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ABSTRACT

CRITICAL ANALYSIS OF A KIMBERLITE OPEN–PIT SLOPE DESIGN PRODUCED BY LIMITED GEOTECHNICAL DATA AND SLOPE DESIGN CHARTS

Ian Mason Snyders

The purpose of the study was to determine a geotechnical model that could be used in the slope design process at Mine A diamond open pit mine. Geotechnical data was collected from the current pit slopes for the purposes of the fourth mining cut-back and deepening of the pit. Model creation required the constructive grouping of data into the four pillars of the geotechnical model designed by Read and Stacey (2009). Circular failure charts (Hoek and Bray, 1981) were used to determine relevant slopes in the soils. Laubscher's (1990) Modified Rock Mass Rating classification system was used for individual kimberlite domains, and competent granitic gneiss, respectively. It was

possible to analyse the slope in the kimberlite separately to the country rocks, due to the vertical nature of the orebody. This separate analysis allowed for a deeper pit to be created. The results were checked by using numerical modelling software. Furthermore, the probability of reducing bench face angles in the granitic gneiss by analysis of stereonets was investigated to reduce risk of wedge failure. Implementation was, however, not found to be practical and daily inspections, instrumentation and installation of geotechnical safety berms were suggested as alternative mitigation methods. An additional geotechnical safety berm is to be implemented immediately below the major shear zone in the south east (geotechnical domain 9). Haulage roads planned to be developed below the shear zone must be located below the safety berm. It is also important that haulage roads are not developed in this shear zone.

A geotechnical model was established with geotechnical data collected from the existing pit. Unfortunately, the confidence of the hydrological data is low, meaning that proper monitoring and pumping of water is essential throughout the project life. In particular, circular failure is possible in the upper 20 m to 40 m of the main pit in high rainfall periods. It is therefore very important to setup and maintain a proper monitoring system, that will give an early warning of a pending slope failure. All data collected during the life of the pit should be evaluated against the recommended slope angles. Changes should be made if unstable conditions are determined from the updated analysis.