

4th SADC GROUNDWATER CONFERENCE

10th -12th of November 2021
VIRTUAL CONFERENCE



Optimisation of Groundwater Monitoring Network for Pongola- uMzimkulu Water Management Area

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12 November 2021*



International Association
of Hydrogeologists
the World-wide Groundwater Organisation



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Background

- ❑ IN RSA, The National Water Act (Act No, 36 of 1998) requires:
 - The establishment and management of national monitoring programmes to:
 - ✓ Facilitate the continued and coordinated monitoring of water resources (including GW) by:
 - Collecting relevant data and information that are adequate and responsive to the present and future challenges of efficient management of the country's water resources.
- ❑ In 2017, Department of Water and Sanitation (in RSA), finalised a technical “**desktop**” study for the “Review, Evaluation and Optimisation of the South African Water Resources Monitoring Network:
 - ✓ focusing on National Monitoring Programmes (inc. Groundwater Monitoring Programmes)
 - The aims where to:
 - Evaluate each monitoring programme in its present condition (2014-2017),
 - Redesign and realign the national water resources monitoring network based on a scientific analysis considering strategic and management objectives of the department and the country.
 - Assess the requirements and implementation mechanisms of specialised monitoring programmes, including:
 - ❖ Acid Mine Drainage (AMD)
 - ❖ Hydraulic Fracturing activities
 - ❖ Dolomites Aquifers
 - ❖ Transboundary Aquifers within RSA areas

