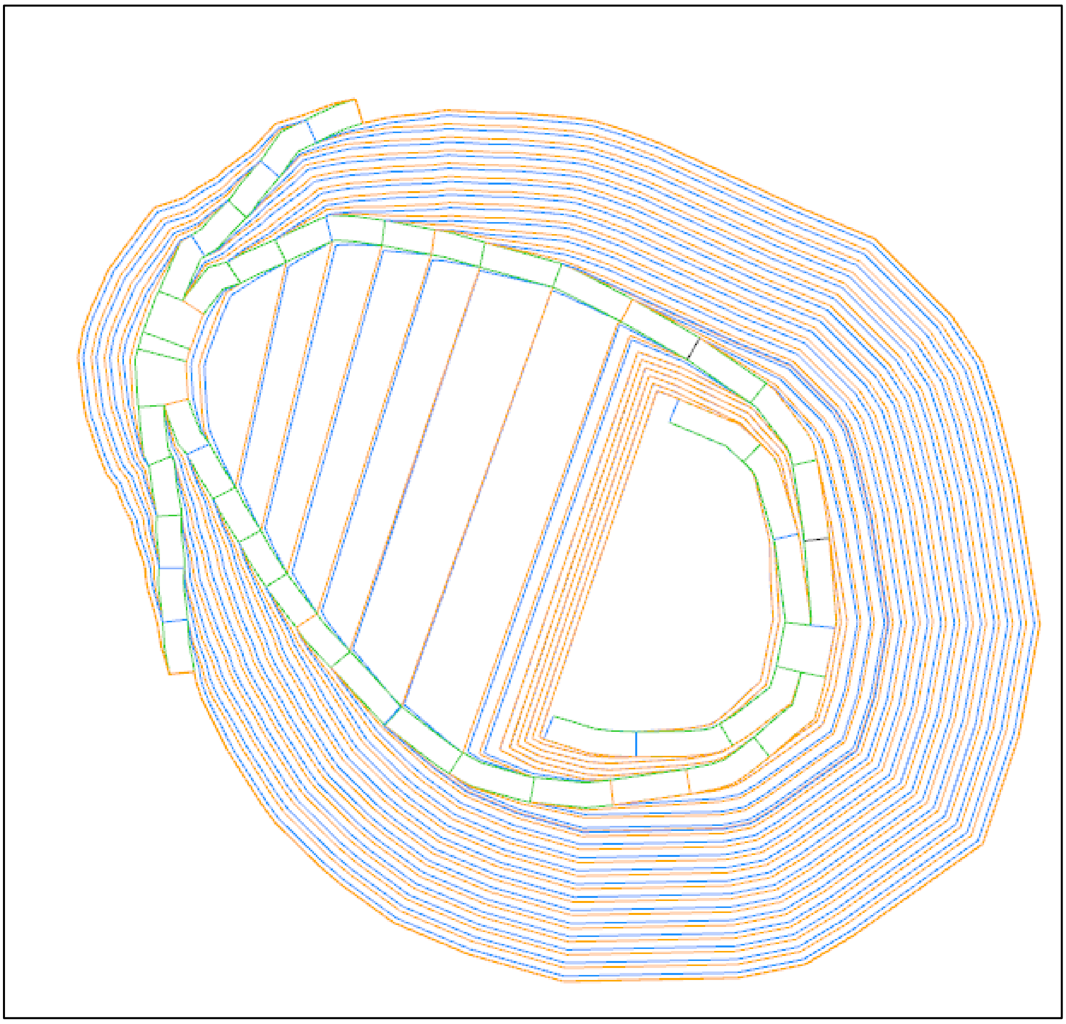


Figure 57 - First split shell design (Deswik CAD, 2024)

The end of the first split shell design provided a platform for the second phase exploration drill program. Ore will be supplied from the benches left behind during this period. The second split shell section's exploration, drilling, and development must be planned in the correct timeframe. Stripping of the section split shell will have to reach sufficient ore supply before the first design is depleted. The southeastern part of the combined solids model was sliced based on the drilling space allowed from the first split shell design. The second optimisation used the sliced model to guide the consecutive split shell design. The final phase of drilling was expected to produce the combined solids model with the same optimal shell. The second split shell design had to stop at elevation 560 to allow for mining space for the final design. All designed surfaces are shown in Figure 58.

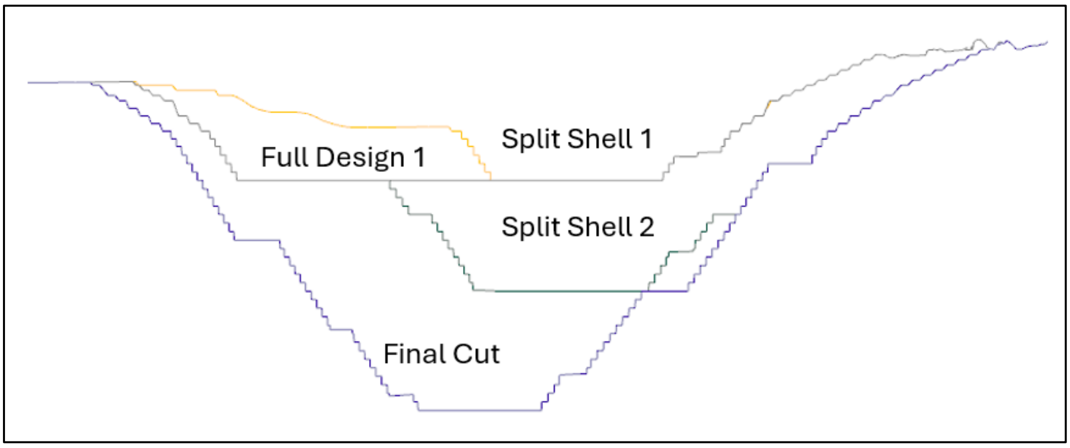


Figure 58 - Split shell designs (Deswik CAD, 2024)

5.5 Discounted Cashflow Results

5.5.1 Production parameters

Production volumes for each scenario were measured using the generated geological block models. The first model is based on the updated exploration program, and the second one has historical ore solids added. The Deswik CAD software's interrogation function calculated all rock types from the models separated into designed bench elevations. When evaluating the production volumes, it was found that separate volumes would be required based on production years. This is due to the various rock types being mined at different costs. Additionally, the various ore rock types have different grades that return yearly revenues. These values had to be placed into the correct production years to ensure the discounted NPV values were correctly calculated.

The first depleted bench scenario calculated was based on the 2024 updated geological model. The current CW was used as a base for ore supply. The production volumes of the optimal pit shell were depleted at such a rate that it would ensure positive plant feed for each year. It was found that the open pit is in a decreasing stripping ratio scenario, requiring high volumes of stripping in the beginning. Table 24 summarises the results. Production started in the third year, with the first two years allocated for the exploration drilling program.

Table 24 - 2024 geological model optimisation production summary (Sociedade Mineira de Kaixepa Mine Planning Department, 2024)

2024 Geological Model Optimisation Production Figures						
	Mining Production				**Processing Production**	
Year	**Ore**	**SAP**	**WGG**	**GG**	**Ore**	**Carats**
	m³ (000)	**m³ (000)**	**m³ (000)**	**m³ (000)**	**m³ (000)**	**ct (000)**
1						
2						
3	600	7 804	5 660	1 818	600	98
4	600	-	-	11 347	600	183
5	600	-	-	3 611	600	94
6	600	-	-	3 026	600	119
7	600	-	-	1 671	600	189
8	600	-	-	730	600	241
9	600	-	-	1 254	600	250
10	600	-	-	986	600	250
11	600	-	-	507	600	250
12	600	-	-	507	600	250
13	600	-	-	308	600	250
14	600	-	-	135	600	250
15	600	-	-	272	600	264
16	85	-	-	-	85	21
TOTALS	**7 885**	**8 561**	**5 660**	**26 172**	**7 885**	**2 710**

The second production scenario calculation was the 2019 Whittle optimisation shell. Production started in the first year as this scenario did not have exploration drilling. The CW Cut 3 design was also the base of ore supply in the initial two years. Production depletion was done the same as in the previous scenario, as these two cash flows will be compared. Production in earlier years required higher stripping volumes than the first scenario due to the larger Whittle pit shell. Table 25 summarises the production depletion for the 2019 Whittle shell.

Table 25 - Whittle optimisation production summary (Sociedade Mineira de Kaixepa Mine Planning Department, 2024)

2019 Whittle Optimisation Production Figures						
	Mining Production				**Processing Production**	
Year	**Ore**	**SAP**	**WGG**	**GG**	**Ore**	**Carats**
	m³ (000)	**m³ (000)**	**m³ (000)**	**m³ (000)**	**m³ (000)**	**ct (000)**
1	600	11 155	10 698	6 790	600	98
2	600	-	-	18 603	600	184
3	600	-	-	5 702	600	83
4	600	-	-	3 705	600	96
5	600	-	-	2 887	600	191
6	600	-	-	2 669	600	248
7	600	-	-	2 460	600	249
8	600	-	-	1 088	600	236
9	600	-	-	1 886	600	250
10	600	-	-	1 537	600	250
11	600	-	-	1 207	600	250
12	600	-	-	911	600	250
13	600	-	-	859	600	250
14	393	-	-	181	393	164
TOTALS	**8 193**	**11 155**	**10 698**	**50 485**	**8 193**	**2 799**

The production profiles of the two scenarios based on the combined geological model were also calculated using the same depletion method. The pushback scenario required five years to complete the exploration program. The split shell scenario only needed two years, with the initial phase of drilling only a hundred meters deep. Both scenarios were depleted, ensuring that the stripping of the consecutive cuts was done at the correct time for continuous ore supply. Production depletion calculations of all four scenarios were added to input tables prepared for the discounted cash flow calculations. Cost and revenue factors were applied to each scenario and added to the cash flow tables. The cash flow input tables are presented in Appendix C of the report. Table 26 shows the pushback scenario production depletion summary.

