# Groundwater potential Eastern Province

# Presentation outline

1. Introduction
2. Main Groundwater projects
3. Rainfall in Eastern Province
4. Hydrogeology of Eastern province
5. Groundwater potential
6. Potential for enhancing recharge and storage

# Objective

**The objective of this presentation is to inform on:**

- Groundwater, recharge and storage enhancement in the Eastern Province
- The main aquifers and
- Recharge mechanisms.

# Introduction

- Water is a precious natural resource that plays a crucial role in securing human health, improving livelihoods, and maintaining the balance in ecosystem. It is abstracted from surface water and groundwater sources for various uses.
- Rwanda with its high demographic and economic growth there is an increase in water demand for domestic and industrial uses. The treated water supply is limited and insufficient to meet the demand. In general water utility companies are focusing on urban areas while the rural remote areas are mainly receiving water through boreholes and springs.

# Introduction

## Groundwater resources in Eastern Province

The Eastern province is characterized by recurrent water scarcity due to the lack of springs and other surface water sources in the region.

The other source of water that can be used is the **groundwater.** However, before its extensive use it is needed to have some information on its distribution, quantity and quality. It is in this line that a study was recently commissioned by RWFA in order to get required information as mentioned above.

# Main groundwater projects

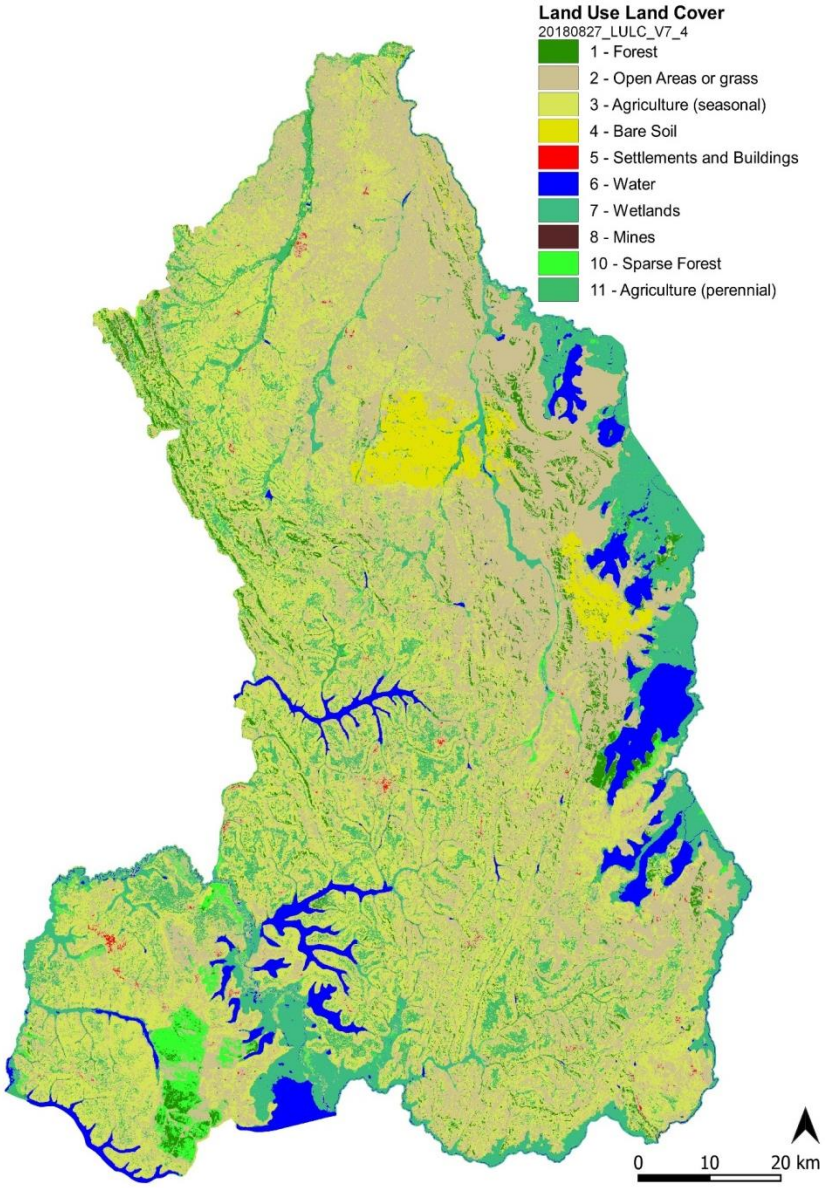
| Name of the project | Current status |
|---|---|
| 200 Boreholes project | A grant from China to be implemented in FY 2019-2020 |
| Boreholes along borderlines | A project that started in FY2018-2019 in a bid to secure quick water supply to communities living on the borderlines. |
| Kanzenze Water treatment plant | A PPP project with Kigali Water Limited. Works are at 17.6% and it will be completed by April 2020. |
| Rehabilitation of Nzove 1 | Nzove I was constructed in 2009 but has several failures today that it requires major rehabilitation. Feasibility studies under procurement stage. |
| Groundwater extraction | Ongoing project implemented by Living Water International Rwanda with a target of 40 boreholes per year for 20 years. |
| Gako beef project | Ongoing project implemented by RAB to drill 13 boreholes in Gako farms. |

