

# 34. Protecting springs — an alternative to spring boxes

## Spring boxes

Many publications describe the protection of springs from contamination using spring boxes similar to the one in Figure 1.

The construction of such a structure takes time and money, and in many cases it may not be really necessary.

## Why use a spring box?

A spring box can be useful as:

- **A sedimentation chamber** where particles of sand carried in the spring water can settle out.
- **A storage chamber**, which is useful for springs where the peak rate of demand exceeds the rate of flow of the spring.
- A method of **protecting the spring water** from contamination.
- A way of **collecting the spring water** by giving it an easy flow path from the aquifer into a delivery pipe.

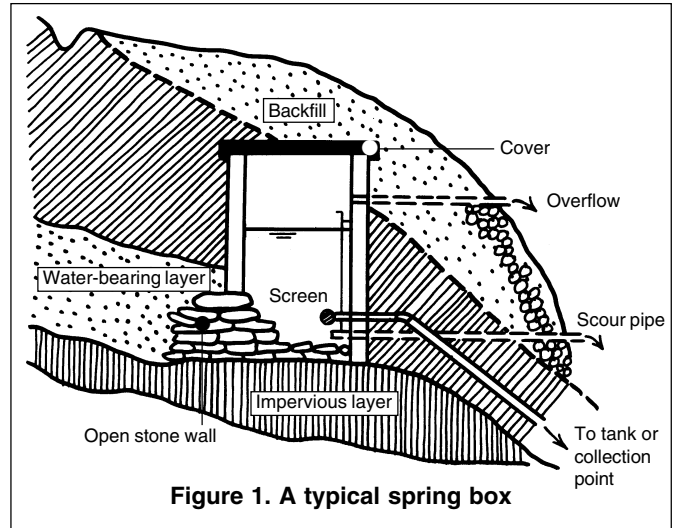


Figure 1. A typical spring box

So it follows that:

- if... water from a spring can be **protected and collected** without a spring box,
  - and if... **no sedimentation is needed** because the water carries only a low level of suspended solids,
  - and if... **no storage is needed** because the water flows at a rate sufficient to meet the peak demand...
- then **no spring box is required**.

## Advantages of protecting a spring without using a spring box

- **Simpler design** ○ easier for local masons to copy ○ quicker construction ○ less cement and local materials needed
- **Reduced cost** ○ more communities may be able to afford to protect a spring ○ protection of low flowing springs becomes more financially viable to funding agencies
- **Suits flatter sites** ○ no provision is needed for the depth of the storage/sedimentation chamber

Each spring is unique and all designs need adapting to suit the type of spring and the topography. The following 7-step guide to protecting a spring without using a spring box assumes a gravity spring with a flow rate of up to about 35 litres/minute, flowing from a granular unconfined aquifer lying on a fairly impermeable strata. Use of the design with higher flow rates is possible in some instances, but more than one delivery pipe and a larger concreted sump behind the headwall are recommended for such flows.

