CLIMATE - HYDROGEOLOGY

Geophysical and Hydrogeological Analysis of the Napu Aquifer

Florence Tanui, Gilbert Ouma, Daniel Olago

Turkana Stakeholder Workshop - Thursday 15 February, 2018

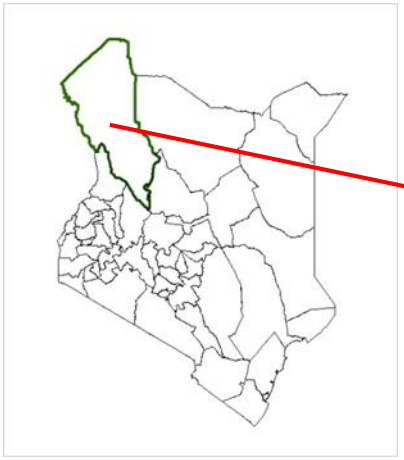
REACH Improving water security for the poor

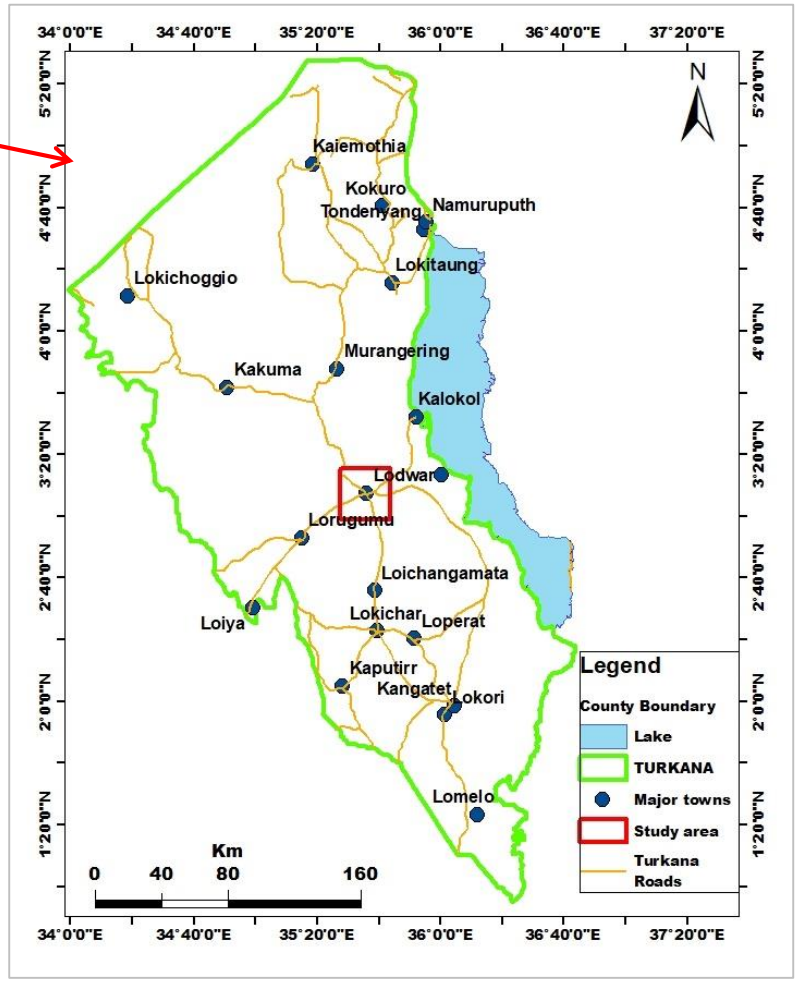
UKaid from the British people

OUTLINE

- Regional Context
- Local Context
- Research Objectives
- Conceptual Framework
- Hydrogeological Characteristics
- Basic Conceptual Model
- Planned Activities

