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Preface

In preparing a Public Report of Exploration Results, Mineral Resources, Mineral Reserves (SAMREC) and their valuations (SAMVAL), the practitioner must satisfy the requirements of SAMREC and SAMVAL Codes. The intention of the Companion Volume is to aid the Competent Person and Competent Mineral Asset Valuator when making these declarations. The objective of this conference and the Companion Volume is to provide a testimony of current industry benchmarks and best practice to be used or referenced when making a declaration. Best practice consistently shows superior results to those achieved with other means or techniques, and as such provides a benchmark for the industry.

It is acknowledged that no single document can cover all accepted industry practices or assist with all possible situations. However, the aim of the Companion Volume is to present the best current knowledge. Expertise is still required when applying best practice as the Competent Person or Competent Mineral Asset Valuator must balance each unique situation with the practices that it has in common with others.

The SAMREC and SAMVAL Codes are guidelines to assist Competent Persons and Competent Mineral Asset Valuators when declaring or valuating Exploration Results, Mineral Resources, or Mineral Reserves. The purpose of the Companion Volume is also to provide information that will be useful to mentor less experienced or inexperienced mineral industry professionals. Despite having these industry practices available, the Competent Person or Competent Mineral Asset Valuators is still required to be prepared to defend themselves to their peers and take responsibly for their work.

The editors and organising committee trust that the reader will find the Companion Volume of great use and guidance in the reporting of Exploration Results, Mineral Resources, or Mineral Reserves and their valuations. Its use will assist practitioners to produce more reliable, and transparent reporting.

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Chairman, Organising Committee

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The SAMREC Code – manual or guide?

K. Lomberg[1] and S.M. Rupprecht[2]
[1]Coffey Mining (SA) Pty Ltd and [2]University of Johannesburg, Republic of South Africa

The SAMREC Code provides minimum standards for reporting of Exploration Results, Mineral Resources and Mineral Reserves, adds credibility to declarations by project promoters and assists in comparisons due to the uniform basis of declaration, assists professionals by providing guidance, assists the Competent Person to demonstrate the legitimacy of the declaration, and provides credibility to the Public Report.

The SAMREC Code provides guidelines and a mechanism to assist in the progression of mining projects. It holds various registered professionals accountable for their work, but does not specify the technical details relating to Exploration Results, Mineral Resources, and Mineral Reserves. The SAMREC Code provides the guidelines that support these declarations, the sustainability of the industry, and efficient exploration for minerals.

A revision or update of the SAMREC Code is necessary because the mineral industry has advanced and changed focus as the prevailing economic and political circumstances have changed. The manner in which projects and mines are funded, developed, and operated is continually changing; there are shifting requirements by the investment community, government and society (social licence to operate); there is a need to promote greater efficiency in capital raising and funding for exploration, mining, and production companies; and the Code must keep abreast of the advances made by other international reporting codes and eliminate possible contradictory reporting practices.

It is important to note that the aim of the update is to provide improved guidance and assistance to the Competent Person. It is not to make reporting more onerous, to create more regulations, nor to make the declaration by the Competent Person more difficult.

Good reporting practices

S.M. Rupprecht
Senior Lecturer, University of Johannesburg, Republic of South Africa

The SAMREC Code sets out the minimum standard for the Public Reporting of Exploration Results, Mineral Resources and Mineral Reserves. When making a declaration the Competent Person (CP) must disclose relevant information concerning the status and characteristics of a mineral deposit that could materially influence the economic value of the deposit and promptly report any material changes. The Johannesburg Stock Exchange (JSE) Listing enlists Panel Readers to review all CP Reports and annual reports for their compliance with the SAMREC Code and Section 12 of the JSE Listing Requirements.

The JSE Readers Panel assists in achieving reporting compliance. However there are still many Public Reports that are not formally reviewed. Thus, the SAMREC Code is largely reliant on self-regulation. Although Clause 11 of the SAMREC Code makes provision for complaints made in respect of Public Reporting, complaints are rarely made. Yet, noncompliant reporting remains an issue within the southern African mineral industry.

This paper investigates compliance of Public Reports and some of the common compliance issues currently being experienced. The paper also discusses methodologies to improve compliance and Public Reporting, such as self-regulation, coaching and training and other means to promote good reporting compliance.

Mineral Resource and Mineral Reserve governance and reporting for AngloGold Ashanti

R. Peattie, V. Chamberlain, and T. Flitton
AngloGold Ashanti

Mineral Resource and Mineral Reserve governance is the comprehensive, overarching management process by which the Mineral Resource and Mineral Reserve is estimated, managed, and reported. Mineral Resource and Mineral Reserve governance provides the Board of Directors and investors with assurance on the integrity of the reported Mineral Resource and Mineral Reserve, which is the primary asset of the company and upon which investment decisions are based. The framework for Mineral Resource and Mineral Reserve governance of a company must be compliant with all regulatory codes as well as internal company policies and procedures. It is critical to ensure that reporting is transparent, appropriate, timeous, and reliable. Good Mineral Resource and Mineral Reserve governance should also ensure that all components in the estimation (from exploration to processing) of the Mineral Resource and Mineral Reserve are auditable and defendable. AngloGold Ashanti (AGA) is acutely aware that its primary asset is its Mineral Resource and Mineral Reserve, and has therefore established a formal Mineral Resource and Mineral Reserve governance process that has been structured to ensure that the Executive Committee and the Board has line of sight to the annual Mineral Resource and Mineral Reserve public reporting, as well as the review findings from a stringent internal and external review programme.

The understanding and importance of sampling in the SAMREC Code

K. Lomberg
Coffey Mining (SA) Pty Ltd

Samples may consist of rock chips, sludge and/or core from soil samples, heavy mineral concentrates, stream sediment samples, drill core, cut channel samples, bulk samples from trenches, or various samples from mine (underground or open pit) workings. In addition to this variety of sample types, samples can be very different sizes. A sample containing precious metals may be a few hundred grams of rock chips, whereas a bulk sample from a diamond pilot plant can be expected to be several hundred tons. The Competent Person (CP) will need to be fully informed about the sampling protocol in each project that he is working on. Each situation will be different and can be expected to be dealt with in accordance with industry best practice. Experience in this aspect of the process is essential. The SAMREC Code calls for five years of relevant experience.

Mineralization beyond Inferred Resources

J.R. Dixon
SRK Consulting (Pty) Ltd., Johannesburg, South Africa

CRIRSCO reporting standards are contained in the CRIRSCO International Reporting Template, first published in July 2006 and updated in November 2013, which defines Exploration Results, Mineral Resources – including sub categories of Measured, Indicated, and Inferred Resources, and Mineral Reserves – including sub-categories of Proved and Probable Reserves. The definitions contained in the CRIRSCO Template have been adopted by CRIRSCO members, although due to specific local requirements minor differences may exist among members' reporting codes and standards. These differences are not considered to be material. Public reporting is targeted at investors and potential investors in mineral exploration and mineral companies. Such stakeholders rely on informed statements relating to Exploration Results, Mineral Resources, or Mineral Reserves prepared by Competent Persons as defined in the Template. CRIRSCO acknowledges that mineralisation may exist beyond those categories contained in the Template, and also that it is common practice among mineral companies to maintain registers or inventories of such material for their own strategic planning purposes. Such purposes include, for example, the prioritization of exploration targets for future work and maintaining records of mineralized material that currently fails to meet requirements for public reporting but may do so in future (for example, if economic conditions change). This paper is intended to expand on CRIRSCO's views on 'Mineralization beyond Inferred Resources' and to explain the relationship between the CRIRSCO-aligned reporting standards and other classification systems that categorize such material.