Table 26 - Pushback scenario production summary (Sociedade Mineira de Kaixepa Mine Planning Department, 2024)

Pushback Approach Production Figures						
	Mining Production				Processing Production	
Year	Ore	SAP	WGG	GG	Ore	Carats
	m³ (000)	m³ (000)	m³ (000)	m³ (000)	m³ (000)	ct (000)
1						
2						
3						
4						
5						
6	600	2 707	553	36	600	78
7	600	-	-	823	600	86
8	600	-	-	695	600	85
9	600	-	-	589	600	82
10	600	-	-	486	600	81
11	600	-	-	385	600	81
12	600	2 330	-	327	600	79
13	600	672	-	442	600	75
14	600	320	1 914	424	600	67
15	600	-	1 664	994	600	67
16	600	-	-	2 658	600	89
17	600	-	-	2 658	600	126
18	600	3 128	-	2 803	600	100
19	600	3 059	1 875	997	600	134
20	600	-	2 737	3 194	600	204
21	600	-	-	5 931	600	250
22	600	-	-	5 931	600	250
23	600	-	-	5 931	600	250
24	600	-	-	3 188	600	261
25	600	-	-	569	600	235
26	600	-	-	341	600	250
27	600	-	-	193	600	250
28	433	-	-	20	433	181
TOTALS	**13 633**	**12 216**	**8 742**	**39 615**	**13 633**	**3 362**

Table 27 shows the summary of the split shell production.

Table 27 - Split shell scenario production summary (Sociedade Mineira de Kaixepa Mine Planning Department, 2024)

Split Shell Approach Production Figures						
	Mining Production				Processing Production	
Year	Ore	SAP	WGG	GG	Ore	Carats
	m³ (000)	m³ (000)	m³ (000)	m³ (000)	m³ (000)	ct (000)
1						
2						
3	600	3 458	3 542	887	600	76
4	600	-	-	556	600	80
5	600	403	443	985	600	72
6	600	-	837	994	600	65
7	600	-	686	1 145	600	75
8	600	5 883	-	382	600	87
9	600	2 317	2 309	1 639	600	91
10	600	600	2 760	3 505	600	87
11	600	748	791	-	600	67
12	600	-	636	903	600	65
13	600	-	-	1 539	600	69
14	600	-	-	1 539	600	82
15	600	-	-	1 539	600	99
16	600	-	-	1 539	600	132
17	600	-	-	1 539	600	187
18	600	-	-	1 539	600	255
19	600	-	-	1 539	600	255
20	600	-	-	1 539	600	307
21	600	-	-	1 284	600	250
22	600	-	-	695	600	250
23	600	-	-	453	600	250
24	600	-	-	239	600	250
25	600	-	-	113	600	250
26	190	-	-	3	190	79
TOTALS	**13 990**	**13 409**	**12 003**	**26 097**	**13 990**	**3 484**

5.5.2 Discounted cashflow

The 2024 geological model produced the highest NPV value, USD 315 million. The 2019 Whittle optimisation calculated the second-highest value, USD 289 million. It was expected that the variance of the two scenarios would have been greater. The additional cost of waste stripping from the 2019 optimisation was expected to negatively impact the NPV more severely. It was subsequently realised that the TVM concept has a more significant impact on the NPV value. The 2019 results benefitted from an earlier start in production.

The pushback approach had the lowest cash flow of USD 110 million. The split shell approach produced a slightly higher value of USD 145 million. The discounted NPV value of these two scenarios is significantly less than the previous two. This indicates that the lower-grade ore mined at higher elevations caused a loss in NPV value. Deeper down in the kimberlite pipe, the higher grade Kimb 4 and 5 domains were the source of revenue that contributed to a positive NPV. The phased exploration drilling method allowed for an earlier start in revenue generation that contributed to an increased NPV. The graph in Figure 59 shows a summary of the undiscounted profit results.

Figure 59 - Undiscounted profit results (Sociedade Mineira de Kaixepa Mine Planning Department, 2024)

5.6 Chapter Summary

The exploration showed decreased drilling meters compared to the plan, which indicated that the kimberlite body was smaller than extrapolated. The resource statement estimation confirmed the suspicion, and the two models were compared. The optimal shell from the updated geological model was smaller than from the 2019 Whittle optimisation. The bigger pit shell was due to the additional ore from the extrapolated model mining a significant volume of additional waste at a cost.

The added lower-grade ore from the combined geological model did not contribute value to the NPV. The optimal pit shell from the combined geological model was almost the same size as the updated model. The pushback and split shell designs were done to calculate the production figures for the cashflows. Production volumes of all scenarios were depleted following the sequence of the bench elevations. This was done to ensure the correct inputs were applied to the correct time frames within the cash flow.

The NPV values of all scenarios were summarised, showing that the updated geological model produced the highest discounted NPV value. The NPV value of the 2019 Whittle optimisation was lower due to the additional stripping cost. The split shell scenario with the phased exploration drilling designs produced a higher NPV than the pushback scenario. The TVM concept proved to have a major impact on the variance between the scenarios. Table 28 shows a summary of the NPV results.

Discounted NPV Summary		
Scenario	**Unit**	**Result**
2019 Optimisation	USD ('000)	$289 343
2024 Optimisation	USD ('000)	$315 439
Pushback Approach	USD ('000)	$109 836
Split Shell Approach	USD ('000)	$144 862

6 CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

This is the last chapter of the research report. It summarises all the chapters and states the observations made from the research applied to the data collected. The most important results will be highlighted. This report will summarise its contributions to developing kimberlite pipes in Angola. It will follow with the main limitations experienced during the research. Based on the findings, recommendations will be made to inform possible future research work.

6.2 Summary of Chapters

This report has presented six chapters that cover the following:

- Introduction;
- Literature Review;
- Research Approach;
- Data for the study;
- Analysis and Findings; and
- Conclusions and Recommendations.

6.3 Research Observations

6.3.1 Initial and complimentary studies

Initial studies focused on the exploration methods used to develop a mineral resource for a kimberlite pipe. The aim was to determine whether there is any scientific evidence that kimberlites might have similar sizes and shapes within a certain area. This would validate the method of extrapolating the kimberlite body at deeper elevations to avoid the capital cost of exploration drilling.

Research methods used in kimberlite exploration drilling and sampling to prove that Sociedade Mineira de Kaixepa's exploration program was at the correct standard to make valid conclusions for this research. Diamond valuation methods were researched to determine whether diamonds could be priced without developing a large open pit.

Open pit optimisation techniques were researched to determine how these could be applied with exploration drilling. The aim was to find methods of earlier access to kimberlite domains at deeper elevations to allow for sampling practices. Optimisation techniques that would allow for phased exploration over the life of mine were researched. This was aimed at facilitating the drilling of shorter intervals to overcome the challenge of drilling within the weakly structured kimberlite.

The required financial inputs for discounted cash flow calculations were studied. This ensured that the discounted NPV value for each scenario was done to the required standards. Angola’s royalty and tax laws were investigated so that they were applied correctly to the cash flow calculations. Various factors affecting the NPV result were researched so that conclusions could be drawn based on the results achieved.

6.3.2 Key findings and observations

Kimberlite pipes are not uniform, and there is no correlation between the size, shape or dip of the orebody within any kimberlite field. The exploration program proved that the Kimb 4 and Kimb 5 domains continued at depth in the CW kimberlite. The kimberlite pipe dipped at a much shallower angle compared to the expectation from the extrapolation that was done previously. This method overestimated the volume of ore within the extrapolated model of the combined Kimb 4 & 5 domain with the highest grade. The large estimated ore model caused the 2019 Whittle optimal pit shell to be too big, mining unnecessary waste at a cost.

The optimisation based on the updated geological model of the exploration drilling program achieved the highest discounted NPV value. The capital spent on the exploration program added value compared to the extrapolated model. This proved that there was no replacement for a high-quality resource estimation, drilling and sampling program.

The lower NPV values achieved from the two optimisations were based on the combined geological model. This proved that the lower-grade ore at higher elevations did not contribute to the NPV value. The lower-grade ore had to be depleted to access the higher-grade Kimb 4 and Kimb 5 domains. The significance of the TVM concept was realised by comparing the pushback and split shell scenarios. The split shell scenario had a shorter initial phase of exploration drilling, allowing for earlier revenue generation. The split shell scenario did allow for phased exploration drilling but still proved to have limitations due to the size of the ore body. The first advanced split section only allowed for one hundred meters of mining in-depth due to the practical mining access required. This forced the second phase of exploration drilling to be done at depth of up to two hundred and fifty metres. The exploration drilling program experienced hole collapse at depths of less thank two hundred and fifty metres, which would risk the feasibility of this drilling approach. The split shell scenario did intersect the Kimb 4 and Kimb 5 domains earlier, which would have allowed for diamond quality evaluation.

6.4 Research Contributions

The research highlighted the importance of proper mineral resource management. The results could advise the government of Angola to adobt the SAMREC Code. This would force investors to make responsible decisions by applying capital to exploration drilling programs. The value added to the mine from proper mineral resource management practices could encourage future investors to invest in Angola. Investments in the under-explored kimberlite-rich areas of the Lunda provinces would contribute to the socio-economic development of the local people.

6.5 Research Limitations

The location of the mine is in a very remote area, which contributed to an increased logistics difficulty. The initial core rigs had many breakdowns, and the spares took a long time to reach the mine. This caused the drilling program to be over-extended, which also increased the completion time of this research report. The difficulty experienced with drilling within the kimberlite material contributed to some of the holes not reaching the desired depths.

6.6 Recommendations for Future Research Work

Exploration drilling is an essential requirement for Mineral Resource management. Using orebody extrapolations is not recommended to avoid the capital cost of exploration drilling. It is recommended that all available forms of exploration drilling options be researched to improve the drilling results in the kimberlite. Advanced technology in chemicals that could be applied to the drilling water might enhance the stability of the holes. The capacity of larger core drill rigs must be researched to identify if that could assist in reaching deeper elevations. It is also recommended that different options for RC drilling be evaluated, which could produce bigger samples with less diamond grinding. This would greatly assist in the valuation of diamonds in deeper kimberlite domains. Mining companies must evaluate the posiblities of using experienced drilling contractors. It will reduce the required capital for drilling equipment and might achieve higher quality results.