REGIONAL CONTEXT OF STUDY AREA

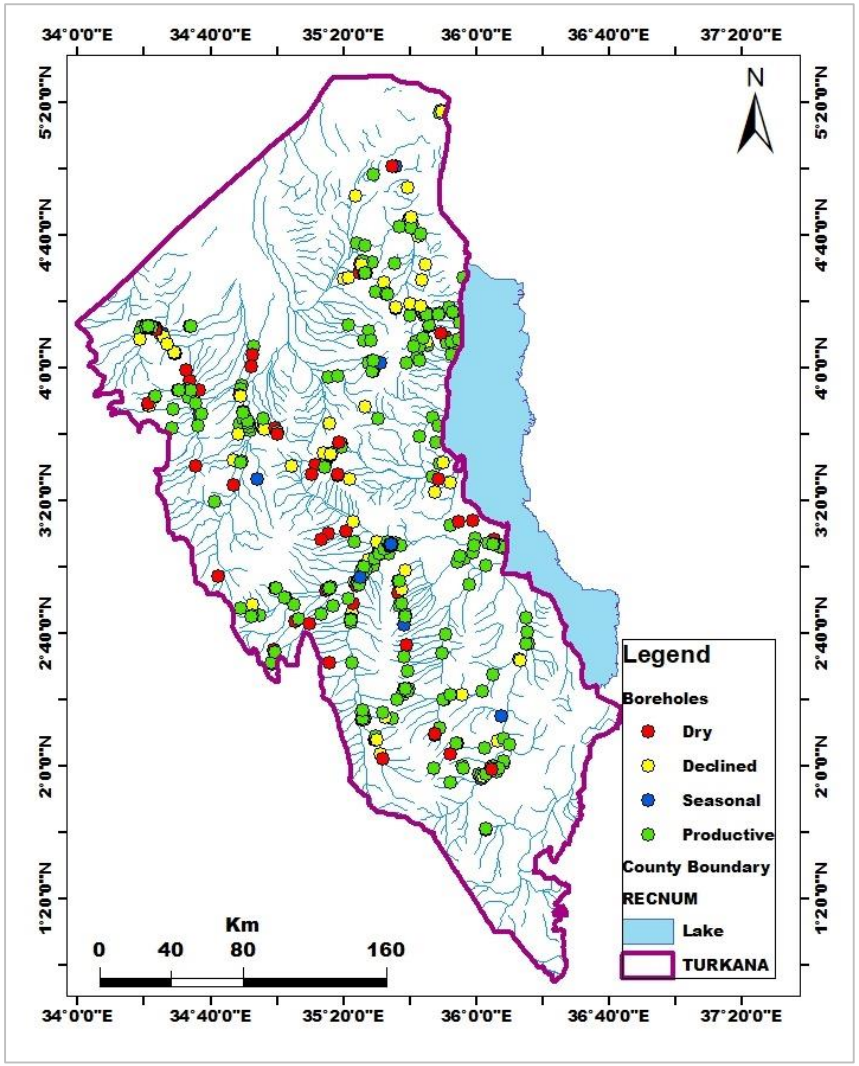




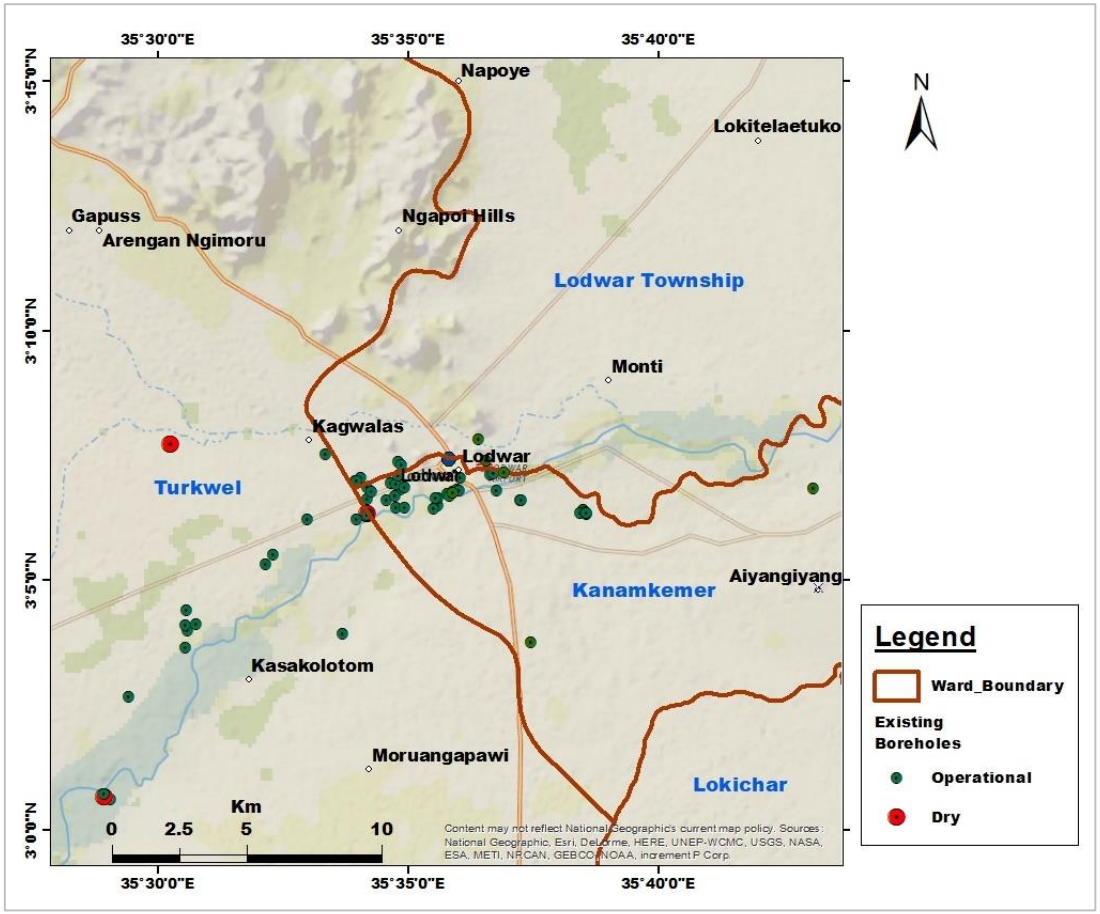
- Study area is located Turkana County in the north western part of Kenya
- Lodwar town, the headquarters of Turkana County depends largely on groundwater for water supply
- Most of the existing boreholes are along Rivers and *laggas* where they are possibly recharged
- Most boreholes experience very low yields during dry seasons and some wells have been reported dry

GROUNDWATER SITUATION IN TURKANA

- A total of 252 boreholes were assessed for their availability for abstraction
- About 14% of initially productive boreholes have dried up
- Boreholes with declined yields are 16% and seasonal wells are 3%
- 68% of the boreholes have not experienced significant drop in yields.



STUDY AREA: LODWAR TOWN & ENVIRONS



- The study covers parts of Turkwel, Kanamkemer and Lodwar Township wards
- The area is 900 km^2
- The major landforms dominating the area are hills, plains and river valleys
- The hills dominate the north-western section and constitute 10% of the total surface area with a maximum elevation of 900 m asl.
- The plains cover about 70% of the area with an average elevation of 500 m asl.
- The river valley has an average elevation of 200-350 m asl.

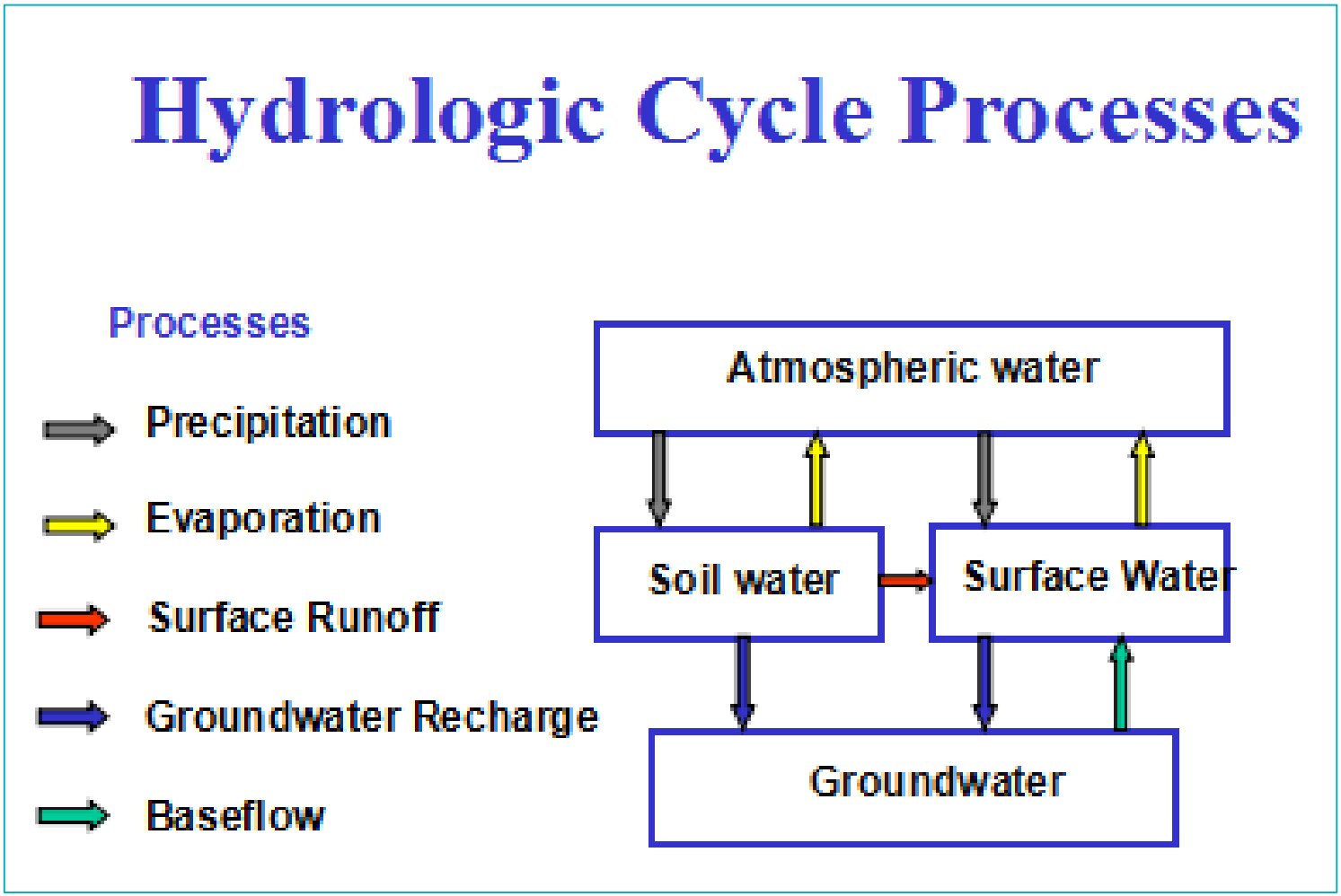
RESEARCH OBJECTIVES

- **Objective 1:** To determine the hydrogeological characteristics of the Napu aquifer