Exploration Results, Exploration Targets and Mineralisation

T R. Marshall
Explorations Unlimited, Johannesburg, South Africa

While the original intent of all of the international reporting codes was to regulate the public reporting of Mineral Resources and Mineral Reserves only, many jurisdictions have seen the need to provide guidance for the reporting of Exploration Targets, which are the lifeblood of junior exploration and mining companies and private operators alike. In harmony with this trend, the SAMREC Code 2016 has greatly expanded the issues surrounding Exploration Results and Exploration Targets and has also introduced the concept of Mineralisation. This document seeks to clarify the concepts and definitions and to assist in clearing misconceptions before they arise. A number of case-study examples are presented in order to illustrate the differences between Exploration Targets that are purely conceptual and those which may be identified as Mineralisation.

Industry best practice for the collection and validation of exploration data with particular reference to a drilling programme

R. McKinney
Coffey Mining (SA) Pty Ltd, Johannesburg, South Africa

The importance of a validated database is often overlooked and it is assumed that if the data runs in a modelling program then the data must be clean. Frequently the data from an exploration programme is not held in a relational database, and there is then an increased risk of it containing errors. A combination of errors can potentially result in some very misleading data that can reduce the confidence in all subsequent work based on the exploration data, lead to incorrect and expensive decisions being made, and ultimately affecting the potential outcomes of the exploration programme. Although errors cannot be eliminated entirely, database validation involves a systematic check of all the aspects of the data collected during the exploration phase so that any remaining errors become irrelevant or the level of risk is made quantifiable by identifying the location and extent of the error. This paper, using a drilling programme as an example, systematically goes through the steps and checks that should be taken when capturing and storing the data, the situations where errors can occur, and the issues that can arise if errors are not discovered, scrutinized, and corrected.

Best-practice sampling methods, assay techniques, and quality control with reference to platinum group elements (PGEs)

K. Lomberg
Coffey Mining (SA) Pty Ltd

In this paper the process of sampling and assaying as it relates in particular to the platinum group elements (PGEs) or metals is presented. A discussion of the geology of the deposits is included to provide an understanding of the mineralization that is considered necessary prior to sampling, as this has a direct bearing on the mineral resource estimate and also the selection of an appropriate mining cut. The discussion includes the selection of the sampling technique (drilling or face sampling), the size of the sample relating to the requirements of the laboratory, the potential mining cut, as well as a reference to sampling theory. The selection of an appropriate assay technique that will yield the optimal result based on sample turnaround, precision, accuracy, and cost is discussed. Examples are drawn from work undertaken on the Bushveld Complex (Merensky Reef, UG2 Chromitite Layer, and Platreef) and Great Dyke (Main Sulphide Zone). A discussion of the appropriate QA/QC programme includes the chain of custody, CRM selection, and the QA/QC process.

The valuation of an exploration project having Inferred Resources

S.M. Rupprecht[1] and G. Njowa[2]
[1]Senior Lecturer, University of Johannesburg and [2]Venmyn Deloitte (Pty) Limited

Mineral Asset valuation of Mineral Resources and Mineral Reserves as the single fundamental asset for a mining company, according to the SAMVAL Code, CIMVAL Code or the VALMIN code, can be carried out using three valuation approaches, namely; the Cash Flow (Income) Approach, Market Approach, and Cost Approach. Under the 2009 SAMVAL Code the Market and Cost approaches are viewed as the preferred approaches to the valuation of Exploration Properties with mainly only Inferred Mineral Resources, with the Cash Flow Approach 'not generally used'. The updated 2016 SAMVAL Code has split Exploration Properties into two categories; early stage and advanced stage Exploration Properties. For both stages of Exploration Properties the Market and Cost Approach is 'widely used', while the Income Approach is 'not generally used' for early stage Exploration Properties and 'less widely used' for advanced stage Exploration Properties. In both versions of the SAMVAL Code the Income Approach is the least preferred method for valuations of exploration projects, with only Mineral Resources and without any credible studies to assess the technical and economic viability.

Under the 2016 SAMVAL Code, an advanced Exploration Property is defined as a project that has undertaken considerable exploration and a Mineral Resource estimate has been defined and a Scoping Study has been applied to determine whether there are reasonable prospects for eventual economic extraction.

This paper looks at the valuation of early Exploration Properties, especially those with mainly Inferred Mineral Resources, with particular attention on the use of the Income Approach. It will discuss circumstances where Inferred Mineral Resources could be or should not be valued using in the Income Approach-based valuation methodologies.

The art of reduction: analysing comparable transactions applicable to early stage exploration properties

A.J. van der Merwe
The MSA Group, Johannesburg, South Africa

The market approach to valuation of mineral assets is the most direct measurement of market value and is generally one of the preferred approaches. However, often it is difficult to find a reasonable number of arm's length transactions involving a mineral property comparable to the one under valuation, considering the host of variables such as commodity, deposit style, grade, depth below surface, cyclic price fluctuation, and administrative regime. To complicate matters further, exploration properties are rarely traded in pure cash transactions. Typical elements that may form part of a deal include cash, property or asset trade-in, equity, future exploration expenditure, and royalties.

In order to use a comparable transaction to support a valuation, such a transaction has to be reduced to a cash equivalent value. Listed equity can easily be converted to a cash value but future spending and royalties are not so easily quantified in cash terms. Elective portions of the transaction terms can be evaluated according to probability limits assigned to them eventuating. Whenever it is difficult to determine a single cash equivalent value, a probabilistic approach is developed – this sits well with the established best practice of providing a reasonable range of values as opposed to a single number. Finally, in most cases there is some time difference between the date of the comparable transaction and the Valuation Date of the subject assets. An adjustment is required to bring the value of the comparable transaction in line with the Valuation Date.

In this paper these various elements of typical transactions involving mineral exploration properties are unravelled and scrutinized. Techniques for reducing non-cash terms to a cash equivalent are submitted and explained.

How Good are Metal Price Forecasts Anyway?

A. McDonald
SRK Consulting (South Africa) (Pty) Ltd

A key component in any cash flow analysis is the metal price forecast that is used. It is important to use an independent metal price forecast, which is typically provided by economic research divisions of investment banks and financial institutions, market specialists, specialist subscriber-based websites, or consensus market forecasts. The paper will examine metal price forecasts from such sources for a number of different commodities over the past 15 years and compare these to the actual metal prices during this same period. This will highlight the inherent uncertainties in any metal price forecast and emphasize the importance of sensitivity analyses in cash flow outputs. Some important conclusions regarding mineral asset valuation will be presented.

Some common risks to avoid in estimating and applying discount rates

J. Burger and N.J. Odendaal
Minxcon (Pty) Limited

Discounted cash flow (DCF) analysis is one of the most widely-accepted methods of mineral asset valuation. Operational and corporate decisions based on a discount rate, without due process, could increase the risk in decision-making. One of the most critical issues for an investor to consider in a strategic acquisition is to estimate the worth of the mineral asset. Another example is software that uses net present value (NPV) to determine the optimal pit shell. In both examples the outcome could be significantly different and costly if a project under consideration is either accepted or rejected. A major problem in determining the appropriate discount rate is the subjective approach towards associated risk, rather than a systematic approach. Determining a realistic discount rate for a given project is therefore one of the most difficult and important aspects of cash flow analysis due to the high sensitivity of value to the discount rate. Discount rate should be determined with the full consideration of technical, economic, and political conditions affecting the specific project. It should also allow for changes to the company's capital structure, in order to avoid unrealistically high or low discount rates over the life of an operation.

In this paper we discuss the methods used in calculating a discount rate; and furthermore how to best apply the discount rate to determine value of a mineral asset.

