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Review of geotechnical challenges experienced within a weak kimberlite zone: a case study at Cullinan diamond mine

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ABSTRACT

The centenary cut is a mechanised block cave with an advanced undercut at Cullinan Diamond Mine. About 25% of the C-Cut block was at risk of not being recoverable following an unplanned pillar on uncaved material that was left on the initiation horizon (undercut). The layout design had to be modified leading to increased drawpoint spacing in an attempt to maintain stable pillars on the extraction horizon. Uncertainty on drawpoint interaction triggered the need for research to be conducted. The consequences of poor draw interaction are often severe and irreversible, evident through early dilution entry and point loading on the extraction level. The research examined the deformation rates experienced as a result of high stresses exerted by the uncaved material on the undercut horizon. Monitoring methods included the use of ZEB-HORIZON 3D mobile scanner, drone, borehole camera and observations using laser technology. In addition, a finite difference model (FLAC3D) was employed to assess stability of a weak zone on the extraction horizon. Preconditioning by blast was one of the tools employed to initiate caving of the ore material around the weakzone or the unplanned pillar. The PC/BC model was used to understand the interaction of the drawzones in the area where the spacing has been increased. The finding of the investigation showed that there was little interaction (the cave propagates upwards in silos leaving solid rock between the drawbells) which agreed with the FLAC3D results**.** The deformation rates at 75% undercutting were influenced by the geometry of the footprint and the strength of the rock mass relative to the abutment stresses at the end construction phase. The deformation rates from the inelastic model compared well with underground measurements though slightly underestimated. Empirical methods suggest that drawpoints should not be spaced 24

m apart which is also greater than 1.5 times the width of the drawzone even in weaker rock types where local instability prevails.