Stages in groundwater exploration

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Stages in a groundwater exploration programme

The main stages of a groundwater exploration programme - which will allow you to assess and sustainably develop groundwater resources - are summarised in the table below, with an indication of costs. Some more detail on each stage is given in the sections below, but this page is not a comprehensive guide to groundwater development. Many other resources are available which do provide detailed guidance and support for groundwater exploration and development, and some of these are listed at the bottom of this page, under **Links to more information**.

Stages of groundwater exploration and an indication of the costs of each

Stage	Notes on costs
Project Management	
Project management is an essential part of projects to develop groundwater. A borehole drilling project can include sensitisation of and training of end users; borehole siting, design, drilling, development and completion; borehole testing (yield and water quality); and pump installation. Each part needs to be professionally run if it is to be successful. RWSN provide guidance in this area, including this guide to Procurement and Contract Management of Drilled Well Construction.	An experienced project manager may be needed to oversee a borehole drilling project.
Siting Boreholes	
Reconnaissance: gathering maps and information (e.g. from existing reports, academic papers etc) on geological and hydrogeological conditions. This is an essential first step for understanding groundwater resources.	A one-off cost: several weeks time of a project staff member or consultant. If new data have to be bought or generated (e.g. from satellite images or field mapping), costs will increase, but not prohibitively so.

Hydrogeological fieldwork: making field observations of the local geology (e.g. from rock exposures or chippings/cuttings from any local hand-dug wells or previously drilled boreholes); hydrogeology; and existing water sources (both dry and wet season sources), and gathering relevant information from discussions with the local community: e.g. how much do existing sources yield; do yields fall or dry up in the dry season; are there water quality problems? Also observe any local pollution sources, such as pit latrines, burial grounds, cattle pens or market areas. This should be done by someone experienced (e.g. who has developed boreholes in this area, or similar areas, before).	Requires a well-trained engineer or hydrogeologist to visit the area.
Geophysical surveying: e.g. resistivity or electromagnetic (EM) techniques. Must be combined with reconnaissance data and hydrogeological fieldwork. It is important to analyse geophysical data correctly so that it gives good information. Investment in training staff is often beneficial.	Geophysical equipment varies in price, but for a single technique (eg resistivity) is generally less than $US20 000. A well-trained geophysics team will need to spend at least 1 day in each area targetted for a new borehole.
Borehole Drilling	
Drilling Supervision: experienced supervision of drilling is essential for the provision of successful and long-lasting water boreholes.	A well-trained hydrogeologist or engineer should be onsite during drilling to supervise the drilling.
Collecting information during drilling: gathering information on geology (e.g. from logging drilled rock chips and measuring penetration rates) and hydrogeology (e.g. from water strikes). Drilling is a unique opportunity to collect useful geological and hydrogeological data from deep underground - data that are not otherwise available.	A well-trained hydrogeologist or engineer should be onsite during drilling to collect good data.
Designing and constructing suitable boreholes. The design of every borehole should be adapted to the particular geology found at the drilling site, based on the information collected during drilling. An introduction to some types of borehole design that are suitable for many hydrogeological environments found in Africa can be found in the chapter **Designing and constructing water points** in MacDonald et al. (2001), which can be freely downloaded online.	A well-trained hydrogeologist or engineer should be onsite during drilling to design the final borehole construction.
Borehole Testing	
Assessing source yield: in most cases, this means assessing the sustainable yield of a borehole or well by carrying out a pumping test. For springs, it may mean measuring spring flow in different seasons. It is important to measure how much the source will yield sustainably in order to know how many people it can serve.	A well-trained hydrogeologist or engineer is needed to carry out a pumping test, and normally they need at least 1 day per borehole. For higher yielding boreholes, an electric pump and generator are likely to be needed.
Assessing water quality: measuring the most important chemical and biological parameters that can impact human health.	Some parameters can be measured quickly in the field using relatively simple equipment, but most need to be collected and sent to a laboratory. A well-trained field technician may be needed to carry out sampling.

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