# Description of the Eastern Province

The Eastern Province is considered as relatively flat within Rwanda and referred to as the Eastern Plains region with an altitude ranging between 1,000 m and 1,500 m. It has the lowest rainfall (800mm to 1000mm per year) and highest average temperature (13ºC to 28ºC) in the country resulting in the highest evapotranspiration rate in Rwanda.

Within the Eastern province can be found some wetlands. Along the southern and eastern border, the Akagera River is present with its many lakes and wetlands.

# LULC map of Eastern province



# Hydrogeology and potential

**Different hydrogeological units or aquifer types located in Eastern province:**

- Granites (Mainly Bugesera and Nyagatare): overall competent and relies on fractures for recharge and transmissivity.
- Schists: considerably less competent than granites and easy to fracture and erode. The fractures easily fill up with weathered materials.

# Hydrogeology and potential

- Quartzites: interbedded throughout the less competent schists, it is the most competent aquifer type identified. Where not fractured or faulted, transmissivity and recharge is non-existent. Very high potential and transmissivity in the rare places where the beds of quartzite are crossed by perpendicular valleys, breaking through.

# Hydrogeology and potential

- **Alluvium:** overlaying most aquifer types. Overall, the alluvium mostly consists of clayey soils which, even though recharge will be high, will not provide high yielding boreholes because of the constricting transmissivity. In some cases, coarse sediments are deposited, and high potential can be identified. Coarse sediments are more common close to meandering fast flowing rivers.