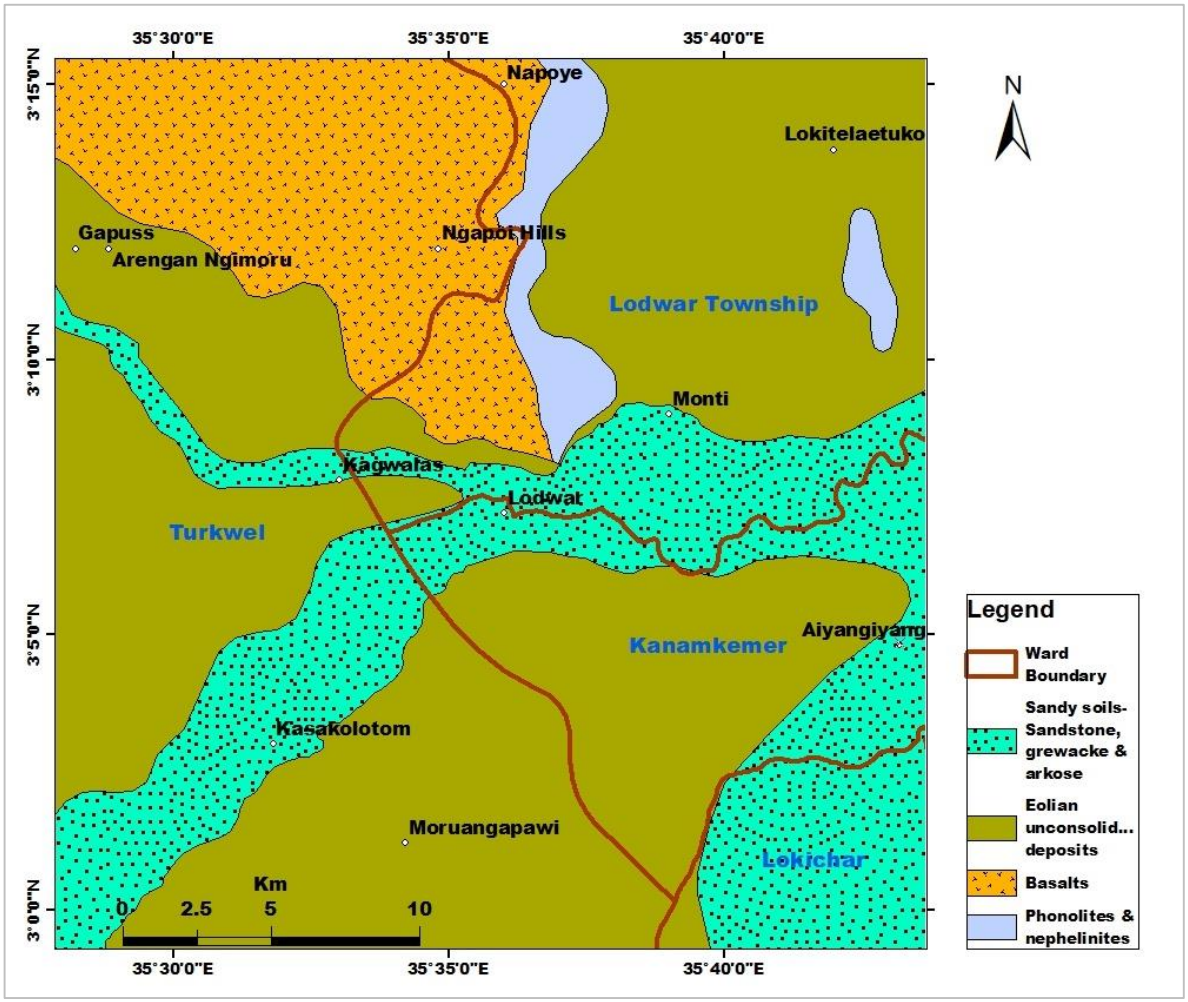
- **Objective 2:** To characterise the aquifer hydrogeochemistry and its susceptibility to pollution

- **Objective 3:** To examine interaction between rainfall, surface water and groundwater and recharge characteristics using isotopic and Water Table Fluctuation (WFT) methods