Comparative transactions in project valuation

A. van Zyl
SRK Consulting (Pty) Ltd.

The Market Approach is one of the key valuation methods and is possibly the most regularly used approach given that it is appropriate for both producing properties and exploration projects. However, particularly in a South African context, there are substantial challenges in finding a reasonable number of comparative transactions. It is often the practice for companies to use general market averages in the absence of sufficient comparable transactions that would facilitate a statistically robust conclusion. This paper argues that it is more appropriate for the Competent Valuator to use judgement and experience in interpreting, contextualizing and adjusting the more relevant transactions rather than arbitrarily applying average values.

Application of the market approach in the valuation of mineral assets – a platinum case study

G. Njowa[1] and C. Musingwini[2]
[1]Venmyn Deloitte (Pty) Limited and [2]School of Mining Engineering, The University of the Witwatersrand

There are three broad categories of valuation approaches used in valuing mineral assets, namely, the Income (cash flow) Approach, Market (sales comparison) Approach and Historical Cost Approach. The Market Approach is the most common valuation approach that can be used to estimate the value of a mineral property across the full spectrum of the stages of development of a mining project from an early stage exploration project to a defunct operation.

The Market Approach estimates value from an analysis of actual transactions for assets that are comparable to the subject asset. The process is essentially that of a comparison and correlation between the subject asset and recently sold similar assets. The difficulty of the comparison method in the mining industry is that there are few true comparable transactions available to use to arrive at a market value, unlike in the real estate sector, where many comparable transactions exist. The underlying reason is because each mineral asset has many characteristics that are unique. For example, mineral assets have specific criteria with respect to key factors such as location, geology, mineralization, reef type, exploration costs incurred, stage of development, and infrastructure already in place.

In this paper, the authors discuss a step-by-step process of how the Market Approach can be applied in the valuation of mineral assets, with practical examples to illustrate the application of this methodology, taking into account the unique characteristics of each mineral deposit. The paper discusses, the pros and cons of such a methodology in different circumstances. It also highlights the authors' fundamental understanding of the difference between 'value' (intrinsic value) and 'price' (market value) and why these fundamental terms must not be confused. The relationship between these two terms is important when conducting a mineral asset valuation.

Valuation of alluvial diamond deposits

T.R. Marshall
Explorations Unlimited, Johannesburg, South Africa

Diamond deposits are different from deposits of other commodities, and these differences are sufficiently marked to allow all reporting codes to have a separate section for Diamond Resource estimation. Within the diamond industry, alluvial deposits have certain peculiarities that set them apart from primary, igneous deposits. It is therefore not surprising that the valuation of alluvial deposits should also have distinctive features. The valuation of alluvial diamond deposits follows the same broad outlines as for any other commodity, and there is, certainly, no difference in the acceptable standard of valuation. The three basic approaches to valuation are Cost, Market, and Income, which can be applicable to various stages in the mineral property life-cycle. Valuation of alluvial diamond deposits, however, typically occurs at the early stages of the life-cycle, before Diamond Resources have been identified. This means that Income methods of valuation are used less frequently than other methods. It also means that the Competent Valuer needs to be aware of certain peculiarities of these deposits that may influence the way in which the valuation is completed.

Considerations for reporting of tailings

N.C. Steenkamp
WorleyParsons RSA, Johannesburg, South Africa

The reporting of tailings has historically posed a conundrum in as far as reporting to the correct level of confidence. Tailings are sometimes over- or underestimated, excluded, or incorrectly reported. Using the correct terminology is important and not just a matter of semantics. Tailings can be defined as a 'mineral' or 'solid material' and as a 'residue stockpile' or 'residue deposit' by current South African mineral reporting codes and law. Tailings need to be included in Public Reports and the company's annual report as either a Resource or a Reserve. According to the 2009 and now the 2016 version of the SAMREC Code, tailings are considered to be a Mineral Resource by default and may be classified as a Reserve after the application of realistically assumed mining, metallurgical, processing, infrastructure, economic, marketing, legal, environmental, social, and governmental Modifying Factors. The following technical aspects need to be understood and considered in order to classify tailings: geochemical and physical characteristics, grain size, homogeneity, level of oxidation, grade(s) or percentage contained, penalty elements, densities (SG) and processable tonnage to be included and non-processable tonnages to be excluded, and volume of the dump. These will determine the 'reasonable prospects for eventual economic extraction' required by the Code. The amount of historical information is also critical, whether or not the tailings were sampled during or prior to deposition and how regularly they were sampled. If no information is available the spacing of the drilling or augering grid, the sampling interval, and number of elements or metals assayed will determine the degree of confidence for classification. Whether or not the tailings are or contain a processable (and by implication saleable) product is also a consideration for inclusion or exclusion. Where historical dumps or current dumps are considered sub-economic, but have potential to be re-worked or reprocessed, the tailings need to be reported. Tailings that are proven unsuitable be utilized furtherthey may be excluded from classification and classified as waste. Material considered as 'waste' becomes subject to the National Environmental Management Waste Act (NEMWA) and has significant cost implication. Legislative considerations, such as the Mineral and Petroleum Resources Development Act (MPRDA), also need to be taken into consideration. It is also crucial to take into account all the minerals,

metals, or elements that are contained in the tailing dumps. This can be considered as part of the legal Modifying Factors. If all proven or potential mineral or metals in the tailings have not applied been for, it leaves the potential for external applications to be lodged for the tailings. Therefore, correct and detailed reporting is essential from the start. In terms of the MPRD amendment, all residues produced under the old-order rights and not applied for now vest with the State. Any tailings remaining after closure of a mine will also vest with the State. Historic tailings are considered a heritage site in terms of South African's National Heritage Resources Act.

The new SANS 10320:2016 versus the 2014 Australian guidelines for the estimation and classification of coal resources – what are the implications for southern African coal resource estimators?

J. Hancox[1] and H. Pinheiro[2]
[1]CCIC Coal (Pty) Ltd, Johannesburg, South Africa and [2]Ariy Consulting and Advisory, Johannesburg, South Africa

The past three decades have witnessed the publishing of reporting codes for all the main stock exchanges, as well as the evolution of a uniform international standard covering the definition, estimation, and public reporting of Mineral Resources. Many of these reporting codes have commodity-specific reporting sections for coal, and four countries have detailed guidelines for reporting on coal resources. In South Africa (SANS 10320:2016) and Australia (the Australian Guidelines for the Estimation and Classification of Coal Resources, 2014) these companion documents have recently been updated. Unlike their parent codes, which have become increasingly similar, these new guidelines have diverged and are different in a number of significant ways. This in turn will have an impact on coal resource estimators working in the coalfields of south-central Africa, particularly in countries where no commodity-specific guidelines for coal exist.

The Application of Modifying Factors

S.M. Rupprecht
University of Johannesburg, Republic of South Africa

Demonstration of the feasibility of economic extraction is not required before Exploration Results or Mineral Resources are reported. However, the use of Modifying Factors is fundamental in demonstrating feasibility and thus in converting a Mineral Resource to a Mineral Reserves. Understanding the application of theses Modifying Factors is important to ensure the correct declaration of a Mineral Reserve. Failure to properly investigate all relevant Modifying Factors can lead to the incorrect conversion of Mineral Resources to Reserves, adding unnecessary risk to a project or even leading to premature closure of a mine. The importance of correctly applying Modifying Factors to Mineral Resources is discussed and examples provided to demonstrate the negative outcomes when Modifying Factors are incorrectly applied.

Traditionally, mining engineers have looked to the more conventional Modifying Factors; such as mining, metallurgical, legal, and economic factors. However, other factors, for example, governmental, social and labour, environmental, and infrastructure factors, previously thought by some engineers to be less significant, are now recognized as key factors. The paper discusses the application of Modifying Factors and their importance in establishing the feasibility of a mining project.