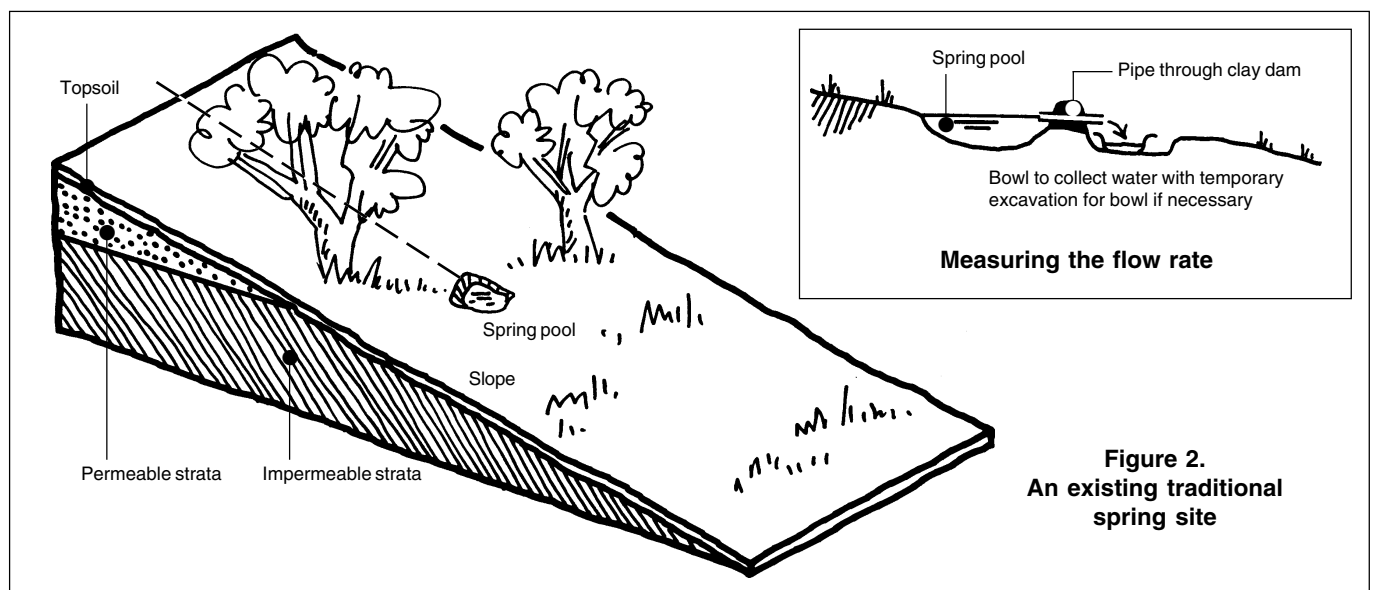


Figure 2. An existing traditional spring site

# Protecting springs — an alternative to spring boxes

## 1. Choose the site

First, check the following:

- Does the community want the spring protected?
- Are local construction materials available?
- Is the community willing to contribute by way of organization, money, labour, materials, transport, etc.?
- Check the existing spring flow rate (e.g. by inserting a pipe into a clay dam at the overflow point and by recording the time taken to fill a container of known volume — see Figure 2). By protecting the spring you may be able to achieve an increased flow, but consider whether there is likely to be enough water to meet the demand.
- During what season of the year are you measuring the flow? Has the community noticed a change of flow with season?
- Latrines, animal pens, etc. uphill of the spring pose a pollution risk. They should be at least 50m away.
- The site needs to slope sufficiently to dispose of surface water and wastewater.

## 2. Find the main flow path/s

- Clear the site of bushes, long grass, etc.
- Starting at the highest point(s) at which there is evidence of water issuing from the soil, excavate narrow trenches uphill following the direction from which most of the water is flowing. Stop when the trench is about 1.0m deep if sufficient water is flowing into the end of the trench from the 'eye' of the spring. If there is more than one main source then several trenches can be joined.
- If there are no main flow paths it may be necessary to excavate a seepage trench across the slope, to intercept water seeping through the aquifer (see Figure 3).