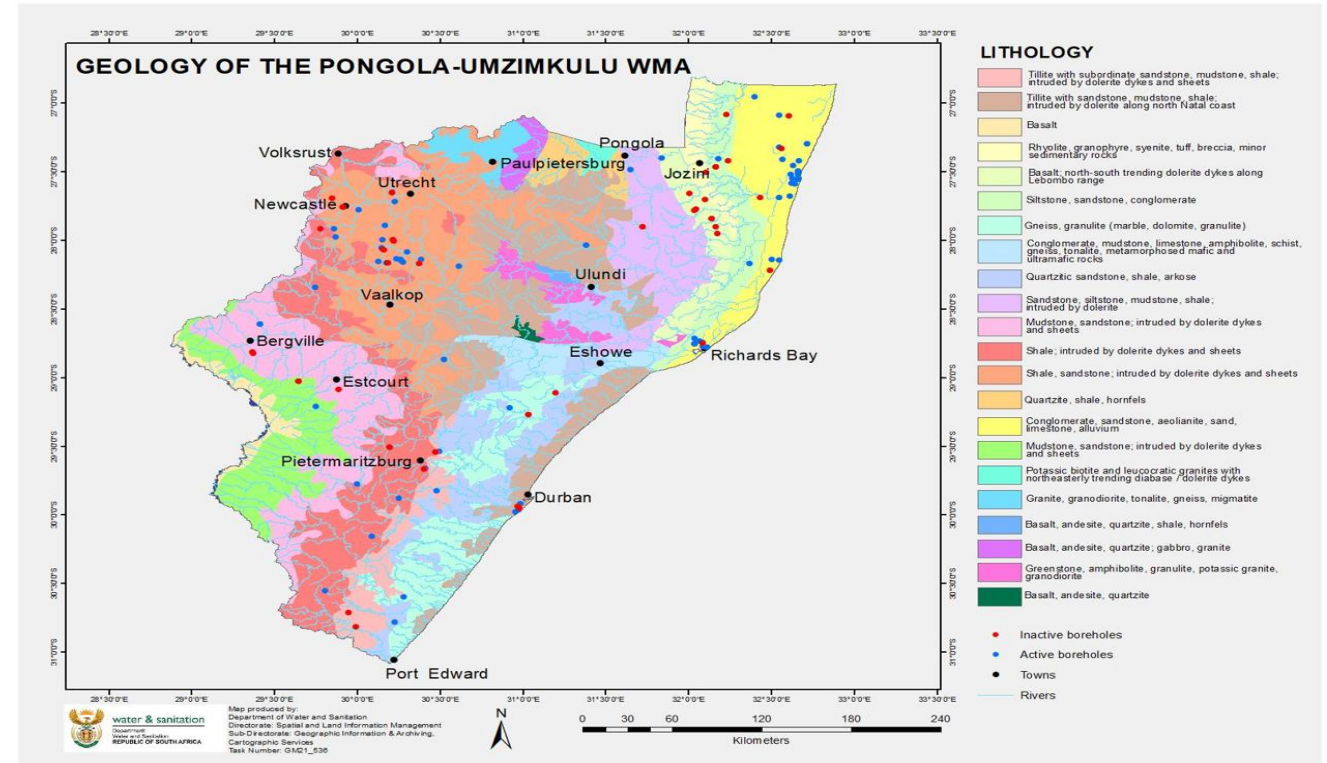
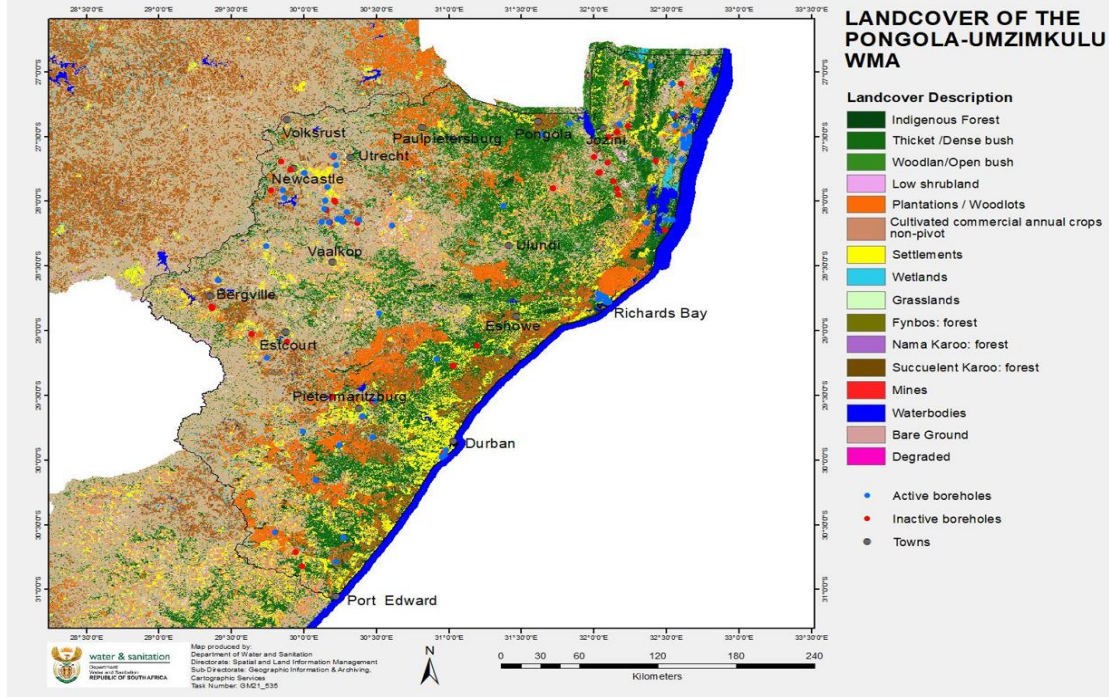
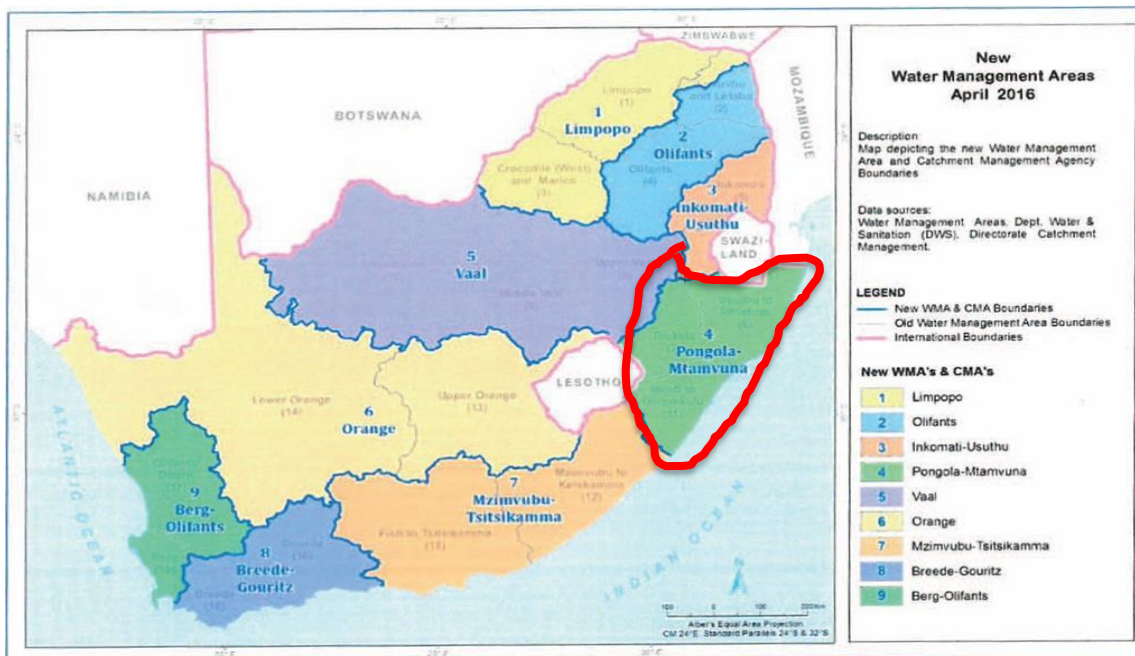
Background... Cont.

