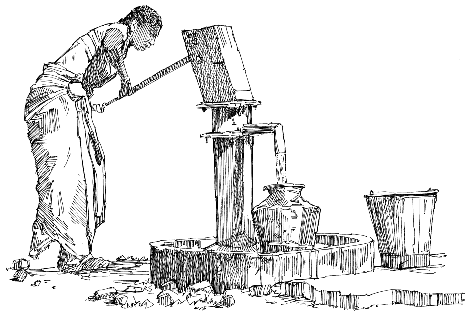
Cleaning and disinfecting boreholes in emergencies



World Health Organization

Steps of rehabilitation

Figure1 outlines a five stage approach to cleaning and disinfecting boreholes after natural disasters. It is an emergency approach designed to rehabilitate boreholes so they produce water of a similar quality to that supplied before the disaster.

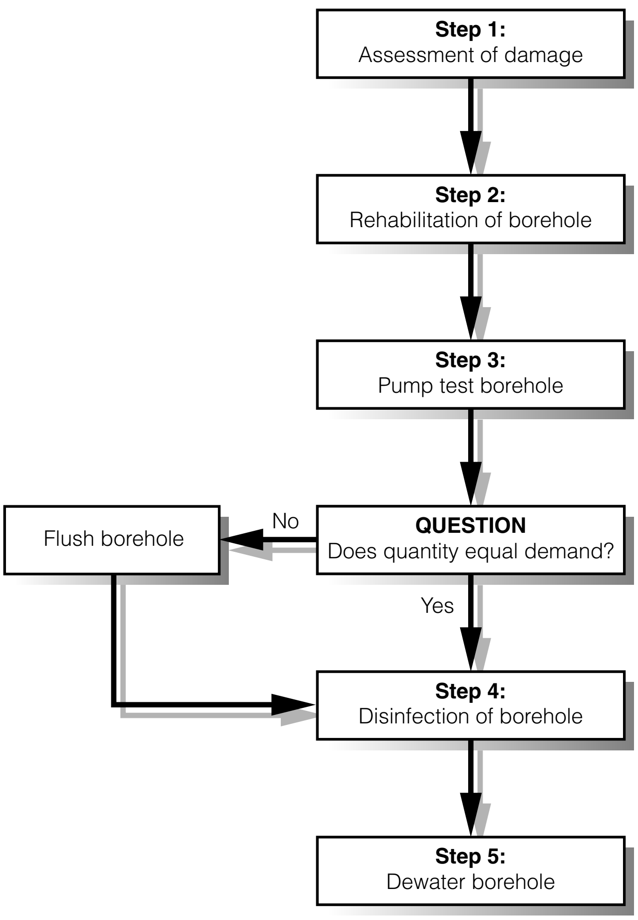
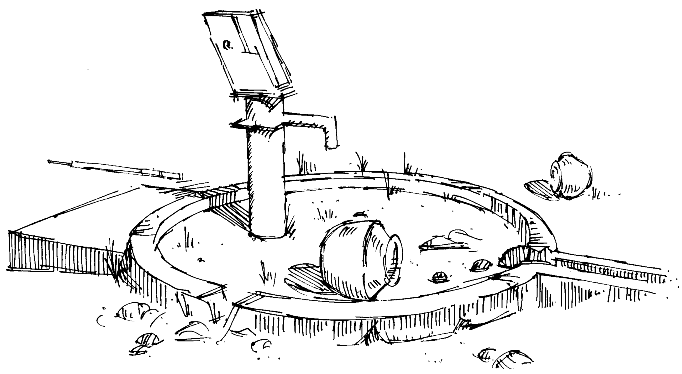


Figure 1. Steps for cleaning and disinfecting a borehole

Step 1: Assessment of damage

The disaster may have damaged the above ground or below ground parts of the borehole. This may have led to contamination of the borehole. The first step must be to assess the extent of the damage to the borehole and pump. The following actions should help you to make your assessment.

