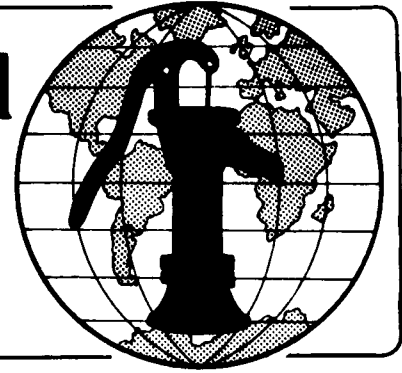


Water for the World



Designing Cable Tool Wells Technical Note No. RWS. 2.D.5

Properly designing cable tool wells, also called percussion drilled wells, is important to ensure a year-round supply of water and to ensure efficient use of personnel and materials. Design involves determining whether the well will be manually or mechanically drilled; selecting a screen; and determining all necessary personnel, materials and equipment. The products of the design process are design drawings of the method of drilling, drawings of the well screen, and a detailed materials list. These products, along with a location map similar to Figure 1 from "Selecting a Well Site," RWS.2.P.3, will be given to the construction foreman before construction begins.

This technical note describes how to design a cable tool well and arrive at these end-products. Read the entire technical note before beginning the design process.

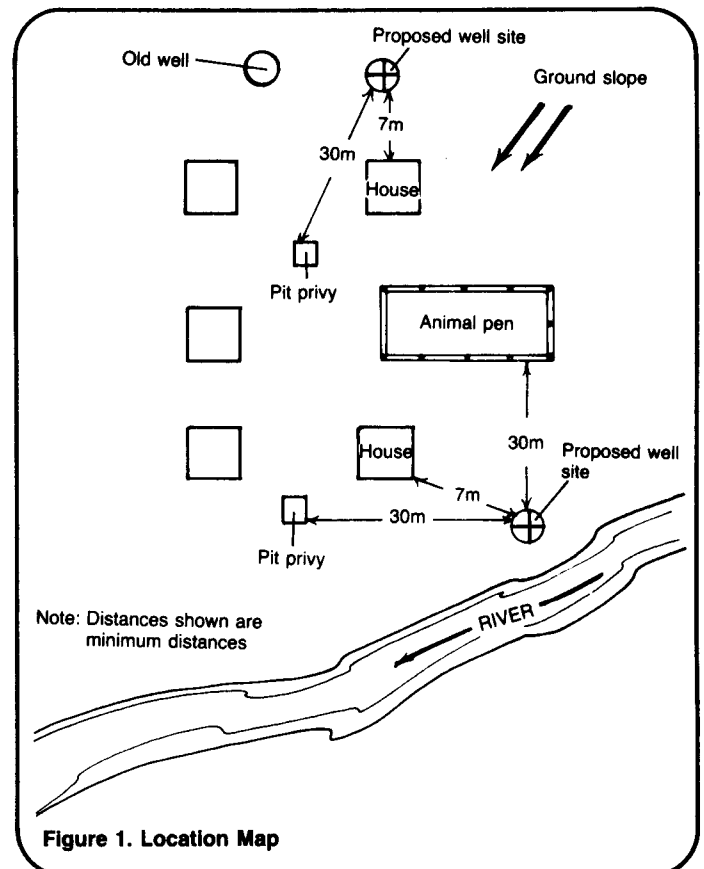
Useful Definitions

AQUIFER - A water-saturated geologic zone that will yield water to springs and wells.

GROUND WATER - Water stored below the ground's surface.

Determining the Drilling Method

In the manual method, the rope or cable supporting the drill bit is secured to a tree or a post driven in the ground. Three to five workers push down on the rope to raise the bit, then quickly raise up to allow the bit to fall. This is a relatively inexpensive operation, but it is physically demanding and the workers must be rotated frequently to avoid fatigue.



In the mechanical method, the rope or cable supporting the drill bit is wrapped around a power take-off or a cathead bolted to the rear drum of a truck or jeep. Alternately tightening and loosening the pull on the loose end of the rope will allow the spinning cathead to raise and drop the drill bit. This method takes less physical effort and is faster than the manual method. It requires a vehicle or other power source, and is therefore more expensive.

When the method of drilling has been determined, prepare a drawing similar to Figure 2a or 2b and give it to the construction foreman.