- ❑ Each existing monitoring network was optimized to:
 - Ensure adequate spatial coverage to eliminate gaps in the network.
 - Prioritise existing, new and sites that require alterations according to each site's contribution towards meeting national objectives as well as each site's relative information contribution.
- ❑ The Study recommended the following for the area:
 - ❑ Baseline stations be implemented first to get a better understanding of regional based water levels. These stations were identified in pristine areas where there were no land or water use activities close by (**suggested borehole density of 1 to 8 sites per 2 500 km²**)
 - ❑ Trend stations were identified in areas of high groundwater use or pollution & should be prioritized per WMA and improved or installed accordingly.

Problem Statement

- ❑ Following the recommendations that were made in the implementation strategy of the Scientific Review Report,
- ❑ After Rigorous comparison between the existing monitoring activities and a theoretical distribution of sites that meet most of the objectives of a national water resources monitoring network.
- ❑ The proposed baseline stations were not specified if is for groundwater quality or groundwater level.
- ❑ Also, the proposed and existing sites of the Pongola-Mtamvuna Water Management Area(WMA4), monitored by KwaZulu Natal region, were found to be located near a valley with a perennial or non-perennial river nearby or in very steep and mountainous areas with intense sugar cane farming, plantations or industries.
- ❑ Therefore, a new approach had to be considered to conduct a thorough desktop feasibility assessment for Pongola Umzimkulu WMA to clean up these noise areas and optimise the monitoring network accordingly.

Pongola-Mtamvuna Water Management Area (WMA4)



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Pongola-Mtamvuna Water Management Area (WMA4)

For Pongola-Mtamvuna (183) 56 new baseline stations and 127 trend stations were proposed in addition to the current monitoring stations.

To implement these recommendations the following factors were considered in conducting a thorough desktop analysis for WMA 4:

- ☐ **Geological setting of the area**

- ☐ **Land use activities**

- ☐ **Transboundary aquifers**

- Check if there are any transboundary within the study area
- Within these aquifers are there any monitoring sites (active and closed)

- ☐ **Aquifer Yield Map of South Africa**

- What is the type of aquifer found in the area and their yield.

- ☐ **Groundwater use in the area**

- Are there any registered groundwater users in the area identified from the National database (WARMS), type of the user and the impact they have on groundwater.