- Meet with community leaders and ask them to briefly outline which boreholes serve which sections of the community.
- Assess the type and extent of damage to the top of the well.
- Remove the handpump or mechanised pump from the borehole.
- Estimate the amount of silt and debris in the borehole using a steel pipe the length of whole depth of the well.
- Check if borehole casing is damaged or out of line. Do this by inserting the steel pipe. If it is out of line the pipe will catch against the side of the borehole. If this happens, select other sites.
- Test the pump (and motor) to see if they are still working or what repairs are necessary.
- Estimate resources needed for repairs (personnel, equipment, time and materials).
- Select the boreholes that are used most and are easiest to repair first.



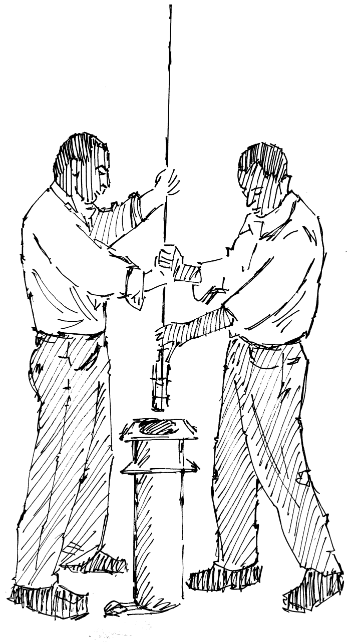
A damaged handpump and surround

Step 2: Rehabilitation of boreholes

Before the borehole can be cleaned, all silt and debris should be removed. The following steps may be followed:

1. If not already removed, take out the pump and motor from the borehole and clean and repair them.

2. Flush the sediment from the borehole using compressed air or water. Place the compressor hose in the borehole and blow out the sediment.



Removing components of a pump

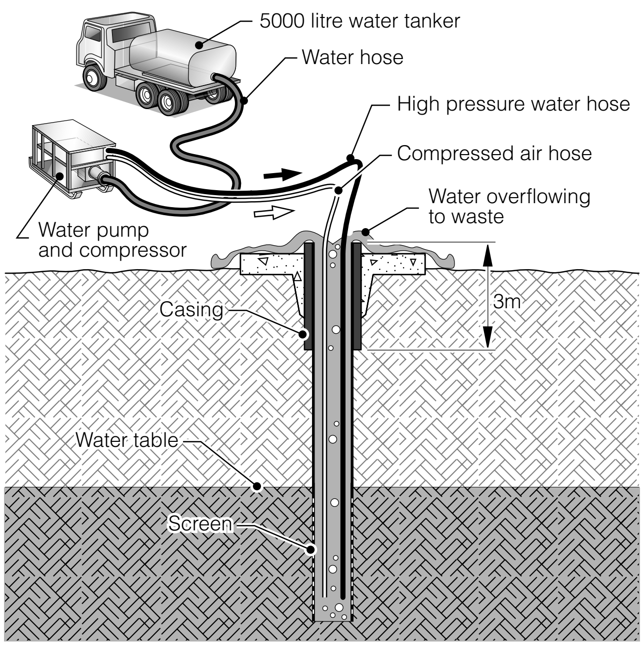


Figure 2. Flushing out a borehole

3. To remove the silt from the borehole filter insert the end of the compressed air hose at the head of the filter. Open the valve until water starts coming out of the top of the borehole. Close valve 1 and open valve 2 until no more air is heard coming out. Repeat until the water coming out of the borehole is clear.