CONCEPTUAL FRAMEWORK



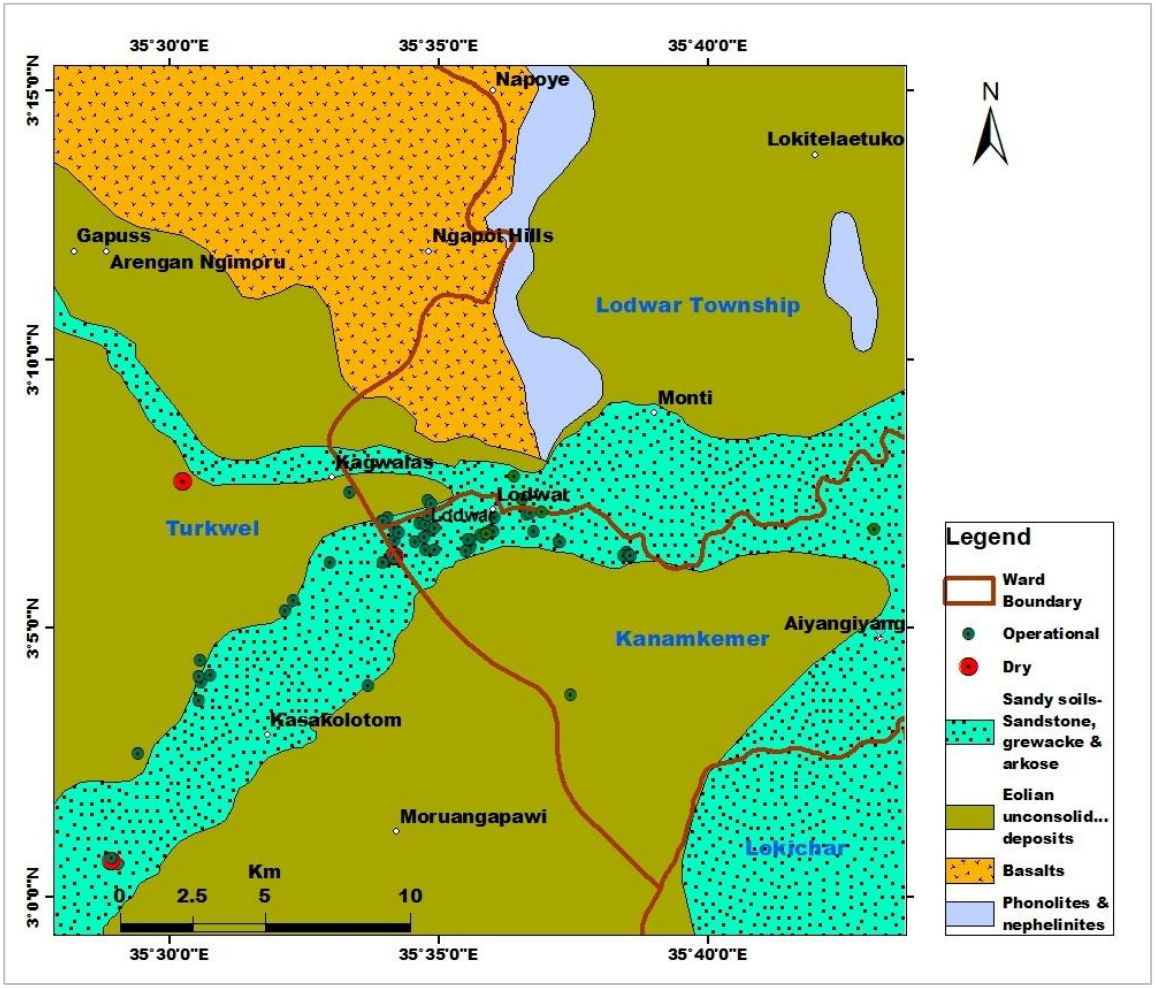
GEOLOGY



Geologic Formations

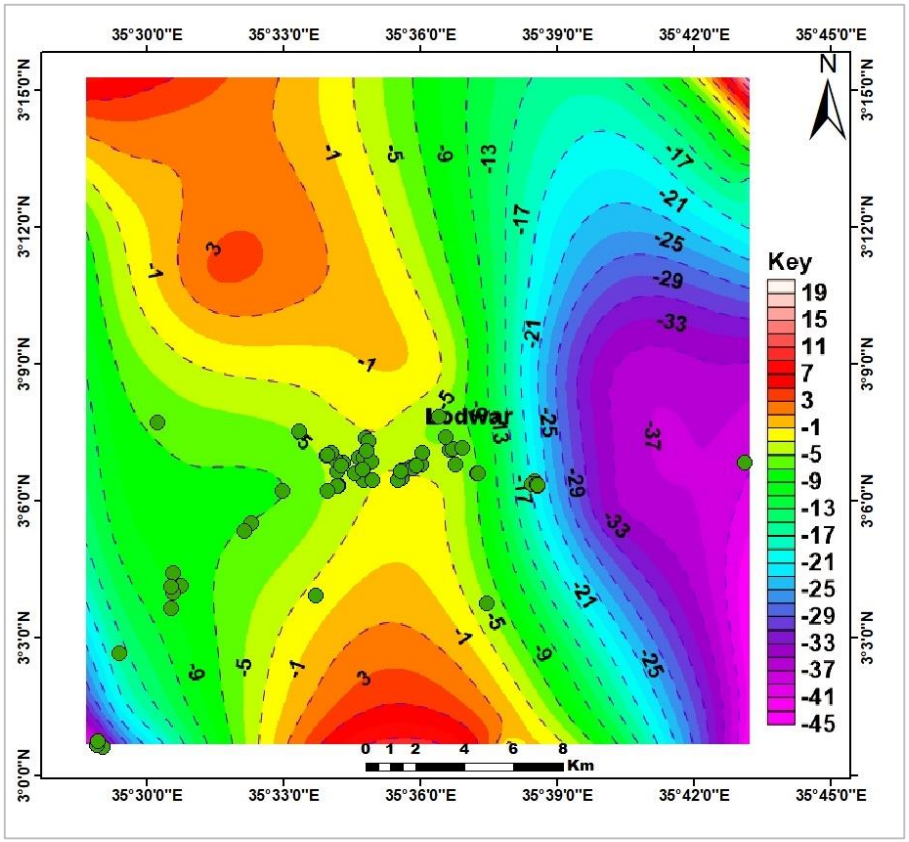
- **Alluvial deposits-** (sandstone, greywacke & arkose)
- Unconsolidated **Eolian Deposits**
- **Volcanic rocks -** basalts, phonolites, nephelinites & rhyolites)
- **Sedimentary rocks –** Turkana Grits (Grits, sandstones & limestones)
- **Undifferentiated basement system –** (gneisses, schist and marbles)

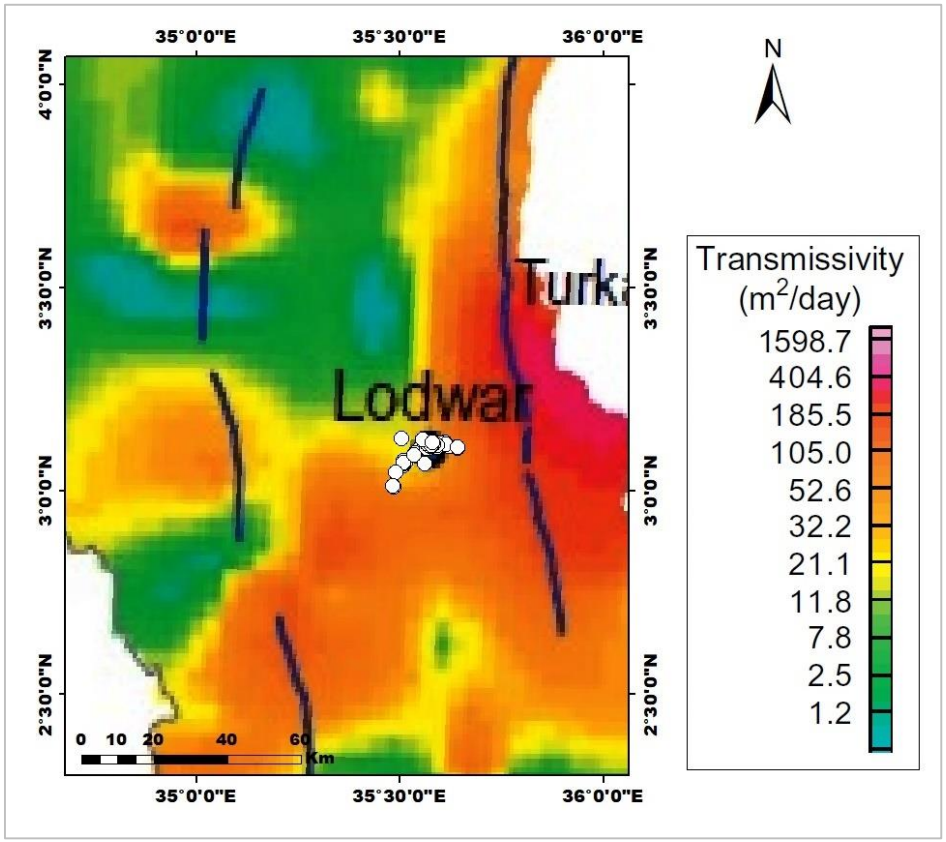
EXISTING BOREHOLES



- About 40 boreholes have been drilled within Lodwar town
- Most reliable boreholes are those found within the river valleys of Turkwel
- The boreholes depths are between 15 and 80m
- Boreholes in the plains have been drilled up to 130 m depth

