

Estimating diamond price for mineral resources and reserves; new observations and insights

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Introduction

The Canadian Institute of Mining, Metallurgy and Petroleum (CIM) "Best Practices Guidelines for Rock Hosted Diamonds" was written in 2008. NI 43-101, "Standards of Disclosure for Mineral Projects" overseen by the Canadian Securities Administrators, was published in 2011 and the CIM "Definition Standards for Mineral Resources and Mineral Reserves" in 2014. The CIM revised and updated its "Estimation of Mineral Resources and Mineral Reserves Best Practice Guideline" in 2019 but the 2008 diamond guidelines were not updated.

In 2022, the CIM recognised that a review of the diamond guidelines was warranted, to incorporate new learnings since 2008 and to align with other international codes of practice. The focus of this review was on the estimation of average diamond price (i.e., the price for a Run-of-Mine [ROM] parcel of diamonds). The main objectives were to provide guidance to the Qualified Person (QP) in selecting parcel sizes for determining average prices and assisting the QPs and investors in understanding levels of uncertainty in these prices.

This study investigated the levels of confidence that can be attached to price estimates based on varying parcel sizes. The findings (still work-in-progress) were compared to current wisdom around recommended parcel sizes in various diamond codes of practice. In addition, a measure was developed (obtained from a first phase of sampling), that can help the QP to quantify any additional bulk sampling requirements for price estimation at a preferred level of statistical confidence.

Diamonds exist in their host rocks as discrete particles in very low concentrations. A one carat per tonne grade is equivalent to 0.2 parts per million. Diamonds vary in size, and each stone making up the population has a different shape, clarity and color; imparting a unique dollar value to that stone.

The dataset used in this study encompassed 34 assets (current or past producing mines with ROM prices from \$20-\$1,500/Ct) from around the world including Canada, Southern Africa, Russia, Brazil and Australia. The information for each asset consisted of the carat weights and dollar values for the gem, near-gem and boart diamonds in 19 or more size classes. All the value information was adjusted to the same year (2022). Detailed pricing remains confidential and to preserve anonymity, each asset name was replaced with a number.

A Monte Carlo (MC) simulation approach was used to calculate confidence limits for diamond price for different assets and parcels of different size. Since detailed pricing was not available for all assets, two simplifications were made to standardise the information used in the MC simulations. First, the size distributions were reduced to 19 size classes starting at a bottom cut-off of 3 diamond sieve (a nominal

square mesh of 1.2 mm). Second, single dollar per carat per size class values were assigned to each of the 19 size classes including the stones greater than 10.8 carats, known as "specials". The assigned dollar per carat values were taken from very large batches of production ranging from tens of thousands of carats to millions of carats depending on the asset. Using this simplified approach, different parcel sizes (500, 1,000, 5,000, 10,000 carats etc.) were simulated 10,000 times for each asset. The resulting average prices were ranked from lowest to highest and confidence limits were calculated for each parcel size tested.

For this study two relative errors around the mean were calculated at the central, 90 percent confidence limits. The "C90/10" refers to a relative error that lies within $\pm 10\%$ of the mean, nine out of ten times. The "C90/20" refers to a relative error that lies within $\pm 20\%$ of the mean, nine out of ten times. The $\pm 10\%$ relative error represents a tight error margin and the $\pm 20\%$ relative error, a looser error margin.

The idea of price differential as a discriminating measure for parcel size

The authors searched for a simple correlation between parcel size and factors that drive price such as diamond size and percentage gem. A discriminating measure emerged when the size and value distributions were combined into cumulative price versus upper critical stone size curves (Figure 1). It was recognised that these cumulative price curves ranged from flat to steep and, in the majority of cases, the populations requiring larger diamond parcels had flatter curves and the populations requiring smaller parcels had steeper curves (Figure 1). A measure for the slope of the curve is the differential dollar per carat between 0.117 carats and 0.90 carats. This size range was selected as it will be present in the parcels recovered from early-stage bulk sampling. Plotting the dollar per carat differential for each asset on the Y axis and parcel size for the same asset on the X axis allowed the X-Y area of the graphic to be broken into four panels with different parcel size requirements. To determine the recommended parcel size for further sampling, the dollar per carat differential measured from the first (Phase 1) bulk sample is plotted on the Y axis at X=0 and a line is projected to the right until it intersects a vertical box boundary. The X position of the block boundary gives the parcel size for Phase 2 sampling at the desired level of confidence (Figure 2).

Insights and observations

This study has confirmed observations made by others (e.g., Gurney et al, 2003) that diamonds in different kimberlites have very different size and quality distributions even if the kimberlites are in close proximity. These observations can apply to different phases within the same pipe.