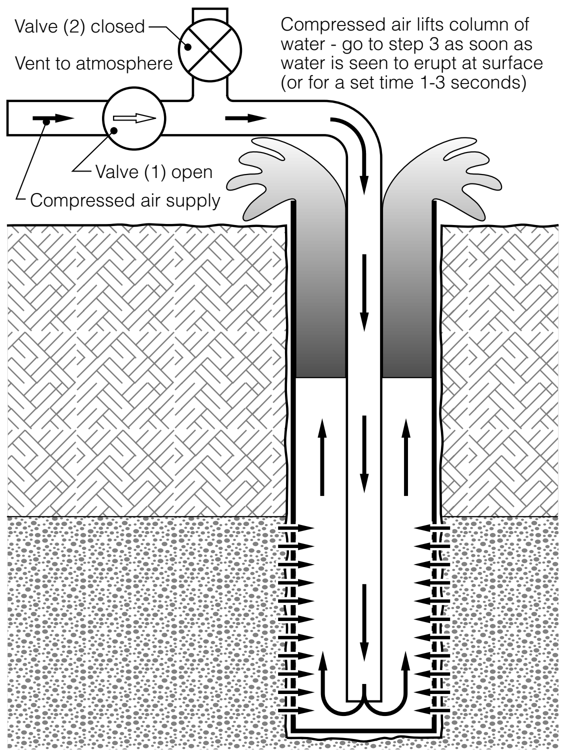


Figure 3. Removing silt with a compressed air hose

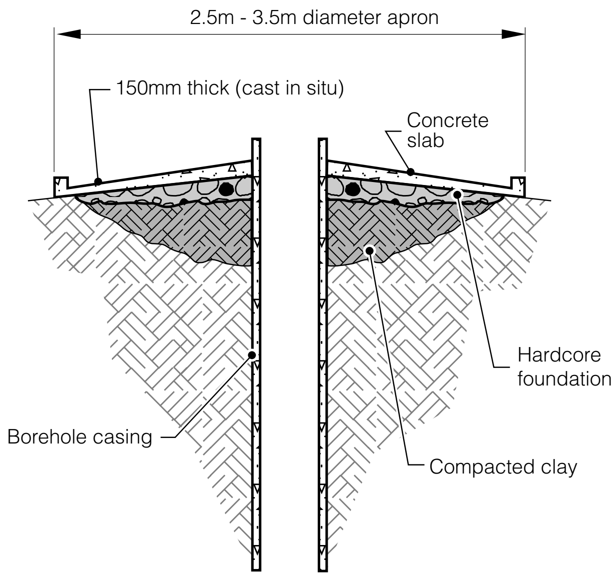


Figure 4. Sanitary seal

4. Reseal the top of the borehole using a clay sanitary seal built around the top.

5. Construct or repair the drainage apron and head wall around the borehole to prevent surface water, insects and rodents entering the borehole.

6. Replace the pump in the hole and check that it is working and the water it is producing is clear of silt. If the water is silty, remove the pump and flush out the borehole. If, after two flushes, the bore is producing silty water, the underground filter is probably broken and no further attempt at repair should be made.

Step 3: Pump test

Handpumps

Once the pump is replaced in the borehole, operate it in the normal way. Ask the local community to assess whether the amount produced is similar to what was produced before the disaster and to compare how easy the pump is to use. If pumping is difficult and a small amount of water is produced it could be a blockage or the pump could be broken. Re-check the pump mechanism and reflush the borehole.

Motorised pump

Measure how much water the pump produces using the procedure shown in Box 1 and the Figure 5 below.

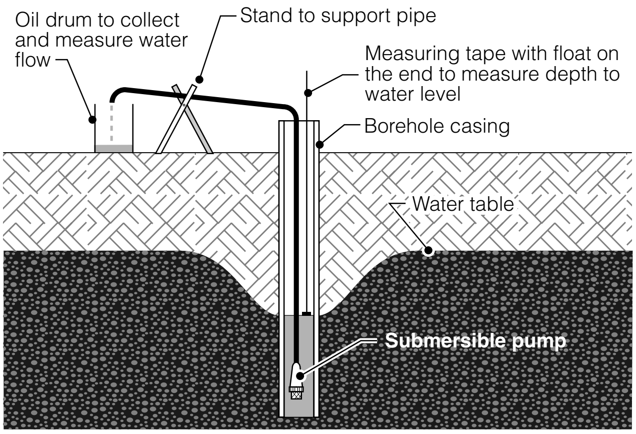


Figure 5. A pump test

Box 1. Estimate flow rate from a borehole

Put a bucket under the outlet from the pump and measure how long it takes to fill.