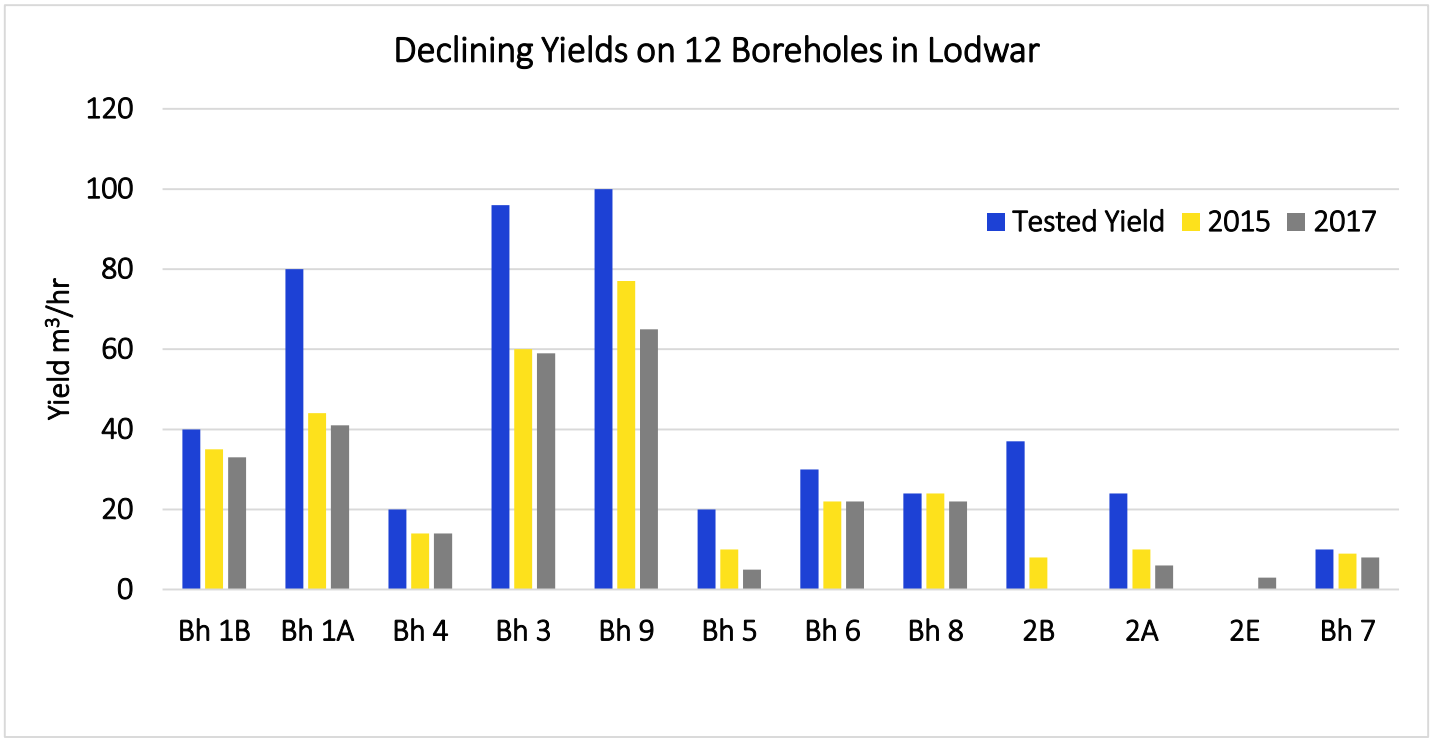
BOUGUER GRAVITY & TRANSMISSIVITY





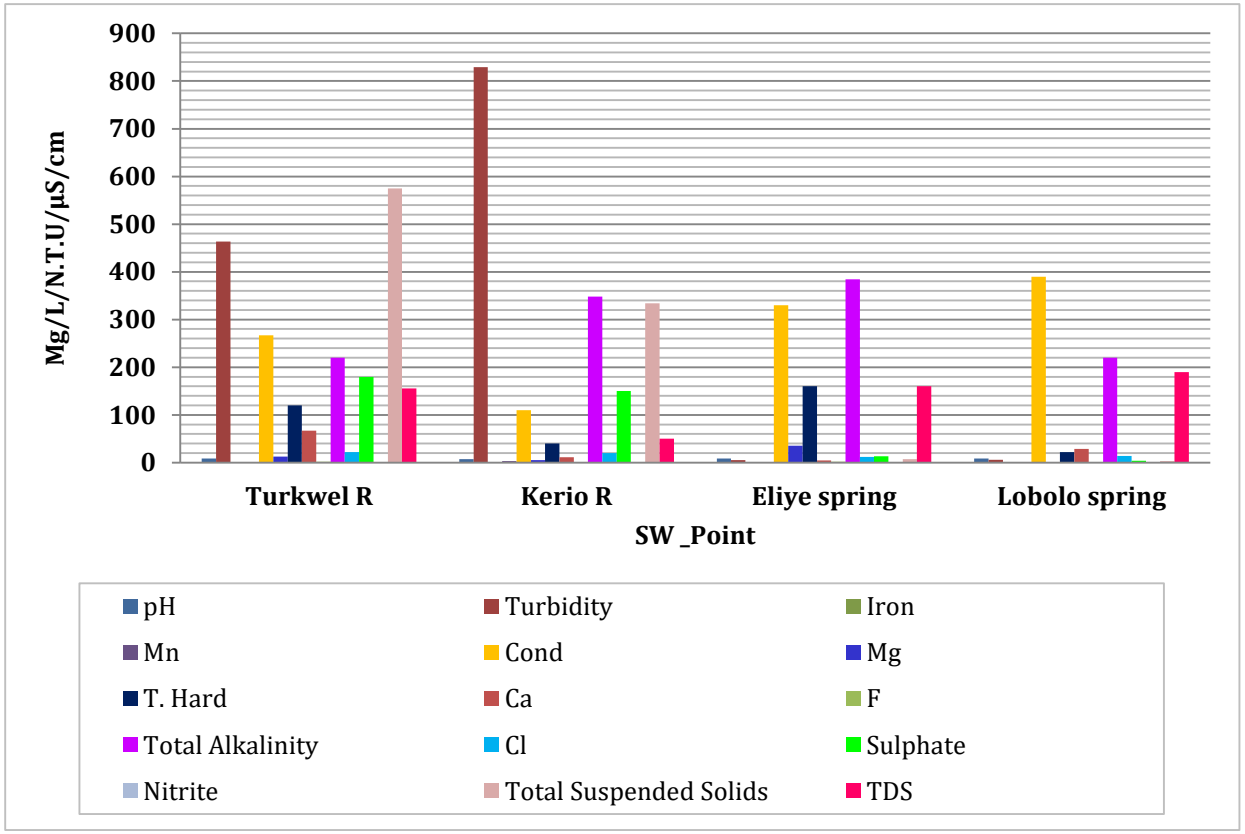
- Boreholes are found in areas of low gravity anomalies (-5 to -13) with medium transmissivity values between 21 to 105 m^2/day
- The values of transmissivity indicate medium to high groundwater potential in the area