Life-of-mine reserves estimation in the dimension stone block extraction industry in South Africa

G. vom Orde[1], I. Coates[2], A.L. Forrester[3], K. Lomberg[4], and R. Stephens[5]
[1]Logistics, process simulation, Gottlieb Duttweiler Institute Switzerland, [2]Geologist, Chemist and Ceramics Technology. Stafford University Great Britain, [3]B Sc. Geology Hons. Rhodes University South Africa, [4]B Sc. Geology & Geochemistry, BSc Geology, B Com (Economics & Statistics), M Eng (Mining Engineering), Pr. Sci Nat, and [5]B Sc. Hons. Mineral Estate Management. Sheffield Hallam University Australia

A very important aspect of any resource evaluation involves the DIMENSION-STONE quarry geology and a methodology how to calculate the quantities of reserves and resources. Reserves are the terms for a particular proven resource. Part of geology is defined in the nature, extent and quality of the products, the markets they serve, and the product pricing structure.

In order to estimate quarry reserves the qualified person must have a good understanding of the geology as well as the commercial and market issues. Estimating the quantities of so called reserves is a common measure for the extent of the geology, but a commercial assessment needs to consider marketability as well.

Reporting of geological model confidence level at AngloGold Ashanti's Mponeng mine

G. Flitton
Mponeng Mine, AngloGold Ashanti Ltd

Estimation in deep-level Witwatersrand gold mines is based on far more limited information than is available for shallower orebodies. A great deal of interpretation and extrapolation of information is essential, especially for complex orebodies. The application of the SAMREC Code in Mineral Resource classification and reporting requires standardisation of the approach for managing of the many risks inherent in Mineral Resource management. In the geological environment, the risk is a function of uncertainty and possible impact, which is indirectly proportional to the quantity and quality of information available decision-making. The calculated confidence levels of grade estimates within homogeneous populations are categorised in order of increasing confidence into Inferred, Indicated and Measured Mineral Resources.

At the AngloGold Ashanti's South African operations the catergorisations are based on a combination of calculated confidence levels and a final review of information density and what it is inferring in relation to current orebody understanding. The application of these categories is moderated according to the inherent complexity and continuity of the orebodies being classified. This allows for orebody confidence to be effectively managed.

Reconciliation of produced grade and tonnage at AngloGold Ashanti

V. Chamberlain, T. Flitton, and R. Peattie
AngloGold Ashanti

In 2009 AngloGold Ashanti (AGA) identified the need to establish a group-wide reconciliation system as the basis for understanding potential opportunities and losses in the mining value chain. A code for the reconciliation of produced grade and tonnage accounts for all stages within the mining chain, including in-situ estimation, mining, transporting, processing, and recovery was therefore developed.

Any reconciliation process must measure the differences between each stage of the mining chain so as to provide useful management information regarding the quality of grade and tonnage estimation, dilution, and ore loss in the individual activities as well as across the operation as a whole. The reconciliation chain encompasses mass, density, and volume measurement, material sampling, sample preparation, chemical analysis, Mineral Resource estimation, data processing, as well as data storage and reporting. From a corporate viewpoint, adopting a consistent approach to the reconciliation of produced grade and tonnage allows a standardized framework for reporting that affords management the tools to easily compare between assets. At an operational level, it allows mine management to focus efficiently on the underlying cause of production problems and ensure that estimating, mining, and processing inefficiencies are discovered and can be corrected while improving the possibility of detecting metal theft or fraud. A fully integrated reconciliation process supported by accurate and relevant measurements allow an overall increase in the confidence in all activities across the reconciliation chain, including confidence in the stated Mineral Reserve.

AGA strives to achieve the highest possible accuracy in accounting and reconciliation activities, thereby improving the quality of management decisions across the entire value chain so as to return full value to the shareholder.

Towards reliable geoscientific data and improved confidence in reporting through existing guidelines and standards: a case for inclusion in SAMCODES reporting

C. Zermatten
SRK Consulting (Pty) Ltd, Johannesburg, South Africa

The geotechnical design of open pit mines utilizes a geotechnical model, which in turn relies heavily on input from a number of other geoscientific disciplines. In collecting geoscientific data for the purpose of building a geotechnical model, a number of standards, guidelines and benchmarks can be utilized to facilitate accurate and relevant data collection. The purpose of a reliable data collection programme in geotechnical engineering is equivalent to that of a reliable ore sampling programme in resource/reserve estimation – that is, sound inputs are needed to produce meaningful results.

Geotechnical design faces additional challenges in that some of the input data is variable – such as changing groundwater conditions due to seasonal changes – and several elements produce range values, not absolute values, with the result that the Competent Person is tasked with applying their mind to selecting a suitable and representative value from the range of results. These elements combine to inform the level of confidence of geoscientific data and the extent of knowledge used when reporting Exploration Results, Mineral Resources, or Mineral Reserves under the South African Code for the Reporting of Exploration Results, Mineral Resources and Mineral Reserves (the SAMREC Code). Consistent handling of data/information in all aspects of the mineral project is needed in order to facilitate transparent and material reporting.

While the standards, guidelines and benchmarks identified in this paper do not provide for the same clarity of quantity in the distinction of Reconnaissance, Inferred, Indicated, and Measured, as those in the South African National Standard (SANS) 10320, the information does build toward the essential aspects of geoscientific knowledge, consistency, reproducibility and therefore confidence. The paper aims to present information that addresses the standardization of the collection of technical data, for the purpose of conforming to the SAMREC principles of materiality, transparency and competency.

It is proposed that industry-wide discussion be undertaken to debate the merits of establishing and implementing a code for the reporting of geotechnical elements in mining that have been relied on during a Mineral Resource/Reserve classification. The code should reside alongside SAMREC, within the SAMCODE family, and is intended to attest the diligence and relevance applied to the geotechnical design process for the purpose of the design that is relied on during a Mineral Resource/Reserve valuation.

While the standards and benchmarks for geoscientific data used in the design of underground mines are equally relevant, they fall outside the scope of the paper.

The quantification of environmental and social risks as SAMREC modifying factors for decision-making in the business case

C. Zermatten, B. Liber, and J.R. Dixon
SRK Consulting (Pty) Ltd, Johannesburg, South Africa

Diligent consideration and comprehensive assessment of various modifying factors that may affect the relationship between Exploration Results, Mineral Resources and Mineral Reserves are required in order to achieve the aims and intentions of the South African Code for the Reporting of Exploration Results, Mineral Resources and Mineral Reserves (SAMREC Code).

Environmental and social risks form part of the modifying factors which are duly considered during the conversion of Resources to Reserves. While the concept of 'social licence to operate' is readily acknowledged regarding mining projects, the quantification of environmental and social risks for the business case will benefit from more attention.

The paper introduces relevant topics to the theme of the quantification of environmental and social risks, risk assessment, as well as risk management and mitigation, which may influence the business case of the conversion of Resources to Reserves. The initiation of the South African Guideline for the Reporting of Environmental, Social and Governance Parameters within the Mining, Oil and Gas Industries (the SAMESG Guideline), which is overseen by the South African Environmental, Social and Governance Committee (SAMESG) Working Group, is introduced.

The paper serves to bridge the paradigms of social licence and the quantification of environmental and social risk for the business case. International and national case examples are mentioned to show the potential of these aspects for significant disruption to mining projects.

Practical steps in reporting social and environmental liability in the mining and oil and gas industries

S. Magnus , N.N. Moeketsi , and A. Clay
Venmyn Deloitte (Pty) Ltd, South Africa

There are extensive technical standards available that provide a detailed framework for the determination of social and environmental liabilities in the extractive industries. These frameworks span the various business units in an organization addressing the technical, engineering, management, and financial accounting requirements for operational environmental management, closure, and remediation. Different business units within an organization often operate autonomously, resulting in unforeseen disconnects regarding the accurate determination and communication of environmental liability. International financial reporting and auditing standards are becoming increasingly stringent regarding the accurate disclosure of organizational environmental liability. The ramifications of these requirements have echoed throughout the extractive industry, most notably through greater recognition of environmental liability in the reporting codes. This article will examine how implementing practical steps in reporting socio-environmental liability can further support the accurate disclosure of organizational socio-environmental liabilities.