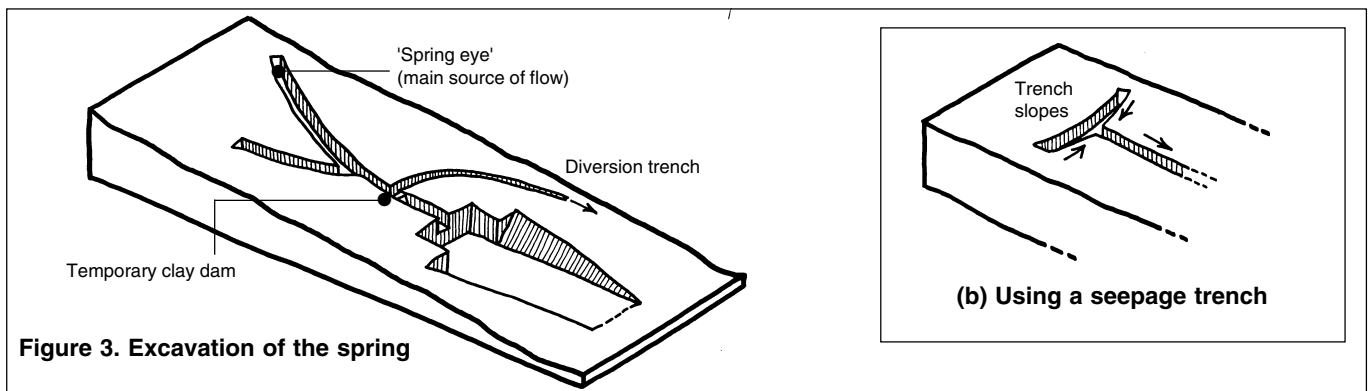


Figure 3. Excavation of the spring

## 3. Protect the source and choose how to convey the water

The spring eye at the head of the trench should be surrounded with clean stones through which water can flow into the trench. Stones of between 10 and 40mm diameter are usually suitable for this, but larger ones can be used. A layer of stones about 100mm deep will usually suffice, and this should then be covered with a layer of rocks and a layer of 'puddled clay' about 100mm deep. This clay is prepared by wetting and kneading it underfoot until it is uniformly plastic. Its purpose is to prevent surface water and grains of backfill material from entering the stone-filled channel. (See Figure 4.)

Once the clay has been trodden into place the remainder of the trench can be backfilled. The excavated material can be used, and it should be compacted by foot in layers of about 100mm. The final layer in the trench should be of topsoil, which is raised a little above the ground to compensate for the future settlement of the backfill. This topsoil should be planted with creeping grass plants to prevent soil erosion.

It is useful for future reference to measure and record the positions of the spring eyes from some permanent features, such as the corners of the headwall, so that if problems occur the eyes can be found again quickly. Alternatively, a large flat stone can be embedded in the topsoil on the surface above the eye to mark its position.

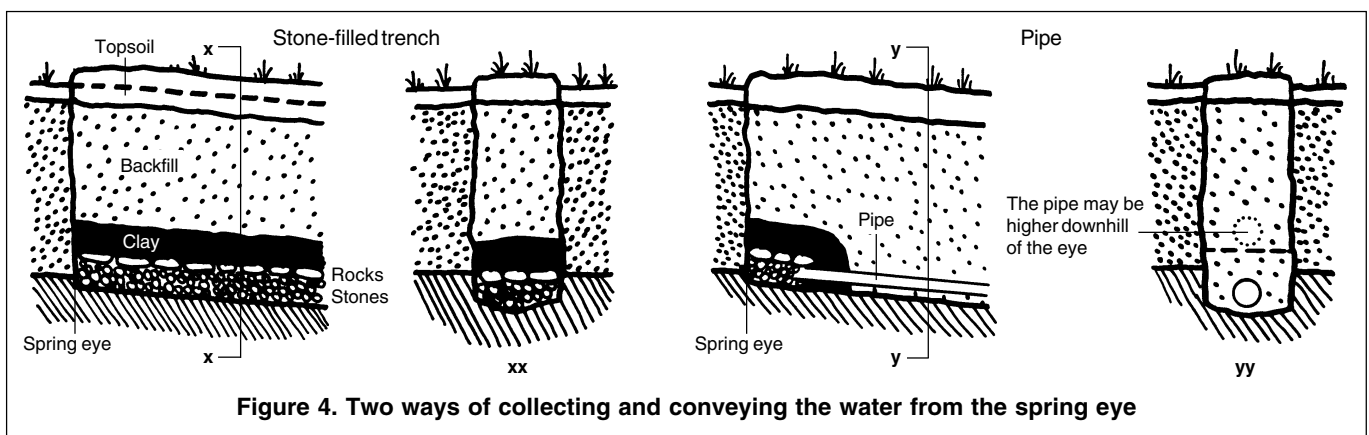
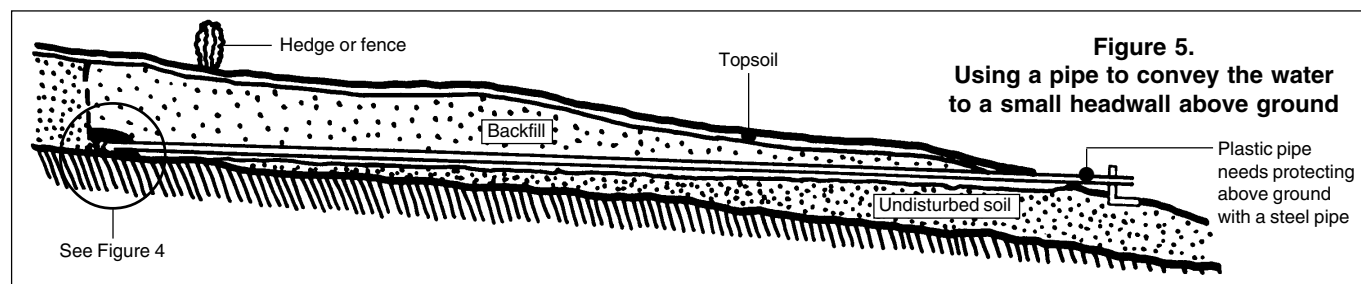