EVIDENCE OF DECLINING YIELDS



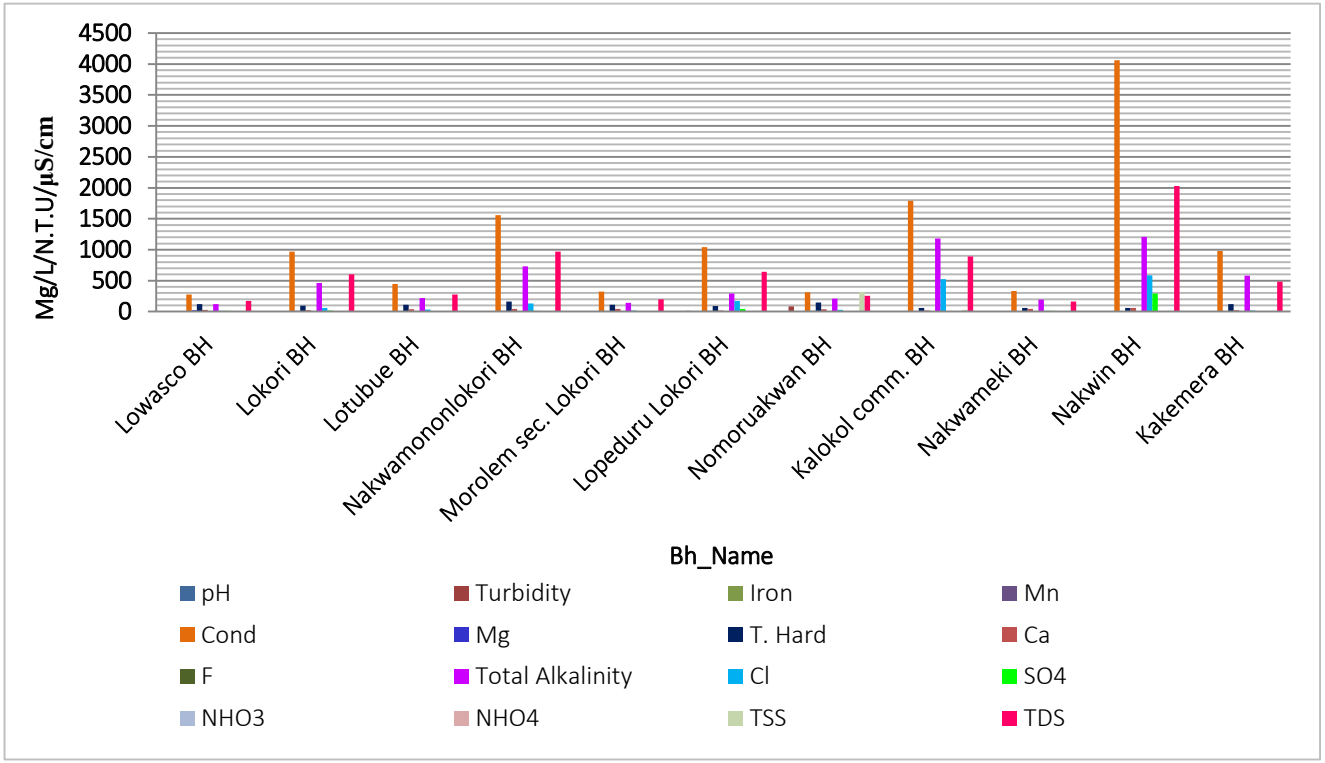
- 12 boreholes mapped during the water audit were analysed for yield-trends
- Declining trend was observed in all the boreholes twelve boreholes where Bh 2B is already dry

WATER QUALITY: SURFACE WATER



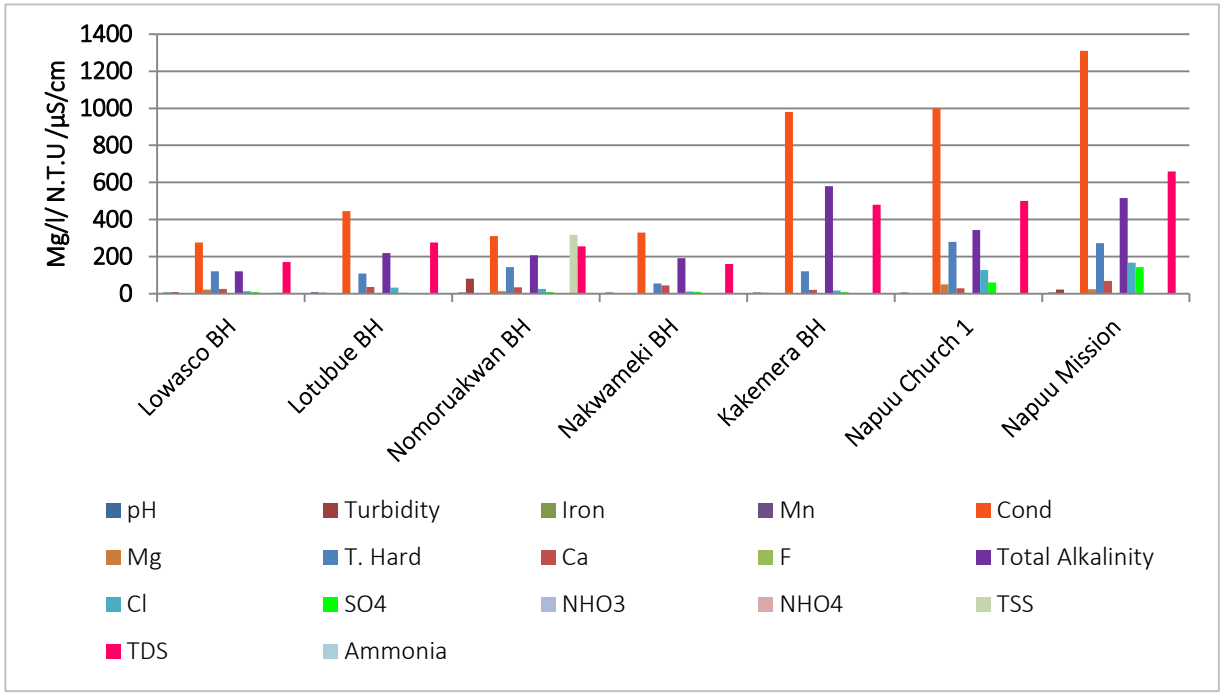
- SW water quality indicate high turbidity values of 464 and 829 N.T.U in Turkwel River and Kerio River, respectively, against a maximum value of 5 N.T.U (KEBS & WHO)
- Total suspended solids (TSS), sulphate, and chloride is higher in the river water than in the springs
- Total dissolved solids (TDS) and conductivity values are higher in the spring waters as well as in the Turkwel River as compared to Kerio River