A discussion of diamond resource classification

N. Lock
Independent Consultant

Classification of diamond resources is a statement of the risk assessment of the mathematical manipulation of geological data. It is the important flag for the non-technical reader of technical reports. Resource categories are of high, reasonable/moderate, or low confidence for Measured, Indicated, and Inferred diamond resources respectively. High confidence equals low risk, and low confidence equals high risk.

The SAMREC Code requires that the Competent Person (CP) must evaluate the geological data and interpretation when assigning resource categories. A numeric outcome of tons and grade (and in the case of diamonds, value expressed as dollars per carat must satisfy the overriding requirement for 'reasonable prospects for eventual economic extraction'. Technical and economic aspects must be considered and CP experience applied with an explicit statement of the assumptions. Absence of sampling information precludes a resource declaration. Microdiamonds are used in grade estimation only in combination with macrodiamonds.

The Code is not prescriptive regarding classification. Each CP, or company, will devise appropriate procedures for the commodity or project, and report transparently. This presentation concentrates on diamond resources from primary (kimberlite) sources. Different companies will establish internal standards to determine reasonable prospects. As a minimum, the CP must consider aspects significant to project economics for resource declaration; large corporations may require a desk engineering study for this purpose.

The Code outlines minimum standards, recommendations, and guidelines.

Oosterveld observes that 'For most operating mines resources fall short of making the Measured Diamond Resource category.' He further comments that the Code 'implies that on a monthly basis production could be accurately forecasted and actual production would not vary more than say 10-15% from the estimate. For most (diamond) mines the variations are much larger.'

The guidelines of the new SAMREC Code reflect this: 'As a result of the above characteristics, diamond deposits rarely achieve Measured status.'

The 2004 SAMREC Inquisition included presentations on diamond resource estimation and classification. A scorecard method is a favoured approach by several companies and consultants. It is based on the concept that geology, volume, density, grade, and value are the five critical building blocks to resource declaration. The score is the accumulation of points on a scale that is divided, based on experience, into groups to define categories. Examples, including comment on the key assumptions, from the Inquisition and from Public Disclosure documents, will be presented to illustrate the range and variety of procedures adopted by different companies and consultants.

Too often drill-hole spacing and the geostatistical evaluation of geospatial data distribution have become overriding factors. Care must be taken not to allow for 'black-box' classification.

Some helpful pointers to better classification include:

- The geological interpretation may be paramount
- The geologist most familiar with the deposit should be involved in the classification
- Consideration should be given to the possible effect of additional drilling and sampling on the likely outcomes of the estimate
- Any variation from the estimate would not significantly affect potential economic viability
- The impact of mining method (and cut-off grade)
- The relevance of reporting periods to the estimate.

Development of a best-practice mineral resource classification system for the De Beers group of companies

S. Duggan[1], A. Grills[1], J. Stiefenhofer[2], and M. Thurston[2]
[1]Z Star Mineral Resource Consultants (Pty) Ltd and [2]De Beers Group Services (Pty) Ltd

The De Beers Group of Companies has operating diamond mines and exploration projects in numerous countries including South Africa, Namibia, Botswana, and Canada. Diamond deposits are often geologically complex and typically characterized by significant variability in terms of grade and other variables. In addition, diamond revenue also needs to be estimated. These issues make evaluation sampling difficult and accurate Mineral Resource estimation problematic. De Beers identified the need for sound Mineral Resource classification that highlighted areas of uncertainty in the Mineral Resource. As a result De Beers has invested considerable time in developing a best-practice Mineral Resource Classification System (MRCS). In 2004 De Beers developed a prototype that identified the five key Mineral Resource criteria of geology, grade, volume, revenue, and density. A set of key questions and associated answers were developed for each criterion and a scoring system introduced. The MRCS prototype was tested on a wide range of De Beers diamond deposits. Critically, this extensive database of deposits allowed the questions, scoring, and priorities to be adjusted until representative and consistent classifications were produced. The MRCS has evolved through time and, more recently, significant changes have been made that include the ability to take cognisance of new data obtained during mining and production performance. The process involves the project geologist completing the five scorecards, which are reviewed internally prior to an independent review and final ratification by a Competent Person (CP). De Beers is of the opinion that the system is leading practice and provides a repeatable and constant depiction of the confidence in the Company's mineral resources.

Diamond Resource/Reserve estimation of alluvial diamond deposits –a case study of Rockwell Resources Inc.

G.A. Norton
Rockwell Diamonds Inc. Douglas, Northern Cape

The 21st century saw an increase in the number of alluvial diamond deposits prospected and mined by commercial companies listed on various international stock exchanges. As a result, the Resource/Reserve of such deposits had to be evaluated in terms of the applicable reporting codes. Historically, this had caused significant problems for international regulators and investors/analysts alike, as many companies (mostly private), trying to maximize the value of their projects, forced all mineralization into Resource/Reserve categories that the available data could not realistically sustain (Lock, 2003; Marshall, 2005). Very little cognisance was taken of the fact that Diamond Resources are required to have reasonable expectations of eventual economical extraction.

Rockwell Diamonds Inc. (Rockwell or the Company) opened its first alluvial diamond mine in South Africa (the Klipdam/Holpan Mine) in 2006. Since then, the Saxendrift, Niewejaarskraal, Wouterspan, and Tirisano mines have been put into operation successfully, and the Rietputs, Zwemkuil, and Remhoogte exploration projects have been added to the RDI portfolio. Since RDI is listed on the Toronto Stock Exchange (TSX) and the Johannesburg Stock Exchange (JSE), it is subject to rigorous regulatory scrutiny. Consequently, the Company has developed a meticulous approach to the assessment, evaluation, and classification of its alluvial gravel deposits, and has established a highly robust classification scheme that has found favour in all the jurisdictions where its public documents are filed.

The classification and Diamond Resource/Reserve estimation procedure adopted by Rockwell is believed to reflect accurately the nature of the alluvial diamond deposits it evaluates and operates. Further, the volume, grade, diamond value, and related financial parameters so determined are sufficiently robust to be used in the company's financial modelling and forward planning.

Evaluating bedrock-based onshore and offshore marine placer deposits using the new SAMREC/SAMVAL Code

R.J. Jacob, P. Saravanakumar, and J.Jacob
Namdeb Diamond Corporation (Pty) Limited

Evaluation of a marine placer deposit requires an understanding of the regional geological framework, the diamond emplacement model and associated geological model, and development of the mineralization (grade) model and the associated revenue model. Understanding of the source-conduit-sink pathway and associated geological processes are very important during the whole evaluation process. The regional geological framework is based on the emplacement model for that particular region or area. Once established, the detailed geological model requires definition with geoscientific data. Focused delineation campaigns, comprising geophysical surveys and possibly widely spaced geological drilling campaigns, need to be conducted to establish the broad geometry and geology of the deposit. The resource development framework, which encompasses grade and revenue sampling, consists of resource delineation and definition stages. Ideally, the resource definition stage requires more detailed geophysical surveys, as well as denser sampling, to move from an Inferred to an Indicated level of confidence. In these deposits, a Measured level of confidence is generally not attained due to a combination of high resource variability and the high costs of sampling.

For revenue modelling purposes, 100–300 stones are needed for size frequency modelling and revenue estimation at an Inferred level of confidence, whereas at least 300–600 stones are needed for an Indicated level of confidence. These numbers are applicable only in an area with a well-known stable diamond assortment. In newly discovered areas, larger diamond parcels will be required to establish the assortment model.