Figure 4. Two ways of collecting and conveying the water from the spring eye

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There are two options for conveying the water from the protected source to the headwall:

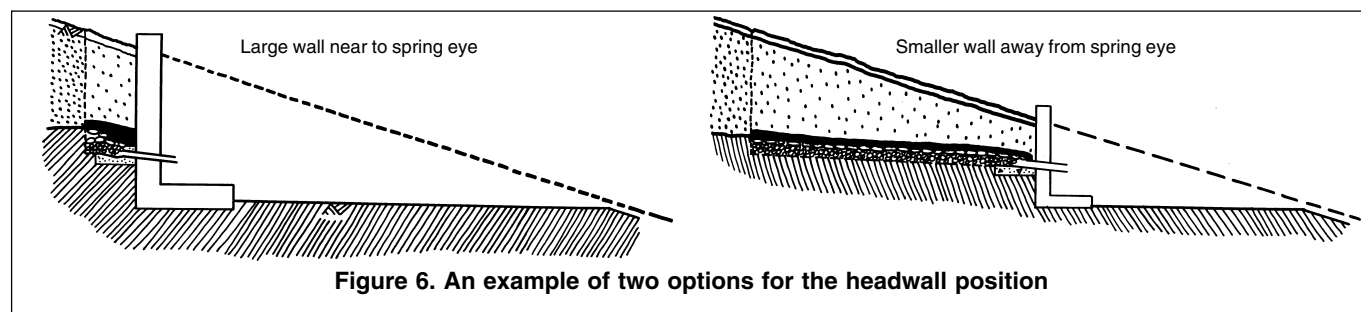
- **A stone-filled trench** If the bottom of the trench that you have dug to the eye is in fairly impermeable strata, and if it is smooth and sloping, then it can be backfilled with a layer of stones in a similar way to that already explained and shown in Figure 4. Water can then flow between the stones and along the trench to the headwall.
- **A pipe** If it is affordable, a 30-50mm internal-diameter plastic pipe can be used to carry the water. This has three advantages:
  - it eliminates the water losses that can occur from stone-filled trenches;
  - it protects the spring water from pollution as it travels to the headwall; and
  - if desired, and if the topography is suitable, the pipe can allow a delivery point to be above ground. This means that a large excavation for the headwall and for the wastewater drain is avoided, and only a small headwall structure is needed to support the delivery pipe.



## 4. Choose the position of the headwall

In choosing the position of the headwall consider the following:

- If stone-filled trenches are being used to convey the water, then the closer the headwall is to the spring eye the less chance there is of the spring water being polluted in the trench, or of it being lost from the trench; **but**
- if the excavation for the headwall is too close to the spring eye, it may adversely affect the local water-flow pattern, and the spring might be lost; **and**
- the closer the headwall is to the spring eye, the higher and stronger the wall will have to be. A smaller headwall further away from the eye may be the most economical solution if the cost of the increased length of pipe or stone-filled trenches is not excessive.

