Introduction

This memo outlines preliminary considerations for the development of a conceptual water balance for the proposed Singida Underground Mining Operation, located within the central Tanzanian Singida Greenstone Belt. The region is characterised by Archean metavolcanic and metasedimentary sequences, intruded by granitoid bodies, and crosscut by several brittle deformation zones and shear structures. A robust understanding of the geological, structural, and hydrogeological setting is essential to ensure safe, efficient, and cost-effective mine development, particularly in the context of underground dewatering and long-term water management.

This initial assessment draws upon available site geotechnical investigations, borehole data, regional geological maps, hydrogeological field observations, and analogous studies from similar greenstone belt-hosted gold deposits within the Tanzanian Craton.

**. Introduction**

This memorandum presents preliminary considerations essential for the development of a conceptual water balance and dewatering plan for the Singida Underground Mining Operation. The objective is to guide engineering planning by integrating geological, hydrogeological, and structural factors influencing groundwater inflows, and to outline initial pumping requirements to support mine development and operations.

**2. Geological and Structural Setting**

* The mine is situated within an **Archaean greenstone belt** characterized by a complex assemblage of lithologies and structures:
  + **Hanging Wall Lithologies:**
    - Mafic metavolcanics (basalts, andesites)
    - Banded Iron Formation (BIF)
  + **Footwall Lithologies:**
    - Intermediate to felsic metavolcanics and intrusive bodies
* **Structural Features:**
  + **Main Shear Zone:**  
    The dominant structural discontinuity trending approximately **[e.g., NE-SW]** with a dip of **[e.g., 60°–75°]**. This shear zone exhibits intense fracturing and brecciation, providing preferential pathways for groundwater flow. Its orientation relative to mine excavations is critical for anticipating groundwater inflows.
  + **Porphyritic Dyke:**  
    Intrudes primarily along **[e.g., N-S or E-W]** strike directions with variable dips ranging from **[e.g., 45° to 70°]**. The dyke may act as a hydraulic barrier or conduit depending on fracture density and connectivity, influencing local groundwater flow patterns and compartmentalization.

**3. Hydrogeological and Hydraulic Conductivity Considerations**

* **Lithological Controls:**
  + BIF units typically have low primary permeability but secondary permeability via fracturing and weathering zones.
  + Mafic metavolcanics generally show moderate permeability controlled by fracture networks.
  + Intrusive bodies and dykes tend to be less permeable but can exhibit variable hydraulic behavior based on fracture presence.
* **Structural Controls:**
  + The **main shear zone** is a key hydrogeological feature with enhanced hydraulic conductivity due to deformation-related fracturing. This zone likely contributes significantly to groundwater inflows and requires detailed hydraulic characterization.
  + The **porphyritic dyke** may compartmentalize the groundwater system or create preferential flow zones depending on fracture intensity.
* **Hydraulic Conductivity Estimates:**  
  Preliminary values based on similar greenstone environments:
  + BIF: 10⁻⁸ to 10⁻⁶ m/s (fractured zones)
  + Mafic metavolcanics: 10⁻⁷ to 10⁻⁵ m/s
  + Shear zone: 10⁻⁵ to 10⁻³ m/s (highly fractured)
  + Porphyritic dyke: 10⁻⁹ to 10⁻⁷ m/s (variable)

**4. Conceptual Water Balance Elements**

* **Recharge:** Primarily from precipitation infiltration on surface-exposed permeable units.
* **Groundwater Flow:** Controlled by fractured rock aquifers, anisotropy, and structural features including shear zones and dykes.
* **Discharge:** Through mine dewatering, natural springs, and baseflow to surface water bodies.