Open pit optimisation techniques are recommended to improve the quality of exploration drilling. Techniques like the split shell design proved valuable, reducing the required exploration drilling depth. The method also added value when earlier revenue was generated. The presence of additional kimberlite bodies within the concession would be advantageous. Additional sources of ore supply could allow exploration drilling in shorter phases. This will allow mining production to continue while the exploration programs are altered between the various stages of the multiple sources. This will enable pushback scenarios to be evaluated at each stage of exploration drilling. It will also present more opportunities for controlled bulk samples at deeper elevations. The valuation of diamonds of kimberlite domains at deeper elevations will provide a higher level of confidence to the shareholders. The success in achieving an optimal NPV result is highly dependent on an accurate geological model. Shareholders need to commit to proper exploration programs to achieve the best results for all stake holders involved.

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APPENDIX A. COMPLETE EXPLORATION DRILL DESIGNS

Appendix Table 1 - Complete exploration vertical drill plan (Sociedade Mineira de Kaixepa Mine Planning Department, 2024)

Complete Exploration Progam - Vertical Drill Hole Design				
HOLE ID	**Dip**	**Length**	**Over-Drill Into Host Rock**	**Total Drilling Length**
DL1-1	-90	84	2	86
DL1-2	-90	49	2	51
DL2-1	-90	81	2	83
DL2-2	-90	192	2	194
DL2-3	-90	127	2	129
DL2-4	-90	88	2	90
DL3-1	-90	27	2	29
DL3-2	-90	133	2	135
DL3-3	-90	360	0	360
DL3-4	-90	314	2	316
DL3-5	-90	152	2	154
DL3-6	-90	131	2	133
DL3-7	-90	98	2	100
DL3-8	-90	52	2	54
DL4-1	-90	219	2	221
DL4-2	-90	360	0	360
DL4-3	-90	360	0	360
DL4-4	-90	294	2	296
DL4-5	-90	206	2	208
DL4-6	-90	153	2	155
DL4-7	-90	55	2	57
DL5-1	-90	180	2	182

DL5-2	-90	360	0	360
DL5-3	-90	360	0	360
DL5-4	-90	360	0	360
DL5-5	-90	360	0	360
DL5-6	-90	175	2	177
DL5-7	-90	91	2	93
DL6-1	-90	142	2	144
DL6-2	-90	321	2	323
DL6-3	-90	360	0	360
DL6-4	-90	360	0	360
DL6-5	-90	360	0	360
DL6-6	-90	187	2	189
DL6-7	-90	52	2	54
DL7-1	-90	293	2	295
DL7-2	-90	360	0	360
DL7-3	-90	360	0	360
DL7-4	-90	340	2	342
DL7-5	-90	175	2	177
DL8-1	-90	360	0	360
DL8-2	-90	360	0	360
DL8-3	-90	327	2	329
DL8-4	-90	119	2	121
DL9-1	-90	48	2	50
DL9-2	-90	113	2	115
DL9-3	-90	25	2	27
TOTAL		**10 082**	**66**	**10 148**

Appendix Table 2 - Complete exploration inclined drill plan (Sociedade Mineira de Kaixepa Mine Planning Department, 2024)

Complete Exploration Progam - Inclined Drill Hole Design				
HOLE ID	**Dip**	**Length**	**Over-Drill Into Host Rock**	**Total Drilling Length**
IN2	-74	125	2	127
IN3	-75	124	2	126
IN4	-82	121	2	123
IN5	-72	126	2	128
IN6	-72	126	2	128
IN7	-75	124	2	126
IN8	-83	121	2	123
IN9	-77	123	2	125
IN10	-70	127	2	129
IN11	-88	110	2	112
IN12	-86	120	2	122
IN13	-89	120	2	122
IN14	-86	241	2	243
IN15	-84	241	2	243
IN16	-71	127	2	129
IN17	-88	120	2	122
IN18	-83	121	2	123
IN19	-88	120	2	122
IN20	-77	123	2	125
IN21	-85	241	2	243
IN22	-83	242	2	244
IN23	-84	241	2	243
IN24	-86	241	2	243
IN25	-84	241	2	243
IN26	-82	237	2	239

IN27	-87	240	2	242
IN28	-87	240	2	242
IN29	-86	241	2	243
IN30	-84	241	2	243
IN31	-81	243	2	245
IN32	-80	244	2	246
IN33	-86	241	2	243
IN34	-89	240	2	242
IN35	-85	241	2	243
IN36	-89	240	2	242
IN37	-83	232	2	234
TOTAL		**6 645**	**72**	**6 717**

APPENDIX B. PHASED EXPLORATION DRILL DESIGNS

Appendix Table 3 - Split shell first phase vertical drill plan (Sociedade Mineira de Kaixepa Mine Planning Department, 2024)

Split Shell First Phase - Vertical Drill Design				
HOLE ID	**Dip**	**Length**	**Over-Drill Into Host Rock**	**Total Drilling Length**
DL2	-90	100	-	100
DL3	-90	100	-	100
DL4	-90	100	-	100
DL5	-90	100	-	100
DL6	-90	100	-	100
DL7	-90	100	-	100
DL8	-90	100	-	100
DL9	-90	100	-	100
DL1-1	-90	84	2	86
DL1-2	-90	49	2	51
DL2-1	-90	81	2	83
DL2-2	-90	100	-	100
DL2-3	-90	100	-	100
DL2-4	-90	88	2	90
DL3-1	-90	27	2	29
DL3-2	-90	100	-	100
DL3-3	-90	100	-	100
DL3-4	-90	100	-	100
DL3-5	-90	100	-	100
DL3-6	-90	100	-	100
DL3-7	-90	100	-	100
DL3-8	-90	52	2	54
DL4-1	-90	100	-	100

DL4-2	-90	100	-	100
DL4-3	-90	100	-	100
DL4-4	-90	100	-	100
DL4-5	-90	100	-	100
DL4-6	-90	100	-	100
DL4-7	-90	55	2	57
DL5-1	-90	100	-	100
DL5-2	-90	100	-	100
DL5-3	-90	100	-	100
DL5-4	-90	100	-	100
DL5-5	-90	100	-	100
DL5-6	-90	100	-	100
DL5-7	-90	100	-	100
DL6-1	-90	100	-	100
DL6-2	-90	100	-	100
DL6-3	-90	100	-	100
DL6-4	-90	100	-	100
DL6-5	-90	100	-	100
DL6-6	-90	100	-	100
DL6-7	-90	52	2	54
DL7-1	-90	100	-	100
DL7-2	-90	100	-	100
DL7-3	-90	100	-	100
DL7-4	-90	100	-	100
DL7-5	-90	100	-	100
DL8-1	-90	100	-	100
DL8-2	-90	100	-	100
DL8-3	-90	100	-	100
DL8-4	-90	90	-	90
DL9-1	-90	48	2	50
DL9-2	-90	100	-	100
DL9-3	-90	25	2	27
TOTAL		**5 051**	**20**	**5 071**

Appendix Table 4 - Split shell first phase inclined drill plan (Sociedade Mineira de Kaixepa Mine Planning Department, 2024)

Split Shell First Phase - Inclined Drill Design				
Hole ID	**Dip**	**Length to Contact**	**Over-Drill Into Host Rock**	**Total Length**
IN1	-72	42	2	44
IN2	-69	43	2	45
IN3	-67	43	2	45
IN4	-85	40	2	42
IN5	-57	47	2	49
IN6	-71	43	2	45
IN7	-71	42	2	44
IN8	-87	40	2	42
IN9	-67	44	2	46
IN10	-63	45	2	47
IN11	-83	40	2	42
IN12	-48	54	2	56
IN13	-59	47	2	49
IN14	-87	40	2	42
IN15	-48	48	2	50
IN16	-48	48	2	50
IN17	-50	52	2	54
IN18	-83	40	2	42
IN19	-51	51	2	53
IN20	-72	42	2	44
IN21	-54	49	2	51
IN22	-58	47	2	49
IN23	-80	81	2	83
IN24	-85	80	2	82
IN25	-65	88	2	90

IN26	-68	65	2	67
IN27	-84	80	2	82
IN28	-83	81	2	83
IN29	-69	86	2	88
IN30	-79	81	2	83
IN31	-71	85	2	87
IN32	-88	80	2	82
IN33	-48	54	2	56
IN34	-83	81	2	83
IN35	-87	40	2	42
IN36	-79	82	2	84
IN37	-78	82	2	84
IN38	-76	82	2	84
IN39	-73	84	2	86
IN40	-77	82	2	84
IN41	-87	80	2	82
IN42	-70	85	2	87
IN43	-76	82	2	84
IN44	-85	80	2	82
IN45	-81	81	2	83
IN46	-60	92	2	94
TOTAL		**2 883**	**92**	**2 975**

Appendix Table 5 - Split shell second phase first part drill plan (Sociedade Mineira de Kaixepa Mine Planning Department, 2024)

Split Shell Second Phase - Drill Design - First Part				
HOLE ID	Dip	Length	Over-Drill Into Host Rock	Total Drilling Length
DH1	-90	33	2	35
DH2	-90	58	2	60
DH3	-90	60	2	62
DH4	-90	18	2	20
DH5	-90	120	2	122
DH6	-90	214	2	216
DH7	-90	235	2	237
DH8	-90	170	2	172
DH9	-90	137	2	139
DH10	-90	56	2	58
DH11	-90	214	2	216
DH12	-90	270	-	270
DH13	-90	270	-	270
DH14	-90	270	-	270
DH15	-90	270	-	270
DH18	-90	270	-	270
DH19	-90	270	-	270
DH20	-90	270	-	270
DH21	-90	270	-	270
IN1	-82	91	2	93
IN2	-88	93	2	95
IN3	-76	91	2	93
IN4	-78	92	2	94
IN5	-85	90	2	92
IN6	-75	93	2	95

IN7	-85	90	2	92
IN19	-75	93	2	95
IN20	-89	180	2	182
IN21	-88	180	2	182
IN22	-87	180	2	182
IN23	-79	183	2	185
IN24	-86	180	2	182
IN25	-87	180	2	182
TOTAL		**5 293**	**50**	**5 343**

Appendix Table 6 - Split shell second phase second part drill plan (Sociedade Mineira de Kaixepa Mine Planning Department, 2024)