WATER QUALITY ANALYSIS: REGIONAL BOREHOLES



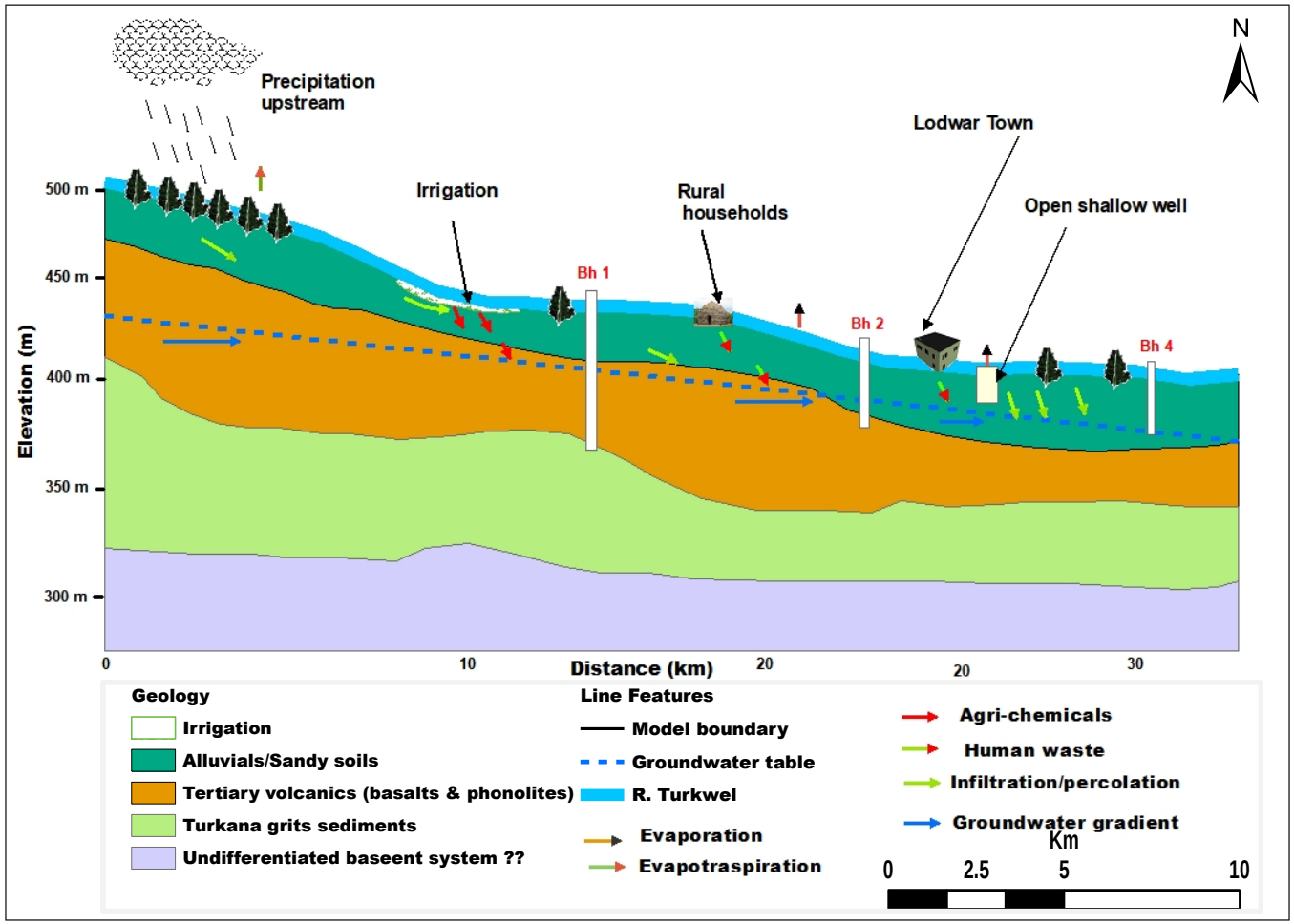
- The turbidity of LOWASCO borehole, Lotubue, Lopeduru, Nomoruakwan and Kalokol community boreholes exceed the recommended value of 5 N.T.U by WHO and KEBS = suggests dynamic & tightly coupled connection with the rivers/laggas
- The chloride content of Kalokol community borehole (525 mg/l) and Nakwin borehole (585 mg/l) is above the WHO and KEBS drinking water quality limit of 250 mg/l

WATER QUALITY: NAPU BOREHOLES



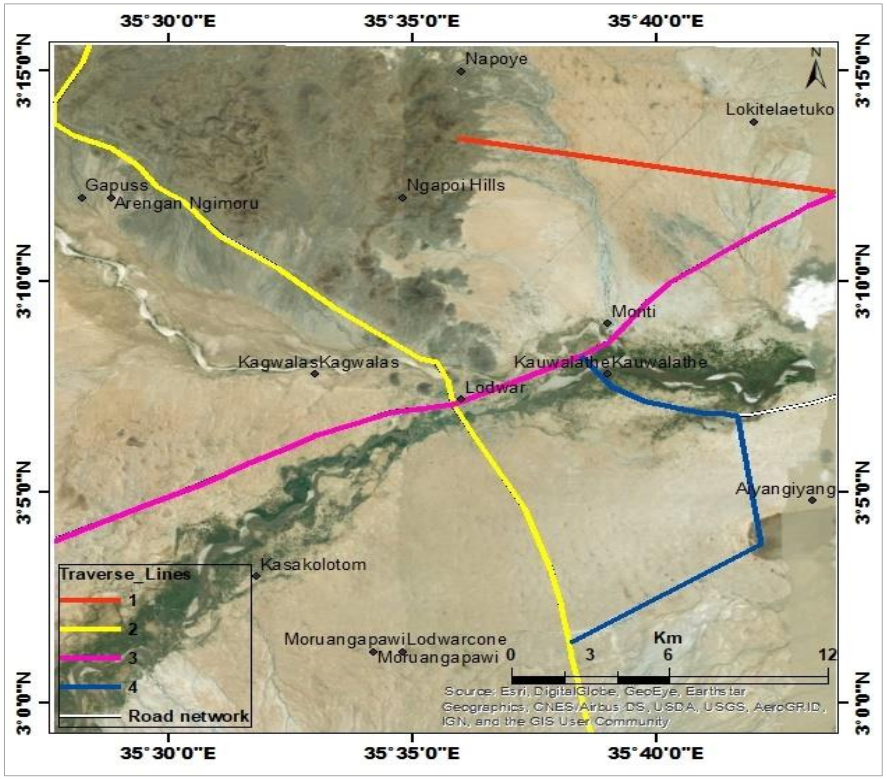
- Results shows high alkalinity of 516 mg/l and iron value of 0.73 mg/l for the Napuu Mission borehole.
- High alkalinity, High turbidity and high TDS is observed in both the surface water and the groundwater = active remobilisation of dispersed evaporative salts/fine clays within surficial soils

