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Hydrogeology of the Sterkfontein Cave System, Cradle of Humankind, South Africa

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ABSTRACT:

A water level rise of almost 3 m in the space of two years in the Sterkfontein Cave system since late-2009 necessitated the re-routing of the tourist path through the cave to successively higher elevations on three occasions. It also raised concern for a possible association with copious acidic and sulphate-rich mine water drainage from the West Rand Goldfield (a.k.a. Western Basin) starting in early-2010, and the related threat to the UNESCO-inscribed fossil site. Although these circumstances have had little impact on the tourist value of the site, a prognosis of the impact on cave water level and quality is indicated by virtue of its karst setting and palaeontological significance. Historical and recent potentiometric data, together with ancillary hydrogeological and hydrochemical information acquired in the course of a water resources monitoring programme for the broader Cradle of Humankind World Heritage Site, provides new insight into the hydrogeology of the cave system. An improved understanding of the hydrophysical and hydrochemical response of the cave water system sheds light on the location of this system within the water resources environment. It is proposed that the present-day maximum cave water level is constrained to an elevation of ~1440 m above mean sea level. The recent electrical conductivity of 78 mS/m for cave water is 32% greater than the 59 mS/m recorded in mid-2010 and earlier. Similarly, the recent sulphate concentration of 161 mg/L is 178% greater than the 58 mg/L recorded before 2010. Compared to coeval values for ambient karst groundwater represented by the normative Zwartkrans Spring water, the magnitude of the increases in the springwater are similar, viz. 48% (from 84 to 124 mS/m) in salinity and 166% (from 154 to 409 mg/L) in sulphate. Although a distinct mine water impact is evident in both instances, the values indicate a muted impact on the cave water chemistry compared to the springwater. These and other documented observations better inform the threat from various poorer quality water sources to the fossil site in particular, and to the broader karst water resource in general. This contextualises concern

for the hydroenvironmental future of Sterkfontein Cave and other nearby fossil sites such as Swartkrans, Rising Star and Bolt's Farm. The dynamic response of the water resources environment to a variety of hydrological and hydrogeological drivers reinforces the need for monitoring vigilance across a range of disciplines.