

HAND-DUG WELLS

Introduction

The traditional method of obtaining groundwater in rural areas of the developing world, and still the most common, is by means of hand-dug wells. However, because they are dug by hand their use is restricted to suitable types of ground, such as clays, sands, gravels and mixed soils where only small boulders are encountered. Some communities use the skill and knowledge of local well-diggers, but often the excavation is carried out, under supervision, by the villagers themselves.

The volume of the water in the well below the standing water table acts as a reservoir, which can meet demands on it during the day and should replenish itself during periods when there is no abstraction.

Dimensions

Depths of hand-dug wells range from shallow wells, about 5 metres deep, to deep wells over 20 metres deep. Wells with depths of over 30 metres are sometimes constructed to exploit a known aquifer. It is impractical to excavate a well which is less than a metre in diameter; an excavation of about 1.5 metres in diameter provides adequate working space for the diggers and will allow a final internal diameter of about 1.2 metres after the well has been lined.

Digging with the sides of the excavation supported

There are several methods of supporting the sides of the excavation while digging proceeds:

- 1** The safest method, and the one preferred by WaterAid, is to excavate within pre-cast concrete rings which later become the permanent lining to the sides of the well. The first ring has a cutting edge, and additional rings are placed on it as excavation proceeds. As material is excavated within the ring, it sinks progressively under its own weight and that of the rings on top of it. This method should always be used in unstable ground. When construction has finished, the joints between the rings which are above the water table should be sealed with cement mortar.
- 2** In suitable ground, excavation may proceed for a short distance without support to the sides; these are then supported by means of concrete poured in situ from the top, between the sides of the excavation and temporary formwork, which becomes the permanent lining to the well. This process is repeated until the water table is reached.
- 3** In suitably stable ground, excavation may proceed within the protection of vertical close-fitting timber boards, supported by horizontal steel rings. The timbers are hammered down as excavation proceeds and additional timbers are added progressively at ground level. The steel rings must be hinged, or in two parts bolted together, so that lower ones can be added as the excavation progresses. The vertical spacing between the rings will depend on the instability of the ground. The well is lined with bricks, or concrete blocks, from the water table upwards, within the timbers as they are withdrawn.

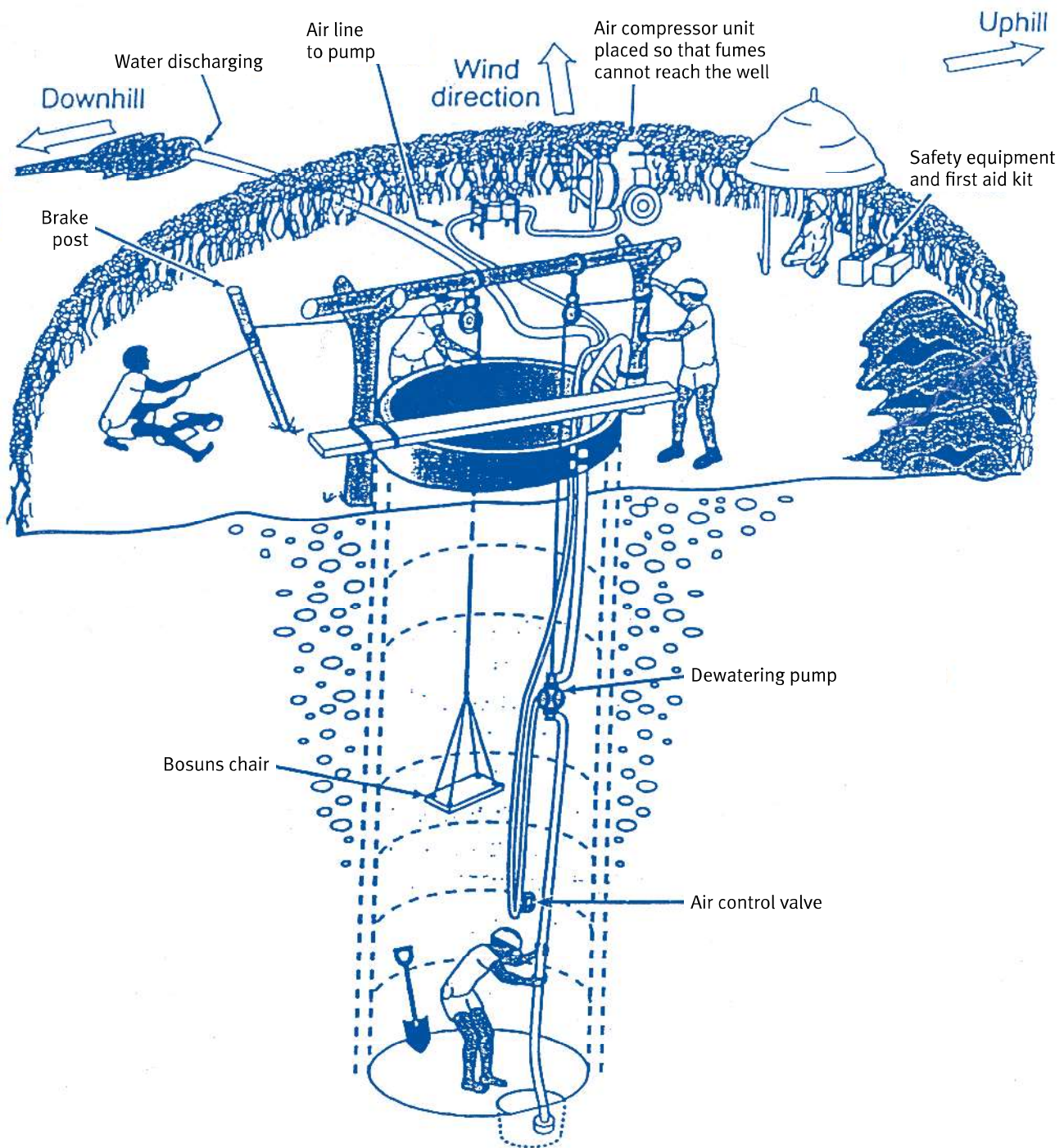
Digging with the sides of the excavation unsupported