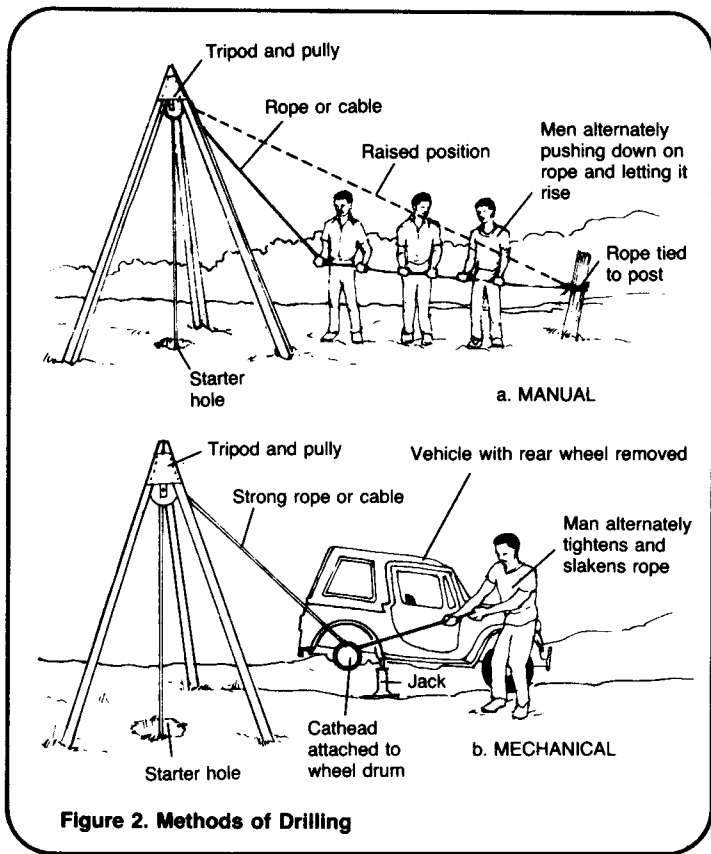


Figure 2. Methods of Drilling

Selecting a Screen

The well screen may be the single most important factor affecting the efficiency of a well. Screens are made either commercially or locally. Commercially made screens are stronger and allow more ground water to enter. In some countries, they may be difficult to obtain. Locally made screens are more readily available, but they are not as strong or as efficient.

Commercial Screens. Probably the best commercial screen is the continuous-slot type, which consists of a triangular-shaped wire wrapped around an array of rods. The screen offers the largest percentage of open area for water to enter, while retaining a small slot size to screen out particles. Another advantage is that the triangular-shaped openings prevent particles from sticking in the screen and clogging it during the developing process, see "Finishing Wells," RWS.2.C.8. The size of the slots can be precisely regulated, and can be as small as 0.15mm. See Figure 3a.

Another commercial screen is the shutter or louver type, which is a metal tube with slots stamped out with a metal die. The disadvantages compared with a continuous-slot type are a smaller percentage of open area; a limited number of slot sizes; and a tendency for the screen to clog during the development process if the aquifer is composed of fine sand. See Figure 3b.

The wrapped-on-pipe screen consists of a perforated pipe wrapped by one or more screens. The disadvantages are the same as for the shutter type screen. See Figure 3c.

Local Screens. Screens can be made from the same materials used for the casing. Since the casings for cable tool wells are generally made from sections of steel pipe, the screen can be a section of pipe with holes drilled in it. The disadvantages of these screens compared with commercial screens are the percentage of open area is lower, thus restricting the entry of groundwater into the well; and the size of the holes cannot be made small enough to screen out fine sand.

When the screen has been selected, prepare a drawing similar to Figures 3a, 3b, 3c, or 4, and give it to the construction foreman.