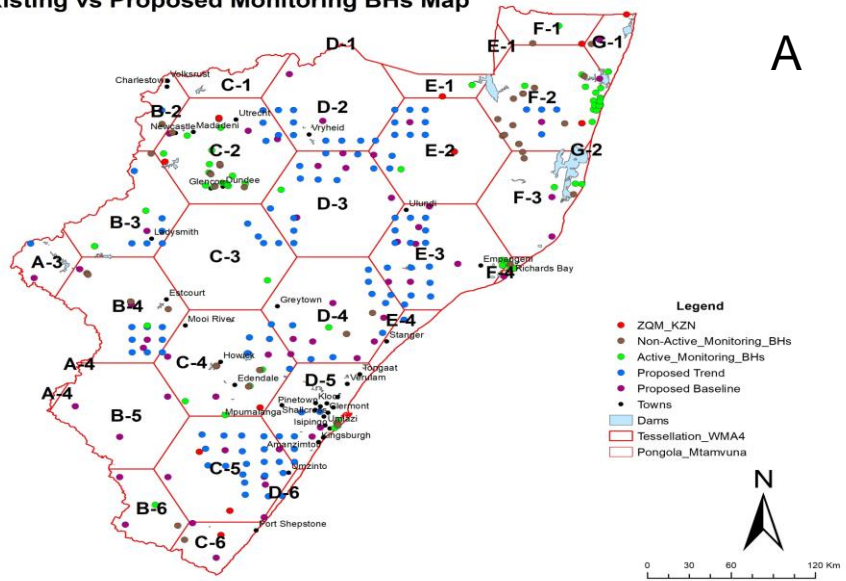
- ☐ **Strategic Source Areas**

- Are there any groundwater monitoring taking place within the identified strategic source area.(WRC)

Approach/methodology

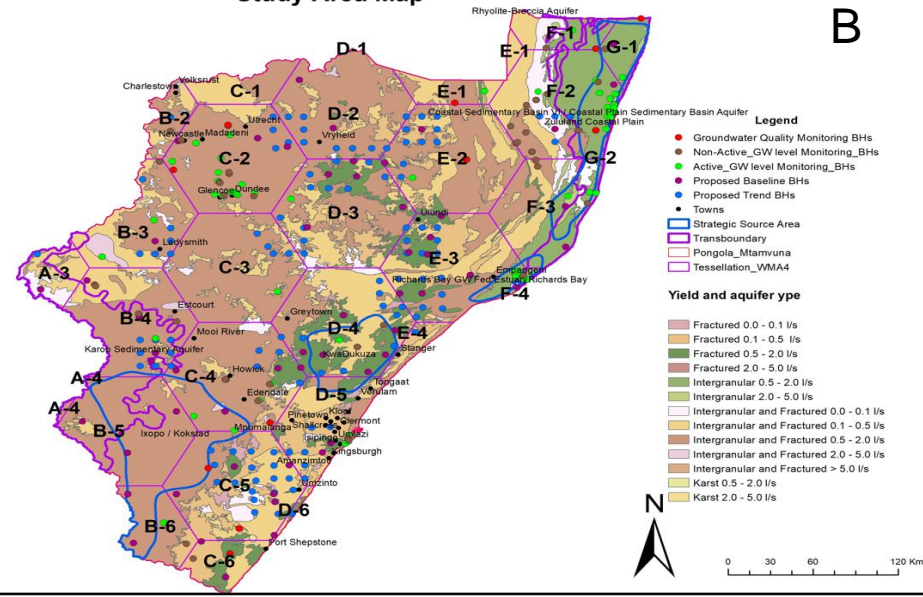
- ❑ The proposed network sites and the existing monitoring boreholes were plotted both on Google Earth and ArcGIS.
- ❑ Tessellation method of hexagon (5000km²) was used to subdivide the area in order to zoom in and have a dialed analysis. Per hexagon, the distribution of the stations, geology, aquifer type, land-use etc were then analyzed this will assist the implementation approach
- ❑ A catalogue/table per hexagon was created considering the above-mentioned factors, to eliminate gaps in the network and ensure adequate spatial coverage, and select the feasible site that is more representative for the monitoring network
- ❑ A site verification will have to be conducted after acquiring all this desktop information, followed by geophysics and siting and drilling of the final proposed stations

