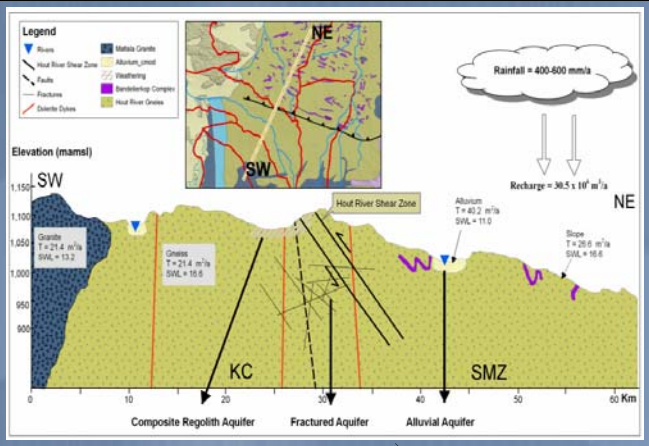
A conceptual model of basement aquifers in Limpopo province, South Africa

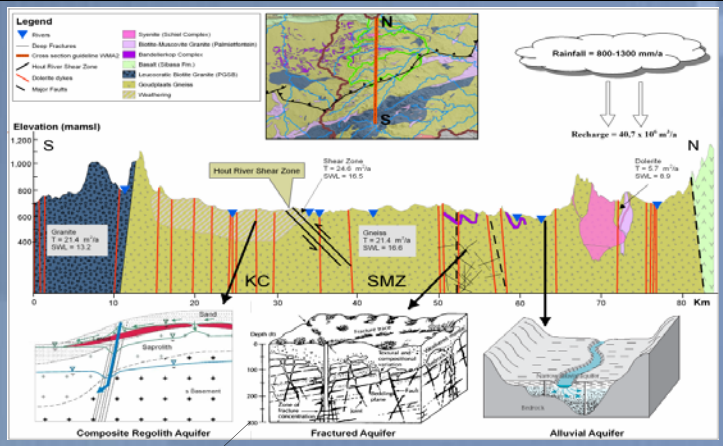
Abstract

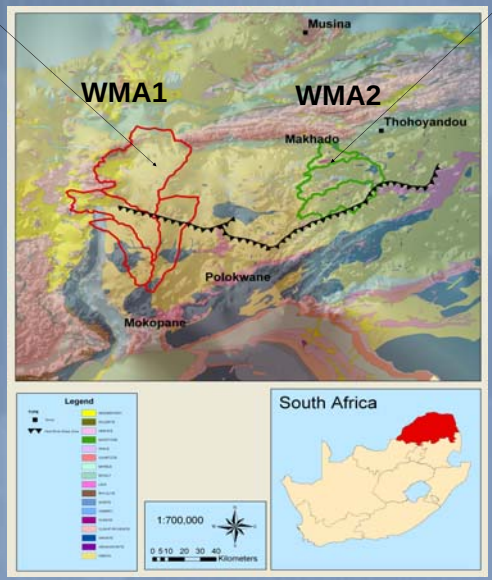
Based on geological data and analyses of over 1000 pumping tests and 300 hydrochemical datasets, conceptual models for the Limpopo (WMA 1) and Luvuvhu/Letaba (WMA 2) Water Management Areas in the Limpopo province of South Africa were developed. Determined transmissivities follow a log-normal distribution, with higher transmissivities observed in boreholes targeting alluvial aquifers or the composite regolith aquifer in closer vicinity to the Hout river shear zone on the southern side of the Limpopo Belt. No spatial relation of transmissivities to the prevailing neo-tectonic stress field is apparent in the dataset, indicating an overriding influence of preferred weathering along structurally weakened zones under paleo- or current stresses.

Aims of the Project

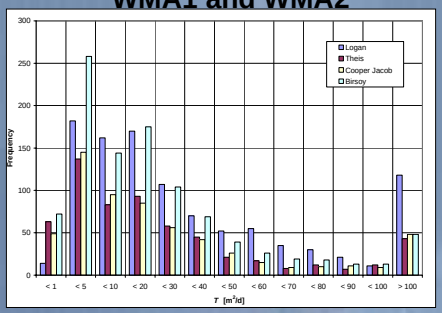
- Identify significant regional water-bearing structural features for groundwater reconnaissance and exploration.
- Conceptualize flow dynamics and flow paths
- Determine reliable storage capacity and storage coefficients for the various geological domains.







Distribution of transmissivities for WMA1 and WMA2



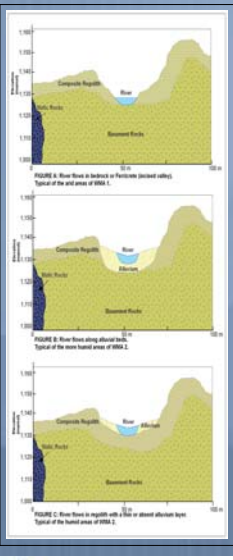
Fractured Rock Aquifers

Prevailing neo-tectonic stress field expected to open NW-SE striking structures in WMA 1 and NNW-SSE striking structures in WMA 2

Higher groundwater yields and transmissivities related to:

- Geological contacts in WMA 1
- Proximity to the Hout River Shear Zone (HRSZ) in WMA1
- Geological structures in WMA 2 (no influence of strike)

Only selected thicker dykes are favourable groundwater targets in WMA 2.

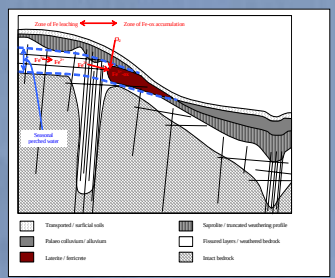


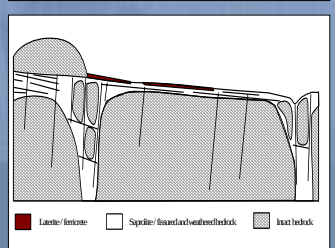
Alluvial Aquifer

Higher transmissivities are observed in boreholes targeting the alluvial aquifer, esp. in closer vicinity to the Hout River Shear Zone.

Three typical variations of drainage systems are identified:

- Drainage features which incise into basement rocks or ferricretes and are typically found in the more arid parts (Figure A).
- Drainage features with alluvium which mostly replaces the regolith as found in the more humid parts (Figure B).
- Drainage features which incise into basement rocks with a thin or absent alluvium typically found in the humid parts with shallower depths of weathering (Figure C).





Composite Regolith Aquifer

Weathered profile depends on:

- Topography,
- Parent rock type,
- Structural features,
- Climate.

The weathered profiles of the two Water Management Areas differ considerably:

- More arid WMA 1 has very little overburden.
- More humid WMA 2 consists of deeper weathered profiles.

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