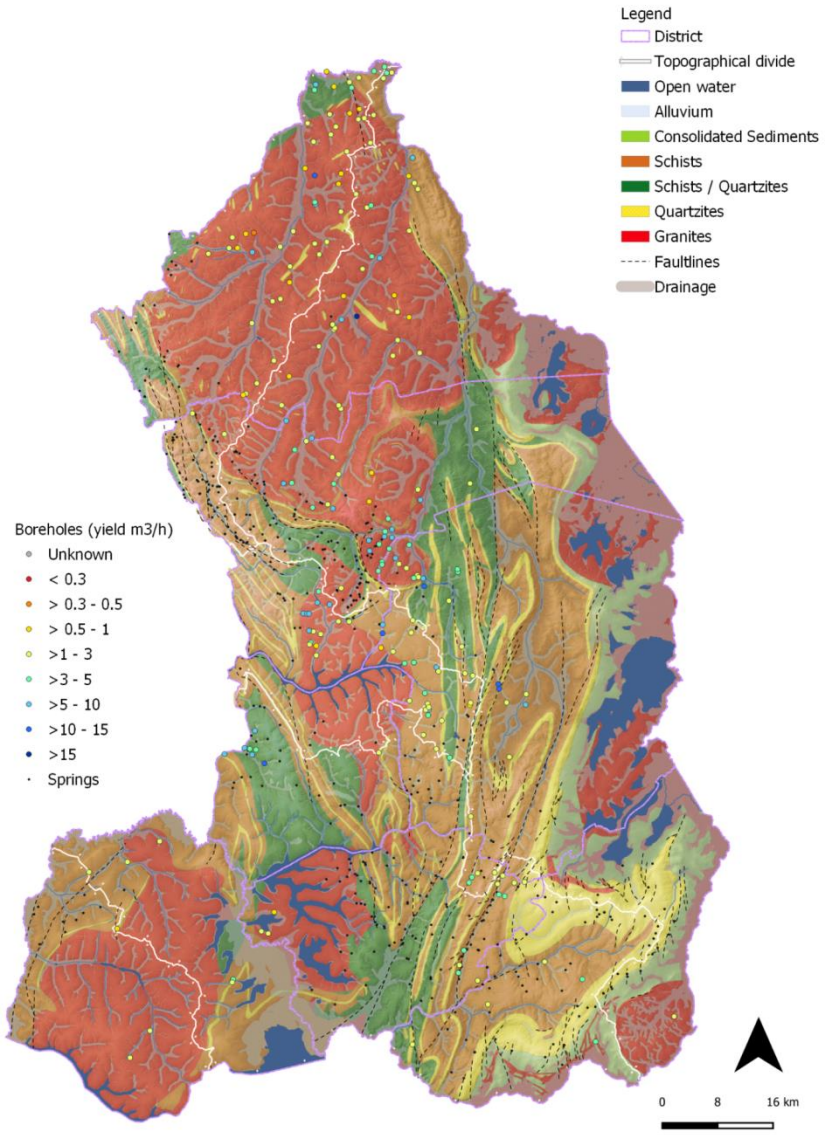
# Hydrogeology and potential

- **Spring potential:** in Eastern province the topography don't allow springs formation except in western part of Gatsibo (higher altitudes). For other areas relatively flat, the groundwater is exploited through the use of boreholes.
- For the Eastern Province, the derived recharge lies between 98,447 to 112,506 $m^3/h$, estimated to decrease to 25% in the driest period. The current abstraction is estimated at 742 $m^3/h$ while the demand is fluctuating between 3,069 and 7,672 $m^3/h$.

# Hydrogeology and potential

- The Eastern Province consists mostly of fractured aquifers which are highly heterogeneous in nature, with possibly little to no relation to surroundings. Calculations for storage, flow and capacity which would apply to more homogeneous and consistent aquifers based on sediments for example, do not work. In order to still provide outputs, generalization need to be made in order to establish a general picture of the above-mentioned characteristics. Fractured basement aquifers cannot be extrapolated and are very localized.

# Hydrogeology map



# Groundwater potential

To find groundwater potential in the eastern province, the information on existing boreholes is used. The borehole yields were interpolated to create a base-map. It should be noted that interpolated borehole yields should be used with care and only serves a planning purpose. Yield differences can be within ranges of a few meters.

# Groundwater potential

The interpolated yield of boreholes is indicated in 3 classes:

- **Low potential:** 1 to 3 m3/h. More typical for the **granite** and **consolidated sediment aquifer** types, unless something significant happens that increases potential.
- **Medium potential:** 3 to 5 $m^3$/h. More typical for the **schist aquifer** types. Less likely to have significant changes (not impossible in conjunction with quartzite aquifer type) but higher over the board potential compared to granite aquifer type.
- **High potential:** 5 to 10 $m^3$/h. More typical for the **quartzite/schist aquifer** type. This aquifer type is most heterogeneous resulting in the highest number of clustered high yielding boreholes, giving this interpolation result.