During the pre-feasibility and feasibility studies, bulk sampling and test mining should be executed to collect data for establishing the geotechnical, mining, and metallurgical parameters. This data is used to populate resource-to-reserve conversion factors, and is critical to establish due to the high sensitivity of marine mining to mining rate.

Diamond valuation: what can a CP do to ensure it is fit for purpose?

C. Gordon-Coker
Mineral Resource Management, De Beers UK Limited

The valuation of a diamond parcel can often be shrouded in mystery. The combinations of size, model (shape), quality, and colour (the diamond assortment) are to some extent subjective and open to considerable interpretation. Furthermore, a diamond is not a commodity and the valuation approach may be subject to proprietary practices with little means of external validation. The particulate nature of diamonds and their extremely low concentration can make it difficult for the Competent Person (CP) to ensure that the sample valuation (and the subsequent revenue model) is both statistically robust and fit for purpose. The 2016 SAMREC/SAMVAL Companion Volume Conference provides an ideal opportunity to share some best-practice insights as to what should be considered when reviewing such a valuation.

Diamond Resource reconciliation in a mature block cave

A. Wolmarans[1], D. du Toit[2], D. Venter[2], and A. Rogers[1]
[1]Petra Diamonds, Johannesburg, South Africa and [2]Petra Diamonds, Finsch Diamond Mine, South Africa

Since its acquisition of Finsch diamond mine in 2011, Petra Diamonds has been focused on maximizing the potential of the remaining Block 4 Resource and the accelerated development of the deeper Block 5 mining levels. In order to maintain a continuous production profile, the life of Block 4 has been optimized to maintain production levels until the Block 5 sublevel cave is in full production.

In this mature block cave environment, the mine plan is sensitive to the accuracy of the Resource and Reserve determination, which relies on the accurate accounting of the ingress of material from pit sidewall failures. Material from sidewall failures will impact on the life of the block cave, and can be added to the Block 4 Reserves if the distribution of waste and kimberlite within the broken material can be understood, and the mixing of the material accurately modelled as it reports to the drawpoints in the block cave. Volumetric differences between the pit scan surfaces are used to quantify pit failure material in order to account for depletion and the relocation of material. In conjunction, block cave mining simulation software is used to estimate material mixing and dilution in order to effectively manage the remaining Reserve.

These robust workflows allow for the development of mine plans at the required level of confidence and provide an accurate estimate of the remnant material that will eventually report to the future Block 5 cave.

Application of the SAMREC code to the evaluation of ruby deposits

P. G. Allan
Independent Precious Stones Geologist

The recent discovery and successful exploitation of world-class ruby deposits in northern Mozambique, coupled with aggressive marketing of coloured stones, has led to an increased interest in the exploration for ruby deposits and the need for a standardised evaluation approach in line with the SAMREC Code. In particular, there is an extremely large range in ruby values between the different types of mineralisation. These extremes in value are further affected by various types of post-recovery heat treatment and glass filling to improve the colour and clarity of the rubies. This paper summarizes some of the important characteristics of the ruby occurrences of northern Mozambique that have a major influence on their economic viability.

Key factors influencing the success of the Orapa Resource Extension Project with reference to SAMREC Table 1

T.V. Rowlands[1] and B.M. Letsatle[2]
[1]De Beers Group Services (Pty) Ltd, Johannesburg, South Africa and
[2]Debswana Diamond Company (Pty) Ltd, Orapa, Botswana

The Orapa Resource Extension Project (OREP) began in 2006, and culminated in the Resource model update that was completed at the end of 2014. The project was informed by conceptual studies for the Cut 3 life extension, ensuring a sound strategic fit with the overall Debswana growth strategy. The development of clear sampling objectives, supported by careful project planning, and the establishment of detailed project governance mechanisms, were critical to the success of the project. The diligence that was applied in these three areas played a key role in the successful execution of the sampling phase. The objective of this paper is to provide readers with insight into these elements of a Resource extension project. Furthermore, the discussion of sampling provides examples of the level of work and measurement that can be carried out to satisfy the requirements of a Competent Person's report, as summarized in SAMREC Table 1, sections 11.2, 11.3, and 11.6. Reference is made to these sections, and their sub-sections, throughout the paper. Drilling and resource estimation are not covered in this paper.

Keynote Presenters

Ken Lomberg

Senior Principal
Coffey

Ken has some 30 years' experience in the minerals industry (especially platinum and gold). He has been involved in exploration and mine geology and has had the privilege of assisting in bringing a mine to full production. His expertise is especially in project management, mineral reserve and resource estimation.

Ken has undertaken mineral resource and reserve estimations and reviews for platinum, gold, copper, uranium and fluorite projects. He has assisted with the reviews or estimation of diamond and coal projects and assisted or compiled Competent Persons Reports/NI 43-101 for various projects that have been listed on the TSX, JSE and AIM stock exchanges

Ken is also Chairman of the SAMREC Working Group which is responsible for the SAMREC Code and represents SAMREC on the CRIRSCO Executive.

David Richard Waalko Dingemans

Consultant
David R W Dingemans Geological Consulting

David Dingemans has been involved in the Minerals Industry for the last 39 years, and his specific expertise includes the Review and Audit of Public Resource and Reserves Statements; Advisor on Exploration Projects, Member of Due Diligence Teams and in the Valuation of Mineral Assets. Previously he was Global Head of Geology for Anglo Coal from 2006 to 2009, a division of Anglo American plc, involved in coal mining and exploration projects worldwide. Before that he was Vice President Geology, responsible for all Geological functions globally within Anglo Coal and he signed off the Public Reporting Statements of Coal Resources and Coal Reserves for Anglo American plc from 1997 to 2009. He had extensive hands-on experience in coal mining Operations in South Africa from 1984 to 1997. Earlier in his career, he spent eight years, from 1977 to 1983, in base metal Exploration and Project Assessment in Southern Africa for the Anglo American Corporation.

James Andrew Hartley Campbell

Chief Executive Officer & President
Rockwell Diamonds Inc

James Campbell has spent almost 30-years in the diamond industry and is currently CEO and President of Rockwell Diamonds Inc. Previous roles include Non Executive Director of Stellar Diamonds plc, Vice President - New Business for Lucara Diamond Corp, Managing Director of African Diamonds plc, Executive Deputy Chairman of West African Diamonds plc and prior to that over twenty years at De Beers, with notable appointments including General Manager for Advanced Exploration & Resource Delivery and Nicky Oppenheimer's Personal Assistant.

Alastair Stuart Macfarlane

Senior Consultant
Tomahee Consulting

- Mine Manager and Consultant Mineral Resource Management, AngloGold.
- Senior Lecturer at Wits University, lecturing in Mine Financial valuation, Mining Methods, Mineral resource management
- Owner and Director Macsim Mining Consultancy, consulting to most mining companies in South Africa, as well as consulting in Zambia, Tanzania, DRC and Australia
- Founder Member and technical Director of Sebilo Resources (Pty)Ltd, an operational BBBEE mining company, operating in the N Cape
- Independent Non Executive director Implats

Dr. Steven Rupprecht

Senior Lecturer
University of Johannesburg

Steven has 29 years mining experience commencing his career in 1986 with Gold Fields of South Africa where he gained underground production mining experience working at Venterspost Gold Mine, East and West Driefontein Gold Mines, and Leeudoorn Gold Mine. In 1997 Steven was moved to Head Office as Group Mining Engineer and Senior Mining Engineer Coal.

In 1999 He joined CSIR Mining Technology as Research Area Manager and worked extensively on the Deepmine and Futuremine Research Programmes. In 2003 Steven joined RSG Global as a Principal Mining Engineer until 2007 when joined Keaton Energy as a Technical Director, a position he held until 2009.

In 2010 joined the University of Johannesburg as Senior Lecture and Director of Mining. He also does mining consultancy work for Borrego Sun and Coffey Mining.