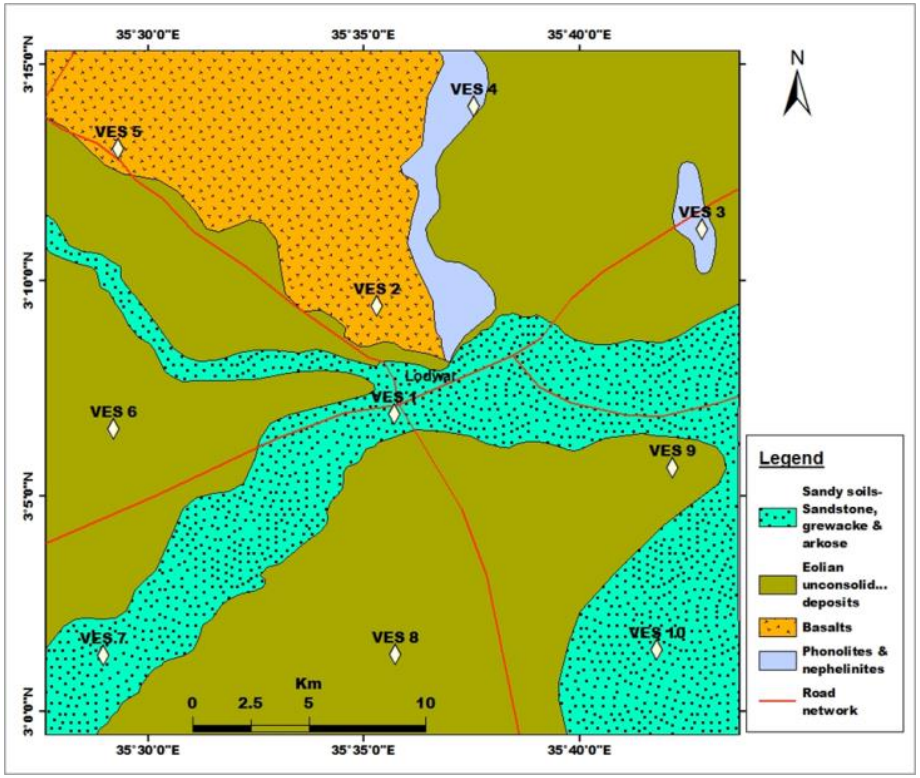
INITIAL SITE CONCEPTUAL MODEL



- Rainfall is experienced upstream where infiltration occurs on laggas and along the Turkwel River
- Boreholes upstream are dug to greater depths
- Irrigation, sewerage and open-defecation result in possible contamination and pollution
- Groundwater gradient follows the topography down to Lodwar

PLANNED ACTIVITIES: GEOLOGICAL MAPPING AND ELECTRICAL RESISTIVITY

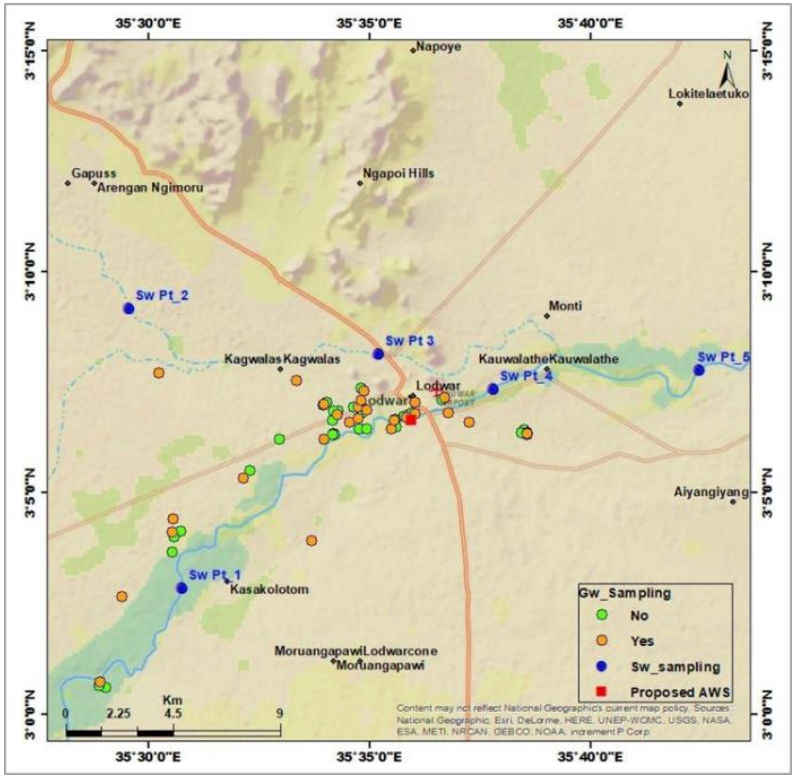




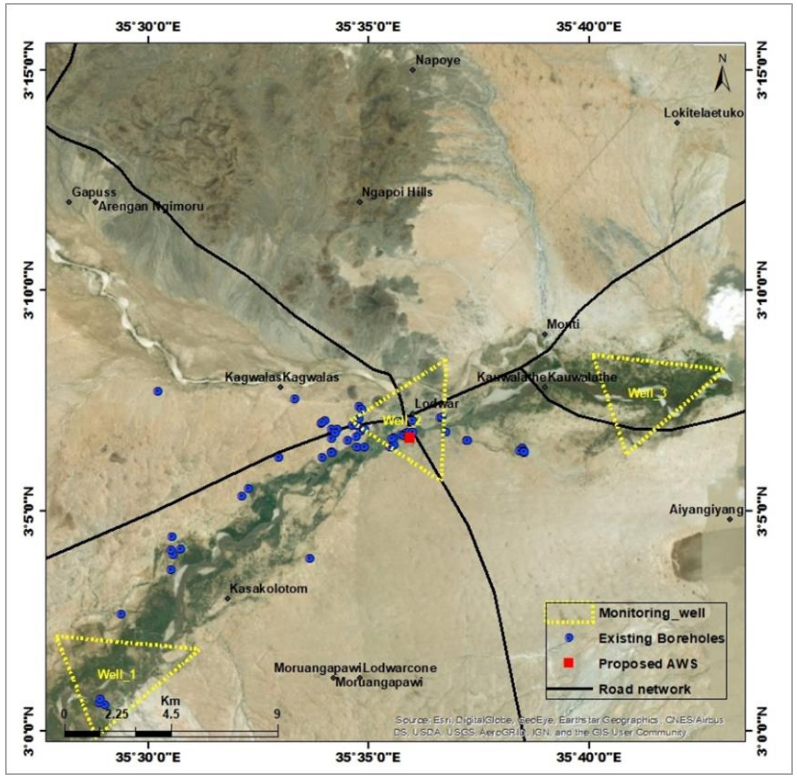
- Investigation of geology and structural features in the area

- Initially 10 vertical electrical resistivity soundings will be carried out to determine the type and depth of the geologic formations as well as aquifer layers.
- Distribution of VES points is based on area geology.

PLANNED ACTIVITIES: WATER SAMPLES & MONITORING



- Collection of groundwater, surface water and rainfall water samples for quality assessment and isotopic analysis



- Involves monitoring of groundwater table and rainfall events in the area (groundwater and rainfall monitoring stations to be established)

REACH

Improving water security for the poor

www.reachwater.org.uk

reach@water.ox.ac.uk

@reachwater

/reachwater

Funded by:

UKaid
from the British people