Analysis showed that the gem profiles were not constant with increasing diamond size. The profiles can be flat, rising, falling or undulating. This observation implies that price modelling is more difficult and carries more risk than has been perceived by the industry.

This study shows how a first bulk sample can be used to characterise the diamonds and to plan the size of any additional bulk sample required to estimate the diamond price for a given level of confidence. The authors suggest a parcel of approximately 1,000 carats should be targeted for the Phase 1 bulk sample.

The long-established recommendation for sampling (all phases combined) is at least 2,000 to 5,000 carats or larger (in extreme cases) for a run-of-mine price estimate. The results of the study show that a target parcel of 5,000 carats is sufficient for 76% of the assets considered assuming a C90/20 level of confidence. This proportion reduces to 35% for a C90/10 level of confidence. A target parcel of 10,000 carats is sufficient for 100% of the assets assuming a C90/20 level of confidence. This proportion reduces to 57% for a C90/10 level of confidence. Fifteen percent of assets require more than 25,000 carats to reach a C90/10 level of statistical confidence in the diamond price.

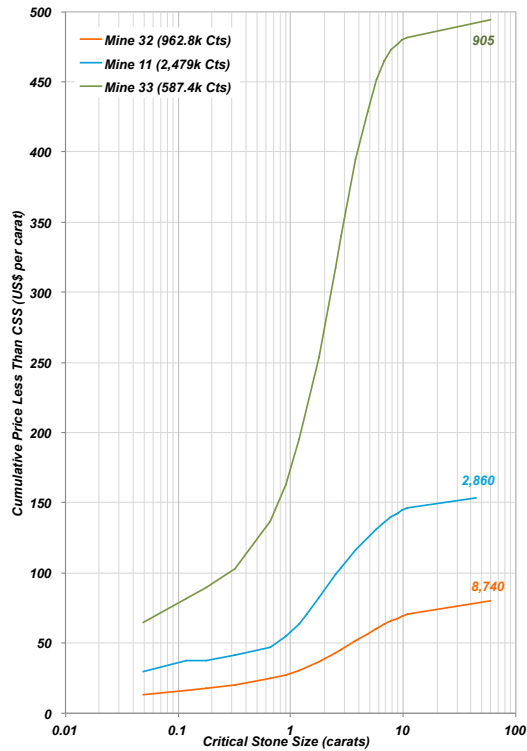


Figure 1: Cumulative price less than CSS for three producing mines inc. parcel sizes. C90/20 level of confidence; parcel sizes shown as annotations.

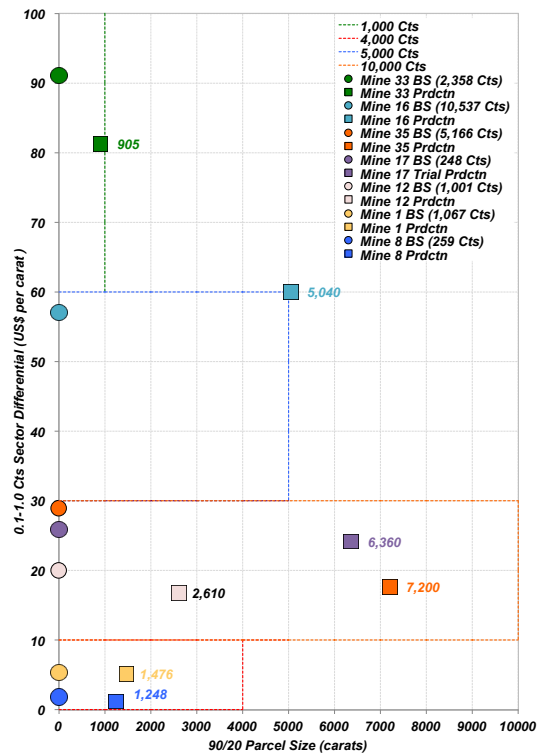


Figure 2: Examples of dollar per carat increments between 0.1 and 1.0 carats from cumulative price curves for seven producing mines with equivalent data from Phase 1 bulk samples (BS parcel sizes in legend).

The primary outcome of this study was an empirical graphical tool that can be used by resource geologists (based on data from Phase 1 sampling) to create an informed estimate of the “target” carats required from the subsequent phases of sampling to meet C90/10 or C90/20 levels of confidence (Figure 2).

The learnings here will be incorporated into the new CIM guidelines. These guidelines will not be prescriptive but will encourage the QP to discuss the rationale for the parcel size used to estimate average diamond price and the associated levels of confidence (e.g. C90/20) for resources and reserves.

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