**Pongola_Mtamtuna
Existing vs Proposed Monitoring BHs Map**



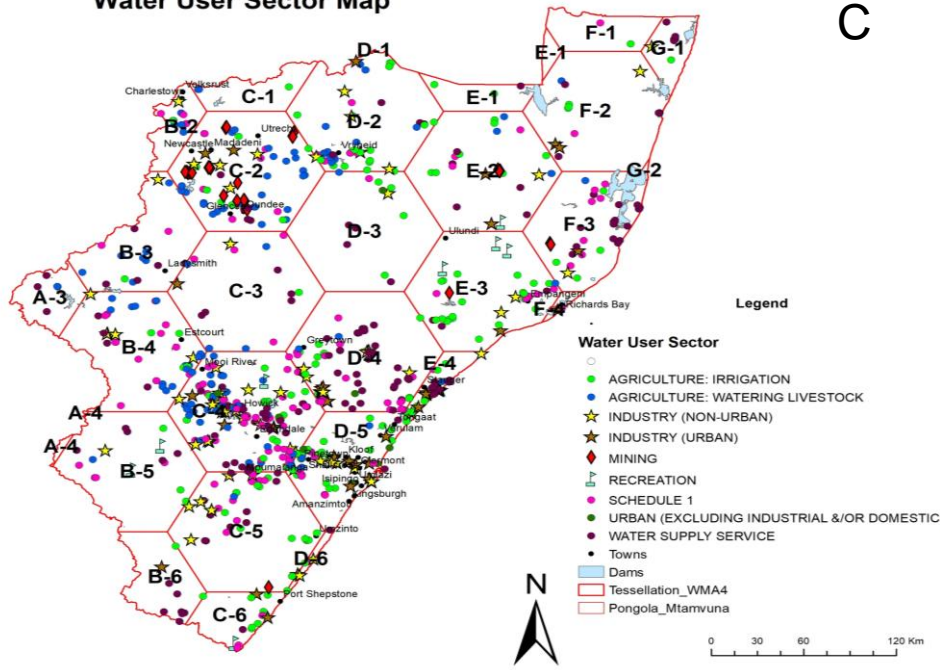
A

**Pongola_Mtamtuna
Study Area Map**



B

**Pongola_Mtamtuna
Water User Sector Map**



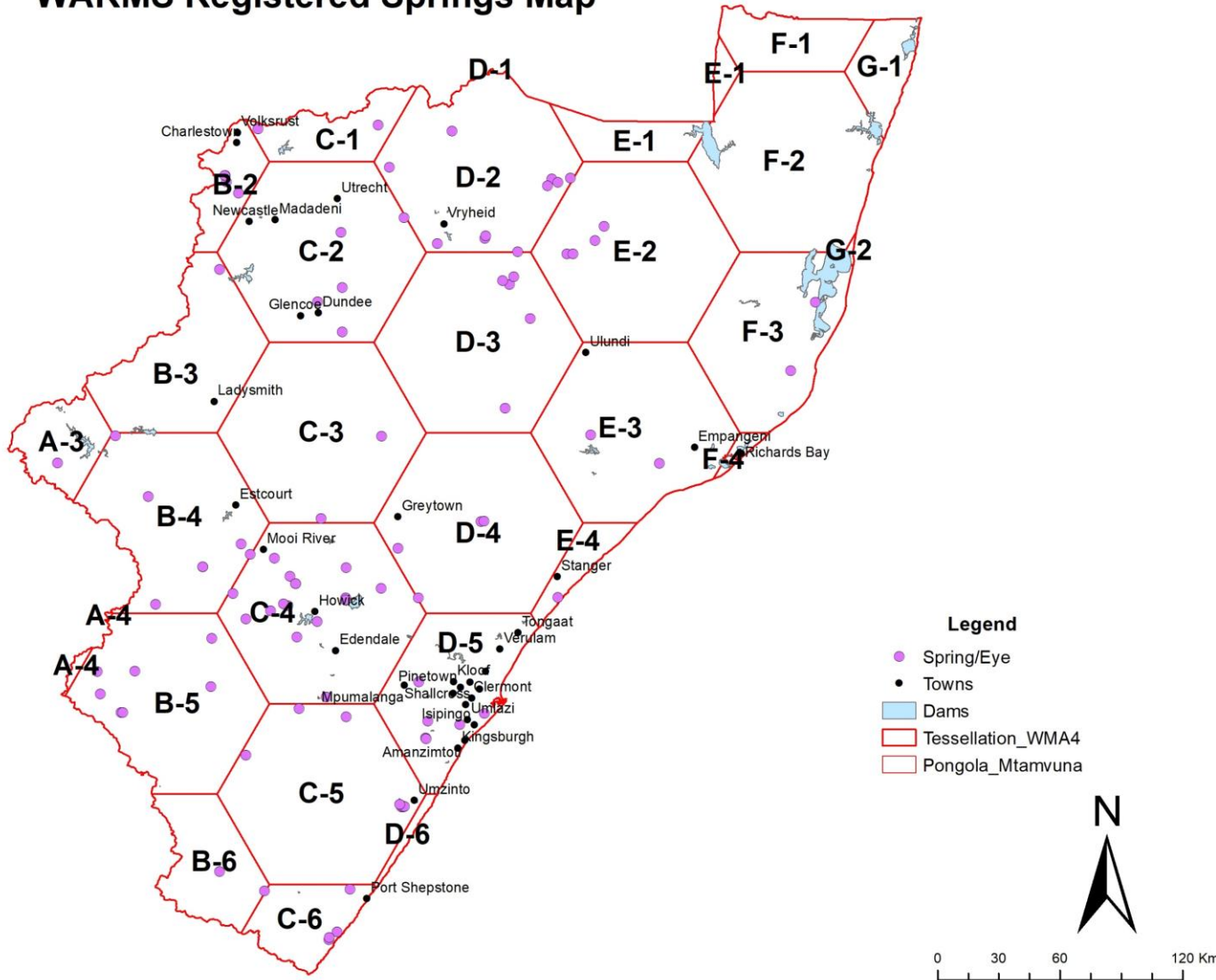
C

- ☐ Map **A** shows the distribution of existing monitoring boreholes and the new proposed monitoring stations (Baseline & Trend)
- ☐ Map **B** shows the different type of aquifers, and how these boreholes are distributed across the area
- ☐ The dominant aquifer type is the intergranular and fractured aquifer, and they have a yield of 0.5 – 2l/s also Karst aquifer with a yield above 5l/s is present