Steven is a Fellow of the South African Institute of Mining and Metallurgy (SAIMM), an co-opted member of the SAIMM Council, vice chairman of the SAMREC working group and member of the SAIMM Technical Programme Committee, and the SAIMM Career Guidance and Educational Committee

Authors CV's

Paul Guthrie Allan

Independent Precious Stones Geologist

Paul Allan (BSc Hons., Dip. Bus. M.) has over 25 years' experience in multi commodity geology, predominantly precious stones exploration and evaluation. Initial experience began with Anglo American Research Laboratory / Debeers in kimberlite mineral chemistry and petrography as well as Wits type Gold Research. Following this Paul contracted to several diamond related ventures throughout Southern Africa (including MPH Botswana) while also lecturing in Geology at the University of Fort Hare. In 2001 Paul again took up employment in the industrial sector with SouthernEra (a Canadian Junior Diamond and platinum company) where he became the Regional Exploration Manager for Southern Africa in 2005.

In 2008 Paul joined Firestone Diamonds Botswana as Project Geologist (Modeling) and as Senior Project Geologist which included responsibility for the geological exploration and evaluation conducted on Firestone Diamonds projects in Botswana and Lesotho. From 2012 to 2014 Paul joined Gemfields as Project Geologist responsible for the geology of their Montepuez Ruby Project in Mozambique. Paul is currently self-employed with various diamond (including Lace Diamond Mining) and precious stone clients (Mozambican Ruby) throughout Southern Africa.

Vaughan Chamberlain

Senior Vice President: Strategic Technical Group
AngloGold Ashanti

Started career at AngloGold Ashanti's Tau Tona mine as a mine geologist, moved in Exploration in South Africa and then into Mineral Resource Evaluation with the Ore Evaluation Department of Anglo American. Transferred into AngloGold when it was formed and took up the role of Manager: Mineral Resource. Later move into a more general role managing the technical disciplines.

John Roger Dixon

Corporate Consultant
SRK Consulting

Roger Dixon Pr.Eng, BSc (Hons) Mining, Hon Life FSAIMM is a mining engineer with over 44 years' experience in the industry. He spent his early career managing deep level gold mines in the Witwatersrand Basin. He was a founder member and chairperson of the South African Mineral Resource Committee (SAMREC) which developed and published the original SAMREC Code in 2000 and the revised version in 2007. Roger is currently one of two South African representatives on the Committee for Mineral Reserves International Reporting Standards (CRIRSCO) an organization which he chaired in 2009-2010. He is currently a corporate consultant with SRK Consulting SA.

Sean Duggan

Director/Principal Analyst
Z Star Mineral Resource Consultants (Pty) Ltd

Sean's career started with Anglo American in base metal and gold exploration and in 1985 he joined to the De Beers Marine team responsible for developing the first successful deep water diamond mining operation. Sean honed his mineral resource skills at Anglo American Minred and as Evaluation Manager at Namdeb. He has specialist expertise in the development of optimal sampling techniques, the design of sampling programmes and mineral resource estimation. As a Z* Principal Analyst and director Sean continues to work primarily on the estimation of diamond deposits which, in recent years, has extended to the evaluation of a range of other commodities including gold, base metals, uranium and industrial minerals.

Tarryn-Marié Flitton

Manager Reporting and Corporate Governance
AngloGold Ashanti Ltd

Graduated from the University of the Witwatersrand in 2000 with a BSc (Hons) in Geology and immediately started working career at Kopanang Gold mine. Tarryn has 14 years' experience on the Witwatersrand goldfields in the field of geoscience, of which more than 10 years are in estimation. Currently the Manager Reporting and Corporate Governance for AngloGold Ashanti based in Johannesburg.

Chris Gordon-Coker

Manager, Mineral Resource Management
London
De Beers (UK) Limited

Chris Gordon-Coker joined De Beers in January 1985 at the then named Central Selling Organisation (CSO), subsequently the Diamond Trading Company (DTC). He worked in Management Information Services in the forecasting team looking at global diamond intakes before moving to the Sales Department analysing production, stocks and availabilities for sale to Sightholders.

In 1999, following his post-graduate studies, he moved to Johannesburg to join the Mineral Resource Management (MRM) team at De Beers CHQ as Diamond Revenue Manager. He was responsible for calculating diamond revenues for all the De Beers operations and global exploration projects. Chris returned to London in February 2003 to run the MRM department at De Beers UK. He and his team continue to generate diamond revenue estimates for new projects and detailed price point forecasts and reconciliations for all the De Beers mines whilst promoting a greater understanding of MRM revenue accountabilities across the Group of Companies.

Philip John Hancox

Managing Director
Caracle Creek International Consulting Coal (Pty) Limited

Dr Philip John Hancox is a graduate of the University of the Witwatersrand with a B.Sc. (Hons.) Geology/Palaeontology and a Ph.D Geology. From 1193-2005 he was a part-time lecturer, associate lecturer, Lecturer and Senior Lecturer, firstly in the Palaeontology Department, then the Geology Department, and finally in the School of Geosciences at the University of the Witwatersrand. He holds a position of Honorary Research Fellow in the School of Geosciences and also lectures the postgraduate course in coal at Rhodes University.

Jurgen Jacob

Head : Mineral Resource and Environment
Namdeb Diamond Corporation (Pty) Limited

Jurgen is a geologist by profession, and holds a Phd from the University of Glasgow, specializing in alluvial diamond deposits and gravel-bed rivers. He is responsible for all aspects of mineral resource and environmental management at Namdeb, including exploration and evaluation of new alluvial diamond deposits, measuring and monitoring resource performance and long term mine planning. Jurgen has held a variety of positions at Namdeb, mainly in the exploration and production environment, and prior to joining Namdeb, was based on a small alluvial diamond mine in the Richtersveld.

Benjamin Moshi Letsatle

Project Manager
Debswana Diamond Company

Benjamin Moshi Letsatle (Ben) is a Resource Geologist with 22 years of experience in diamond exploration and mining. After obtaining his first degree in Geology from the University of Botswana, Ben gained a BSc Honours degree in Geology from Rhodes University and a Master's degree in Project Management from the University of Southern Queensland, Australia.

Ben is currently a Resource Evaluation Project Manager for Debswana Diamond Company in Botswana. He recently managed and successfully delivered the Orapa Resource Extension Project (OREP). Prior to joining Debswana, Ben worked for De Beers Group Exploration in Botswana and South Africa (Kimberley and Finsch Mines) as a Field Geologist, Senior Project Geologist and Exploration Laboratory Manager.

Norman Philip Lock

Independent Consultant

Norman began work at Orapa in 1967. He graduated from Leeds University in 1972 and returned to Botswana with De Beers. In early 1973 he drilled the Jwaneng discovery hole. He transferred to the Letseng Mine in Lesotho and completed a PhD on Letseng in 1980. He worked with the Botswana Geological Survey for 10 years before joining Botswana Diamondfields in 1990.

Norman has been a consultant from 2000, with RSG Global and MSA Geoservices. From 2009 with Coffey Mining in Toronto he collaborated with colleagues in South America, Africa and Australia. Since late 2013 he has been a freelance consultant.

He was secretary to the diamond group for the SAMREC Inquisition in 2005/6 and has contributed to numerous technical reports under JORC, SAMREC and NI43-101 as well as compliance issues with regulators in Canada and South Africa.

Mrs Sarah Magnus

ESG leader
Venmyn Deloitte

Sarah has worked in the field of Environmental Sciences for 8 years and presently leads the Venmyn Deloitte Sustainability Solutions team.