Amount of water pumped in 1 hour is:

$$\left(\frac{A \times C}{B}\right) - B$$

Where:
A = The volume of the bucket in litres
B = Number of seconds taken to fill the bucket
C = 3600 seconds
Q = flow (litres/hour)

Compare the flow rate with what was produced before the disaster. If it is significantly less check the pump and motor for damage and/or flush the borehole again. If this does not change the flow rate either accept the lower flow or abandon the hole.

Step 4: Disinfecting the borehole

Following the rehabilitation of the borehole, test the levels of turbidity and pH to ensure that chlorination will be effective. This can be done using simple hand-held equipment. Never chlorinate turbid water because the suspended particles can protect the microorganisms. Table 1 outlines why pH and turbidity are important and what can be done to ensure guideline levels are met.

If the turbidity of the water is greater than 5NTU after the cleaning and rehabilitation stage, pump out the water, allow the well to refill and then re-test turbidity levels.

WHO endorses the disinfection of drinking water in emergency situations. There are various ways of disinfecting wells but the most common is chlorination as it leaves a residual disinfectant in the water afterwards.

Table 1. Physico-chemical parameters

Parameter	WHO GDWQ	Why?	Corrective action
pH	6 – 8	pH of 6.8-7.2 is required to reduce level of chlorine required.	If pH is less than 6 add hydrated lime (calcium hydroxide)
Turbidity	< 5NTU (20NTU emergency limit)	High turbidity (>5NTU) requires more chlorine to oxidise organic matter	Dewater well and rebleach well lining using chlorine solution

The chlorine compound most commonly used is calcium hypochlorite as high test hypochlorite (HTH) in powder or granule form. Also used is sodium hypochlorite in liquid bleach form. Each chlorine compound has a different amount of usable chlorine depending on the quantity of time the product has been stored or exposed to the atmosphere. The best type of chlorine in an emergency is HTH as this normally contains 50 to 70% chlorine. Box 2 outline methods for calculating appropriate chlorine doses for HTH granule chlorine.

Bleach gives off chlorine gas which is very dangerous. Try to clean the well lining using a brush on the end of a series of connected 25mm diameter metal pipes.

The amount of chlorine needed will depend on the volume of water in the borehole. Add 1 litre of 0.2% chlorine solutions for every 100 litres of water in the borehole. Leave the water undisturbed for at least 30 minutes.

Do not allow anyone to use the well during the cleaning process. The water will have a strong concentration of chlorine that will give it a bad taste and smell and could be dangerous.

Box 2. Disinfecting a borehole using Calcium Hypochlorie (HTH)

Equipment

- 20 litre bucket
- HTH chlorine granuals or powder

Method

- Fill the bucket with clear water from the borehole
- Add 50g of HTH powder and stir until disolved
- Calculate the volume of water in the borehole using the formula:

$$V = \frac{\pi D^2}{4} \times h$$

Where

V = volume of water in the well (m^3)
D = diameter of the well (m)
h = depth of water (m)
π = 3.142

- Fill the bucket with clear water from the well.
- Add 50g of HTH and stir unitl disolved.

For every cubic metre (m^3) of water in the borehole add 10 litres (half bucket) of the chlorine solution.

Step 5: Dewater borehole

Following the contact period, dewater the borehole once again using compressed air. When the borehole has refilled, wait a further 30 minutes and measure the chlorine concentration using a comparator. If the residual chlorine concentration is less than 0.5mg/l the borehole is safe to use. If the concentration is greater than 0.5mg/l, remove all the water from the well again and repeat the process.

Further information

Godfrey, S. and Ball, P. (2003) 'Making Boreholes Work – Rehabilitation strategies from Angola', *29th WEDC Conference Proceedings,* WEDC, Loughborough, UK.

Ball, P. (1999) *Drilled Wells,* SKAT Publications, Geneva, Switzerland.

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