Split Shell Second Phase - Drill Design - Second Part				
HOLE ID	Dip	Length	Over-Drill Into Host Rock	Total Drilling Length
DH16	-90	68	2	70
DH17	-90	270	-	270
DH22	-90	219	2	221
DH23	-90	270	-	270
DH24	-90	270	-	270
DH25	-90	270	-	270
DH26	-90	270	-	270
DH27	-90	37	2	39
DH28	-90	270	-	270
DH29	-90	268	2	270
DH30	-90	165	2	167
DH31	-90	123	2	125
DH32	-90	77	2	79
DH33	-90	120	2	122
DH34	-90	72	2	74
DH35	-90	58	2	60
IN8	-75	93	2	95
IN9	-85	90	2	92
IN10	-79	92	2	94
IN11	-77	92	2	94
IN12	-69	96	2	98
IN13	-72	95	2	97
IN14	-65	99	2	101

IN15	-86	90	2	92
IN16	-72	95	2	97
IN17	-81	91	2	93
IN18	-73	94	2	96
IN26	-85	181	2	183
IN27	-82	182	2	184
IN28	-78	184	2	186
IN29	-87	180	2	182
IN30	-82	182	2	184
IN31	-69	193	2	195
IN32	-88	180	2	182
IN33	-83	181	2	183
TOTAL		**4 979**	**56**	**5 035**

APPENDIX C. CASH FLOW PRODUCTION TABLE

Appendix Table 7 - 2024 updated geological model cash flow inputs (Sociedade Mineira de Kaixepa Mine Planning Department, 2024)

2024 Updated Geological Model Open Pit Optimisation - Cashflow Production and Cost Inputs																		
INPUTS	Unit																	
Production Year	No		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Mining Production																		
Mining Saprolite	m^3 '000/year		-	-	7 804	-	-	-	-	-	-	-	-	-	-	-	-	-
Mining WGG	m^3 '000/year		-	-	5 660	-	-	-	-	-	-	-	-	-	-	-	-	0
Mining GG	m^3 '000/year	3 200.00	-	-	1 818	11 347	3 611	3 026	1 671	730	1 254	986	507	507	308	135	272	-
Mining Ore	m^3 '000/year	4 400.00	-	-	600	600	600	600	600	600	600	600	600	600	600	600	600	85
Mining Cost		**Mining Unit Costs ($/m³)**																
Mining Saprolite	$ '000/year	$5.87	$0.00	$0.00	$45 809.33	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Mining WGG	$ '000/year	$7.39	$0.00	$0.00	$41 828.51	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Mining GG	$ '000/year	$8.91	$0.00	$0.00	$16 195.92	$101 102.20	$32 171.22	$26 964.05	$14 889.81	$6 501.77	$11 175.26	$8 781.92	$4 520.71	$4 520.71	$2 746.51	$1 203.96	$2 419.22	$0.00
Mining Ore	$ '000/year	$8.91	$0.00	$0.00	$5 346.00	$5 346.00	$5 346.00	$5 346.00	$5 346.00	$5 346.00	$5 346.00	$5 346.00	$5 346.00	$5 346.00	$5 346.00	$5 346.00	$5 346.00	$755.28
Ore Processing Production																		
Ore Processing	m^3 '000/year		-	-	600	600	600	600	600	600	600	600	600	600	600	600	600	85
Processing Cost		**Processing Unit Costs ($/m³)**																
Ore Processing	$/year	$26.10	$0.00	$0.00	$15 660.00	$15 660.00	$15 660.00	$15 660.00	$15 660.00	$15 660.00	$15 660.00	$15 660.00	$15 660.00	$15 660.00	$15 660.00	$15 660.00	$15 660.00	$2 212.44
Fixed Cost		**Processing Unit Costs ($/m³)**																
Ore Processing Fixed Cost	$/Year	$20.50	$0.00	$0.00	$12 300.00	$12 300.00	$12 300.00	$12 300.00	$12 300.00	$12 300.00	$12 300.00	$12 300.00	$12 300.00	$12 300.00	$12 300.00	$12 300.00	$12 300.00	$1 737.74
Total Variable Cost	**$ '000/year**		**$0.00**	**$0.00**	**$109 779.76**	**$107 048.20**	**$38 117.22**	**$32 910.05**	**$20 835.81**	**$12 447.77**	**$17 121.26**	**$14 727.92**	**$10 466.71**	**$10 466.71**	**$8 692.51**	**$7 149.96**	**$8 365.22**	**$840.05**
Unit Variable Cost	**$ '000/m³ processed**		**$0.00**	**$0.00**	**$182.97**	**$178.41**	**$63.53**	**$54.85**	**$34.73**	**$20.75**	**$28.54**	**$24.55**	**$17.44**	**$17.44**	**$14.49**	**$11.92**	**$13.94**	**$9.91**
Fixed Cost	**$ '000/year**		**$0.00**	**$0.00**	**$15 660.00**	**$15 660.00**	**$15 660.00**	**$15 660.00**	**$15 660.00**	**$15 660.00**	**$15 660.00**	**$15 660.00**	**$15 660.00**	**$15 660.00**	**$15 660.00**	**$15 660.00**	**$15 660.00**	**$2 212.44**
Carat Production	**$ '000/year**		**-**	**-**	**98**	**183**	**94**	**119**	**189**	**241**	**250**	**250**	**250**	**250**	**250**	**250**	**264**	**21**
Yearly Average Grade	**ct/m³**		**-**	**-**	**0.163**	**0.305**	**0.156**	**0.198**	**0.315**	**0.402**	**0.417**	**0.417**	**0.417**	**0.417**	**0.417**	**0.417**	**0.440**	**0.251**

Appendix Table 8 - 2019 Whittle optimisation cash flow inputs (Sociedade Mineira de Kaixepa Mine Planning Department, 2024)

2019 Whittle Optimisation - Cashflow Production and Cost Inputs																
INPUTS	Unit															
Production Year	No		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mining Production																
Mining Saprolite	m³ '000/year		11 155	-	-	-	-	-	-	-	-	-	-	-	-	-
Mining WGG	m³ '000/year		10 698	-	-	-	-	-	-	-	-	-	-	-	-	-
Mining GG	m³ '000/year	3 200.00	6 790	18 603	5 702	3 705	2 887	2 669	2 460	1 088	1 886	1 537	1 207	911	859	181
Mining Ore	m³ '000/year	4 400.00	600.00	600.00	600	600	600	600	600	600	600	600	600	600	600	393
Mining Cost		**Mining Unit Costs ($/m³)**														
Mining Saprolite	$ '000/year	$5.87	$65 479.27	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Mining WGG	$ '000/year	$7.39	$79 058.39	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Mining GG	$ '000/year	$8.91	$60 496.97	$165 753.67	$50 807.72	$33 013.46	$25 725.07	$23 784.84	$21 917.37	$9 692.97	$16 800.92	$13 691.33	$10 756.60	$8 119.24	$7 650.35	$1 613.82
Mining Ore	$ '000/year	$8.91	$5 346.00	$5 346.00	$5 346.00	$5 346.00	$5 346.00	$5 346.00	$5 346.00	$5 346.00	$5 346.00	$5 346.00	$5 346.00	$5 346.00	$5 346.00	$3 504.01
Ore Processing Production																
Ore Processing	m³ '000/year		600	600	600	600	600	600	600	600	600	600	600	600	600	393
Processing Cost		**Processing Unit Costs ($/m³)**														
Ore Processing	$/year	$26.10	$15 660.00	$15 660.00	$15 660.00	$15 660.00	$15 660.00	$15 660.00	$15 660.00	$15 660.00	$15 660.00	$15 660.00	$15 660.00	$15 660.00	$15 660.00	$10 264.27
Fixed Cost		**Processing Unit Costs ($/m³)**														
Ore Processing Fixed Cost	$/Year	$20.50	$12 300.00	$12 300.00	$12 300.00	$12 300.00	$12 300.00	$12 300.00	$12 300.00	$12 300.00	$12 300.00	$12 300.00	$12 300.00	$12 300.00	$12 300.00	$8 061.97
Total Variable Cost	**$ '000/year**		**$210 980.62**	**$171 699.67**	**$56 753.72**	**$38 959.46**	**$31 671.07**	**$29 730.84**	**$27 863.37**	**$15 638.97**	**$22 746.92**	**$19 637.33**	**$16 702.60**	**$14 065.24**	**$13 596.35**	**$5 511.10**
Unit Variable Cost	**$ '000/m³ processed**		**$351.63**	**$286.17**	**$94.59**	**$64.93**	**$52.79**	**$49.55**	**$46.44**	**$26.06**	**$37.91**	**$32.73**	**$27.84**	**$23.44**	**$22.66**	**$14.01**
Fixed Cost	**$ '000/year**		**$15 660.00**	**$15 660.00**	**$15 660.00**	**$15 660.00**	**$15 660.00**	**$15 660.00**	**$15 660.00**	**$15 660.00**	**$15 660.00**	**$15 660.00**	**$15 660.00**	**$15 660.00**	**$15 660.00**	**$10 264.27**
Carat Production	**$ '000/year**		**98**	**184**	**83**	**96**	**191**	**248**	**249**	**236**	**250**	**250**	**250**	**250**	**250**	**164**
Yearly Average Grade	**ct/m³**		**0.163**	**0.307**	**0.138**	**0.159**	**0.318**	**0.413**	**0.415**	**0.393**	**0.417**	**0.417**	**0.417**	**0.417**	**0.417**	**0.417**

Appendix Table 9 – Completed exploration drilling scenario cash flow inputs – years 1 to 14 (Sociedade Mineira de Kaixepa Mine Planning Department, 2024)