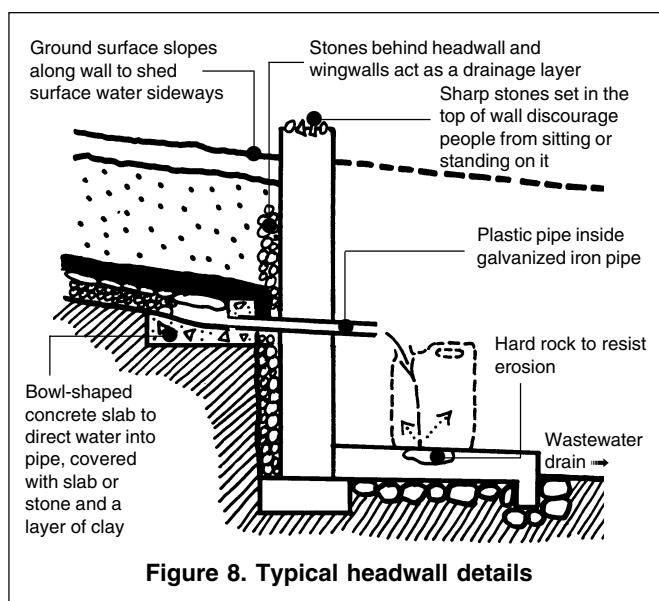
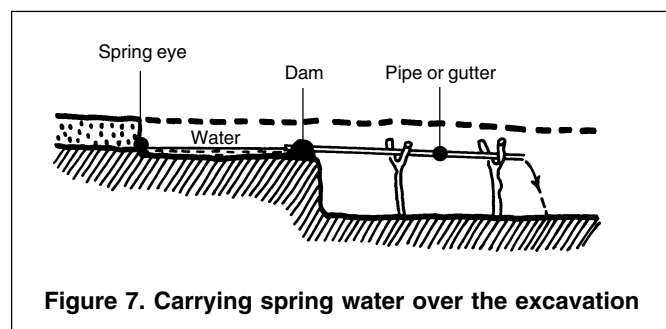


## 5. Excavate for and construct the headwall, wingwalls and access

### 1: Divert the water

The headwall needs to be constructed in dry conditions. During construction the flow of spring water into the excavation can be prevented in two ways:

- By using a temporary clay dam in the main trench to divert the water into a diversion trench (see Figure 3).
- By carrying the water over the excavation in a pipe or locally made gutter (e.g. of bamboo or split banana tree trunk) supported on forked sticks (see Figure 7).



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## 2: Build the headwall and wingwalls

A variety of materials can be used to build the headwall, but well-burnt bricks, concrete blocks, or stones laid in a 1:3 cement:sand mortar are the most common materials. Small wingwalls at right angles to the headwall help to support it against the soil pressure. A drainage layer behind the headwall prevents hydrostatic forces from acting on the wall.

## 3: Build the apron slab and steps

The purpose of the apron slab and steps is to give users convenient access to the delivery pipe. The apron slab also protects the wall foundations and it should slope to discharge wastewater into the drain. If the users approach from both sides of the spring, then two sets of steps may be provided, or a simple footbridge can be built across the drain. It may be possible to avoid the use of steps altogether by providing access alongside the drain serving the apron slab.