In stable ground, wells are often excavated down to water level without a lining, and are lined with in situ concrete, or with pre-cast concrete rings, from this level upwards.

Wells safely dug during the dry season may become unstable when the water level rises in the wet season and therefore must be lined before this occurs to prevent a collapse.

Although in firm stable ground unlined wells may be safely excavated and may give long service in operation, it is prudent, and in most cases essential, to provide a permanent supporting lining which will support the sides of the excavation and prevent them from collapsing; suitable lining materials are concrete, reinforced concrete, ferrocement, masonry, brickwork, etc.

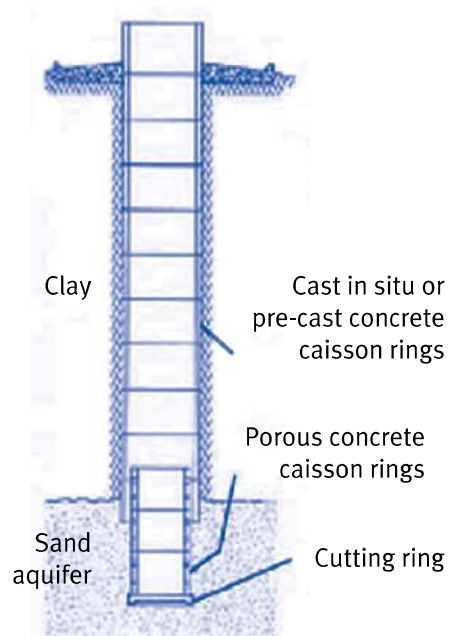
A safe well digging operation



Excavation below the water level

Regardless of which method has been used to excavate the well to the water table, excavation below this level should never be attempted until the sides of the excavation have received the support of their permanent lining, from water table to ground level.

Excavation below the water table should be carried out within pre-cast concrete caisson rings of a smaller diameter than the rest of the well. The initial caisson ring is provided with a cutting edge and additional rings are placed on top of it; as the material within is excavated, the rings sink progressively under their own weight. To facilitate the ingress of water, these lower rings are often constructed with porous, or no-fines, concrete and their joints are left unpointed. See the opposite diagram:

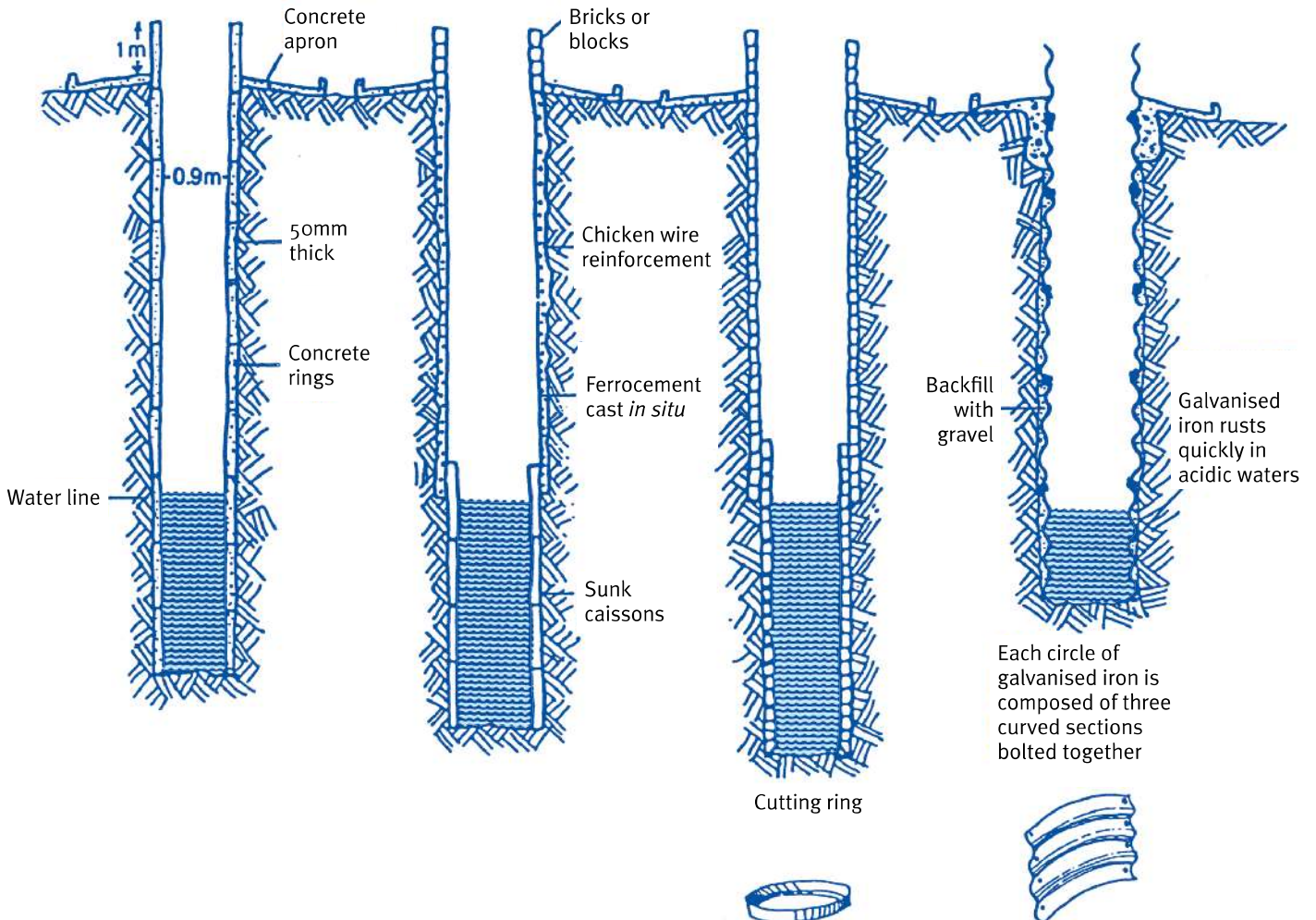


Alternative ways of lining a well

Although WaterAid favours the use of pre-cast concrete rings, which become the permanent lining of the well after being sunk progressively as excavation proceeds within them, many other materials have been used successfully. Some of these are shown in the following diagrams:

Alternative methods

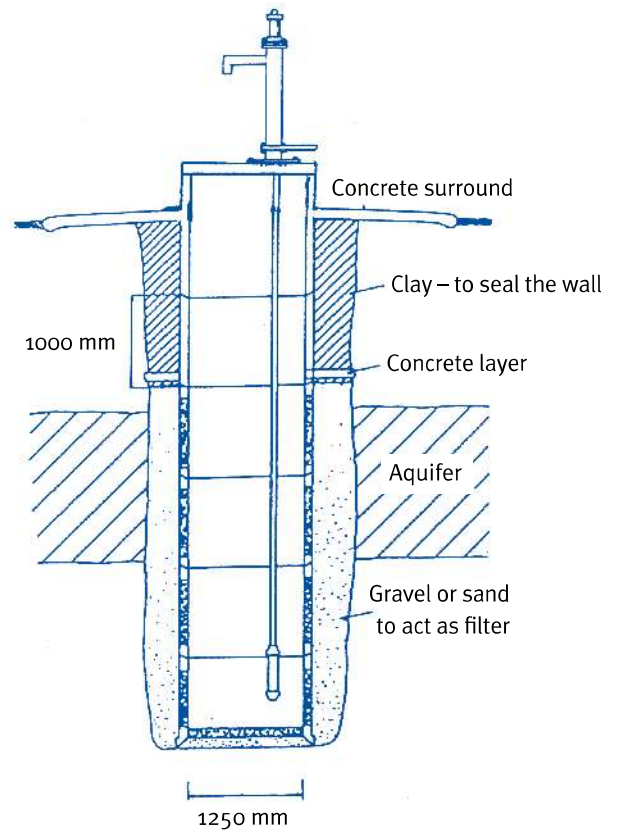
- 1 Sinking caissons (concrete rings).
- 2 Reinforced concrete or ferrocement cast *in situ* above water line, concrete rings sunk below the water line.
- 3 Masonry lining of burnt bricks above water line, caisson made of blocks with cutting ring below water line.
- 4 Galvanised iron rings bolted together as temporary measure for emergencies.



Completion

After construction of the well shaft has been completed, the bottom is plugged with gravel. This helps to prevent silty material from clay soils, or fines from sandy materials, being drawn into the well. Any annular space between the pre-cast caisson well rings and the side of the excavation should also be filled with gravel; such filling behind the rings which are below the water helps to increase water storage and to prevent the passage of fine silts and sands into the well.

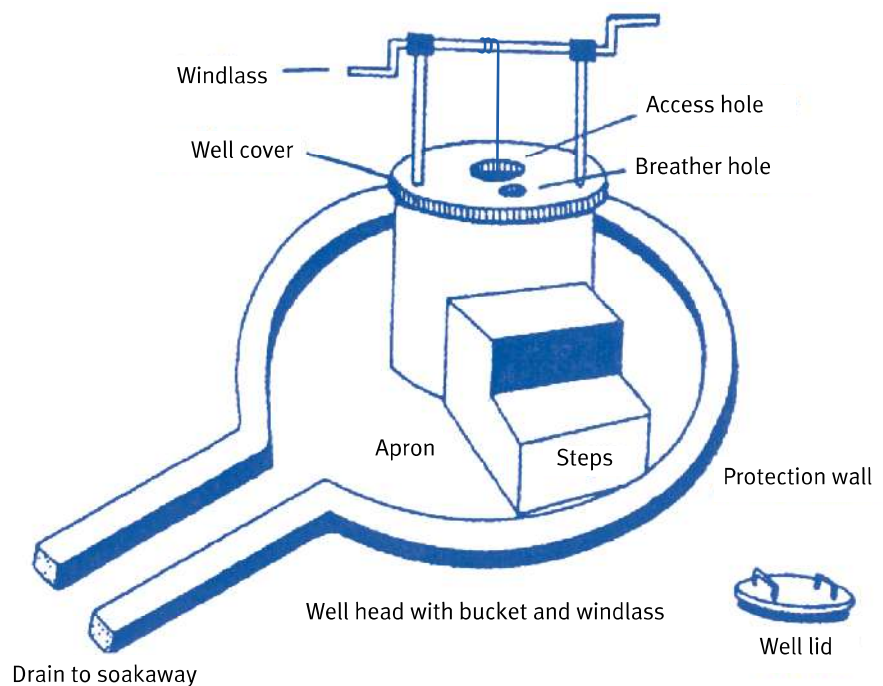
The space behind the top three metres, or so, of the well rings should be backfilled to ground level with puddled clay, or concrete, and the well rings should project about one metre above a concrete apron. This apron provides a sanitary seal to prevent polluted surface water seeping into the well and should slope away from it and drain into a channel which discharges into a soakaway.



Abstraction

It is desirable for the well to have a concrete cover slab to reduce the possibility of contamination. Water is abstracted by means of either a bucket and windlass above an access hole, or a handpump, depending upon the yield of water available and the ability of the benefiting community to pay for ongoing maintenance for the handpump, spare parts, etc. A hand-dug well fitted with a handpump can serve the needs of about 300 people.

The following diagram shows a typical layout for the well head of a well with a hand operated windlass:



REFERENCE:

1. **Watt S B and Wood W E** (1985) *Hand-dug - wells and their construction*
IT Publications
2. *WaterAid's Health and Safety Policy* (July 2000)