Combined Model Completed Exploration Drilling Program - Cashflow Production and Cost Inputs																
INPUTS	Unit															
Production Year	No		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mining Production																
Mining Saprolite	m^3 '000/year		-	-	-	-	-	2 707	-	-	-	-	-	2 330	672	320
Mining WGG	m^3 '000/year		-	-	-	-	-	553	-	-	-	-	-	-	-	1 914
Mining GG	m^3 '000/year		-	-	-	-	-	36	823	695	589	486	385	327	442	424
Mining Ore	m^3 '000/year		-	-	-	-	-	600	600	600	600	600	600	600	600	600
Mining Cost		**Mining Unit Costs ($/$m^3$)**														
Mining Saprolite	$ '000/year	$5.87	$0.00	$0.00	$0.00	$0.00	$0.00	$15 891.31	$0.00	$0.00	$0.00	$0.00	$0.00	$13 679.65	$3 944.54	$1 878.63
Mining WGG	$ '000/year	$7.39	$0.00	$0.00	$0.00	$0.00	$0.00	$4 087.25	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$14 142.09
Mining GG	$ '000/year	$8.91	$0.00	$0.00	$0.00	$0.00	$0.00	$319.53	$7 330.42	$6 189.53	$5 246.01	$4 328.89	$3 434.77	$2 916.77	$3 934.28	$3 778.51
Mining Ore	$ '000/year	$8.91	$0.00	$0.00	$0.00	$0.00	$0.00	$5 346.00	$5 346.00	$5 346.00	$5 346.00	$5 346.00	$5 346.00	$5 346.00	$5 346.00	$5 346.00
Ore Processing Production																
Ore Processing	m^3 '000/year		-	-	-	-	-	600	600	600	600	600	600	600	600	600
Processing Cost		**Processing Unit Costs ($/$m^3$)**														
Ore Processing	$/year	$26.10	$0.00	$0.00	$0.00	$0.00	$0.00	$15 660.00	$15 660.00	$15 660.00	$15 660.00	$15 660.00	$15 660.00	$15 660.00	$15 660.00	$15 660.00
Fixed Cost		**Processing Unit Costs ($/$m^3$)**														
Ore Processing Fixed Cost	$/Year	$20.50	$0.00	$0.00	$0.00	$0.00	$0.00	$12 300.00	$12 300.00	$12 300.00	$12 300.00	$12 300.00	$12 300.00	$12 300.00	$12 300.00	$12 300.00
Total Variable Cost	**$ '000/year**		**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$26 244.09**	**$13 276.42**	**$12 135.53**	**$11 192.01**	**$10 274.89**	**$9 380.77**	**$22 542.42**	**$13 824.82**	**$25 745.23**
Unit Variable Cost	**$ '000/m^3 processed**		**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$43.74**	**$22.13**	**$20.23**	**$18.65**	**$17.12**	**$15.63**	**$37.57**	**$23.04**	**$42.91**
Fixed Cost	**$ '000/year**		**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$15 660.00**	**$15 660.00**	**$15 660.00**	**$15 660.00**	**$15 660.00**	**$15 660.00**	**$15 660.00**	**$15 660.00**	**$15 660.00**
Carat Production	**$ '000/year**		**-**	**-**	**-**	**-**	**-**	**78**	**86**	**85**	**82**	**81**	**81**	**79**	**75**	**67**
Yearly Average Grade	**ct/m^3**		**-**	**-**	**-**	**-**	**-**	**0.130**	**0.143**	**0.142**	**0.137**	**0.136**	**0.134**	**0.131**	**0.125**	**0.112**

Appendix Table 10 - Completed exploration drilling scenario cash flow inputs – years 14 to 28 (Sociedade Mineira de Kaixepa Mine Planning Department, 2024)

Combined Model Completed Exploration Drilling Program - Cashflow Production and Cost Inputs																
INPUTS	Unit															
Production Year	No		15	16	17	18	19	20	21	22	23	24	25	26	27	28
Mining Production																
Mining Saprolite	m³ '000/year		-	-	-	3 128	3 059	-	-	-	-	-	-	-	-	-
Mining WGG	m³ '000/year		1 664	-	-	-	1 875	2 737	-	-	-	-	-	-	-	-
Mining GG	m³ '000/year		994	2 658	2 658	2 803	997	3 194	5 931	5 931	5 931	3 188	569	341	193	20
Mining Ore	m³ '000/year		600	600	600	600	600	600	600	600	600	600	600	600	600	433
Mining Cost		**Mining Unit Costs ($/m³)**														
Mining Saprolite	$ '000/year	$5.87	$0.00	$0.00	$0.00	$18 358.60	$17 956.40	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Mining WGG	$ '000/year	$7.39	$12 295.35	$0.00	$0.00	$0.00	$13 852.76	$20 228.01	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Mining GG	$ '000/year	$8.91	$8 856.64	$23 680.94	$23 680.94	$24 977.34	$8 885.79	$28 455.05	$52 843.63	$52 843.63	$52 843.63	$28 409.00	$5 073.40	$3 042.38	$1 718.97	$175.67
Mining Ore	$ '000/year	$8.91	$5 346.00	$5 346.00	$5 346.00	$5 346.00	$5 346.00	$5 346.00	$5 346.00	$5 346.00	$5 346.00	$5 346.00	$5 346.00	$5 346.00	$5 346.00	$3 862.13
Ore Processing Production																
Ore Processing	m³ '000/year		600	600	600	600	600	600	600	600	600	600	600	600	600	433
Processing Cost		**Processing Unit Costs ($/m³)**														
Ore Processing	$/year	$26.10	$15 660.00	$15 660.00	$15 660.00	$15 660.00	$15 660.00	$15 660.00	$15 660.00	$15 660.00	$15 660.00	$15 660.00	$15 660.00	$15 660.00	$15 660.00	$11 313.31
Fixed Cost		**Processing Unit Costs ($/m³)**														
Ore Processing Fixed Cost	$/Year	$20.50	$12 300.00	$12 300.00	$12 300.00	$12 300.00	$12 300.00	$12 300.00	$12 300.00	$12 300.00	$12 300.00	$12 300.00	$12 300.00	$12 300.00	$12 300.00	$8 885.93
Total Variable Cost	**$ '000/year**		**$27 097.99**	**$29 626.94**	**$29 626.94**	**$49 281.94**	**$46 640.95**	**$54 629.06**	**$58 789.63**	**$58 789.63**	**$58 789.63**	**$34 355.00**	**$11 019.40**	**$8 988.38**	**$7 664.97**	**$4 471.26**
Unit Variable Cost	**$ '000/m³ processed**		**$45.16**	**$49.38**	**$49.38**	**$82.14**	**$77.73**	**$91.05**	**$97.98**	**$97.98**	**$97.98**	**$57.26**	**$18.37**	**$14.98**	**$12.77**	**$10.32**
Fixed Cost	**$ '000/year**		**$15 660.00**	**$15 660.00**	**$15 660.00**	**$15 660.00**	**$15 660.00**	**$15 660.00**	**$15 660.00**	**$15 660.00**	**$15 660.00**	**$15 660.00**	**$15 660.00**	**$15 660.00**	**$15 660.00**	**$11 313.31**
Carat Production	**$ '000/year**		**67**	**89**	**126**	**100**	**134**	**204**	**250**	**250**	**250**	**261**	**235**	**250**	**250**	**181**
Yearly Average Grade	**ct/m³**		**0.112**	**0.148**	**0.210**	**0.166**	**0.223**	**0.341**	**0.416**	**0.416**	**0.416**	**0.436**	**0.392**	**0.417**	**0.417**	**0.417**

Appendix Table 11 - Phased exploration drilling scenario cash flow inputs – years 1 to 13 (Sociedade Mineira de Kaixepa Mine Planning Department, 2024)

Combined Model Phased Exploration Drilling Program - Cashflow Production and Cost Inputs															
INPUTS	Unit														
Production Year	No		1	2	3	4	5	6	7	8	9	10	11	12	13
Mining Production															
Mining Saprolite	m³ '000/year		-	-	3 458	-	403	-	-	5 883	2 317	600	748	-	-
Mining WGG	m³ '000/year		-	-	3 542	-	443	837	686	-	2 309	2 760	791	636	-
Mining GG	m³ '000/year		-	-	887	556	985	994	1 145	382	1 639	3 505	-	903	1 539
Mining Ore	m³ '000/year		-	-	600	600	600	600	600	600	600	600	600	600	600
Mining Cost		**Mining Unit Costs ($/m³)**													
Mining Saprolite	$ '000/year	$5.87	$0.00	$0.00	$20 300.77	$0.00	$2 364.04	$0.00	$0.00	$34 532.22	$13 601.63	$3 522.00	$4 388.23	$0.00	$0.00
Mining WGG	$ '000/year	$7.39	$0.00	$0.00	$26 173.12	$0.00	$3 276.75	$6 183.61	$5 066.74	$0.00	$17 060.99	$20 394.78	$5 849.08	$4 700.47	$0.00
Mining GG	$ '000/year	$8.91	$0.00	$0.00	$7 907.04	$4 951.22	$8 774.26	$8 857.85	$10 204.44	$3 403.29	$14 603.43	$31 229.68	$0.00	$8 045.70	$13 712.98
Mining Ore	$ '000/year	$8.91	$0.00	$0.00	$5 346.00	$5 346.00	$5 346.00	$5 346.00	$5 346.00	$5 346.00	$5 346.00	$5 346.00	$5 346.00	$5 346.00	$5 346.00
Ore Processing Production															
Ore Processing	m³ '000/year		-	-	600	600	600	600	600	600	600	600	600	600	600
Processing Cost		**Processing Unit Costs ($/m³)**													
Ore Processing	$/year	$26.10	$0.00	$0.00	$15 660.00	$15 660.00	$15 660.00	$15 660.00	$15 660.00	$15 660.00	$15 660.00	$15 660.00	$15 660.00	$15 660.00	$15 660.00
Fixed Cost		**Processing Unit Costs ($/m³)**													
Ore Processing Fixed Cost	$/Year	$20.50	$0.00	$0.00	$12 300.00	$12 300.00	$12 300.00	$12 300.00	$12 300.00	$12 300.00	$12 300.00	$12 300.00	$12 300.00	$12 300.00	$12 300.00
Total Variable Cost	**$ '000/year**		**$0.00**	**$0.00**	**$60 326.93**	**$10 897.22**	**$20 361.05**	**$20 987.46**	**$21 217.18**	**$43 881.51**	**$51 212.04**	**$61 092.45**	**$16 183.31**	**$18 692.17**	**$19 658.98**
Unit Variable Cost	**$ '000/m³ processed**		**$0.00**	**$0.00**	**$100.54**	**$18.16**	**$33.94**	**$34.98**	**$35.36**	**$73.14**	**$85.35**	**$101.82**	**$26.97**	**$31.15**	**$32.76**
Fixed Cost	**$ '000/year**		**$0.00**	**$0.00**	**$15 660.00**	**$15 660.00**	**$15 660.00**	**$15 660.00**	**$15 660.00**	**$15 660.00**	**$15 660.00**	**$15 660.00**	**$15 660.00**	**$15 660.00**	**$15 660.00**
Carat Production	**$ '000/year**		**-**	**-**	**76**	**80**	**72**	**65**	**75**	**87**	**91**	**87**	**67**	**65**	**69**
Yearly Average Grade	**ct/m³**		**-**	**-**	**0.127**	**0.134**	**0.120**	**0.108**	**0.125**	**0.145**	**0.152**	**0.144**	**0.111**	**0.109**	**0.115**