- ☐ Also, Strategic groundwater resource areas are indicated on the map as well as the transboundary aquifer present.
- ☐ Map **C** shows all the groundwater abstraction activities within the WMA, (WARMS)
- ☐ Such information is important in the development of monitoring objectives per area, e.g., C-2 have lot of mining activities, therefore, AMD monitoring might be an objective
- ☐ Area C-4, E-3 is more of irrigation activities and might need to monitor for nitrate and so on

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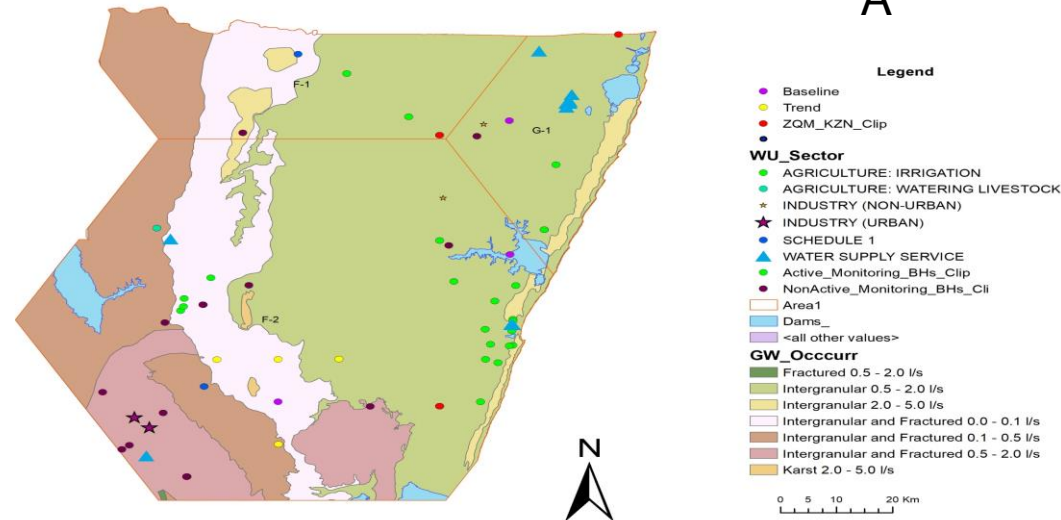
Pongola_Mtamvuna WARMS Registered Springs Map