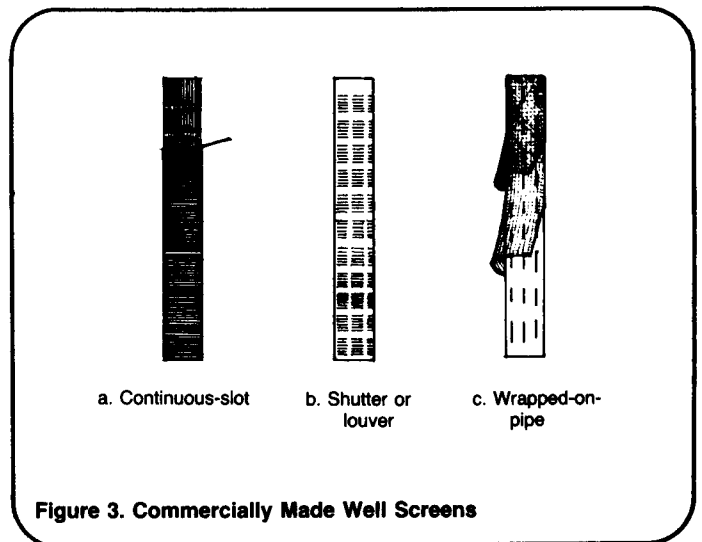


Figure 3. Commercially Made Well Screens

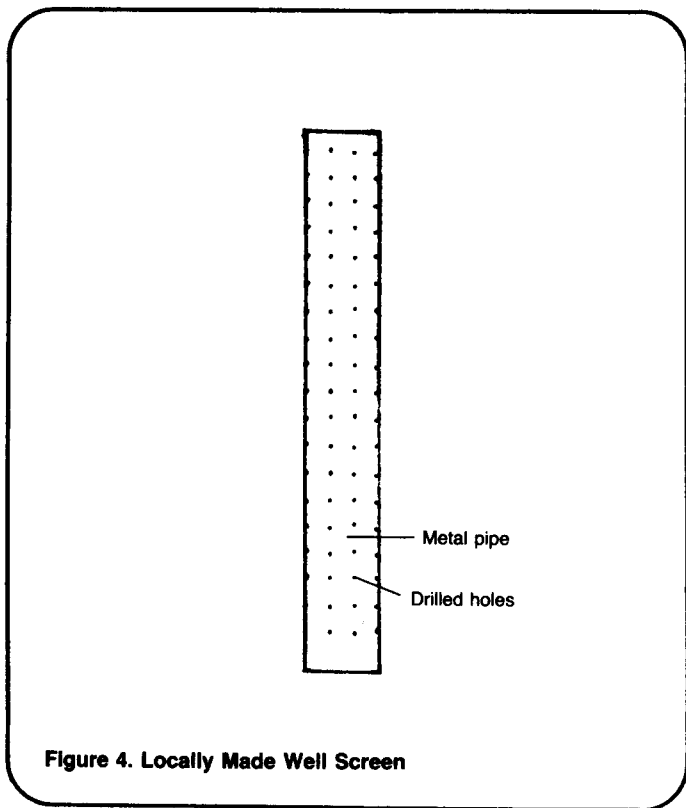


Figure 4. Locally Made Well Screen

Table 1. Sample Materials List for a Cable Tool Well

| Item | Description | Quantity | Estimated Cost |
|-----------|---|-------------------|----------------|
| Personnel | Foreman | 1 | --- |
| | Blacksmith | 1 | --- |
| | Workers | 10 | --- |
| Supplies | Steel pipe section for casing; (75mm diameter, 2.0m long) | --- | --- |
| | Pipe couplings | --- | --- |
| | Well screen | --- | --- |
| | Plug to seal bottom of screen | --- | --- |
| | Cement mix | ---m ³ | --- |
| Equipment | Tripod and pulley | --- | --- |
| | Heavy-duty ropes; each 50m long | --- | --- |
| | Percussion bit; 100mm x 1.5m long; 80kg | --- | --- |
| | Hollow rod bit; 100mm diameter; 1.0m long | --- | --- |
| | Bailer; 50mm diameter, 1.0m long | --- | --- |
| | Fishing tool | --- | --- |
| | Anvil | --- | --- |
| | Hammers (blacksmith) | --- | --- |
| | Hacksaw | --- | --- |
| | Metal files | --- | --- |
| | Wrenches | --- | --- |
| | Screwdrivers | --- | --- |
| | Shovels | --- | --- |
| | Measuring tape | --- | --- |
| | Plumb bob and line | --- | --- |
| Other | --- | --- | |

Total Estimated Cost = ---

Determining Personnel, Materials, and Equipment

A foreman is needed to oversee well construction. A blacksmith may be needed to dress or repair the drill bit. Five to ten workers, fewer for the mechanical method, will be needed to raise and lower the drill bit.

Materials needed include a well screen and casing material. Concrete mix and/or gravel will be needed to line the top 3m of the well shaft.

Equipment needed includes a drilling tripod and pulley, heavy-duty rope or cable, percussion bit, hollow rod bit, bailer, and a fishing tool to be used if the rope breaks. Hand tools include

metal files, a hacksaw, wrenches, screwdrivers, and shovels. If the well is drilled mechanically, equipment needed includes a gasoline- or diesel-powered engine, fuel, oil, grease for the cathead, and maintenance tools.

When all personnel, materials, and equipment have been determined, prepare a materials list similar to Table 1 and give it to the construction foreman.

To summarize, give the construction foreman design drawings of the method of drilling, drawings of the well screen, a detailed materials list similar to Table 1, and a location map similar to Figure 1.