Appendix Table 12 - Phased exploration drilling scenario cash flow inputs – years 14 to 26 (Sociedade Mineira de Kaixepa Mine Planning Department, 2024)

Combined Model Phased Exploration Drilling Program - Cashflow Production and Cost Inputs															
INPUTS	Unit														
Production Year	No		14	15	16	17	18	19	20	21	22	23	24	25	26
Mining Production															
Mining Saprolite	m³ '000/year		-	-	-	-	-	-	-	-	-	-	-	-	-
Mining WGG	m³ '000/year		-	-	-	-	-	-	-	-	-	-	-	-	-
Mining GG	m³ '000/year		1 539	1 539	1 539	1 539	1 539	1 539	1 539	1 284	695	453	239	113	3
Mining Ore	m³ '000/year		600	600	600	600	600	600	600	600	600	600	600	600	190
Mining Cost		**Mining Unit Costs ($/m³)**													
Mining Saprolite	$ '000/year	$5.87	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Mining WGG	$ '000/year	$7.39	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Mining GG	$ '000/year	$8.91	$13 712.98	$13 712.98	$13 712.98	$13 712.98	$13 712.98	$13 712.98	$13 712.98	$11 437.73	$6 194.64	$4 036.66	$2 133.63	$1 010.29	$26.57
Mining Ore	$ '000/year	$8.91	$5 346.00	$5 346.00	$5 346.00	$5 346.00	$5 346.00	$5 346.00	$5 346.00	$5 346.00	$5 346.00	$5 346.00	$5 346.00	$5 346.00	$1 694.46
Ore Processing Production															
Ore Processing	m³ '000/year		600	600	600	600	600	600	600	600	600	600	600	600	190
Processing Cost		**Processing Unit Costs ($/m³)**													
Ore Processing	$/year	$26.10	$15 660.00	$15 660.00	$15 660.00	$15 660.00	$15 660.00	$15 660.00	$15 660.00	$15 660.00	$15 660.00	$15 660.00	$15 660.00	$15 660.00	$4 963.57
Fixed Cost		**Processing Unit Costs ($/m³)**													
Ore Processing Fixed Cost	$/Year	$20.50	$12 300.00	$12 300.00	$12 300.00	$12 300.00	$12 300.00	$12 300.00	$12 300.00	$12 300.00	$12 300.00	$12 300.00	$12 300.00	$12 300.00	$3 898.59
Total Variable Cost	**$ '000/year**		**$19 658.98**	**$19 658.98**	**$19 658.98**	**$19 658.98**	**$19 658.98**	**$19 658.98**	**$19 658.98**	**$17 383.73**	**$12 140.64**	**$9 982.66**	**$8 079.63**	**$6 956.29**	**$1 911.21**
Unit Variable Cost	**$ '000/m³ processed**		**$32.76**	**$32.76**	**$32.76**	**$32.76**	**$32.76**	**$32.76**	**$32.76**	**$28.97**	**$20.23**	**$16.64**	**$13.47**	**$11.59**	**$10.05**
Fixed Cost	**$ '000/year**		**$15 660.00**	**$15 660.00**	**$15 660.00**	**$15 660.00**	**$15 660.00**	**$15 660.00**	**$15 660.00**	**$15 660.00**	**$15 660.00**	**$15 660.00**	**$15 660.00**	**$15 660.00**	**$4 963.57**
Carat Production	**$ '000/year**		**82**	**99**	**132**	**187**	**255**	**255**	**307**	**250**	**250**	**250**	**250**	**250**	**79**
Yearly Average Grade	**ct/m³**		**0.137**	**0.166**	**0.221**	**0.312**	**0.425**	**0.425**	**0.512**	**0.417**	**0.417**	**0.417**	**0.417**	**0.417**	**0.417**

APPENDIX D. DISCOUNTED CASH FLOW CALCULATIONS

Appendix Table 13 - 2024 updated geological model discounted cash flow calculations (Sociedade Mineira de Kaixepa Mine Planning Department, 2024)

CASHFLOW - 2024 Updated Geological Model Open Pit Optimisation																		
PROJECT YEAR	Units	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
PRODUCTION/SALES & REVENUE																		
Remaining Ore	m³ ('000)		7 885	7 885	7 285	6 685	6 085	5 485	4 885	4 285	3 685	3 085	2 485	1 885	1 285	685	85	-
Ore Processed	m³ ('000)		-	-	600	600	600	600	600	600	600	600	600	600	600	600	600	85
Recovery Grade	ct/m³		-	-	0.163	0.305	0.156	0.198	0.315	0.402	0.417	0.417	0.417	0.417	0.417	0.417	0.440	0.251
Carats Recovered	carats ('000)		-	-	98	183	94	119	189	241	250	250	250	250	250	250	264	21
Diamond Price	$/ct		$1 138.00	$1 138.00	$1 138.00	$1 138.00	$1 138.00	$1 138.00	$1 138.00	$1 138.00	$1 138.00	$1 138.00	$1 138.00	$1 138.00	$1 138.00	$1 138.00	$1 138.00	$1 138.00
Total Revenue	$ ('000)		$0.00	$0.00	$111 370.35	$208 531.24	$106 455.51	$134 896.01	$214 750.78	$274 436.68	$284 421.80	$284 727.60	$284 727.60	$284 727.60	$284 727.60	$284 727.60	$300 694.10	$24 259.67
COST																		
Variable Cost	$ ('000)		$0.00	$0.00	($109 779.76)	($107 048.20)	($38 117.22)	($32 910.05)	($20 835.81)	($12 447.77)	($17 121.26)	($14 727.92)	($10 466.71)	($10 466.71)	($8 692.51)	($7 149.96)	($8 365.22)	($840.05)
Fixed Cost	$ ('000)		$0.00	$0.00	($15 660.00)	($15 660.00)	($15 660.00)	($15 660.00)	($15 660.00)	($15 660.00)	($15 660.00)	($15 660.00)	($15 660.00)	($15 660.00)	($15 660.00)	($15 660.00)	($15 660.00)	($2 212.44)
Total Costs	$ ('000)		$0.00	$0.00	($125 439.76)	($122 708.20)	($53 777.22)	($48 570.05)	($36 495.81)	($28 107.77)	($32 781.26)	($30 387.92)	($26 126.71)	($26 126.71)	($24 352.51)	($22 809.96)	($24 025.22)	($3 052.48)
EBIT																		
EBIT	$ ('000)	$2 478 692.58	$0.00	$0.00	($14 069.40)	$85 823.05	$52 678.29	$86 325.97	$178 254.98	$246 328.90	$251 640.54	$254 339.68	$258 600.89	$258 600.89	$260 375.09	$261 917.64	$276 668.88	$21 207.18
CAPEX																		
CAPEX	US$(Millions)	($2 968.70)	($1 979.14)	($989.57)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
ROYALTIES																		
Rate	%		0.00%	0.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
Royalty Paid	$ ('000)		$0.00	$0.00	($5 568.52)	($10 426.56)	($5 322.78)	($6 744.80)	($10 737.54)	($13 721.83)	($14 221.09)	($14 236.38)	($14 236.38)	($14 236.38)	($14 236.38)	($14 236.38)	($15 034.71)	($1 212.98)
INCOME TAX																		
Non-mining Costs			$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Taxable Income	$ ('000)		$0.00	$0.00	($14 069.40)	$85 823.05	$52 678.29	$86 325.97	$178 254.98	$246 328.90	$251 640.54	$254 339.68	$258 600.89	$258 600.89	$260 375.09	$261 917.64	$276 668.88	$21 207.18
Tax Paid	$ ('000)	**25%**	$0.00	$0.00	$0.00	($21 455.76)	($13 169.57)	($21 581.49)	($44 563.74)	($61 582.23)	($62 910.14)	($63 584.92)	($64 650.22)	($64 650.22)	($65 093.77)	($65 479.41)	($69 167.22)	($5 301.80)
CASHFLOW																		
Cashflow	$ ('000)	**$1 698 360.67**	($1 979.14)	($989.57)	($19 637.92)	$53 940.72	$34 185.94	$57 999.67	$122 953.69	$171 024.84	$174 509.32	$176 518.38	$179 714.29	$179 714.29	$181 044.94	$182 201.85	$192 466.95	$14 692.40
Discounted Cashflow	$ ('000)	**18.06%**	($1 676.38)	($709.97)	($11 934.03)	$27 765.51	$14 905.06	$21 419.48	$38 461.14	$45 314.48	$39 164.59	$33 555.38	$28 936.90	$24 510.34	$20 914.63	$17 828.46	$15 951.98	$1 031.45
NPV	$ ('000)	**$315 439.01**																

Appendix Table 14 – 2019 Whittle optimisation discounted cash flow calculations (Sociedade Mineira de Kaixepa Mine Planning Department, 2024)