The Sustainability Solutions team provides a diverse range of services, including governance planning, programme management and implementation, enterprise risk management, impact management and planning, management systems alignment and implementation, performance and assurance, technical reporting, due diligence and assessment of rehabilitation and closure liability. Technical reports include Competent and Qualified Persons' Reports for company listings on various international stock exchanges, as well as other regulatory reporting. Sarah's experience includes working on projects located in Italy, Kazakhstan, Russia, Mali, Namibia, Uganda, Tanzania, Zimbabwe, Madagascar, Mozambique, Botswana, Zambia, DRC, the United Kingdom, and within South Africa. Commodities include gold, platinum, chromite, metals, base metals, diamonds, iron ore, industrial minerals, coal and uranium.

Sarah actively provides audit support and transactional support for Deloitte's Global Audit and Corporate Finance teams, and serves as a member of the Core Mining Team in the UK as well as being recognised as an environmental subject matter expert within the energy and resources sectors for Deloitte globally.

She serves as the first and current Chairman of the South African guideline for the reporting of environmental, social and governance (ESG) parameters within the mining and oil and gas industries (the SAMESG).

Tania Ruth Marshall

Geological Consultant
Explorations Unlimited

Tania R Marshall has been actively, and continuously, involved in the alluvial diamond exploration/mining industry since 1985. She started her career with GFSA, before joining a small private company, prospecting for diamonds and other precious stones up and down Africa.

In 1996 Dr Marshall founded EXPLORATIONS UNLIMITED and has since been involved in consulting and contracting to both South African and international companies involved in the exploration and mining of alluvial diamond deposits. She has worked actively in Africa, South America, Australia and Asia.

In addition to consulting, Dr Marshall continues to write and lecture widely on the subject of alluvial diamond deposition, exploration, evaluation and valuation, in which fields she enjoys an international reputation. She sits on the SAMREC and SAMVAL Committees and is currently the Chair of the SAMCODES Standards Committee (SSC).

Andrew John McDonald

Principal Engineer
SRK Consulting (SA) (Pty) Ltd

Has over 40 years of diverse experience in a range of management, technical and financial activities, the past 20 of which have been involved in the fields of engineering studies, statutory reporting for stock exchanges and financial evaluation of mineral projects throughout Africa and other international locations. Has undertaken numerous mineral property and project valuations since 1996.

Rachel Louise McKinney

Database Manager
Coffey International

I have 17 years of experience in exploration geology and have worked in various parts of sub Saharan Africa. I have been involved in a number of different projects on various commodities including platinum, iron ore, gold and base metals, from grass roots to feasibility stage. For the last 7 years I have been the database manager at Coffey and have worked on a number of large resource drill outs in southern Africa which has included data compilation, validation, assay and QA\QC analysis as well as assisting with the compilation of code compliant reports.

Godknows Njowa

Snr Manager
Deloitte

Mr Njowa started his mining career as graduate learner mine at AA Mines (Shabanie mine) in Zimbabwe, and moved on to join Rio Tinto Zimbabwe in various capacities in Mine Finance and Project Evaluation. After completing his master's degree at Wits he joined Venmyn Deloitte. His key areas of expertise lie the combination of skills in Mining Engineering Financial Management and Accounting. Currently he leads a team in financial valuation of mineral and mining projects, technical and economic review, due diligences, MRM and mineral resources and mineral reserve estimation.

Richard Peattie

VP Mineral Resource
AngloGold Ashanti

Graduated from the University of the Witwatersrand in 1992 with a BSc (Hons) in Geology and immediately started working career at Western Deep Levels Gold mine. Since then have worked in a number of roles and at a number of mines around the world in countries that included South Africa, Mali and the DRC. In 2007 got a Master of Philosophy in Geostatistics from the University of Queensland in Australia. Currently the VP Mineral Resources for AngloGold Ashanti based in Johannesburg.

Nicolaas Casper Steenkamp

Senior Associate
Advisian (WorleyParsons RSA)

Dr Nicolaas C. Steenkamp works as Geologist and has over 10 years of experience in a broad range of fields. Currently he is involved in contractor management, geological, geotechnical and geometallurgical project work and studies. Dr Steenkamp has a background in the geological field that includes, but is not limited to: Geological- and geotechnical core logging, underground face mapping, regional surface mapping, greenfields- and brownfields exploration. He has also been involved in technical reporting, due diligence and desktop studies. He also has a background in X-ray analytical methods, specifically EMP and XRF. He is involved in a shaft sinking and decline rehabilitation project where a unique set of geological and geotechnical challenges are faced in terms of development through sand and stiff clays. He is the current Geology Stream Lead for Advisian.

Andrew Tobias van Zyl

Partner and Principal Consultant
SRK Consulting South Africa

Andrew van Zyl, Partner and Principal Consultant at SRK Consulting, holds a B Eng (Chemical) and M Com (Financial Economics) and worked in production and project roles up to 2006, when his focus shifted to strategy, business development and valuation. Andrew has spent several years as technical advisor to government committees overseeing the negotiation of mining conventions and rail and mineral terminal concessions. He has experience in valuing metals and minerals assets, including iron ore, manganese, chrome, copper, coal, gold and the platinum group metals. He has lectured in exchange rate theory and corporate valuation at the University of Johannesburg and has presented

André Johannes van der Merwe

Head of Mining Studies
The MSA Group (Pty) Ltd

André van der Merwe started his career in 1987 with the JCI Ltd as an exploration geophysicist. He expanded his experience by working as a mine geologist in a Witwatersrand gold mine and a rock engineer with the Miningtek division of the CSIR. The late 90s allowed André to increase his knowledge geographically and at executive level. In 1999 André successfully started up a local branch of an Australian consultant (Resource Service Group) which taught some tough lessons on cash-flow management. André next joined SRK Consulting, where he became a Partner.

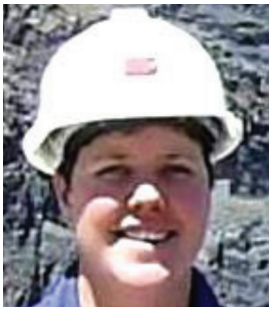
In 2007 he took on the role of the Operations Manager at a platinum junior (Nkwe Platinum) , where he planned, budgeted and manged a very large project form first drillhole through feasibility stage and initiated the next stage: construction of a world-class mine. The collapse of the minerals market put paid to the dream of building a mine from scratch. Currently André heads up the Mining Studies department at the MSA Group.

André enjoys the challenge of the mining industry for the opportunities they present to achieve something worthwhile working with professional teams and mentoring bright, receptive minds.

Anton Wolmarans

Mineral Resource Manager
Petra Diamonds SA Pty Ltd.

After completing an Honours degree in Exploration Geophysics at the University of Pretoria in 1994, I joined Anglo American and went exploring for gold and base metals in West Africa. I returned to South Africa to join the Geophysics team at the Africa Exploration division of De Beers, looking for kimberlites all over Africa, and a few other continents. With a growing interest in resource evaluation and mining, I focussed on in-mine geophysics with the Mineral Resource Management (MRM) department at De Beers Group Services. My experience broadened in MRM shifting from geophysics into geological modelling and mineral resource development, with a good measure of resource and reserve reporting. When the opportunity came to join one of De Beer's largest operations as the Mineral Resource Manager, I took up the challenge. I finally left De Beers after 16 years to join the Mineral Resource Management team at the vibrant and dynamic Petra Diamonds.



Carrie Zermatten

Engineering Geologist
SRK Consulting (Pty) Ltd

Carrie is an engineering geologist at SRK Consulting and has been involved in mining for 11 years. She specialises in risk assessments (qualitative and quantitative) and project management. Her expertise extends to slope stability investigations including database compilation, analyses (empirical, kinematic and numerical) and interpretation. She has worked in Botswana, Mozambique, Uganda, Japan and extensively throughout South Africa; she has previously conducted techno-economic evaluations for alluvial diamonds, feldspar, tungsten, mica, sandstone, sand, kaolinite and coal deposits amenable to exploitation by small-scale miners.