MINISTRY OF AGRICULTURE, IRRIGATION AND WATER DEVELOPMENT

Standard Operating Procedure for Groundwater Level Monitoring

Document No GW03/2012

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Contents

1.0 GENERAL INFORMATION

1.1 Purpose

The purpose of this document is to give guidance in the performance of groundwater level monitoring and to provide recommended quality assurance and quality control (QA/QC) procedures.

1.2 Application

The procedures contained in this document are to be used by Hydrogeologists and Technicians when measuring groundwater levels using electric sounders/dip meter and/or digital data loggers for the National Groundwater Monitoring System.

1.3 Scope

This document describes procedures for groundwater level monitoring in Malawi. It will facilitate the acquisition of accurate and useable data for the National Groundwater Monitoring System.

1.5 Groundwater division SOPs

The following documents form part of the series of standard Operating Procedures for best management practices in groundwater management:

Document No.	**Title**
GW01/2012	Standard Operating Procedure: Drilling and Construction of National Boreholes
GW02/2012	Standard Operating Procedure for Aquifer Pumping Tests
GW03/2012	**Standard Operating Procedure for groundwater level monitoring**
GW04/2012	Standard Operating Procedure for groundwater sampling
GW05/2012	Standard Operating Procedure for operation and management of the national groundwater database
GW06/2012	Standard Operating Procedures: Water Use Permitting
GW07/2012	Standard Operating Procedures for Groundwater Use Permitting

All official copies of the division's documents are kept, in electronic format and hard copies, by the office of the Deputy Director – Groundwater Resources.

1.6 Definitions of terms

Datalogger	Electronic device that records water level data over time in a borehole using sensors.
Groundwater	Water stored in water-bearing underground geologic formations.
Monitoring borehole	A borehole drilled in a selected location for the purpose of observing parameters such as water levels and for the collection of water samples.

1.7 Health and safety

Proper safety precautions must be observed when monitoring groundwater levels. A health and safety plan must be prepared prior to field work and must be followed during monitoring. The plan should address all potential and known hazards.

The following personal protective clothing (PPE) is recommended, as a minimum requirement, during monitoring for health and safety reasons:

- Hard hat
- Eye protection (when needed)
- Hearing protection (when needed)
- Dust protection (when needed)
- Gloves (when needed)

2.0 EQUIPMENT AND TOOLS

1) Water level measurements form/log book or electronic field log book.
2) Electronic dip meter. The dip meter should have charged batteries and a working indicator signal, checked before leaving the office.
3) Master lock keys, wrenches, sockets and bolt cutters to open monitoring wells.
4) Distilled water in a squirt bottle and a clean cloth or paper towels.
5) Laptop computer.

3.0 PROCEDURE

3.1 Manual water level measurements

Groundwater level measurements from the National Groundwater Monitoring Network will be collected on the same day once a week. In the event that a borehole cannot be located, a handheld GPS unit shall be used to locate the borehole. The following procedure shall be followed at each site:

1) Record the date, time, borehole number, GPS or surveyed X, Y, Z coordinates of the borehole, the height of the measuring point above the ground from which the reading will be taken, natural phenomena e.g. duration of sunshine, wind speed, magnitude and intensity of rains and any nearby activities that could be affecting groundwater levels as such irrigation, production boreholes and test pumping.
2) Check if the dip meter is working before lowering the probe into the well by dipping the probe into a container of clean water. Make sure the audible indicator sounds or the indicator needle deflects, indicating proper functioning of the dip meter.
3) Unlock the borehole and open or remove the borehole cap.
4) Lower the dip meter slowly into the borehole until the audio or needle or light indicator signifies contact with the groundwater.
5) Read and record the groundwater level depth (in metres) with the tape directly against the measuring point on the borehole casing. Groundwater level measurements shall have an accuracy of ±0.5cm.
6) Reduce the measurement to ground surface by subtracting the distance of the measuring point above ground level to the measurement above.
7) Repeat the measurement to verify the result. The measurements should agree within ±0.5cm.
8) Clean the part of the tape and probe that came in contact with water by rinsing thoroughly with distilled water or by soaking a cloth or paper towel with distilled water and wiping down the length of the dip meter.

3.2 Datalogger data collection

Groundwater monitoring boreholes equipped with data loggers shall be visited at least once every month to check and ensure the integrity of the monitoring site and its data. A GPS unit will be used to locate the borehole site. The following activities shall be performed at the monitoring borehole:

1) Record the date, time, borehole number, GPS or surveyed X, Y, Z coordinates of the borehole, the height of the measuring point above the ground level, the data logger that is being downloaded and any nearby activities that could be affecting groundwater levels such as irrigation, production boreholes and test pumping.
2) Unlock the borehole and remove the borehole cap.
3) Connect the data logger to the laptop computer (remove the data logger from the borehole and connect it to the laptop using a downloading cable for the data logger suspended using rope).
4) Download data from the data logger and store the data in the laptop until it is backed up in the office.
5) Once downloaded, look at the data to ensure the data looks accurate. Make a note in the log book of any data that looks strange or incorrect. Any such data shall be examined further in the office.
6) Take a manual groundwater level measurement, using the procedure in the previous section, for use in converting the data logger readings to exact levels by applying a constant data shift to the measurements.

4.0 QUALITY ASSURANCE AND QUALITY CONTROL (QA AND QC)

1) Trained personnel, mainly Technicians, shall be assigned groundwater level monitoring tasks.
2) All boreholes to be monitored shall have a marked measuring point, and its length above ground level shall be measured. This point shall be clearly marked so that anyone unfamiliar with the borehole will identify the reference point.
3) All manual groundwater level measurements shall have an accuracy of ±0.5cm.
4) Routine field audits to evaluate how well employees follow procedures shall be performed.

5.0 REFERENCES

The following documents were consulted in the preparation of this SOP:

Department of Environmental Protection, 2001. Groundwater Monitoring Guidance Manual, Commonwealth of Pennsylvania

NCDENR, DWQ USGS, 2008. Standard Operating Procedures For Groundwater Research Stations: North Carolina Piedmont And Mountains Groundwater Resource Evaluation Program, North Carolina

Sterrett, R. J., 2007. Groundwater and Wells (Third ed.), Johnson Screens., New Brighton, Minnesota

Washington Conservation District, 2007. Water Monitoring Program, Standard Operating Procedure (S.O.P.) No. 1: Groundwater Monitoring, USA.