CASHFLOW - 2019 Whittle Open Pit Optimisation																
PROJECT YEAR	Units	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
PRODUCTION/SALES & REVENUE																
Remaining Ore	m³ ('000)		8 193	7 593	6 993	6 393	5 793	5 193	4 593	3 993	3 393	2 793	2 193	1 593	993	600
Ore Processed	m³ ('000)		600	600	600	600	600	600	600	600	600	600	600	600	600	393
Recovery Grade	ct/m³		0.163	0.307	0.138	0.159	0.318	0.413	0.415	0.393	0.417	0.417	0.417	0.417	0.417	0.417
Carats Recovered	carats ('000)		98	184	83	96	191	248	249	236	250	250	250	250	250	164
Diamond Price	$/ct		$1 138.00	$1 138.00	$1 138.00	$1 138.00	$1 138.00	$1 138.00	$1 138.00	$1 138.00	$1 138.00	$1 138.00	$1 138.00	$1 138.00	$1 138.00	$1 138.00
Total Revenue	$ ('000)		$111 370.35	$209 399.38	$94 183.86	$108 888.27	$217 337.33	$281 664.20	$283 569.58	$268 620.17	$284 727.60	$284 727.60	$284 727.60	$284 727.60	$284 727.60	$186 623.23
COST																
Variable Cost	$ ('000)		($210 980.62)	($171 699.67)	($56 753.72)	($38 959.46)	($31 671.07)	($29 730.84)	($27 863.37)	($15 638.97)	($22 746.92)	($19 637.33)	($16 702.60)	($14 065.24)	($13 596.35)	($5 511.10)
Fixed Cost	$ ('000)		($15 660.00)	($15 660.00)	($15 660.00)	($15 660.00)	($15 660.00)	($15 660.00)	($15 660.00)	($15 660.00)	($15 660.00)	($15 660.00)	($15 660.00)	($15 660.00)	($15 660.00)	($10 264.27)
Total Costs	$ ('000)		($226 640.62)	($187 359.67)	($72 413.72)	($54 619.46)	($47 331.07)	($45 390.84)	($43 523.37)	($31 298.97)	($38 406.92)	($35 297.33)	($32 362.60)	($29 725.24)	($29 256.35)	($15 775.36)
EBIT																
EBIT	$ ('000)	$2 295 892.86	($115 270.27)	$22 039.71	$21 770.14	$54 268.81	$170 006.26	$236 273.36	$240 046.21	$237 321.20	$246 320.68	$249 430.27	$252 365.00	$255 002.36	$255 471.25	$170 847.87
CAPEX																
CAPEX	$ ('000)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
ROYALTIES																
Rate	%		5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
Royalty Paid	$ ('000)		($5 568.52)	($10 469.97)	($4 709.19)	($5 444.41)	($10 866.87)	($14 083.21)	($14 178.48)	($13 431.01)	($14 236.38)	($14 236.38)	($14 236.38)	($14 236.38)	($14 236.38)	($9 331.16)
INCOME TAX																
Non-mining Costs			$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Taxable Income	$ ('000)		($115 270.27)	$22 039.71	$21 770.14	$54 268.81	$170 006.26	$236 273.36	$240 046.21	$237 321.20	$246 320.68	$249 430.27	$252 365.00	$255 002.36	$255 471.25	$170 847.87
Tax Paid	$ ('000)	**25%**	$0.00	($5 509.93)	($5 442.53)	($13 567.20)	($42 501.57)	($59 068.34)	($60 011.55)	($59 330.30)	($61 580.17)	($62 357.57)	($63 091.25)	($63 750.59)	($63 867.81)	($42 711.97)
CASHFLOW																
Cashflow	$ ('000)	**$1 533 837.36**	($120 838.79)	$6 059.81	$11 618.41	$35 257.19	$116 637.83	$163 121.81	$165 856.18	$164 559.89	$170 504.13	$172 836.32	$175 037.37	$177 015.39	$177 367.06	$118 804.74
Discounted Cashflow	$ ('000)	**18.06%**	($102 353.71)	$4 347.64	$7 060.55	$18 148.33	$50 854.05	$60 241.44	$51 881.46	$43 601.53	$38 265.72	$32 855.44	$28 183.84	$24 142.25	$20 489.76	$11 625.05
NPV	$ ('000)	**$289 343.35**														

Appendix Table 15 - Completed exploration drilling scenario discounted cashflow calculations – years 1 to 14 (Sociedade Mineira de Kaixepa Mine Planning Department, 2024)

CASHFLOW - Combined Model Completed Exploration Drilling Program - Cashflow Production and Cost Inputs																
PROJECT YEAR	Units	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
PRODUCTION/SALES & REVENUE																
Remaining Ore	m³ ('000)		13 633	13 633	13 633	13 633	13 633	13 033	12 433	11 833	11 233	10 633	10 033	9 433	8 833	8 233
Ore Processed	m³ ('000)		-	-	-	-	-	600	600	600	600	600	600	600	600	600
Recovery Grade	ct/m³		-	-	-	-	-	0.130	0.143	0.142	0.137	0.136	0.134	0.131	0.125	0.112
Carats Recovered	carats ('000)		-	-	-	-	-	78	86	85	82	81	81	79	75	67
Diamond Price	$/ct		$1 138.00	$1 138.00	$1 138.00	$1 138.00	$1 138.00	$1 138.00	$1 138.00	$1 138.00	$1 138.00	$1 138.00	$1 138.00	$1 138.00	$1 139.00	$1 140.00
Total Revenue	$ ('000)		$0.00	$0.00	$0.00	$0.00	$0.00	$88 977.60	$97 719.41	$96 814.02	$93 737.86	$92 641.27	$91 692.08	$89 744.85	$85 372.94	$76 878.52
COST																
Variable Cost	$ ('000)		$0.00	$0.00	$0.00	$0.00	$0.00	($26 244.09)	($13 276.42)	($12 135.53)	($11 192.01)	($10 274.89)	($9 380.77)	($22 542.42)	($13 824.82)	($25 745.23)
Fixed Cost	$ ('000)		$0.00	$0.00	$0.00	$0.00	$0.00	($15 660.00)	($15 660.00)	($15 660.00)	($15 660.00)	($15 660.00)	($15 660.00)	($15 660.00)	($15 660.00)	($15 660.00)
Total Costs	$ ('000)		$0.00	$0.00	$0.00	$0.00	$0.00	($41 904.09)	($28 936.42)	($27 795.53)	($26 852.01)	($25 934.89)	($25 040.77)	($38 202.42)	($29 484.82)	($41 405.23)
EBIT																
EBIT	$ ('000)	$2 873 664.03	$0.00	$0.00	$0.00	$0.00	$0.00	$47 073.51	$68 782.99	$69 018.49	$66 885.85	$66 706.38	$66 651.31	$51 542.43	$55 888.12	$35 473.29
CAPEX																
CAPEX	$ ('000)	($8 576.26)	($1 979.14)	($1 979.14)	($1 979.14)	($1 979.14)	($659.71)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
ROYALTIES																
Rate	%		5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
Royalty Paid	$ ('000)		$0.00	$0.00	$0.00	$0.00	$0.00	($4 448.88)	($4 885.97)	($4 840.70)	($4 686.89)	($4 632.06)	($4 584.60)	($4 487.24)	($4 268.65)	($3 843.93)
INCOME TAX																
Non-mining Costs			$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Taxable Income	$('000)		$0.00	$0.00	$0.00	$0.00	$0.00	$47 073.51	$68 782.99	$69 018.49	$66 885.85	$66 706.38	$66 651.31	$51 542.43	$55 888.12	$35 473.29
Tax Paid	$ ('000)	**25%**	$0.00	$0.00	$0.00	$0.00	$0.00	($11 768.38)	($17 195.75)	($17 254.62)	($16 721.46)	($16 676.59)	($16 662.83)	($12 885.61)	($13 972.03)	($8 868.32)
CASHFLOW																
Cashflow	$ ('000)	**$1 953 977.51**	($1 979.14)	($1 979.14)	($1 979.14)	($1 979.14)	($659.71)	$30 856.25	$46 701.27	$46 923.17	$45 477.50	$45 397.72	$45 403.88	$34 169.58	$37 647.44	$22 761.04
Discounted Cashflow	$ ('000)	**18.06%**	($1 676.38)	($1 419.94)	($1 202.73)	($1 018.74)	($287.63)	$11 395.32	$14 608.62	$12 432.69	$10 206.38	$8 629.91	$7 310.76	$4 660.22	$4 349.10	$2 227.17
NPV	$ ('000)	**$109 836.17**														

Appendix Table 16 - Completed exploration drilling scenario discounted cashflow calculations – years 15 to 28 (Sociedade Mineira de Kaixepa Mine Planning Department, 2024)

CASHFLOW - Combined Model Completed Exploration Drilling Program - Cashflow Production and Cost Inputs																
PROJECT YEAR	Units	0	15	16	17	18	19	20	21	22	23	24	25	26	27	28
PRODUCTION/SALES & REVENUE																
Remaining Ore	m³ ('000)		7 633	7 033	6 433	5 833	5 233	4 633	4 033	3 433	2 833	2 233	1 633	1 033	433	-
Ore Processed	m³ ('000)		600	600	600	600	600	600	600	600	600	600	600	600	600	433
Recovery Grade	ct/m³		0.112	0.148	0.210	0.166	0.223	0.341	0.416	0.416	0.416	0.436	0.392	0.417	0.417	0.417
Carats Recovered	carats ('000)		67	89	126	100	134	204	250	250	250	261	235	250	250	181
Diamond Price	$/ct		$1 141.00	$1 142.00	$1 143.00	$1 144.00	$1 145.00	$1 146.00	$1 147.00	$1 148.00	$1 149.00	$1 150.00	$1 151.00	$1 152.00	$1 153.00	$1 154.00
Total Revenue	$ ('000)		$76 951.72	$101 628.02	$144 026.21	$114 036.04	$152 887.65	$234 271.15	$286 496.13	$286 745.91	$286 845.96	$300 673.77	$270 444.31	$288 230.40	$288 480.60	$208 588.81
COST																
Variable Cost	$ ('000)		($27 097.99)	($29 626.94)	($29 626.94)	($49 281.94)	($46 640.95)	($54 629.06)	($58 789.63)	($58 789.63)	($58 789.63)	($34 355.00)	($11 019.40)	($8 988.38)	($7 664.97)	($4 471.26)
Fixed Cost	$ ('000)		($15 660.00)	($15 660.00)	($15 660.00)	($15 660.00)	($15 660.00)	($15 660.00)	($15 660.00)	($15 660.00)	($15 660.00)	($15 660.00)	($15 660.00)	($15 660.00)	($15 660.00)	($11 313.31)
Total Costs	$ ('000)		($42 757.99)	($45 286.94)	($45 286.94)	($64 941.94)	($62 300.95)	($70 289.06)	($74 449.63)	($74 449.63)	($74 449.63)	($50 015.00)	($26 679.40)	($24 648.38)	($23 324.97)	($15 784.57)
EBIT																
EBIT	$ ('000)	$2 873 664.03	$34 193.73	$56 341.08	$98 739.27	$49 094.10	$90 586.70	$163 982.09	$212 046.50	$212 296.28	$212 396.34	$250 658.78	$243 764.92	$263 582.02	$265 155.63	$192 804.25
CAPEX																
CAPEX	$ ('000)	($8 576.26)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
ROYALTIES																
Rate	%		5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
Royalty Paid	$ ('000)		($3 847.59)	($5 081.40)	($7 201.31)	($5 701.80)	($7 644.38)	($11 713.56)	($14 324.81)	($14 337.30)	($14 342.30)	($15 033.69)	($13 522.22)	($14 411.52)	($14 424.03)	($10 429.44)
INCOME TAX																
Non-mining Costs			$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Taxable Income	$('000)		$34 193.73	$56 341.08	$98 739.27	$49 094.10	$90 586.70	$163 982.09	$212 046.50	$212 296.28	$212 396.34	$250 658.78	$243 764.92	$263 582.02	$265 155.63	$192 804.25
Tax Paid	$ ('000)	**25%**	($8 548.43)	($14 085.27)	($24 684.82)	($12 273.53)	($22 646.67)	($40 995.52)	($53 011.63)	($53 074.07)	($53 099.08)	($62 664.69)	($60 941.23)	($65 895.50)	($66 288.91)	($48 201.06)
CASHFLOW																
Cashflow	$ ('000)	**$1 953 977.51**	$21 797.71	$37 174.41	$66 853.14	$31 118.78	$60 295.64	$111 273.01	$144 710.07	$144 884.92	$144 954.95	$172 960.39	$169 301.47	$183 274.99	$184 442.69	$134 173.75
Discounted Cashflow	$ ('000)	**18.06%**	$1 806.63	$2 609.75	$3 975.34	$1 567.37	$2 572.37	$4 021.00	$4 429.35	$3 756.32	$3 183.24	$3 217.21	$2 667.42	$2 445.86	$2 084.91	$1 284.66
NPV	$ ('000)	**$109 836.17**														