# Groundwater potential

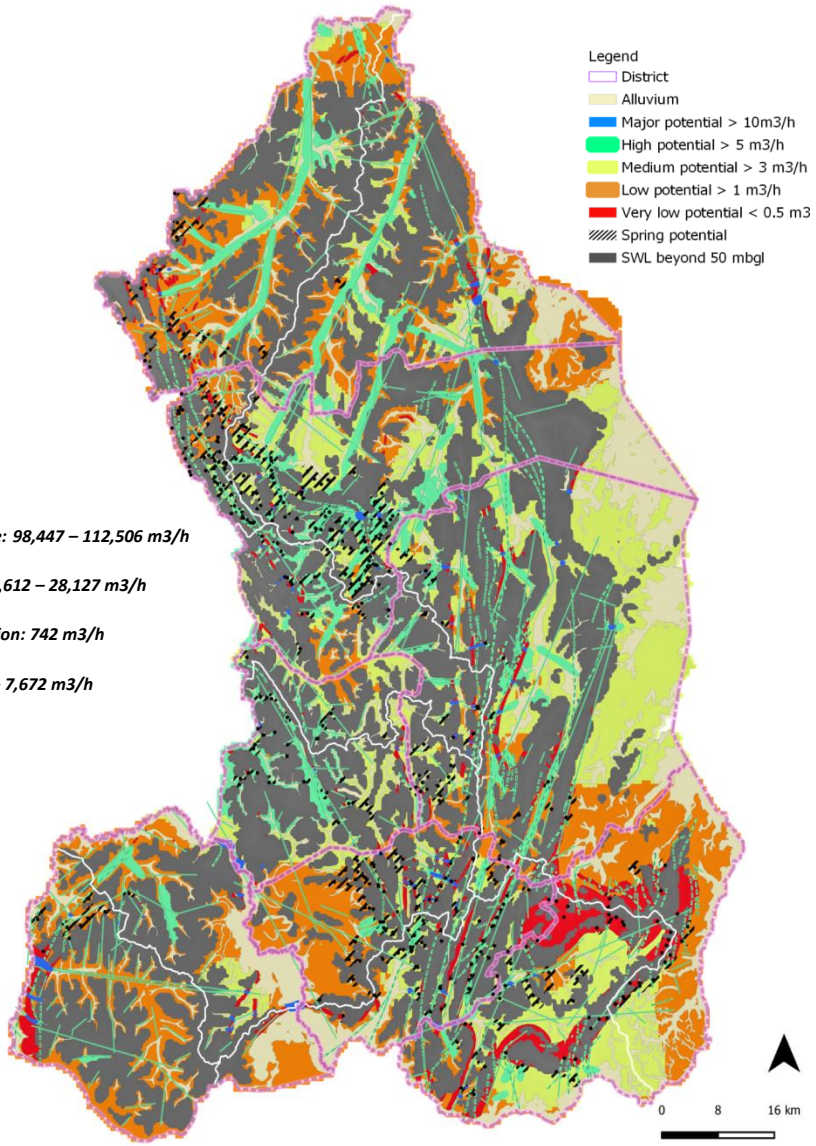
The following classes were not based on interpolation, but rather on observations and identification of features:

- **Major potential:** Surpassing 10 $m^3$/h. Otherwise referred to as a class 1 target. These are areas identified in the quartzite ridges where a valley breaks through the quartzite band in perpendicular fashion as described in Figure 31. These areas have the highest potential found in Eastern Province, but need to be identified with pinpoint accuracy using geophysics, since missing the feature puts you in the next category.,
- **Very low potential:** less than 0.5$m^3$/h. These are signified by the quartzite ridges that are not broken. Since there is no transmissivity and recharge, there is no potential. The difference in result between yield in solid quartzite and broken quartzite is significant. Differentiating between the two using geophysics and in the field, is delicate work.

# Groundwater potential

Alluvial aquifers have a good groundwater potential if they contain coarse material that are hydraulically connected to the current river course. Borehole drilled in coarse grained deposits of Akagera river near Kigali yielded 50 $m^3$/hr on average from a depth of less than 20 m. The sediments near the Akagera river along the south eastern and eastern border of the Eastern Province could also have a higher groundwater potential. A verification with geophysics is needed to know what level of potential is on location.

