MAKERERE UNIVERSITY

COLLEGE OF ENGINEERING, DESIGN, ART, AND TECHNOLOGY

SCHOOL OF ENGINEERING

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING CIVIL ENGINEERING

FIELD TRIP ON BOREHOLE DRILLING EXERCISE.

KISOZI HEALTH CENTER III, BUSUKUMA DIVISION WAKISO DISTRICT

COURSE: WATER RESOURCES ENGINEERING II

(GRUNDWATER INVESTIGATION)

Date: 17th March 2026,

LECTURER: Dr. Philip M. Nyenje

Abstract

This report presents findings and observations from a field visit conducted by Civil Engineering Year Four and Master's students from Makerere University to Kisozi Health Center III, located in Busukuma Division, Wakiso District. The field exercise was organized as part of the Water Resources Engineering II course to provide practical exposure to groundwater investigation and borehole drilling techniques. The visit focused on the implementation stage of borehole construction using the air rotary drilling method, with compressed air pressures ranging from 300 to 900 psi. Students were introduced to key aspects of groundwater exploration, including electrical resistivity geophysical surveys, borehole drilling procedures, casing installation, aquifer identification, well development, and water quality testing. Two potential aquifers were identified at depths of approximately 35–40 meters and 65–78 meters. The field experience provided valuable insight into real-world groundwater development practices and enhanced students' ability to relate theoretical knowledge to practical engineering applications.

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1 Introduction to the visit

The Civil Engineering Year Four students, together with Master's students in Water Resources Engineering from Makerere University, conducted a field visit to Kisozi Health Center III, located in Busukuma Division, Wakiso District. The visit was organized by the Department of Civil and Environmental Engineering under the guidance of Dr. Philip M. Nyenje.

The purpose of the field trip was to provide students with practical exposure to groundwater investigation and borehole drilling operations as part of the Water Resources Engineering II course.

During the visit, students observed the drilling of a deep groundwater well using the air rotary drilling technique. The activity provided an opportunity to understand the operational procedures involved in groundwater exploration and borehole construction.

The site engineer, Eng. Tumusiime Beatrice guided the students, who explained the different stages of borehole development, including geophysical investigation, drilling operations, casing installation, well development, and water quality testing.

The geographical coordinates of the site are Latitude 0.52893° North and Longitude 32.57069° East.

The area lies within the Precambrian Basement Complex geological formation, which is common in many parts of Uganda. Groundwater in such regions is generally stored in weathered rock layers and fractured basement formations.

The borehole is intended to provide a reliable water supply to the health facility and the surrounding community.

Figure 1-1 Makerere University students during the site visit

2 Objectives of the Field Visit

To observe the practical process involved in borehole drilling.

To understand the groundwater investigation techniques used before drilling.

To study the drilling equipment and technology used in groundwater development.

To understand the geological factors influencing groundwater occurrence.

To relate theoretical knowledge learned in class to practical field operations.

3 Air Rotary Drilling System

3.1 Borehole Drilling Equipment and Main Components

The drilling operation involved several key pieces of equipment used during borehole construction.

The drilling rig provided the mechanical force required to penetrate the subsurface formations.

An air compressor generating pressures between 300 and 900 psi was used to circulate compressed air through the drill pipes to remove drill cuttings.

Drill pipes transmitted rotational movement and compressed air from the drilling rig to the drill bit.

The drill bit was responsible for breaking and penetrating rock formations.

Casing pipes were installed to prevent borehole collapse and protect the equipment during the drilling process. The drilling operation involved the use of 8-inch casing pipes used during the drilling process, later to be replaced by 6-inch casing pipes with screens along the aquifer regions.

Figure 3-1 Setting up a drilling rig

3.2 Types of Borehole Drilling Methods

The site engineer explained two common borehole drilling methods used in groundwater development.

Air rotary drilling uses compressed air to remove drill cuttings from the borehole and is suitable for hard rock formations.

Mud rotary drilling uses drilling mud to transport cuttings and stabilize borehole walls and is typically used in softer geological formations.

3.3 Borehole Drilling Process

Before drilling, a geophysical investigation was conducted using electrical resistivity methods to determine suitable drilling locations.

A one-dimensional electrical resistivity survey was used to determine vertical variations in subsurface layers.

A two-dimensional resistivity survey was conducted as a confirmatory investigation.

After site preparation, drilling commenced using the air rotary drilling technique with compressed air pressure ranging between 300 and 900 psi.

Casing pipes were installed during drilling to support the borehole walls and also to protect the equipment.

Once the target depth was reached, well development will be conducted to remove fine materials and improve water yield.

Figure 3-2 Drilling bit

4 Geological Characteristics of the Area

The geology of the area is dominated by weathered basement formations.

The overburden thickness in the area was estimated to be approximately 35 meters.

Below the overburden lies the basement rock formation which contains fractures that allow groundwater storage and movement.

5 Aquifer System and Groundwater Occurrence

Two aquifers were identified during the groundwater investigation, as informed by the site Engineer.

The first aquifer was expected between depths of approximately 35 and 40 meters.

A deeper aquifer was expected between depths of approximately 65 and 78 meters.

The two aquifers were identified during the Geophysical investigation as confined aquifers, which are usually more reliable and less susceptible to contamination.

6 Well Development and Water Quality Testing

After drilling, the borehole will undergo well development to remove fine materials and improve groundwater flow.

The well development process typically lasts for about 72 hours.

Water quality testing is conducted after completion of well development to determine the suitability of the water for human consumption.

7 Lessons Learned

The field visit enabled students to connect theoretical classroom knowledge with real engineering practice.

Students gained practical understanding of groundwater investigation techniques, including electrical resistivity surveys.

The exercise provided exposure to modern borehole drilling technology, such as air rotary drilling.

The visit demonstrated the importance of geology in determining groundwater availability.

Students also acquired knowledge about the importance of proper well development and water quality testing in ensuring a sustainable water supply.

8 Conclusion

The field visit to Kisozi Health Center III provided valuable practical experience in groundwater investigation and borehole drilling operations.

The exercise enhanced the understanding of borehole construction techniques, aquifer identification, and well development procedures.

Such field experiences are important in civil engineering education because they allow students to relate theoretical knowledge to real-world engineering practice.

9 Vote of Thanks

The Civil Engineering Year Four students express their sincere gratitude to all individuals and organizations that made the field visit successful.

Special appreciation is extended to Dr. Robina Kulabako, Head of the Department of Civil and Environmental Engineering, for supporting the field exercise.

Special thanks also go to Dr. Philip M. Nyenje for organizing and guiding the field visit.

The students also acknowledge the support from Engineering Without Borders – East Africa and the Rotary Club of Kiwenda for facilitating the field learning experience.

Finally, appreciation goes to Eng. Tumusiime Beatrice for providing detailed professional explanations during the drilling exercise.

10 Appendix

Appendix A: Field Photographs of Borehole Drilling Operations.

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Rotary
Club of Kiwenda

Figure 10-1 Drilling bit

Figure 10-2 Drilling pipes

Figure 10-3 installation of casing

Figure 10-4 Drilling bit and 8-inch casing


Rotary