Appendix Table 17 - Phased exploration drilling scenario discounted cashflow calculations – years 1 to 13 (Sociedade Mineira de Kaixepa Mine Planning Department, 2024)

CASHFLOW - Combined Model Phased Exploration Drilling Program - Cashflow Production and Cost Inputs															
PROJECT YEAR	Units	0	1	2	3	4	5	6	7	8	9	10	11	12	13
PRODUCTION/SALES & REVENUE															
Remaining Ore	m³ ('000)		13 990	13 990	13 390	12 790	12 190	11 590	10 990	10 390	9 790	9 190	8 590	7 990	7 390
Ore Processed	m³ ('000)		-	-	600	600	600	600	600	600	600	600	600	600	600
Recovery Grade	ct/m³		-	-	0.127	0.134	0.120	0.108	0.125	0.145	0.152	0.144	0.111	0.109	0.115
Carats Recovered	carats ('000)		-	-	76	80	72	65	75	87	91	87	67	65	69
Diamond Price	$/ct		$1 138.00	$1 138.00	$1 138.00	$1 138.00	$1 138.00	$1 138.00	$1 138.00	$1 138.00	$1 138.00	$1 138.00	$1 138.00	$1 138.00	$1 139.00
Total Revenue	$ ('000)		$0.00	$0.00	$86 760.74	$91 187.70	$82 132.37	$73 939.91	$85 351.87	$99 263.96	$103 559.44	$98 618.02	$75 881.70	$74 292.56	$78 925.28
COST															
Variable Cost	$ ('000)		$0.00	$0.00	($60 326.93)	($10 897.22)	($20 361.05)	($20 987.46)	($21 217.18)	($43 881.51)	($51 212.04)	($61 092.45)	($16 183.31)	($18 692.17)	($19 658.98)
Fixed Cost	$ ('000)		$0.00	$0.00	($15 660.00)	($15 660.00)	($15 660.00)	($15 660.00)	($15 660.00)	($15 660.00)	($15 660.00)	($15 660.00)	($15 660.00)	($15 660.00)	($15 660.00)
Total Costs	$ ('000)		$0.00	$0.00	($75 986.93)	($26 557.22)	($36 021.05)	($36 647.46)	($36 877.18)	($59 541.51)	($66 872.04)	($76 752.45)	($31 843.31)	($34 352.17)	($35 318.98)
EBIT															
EBIT	$ ('000)	$3 083 522.00	$0.00	$0.00	$10 773.80	$64 630.48	$46 111.32	$37 292.45	$48 474.69	$39 722.45	$36 687.40	$21 865.56	$44 038.38	$39 940.39	$43 606.30
CAPEX															
CAPEX	$ ('000)	($9 400.90)	($1 979.14)	($1 979.14)	($164.93)	$0.00	$0.00	($1 979.14)	($659.71)	$0.00	$0.00	$0.00	$0.00	($1 979.14)	($659.71)
ROYALTIES															
Rate	%		5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
Royalty Paid	$ ('000)		$0.00	$0.00	($4 338.04)	($4 559.39)	($4 106.62)	($3 697.00)	($4 267.59)	($4 963.20)	($5 177.97)	($4 930.90)	($3 794.08)	($3 714.63)	($3 946.26)
INCOME TAX															
Non-mining Costs			$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Taxable Income	$ ('000)		$0.00	$0.00	$10 773.80	$64 630.48	$46 111.32	$37 292.45	$48 474.69	$39 722.45	$36 687.40	$21 865.56	$44 038.38	$39 940.39	$43 606.30
Tax Paid	$ ('000)	**25%**	$0.00	$0.00	($2 693.45)	($16 157.62)	($11 527.83)	($9 323.11)	($12 118.67)	($9 930.61)	($9 171.85)	($5 466.39)	($11 009.60)	($9 985.10)	($10 901.58)
CASHFLOW															
Cashflow	$ ('000)	**$2 103 878.46**	($1 979.14)	($1 979.14)	$3 577.39	$43 913.48	$30 476.87	$22 293.21	$31 428.71	$24 828.64	$22 337.57	$11 468.27	$29 234.70	$24 261.53	$28 098.75
Discounted Cashflow	$ ('000)	**18.06%**	($1 676.38)	($1 419.94)	$2 173.99	$22 604.07	$13 287.90	$8 232.96	$9 831.21	$6 578.56	$5 013.15	$2 180.07	$4 707.26	$3 308.91	$3 246.02
NPV	$ ('000)	**$144 862.35**													

Appendix Table 18 - Phased exploration drilling scenario discounted cashflow calculations – years 14 to 26 (Sociedade Mineira de Kaixepa Mine Planning Department, 2024)

CASHFLOW - Combined Model Phased Exploration Drilling Program - Cashflow Production and Cost Inputs															
PROJECT YEAR	Units	0	14	15	16	17	18	19	20	21	22	23	24	25	26
PRODUCTION/SALES & REVENUE															
Remaining Ore	m³ ('000)		6 790	6 190	5 590	4 990	4 390	3 790	3 190	2 590	1 990	1 390	790	190	-
Ore Processed	m³ ('000)		600	600	600	600	600	600	600	600	600	600	600	600	190
Recovery Grade	ct/m³		0.137	0.166	0.221	0.312	0.425	0.425	0.512	0.417	0.417	0.417	0.417	0.417	0.417
Carats Recovered	carats ('000)		82	99	132	187	255	255	307	250	250	250	250	250	79
Diamond Price	$/ct		$1 140.00	$1 141.00	$1 142.00	$1 143.00	$1 144.00	$1 145.00	$1 146.00	$1 147.00	$1 148.00	$1 149.00	$1 150.00	$1 151.00	$1 152.00
Total Revenue	$ ('000)		$93 860.74	$113 462.58	$151 149.42	$214 194.79	$291 789.29	$292 044.35	$352 068.06	$286 979.89	$287 230.25	$287 480.50	$287 730.75	$287 981.16	$91 357.59
COST															
Variable Cost	$ ('000)		($19 658.98)	($19 658.98)	($19 658.98)	($19 658.98)	($19 658.98)	($19 658.98)	($19 658.98)	($17 383.73)	($12 140.64)	($9 982.66)	($8 079.63)	($6 956.29)	($1 911.21)
Fixed Cost	$ ('000)		($15 660.00)	($15 660.00)	($15 660.00)	($15 660.00)	($15 660.00)	($15 660.00)	($15 660.00)	($15 660.00)	($15 660.00)	($15 660.00)	($15 660.00)	($15 660.00)	($4 963.57)
Total Costs	$ ('000)		($35 318.98)	($35 318.98)	($35 318.98)	($35 318.98)	($35 318.98)	($35 318.98)	($35 318.98)	($33 043.73)	($27 800.64)	($25 642.66)	($23 739.63)	($22 616.29)	($6 874.78)
EBIT															
EBIT	$ ('000)	$3 083 522.00	$58 541.76	$78 143.59	$115 830.44	$178 875.81	$256 470.30	$256 725.36	$316 749.08	$253 936.16	$259 429.61	$261 837.83	$263 991.13	$265 364.87	$84 482.80
CAPEX															
CAPEX	$ ('000)	($9 400.90)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
ROYALTIES															
Rate	%		5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
Royalty Paid	$ ('000)		($4 693.04)	($5 673.13)	($7 557.47)	($10 709.74)	($14 589.46)	($14 602.22)	($17 603.40)	($14 348.99)	($14 361.51)	($14 374.02)	($14 386.54)	($14 399.06)	($4 567.88)
INCOME TAX															
Non-mining Costs			$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Taxable Income	$ ('000)		$58 541.76	$78 143.59	$115 830.44	$178 875.81	$256 470.30	$256 725.36	$316 749.08	$253 936.16	$259 429.61	$261 837.83	$263 991.13	$265 364.87	$84 482.80
Tax Paid	$ ('000)	**25%**	($14 635.44)	($19 535.90)	($28 957.61)	($44 718.95)	($64 117.58)	($64 181.34)	($79 187.27)	($63 484.04)	($64 857.40)	($65 459.46)	($65 997.78)	($66 341.22)	($21 120.70)
CASHFLOW															
Cashflow	$ ('000)	**$2 103 878.46**	$39 213.28	$52 934.57	$79 315.36	$123 447.12	$177 763.26	$177 941.81	$219 958.40	$176 103.12	$180 210.70	$182 004.35	$183 606.81	$184 624.60	$58 794.22
Discounted Cashflow	$ ('000)	**18.06%**	$3 837.02	$4 387.30	$5 568.17	$7 340.64	$8 953.48	$7 591.46	$7 948.50	$5 390.25	$4 672.18	$3 996.85	$3 415.25	$2 908.84	$784.63
NPV	$ ('000)	**$144 862.35**													