# Groundwater potential map



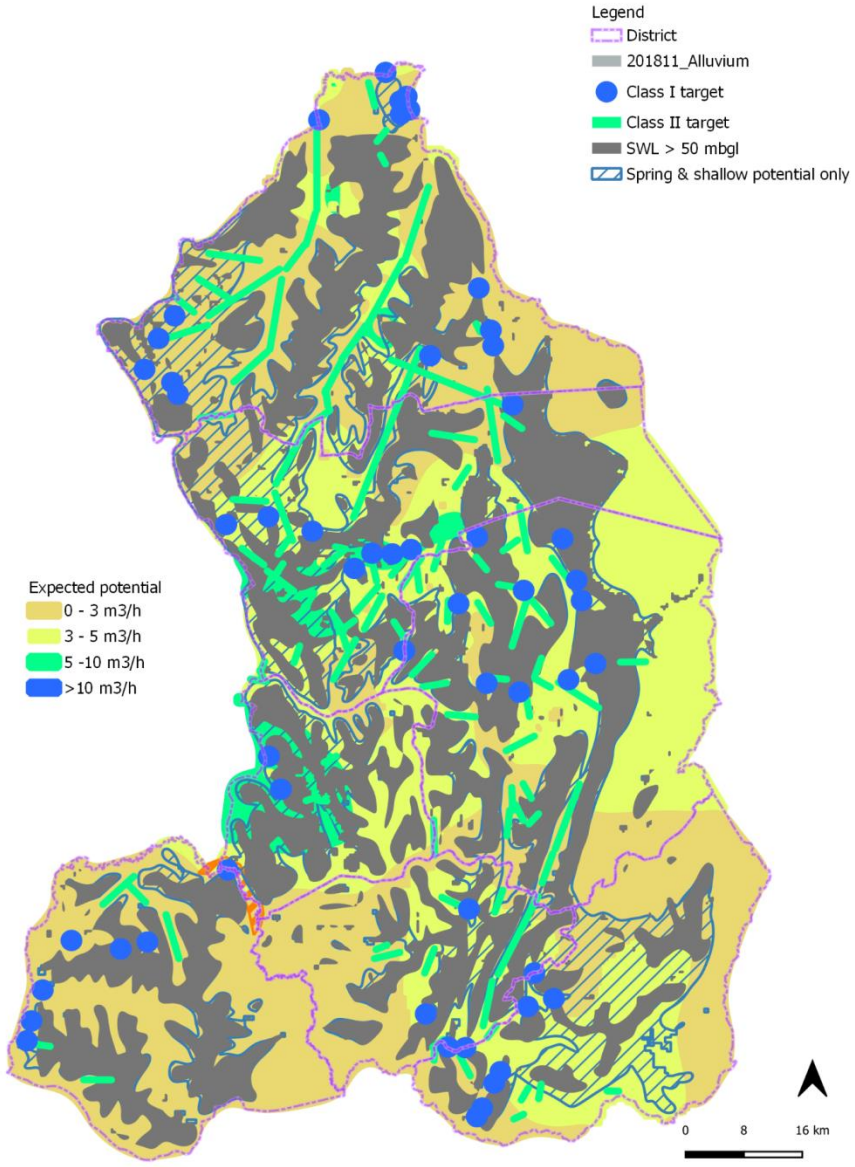

***Derived recharge: 98,447 – 112,506 m3/h***

***Dry recharge: 24,612 – 28,127 m3/h***

***Current abstraction: 742 m3/h***

***Demand: 3,069 – 7,672 m3/h***

# Groundwater aquifer map



# Potential for enhancing recharge and storage.

Enhancing recharge and storage of excess water during wet period can strongly increase water resources and water availability in periods of water scarcity. There is a wide range of possible interventions and strategies to increase recharge and storage. These include:

- ✓ Valley dams
- ✓ Water reservoirs
- ✓ Valley tanks
- ✓ Sand dams
- ✓ Subsurface dams
- ✓ Recharge facilities and
- ✓ A variety of agricultural soil and water management interventions.

# THE END