- ☐ This map shows the distribution of the springs across the WMA.
- ☐ Recommendation made was to adopt some springs and use them as baseline monitoring points for groundwater quality
- ☐ Assessments of these springs in terms of their condition and on site location will be conducted before any decision is made

Pongola_Mtamvuna

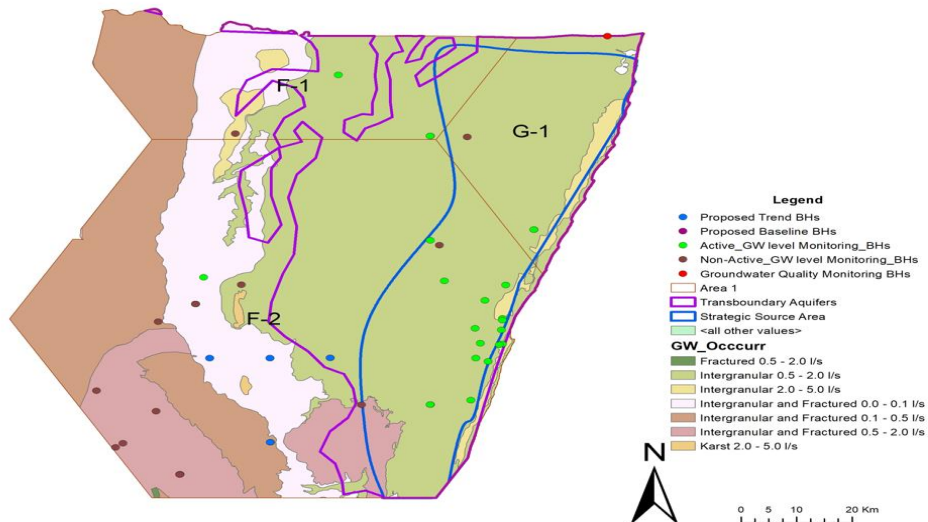
A



- ☐ Map **A** shows the distribution of the sites per area in a microscopic point of view.
- ☐ Map **B** after overlying the different maps e.g. transboundary, strategic water source area to do proper analysis and select the best possible site to implement for the optimisation purpose (Considering all factors such as land use, geology etc)
- ☐ After these analyses we can select areas to conduct geophysics and so forth

Pongola_Mtamvuna
Study Area no1 Map

B



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Output from the Hexagon analysis

AREA 1	F1, F2 and G1
Mseleni Kwazulu Natal area; New baseline; Recharge ≥ 80 mm/a - 1000 km	
Number	PM4W70ANB0167
Latitude	-27.350015
Longitude	32.657037
The proposed site is plotted within Zululand Coastal Plain strategic source area and Coastal Plain Sedimentary Basin Transboundary Aquifer. The aquifer type is fractured with a yield of 0.5 - 2.0 l/s. About 10km from the proposed baseline there are existing active water level monitoring boreholes (W7N0017, W7N0007, W7N0008, W7N0010, W7N0011 and W7N0017) also one destroyed borehole W7N0006.	
New position proposed	
New associated trend positions proposed	
32.284402	-27.58158
32.284402	-27.58158
32.382144	-27.581289
32.285008	-27.76874
New sites planned	

Conclusion

- ❑ This is the comprehensive desktop analysis of the optimization outcome.
- ❑ This study took into account recommendations that were made in the implementation strategy from the scientific review report.
- ❑ The hexagon analysis proved to be best approach for this study as irregular distribution of the monitoring sites and gaps in the network were identified.
- ❑ In E-3 there is a lot of activities from mining, to agriculture and recreation water users, however, no groundwater quality station is proposed in the area and the current monitoring is only concentrated in one side for groundwater level only. This area needs additional monitoring stations and proper distribution of the monitoring sites to ensure adequate coverage of the area.
- ❑ Hexagon analysis can assist in the development of site specific monitoring objectives.
- ❑ This analysis also assisted in identifying existing boreholes that can be used to supplement the current monitoring purposes through engagements with the owners and avoid drilling cost and so forth.
- ❑ An implementation document for this area with all the recommended stations based on this analyses will be developed, which will then guide into upcoming site verification, geophysical survey, siting and drilling activities
- ❑ Successful implementation of this optimisation outcome lies in the support from all different stakeholders locally and international.



water & sanitation

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Thank you 😊

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