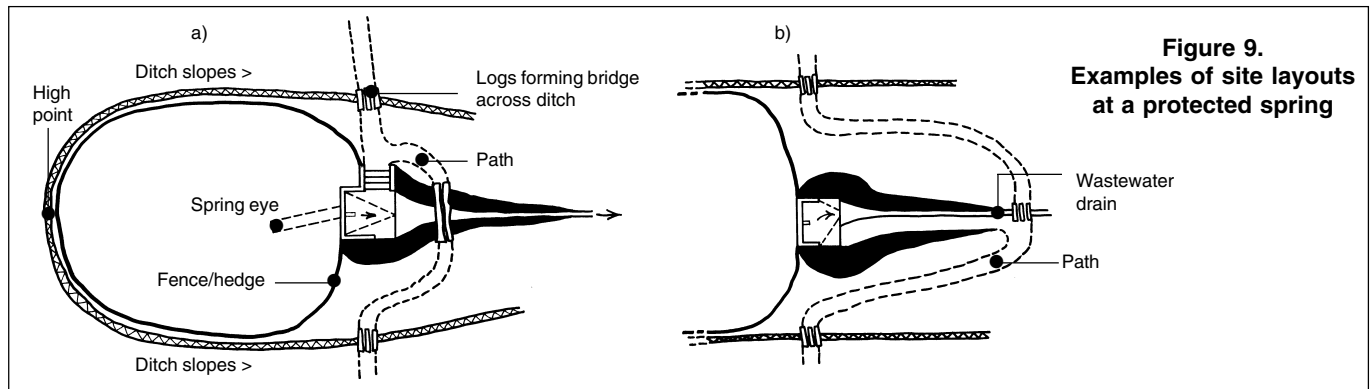


Figure 9.  
Examples of site layouts  
at a protected spring

## 6. Construct the surface water diversion ditch and fence

The area immediately above and uphill of the spring eyes needs to be fenced off to prevent pollution from people or animals. The fence should extend at least 10m uphill of the spring eyes. To prevent polluted surface water from flowing through the fence onto the site of the spring, a free-draining ditch should be constructed uphill of the fence. The alignment of the ditch needs to be chosen to suit the topography before the fence is built beside it. A hedge of animal-resistant bushes usually makes a good permanent fence. The area inside the fence should be planted with creeping perennial grass if it is available, and other vegetation should be cut down to keep the area tidy and to prevent roots from penetrating the spring water trenches.

## 7. Train the community

The training of the community should start even before work commences on the spring. They need to understand how common water-borne diseases are spread, and how the clean water from the spring can easily become polluted before they drink it. Regular visits to the spring by a health educator are usually necessary to encourage proper water use and spring maintenance. Where the community appoints a spring committee and one or two caretakers, these people can be trained to be aware of the health risks associated with the spring and they can be encouraged to explain these to the users.

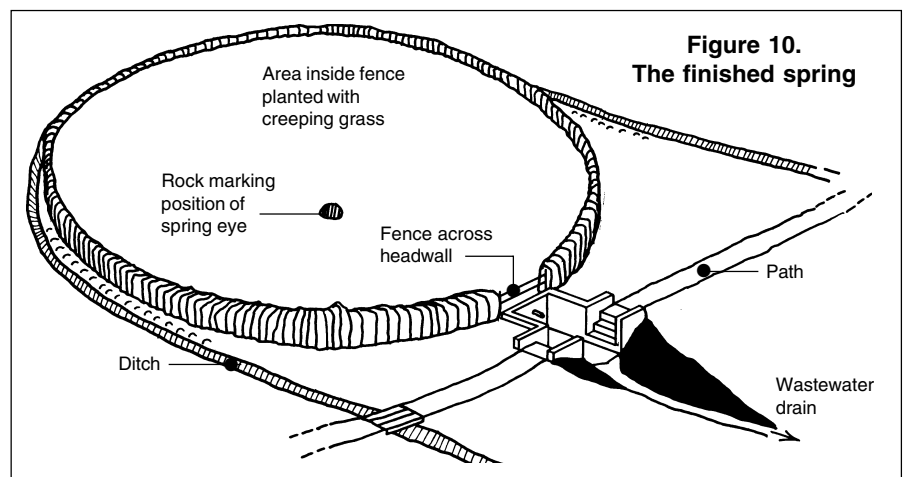


Figure 10.  
The finished spring

## Further reading

Hofkes, E.H. (ed.), *Small Community Water Supplies: Technology of Small Water Supply Systems in Developing Countries*, IRC Technical Paper No. 18, Wiley & Sons, Chichester, 1983.

Rous, T., 'Protecting a shallow seepage spring', *Waterlines*, Vol.4 No.2, IT Publications, London, 1985.

Tobin, V., and Cairncross, S. Technical Brief No. 3: Protecting a Spring, *Waterlines*, Vol.3 No.3, IT Publications, London, 1985.

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