

# Springs

Springs are places where water that has been filtered through soil and rock reappears from underground. This filtration removes the microbes from the water and spring water is therefore often safe to drink.

Sometimes rivers or streams pass underground and reappear downstream. This is especially common in areas of limestone. These can look like springs but the water has not been filtered in the same way and it is less likely that they will be safe water sources.

Water on the surface of the ground will filter down through soil and rocks until it reaches a level through which it cannot pass (an impervious layer), or reaches a level in the ground where the soil or rock is saturated with water (the water table). The water table is not a flat surface, but roughly follows the shape of the land surface above it. Groundwater will flow down slopes in the water table until the level intersects the land surface or is forced to the surface by an impervious layer.

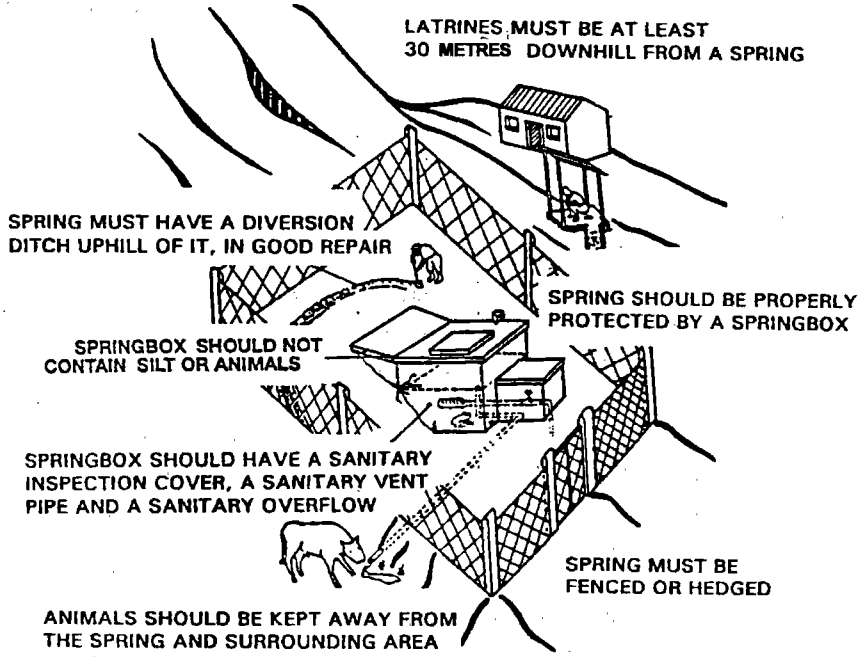
If the water becomes sandwiched between two impervious layers then enough pressure may be exerted to force water up through a hole. This is called an artesian spring.

Sanitary inspections of spring source water supplies

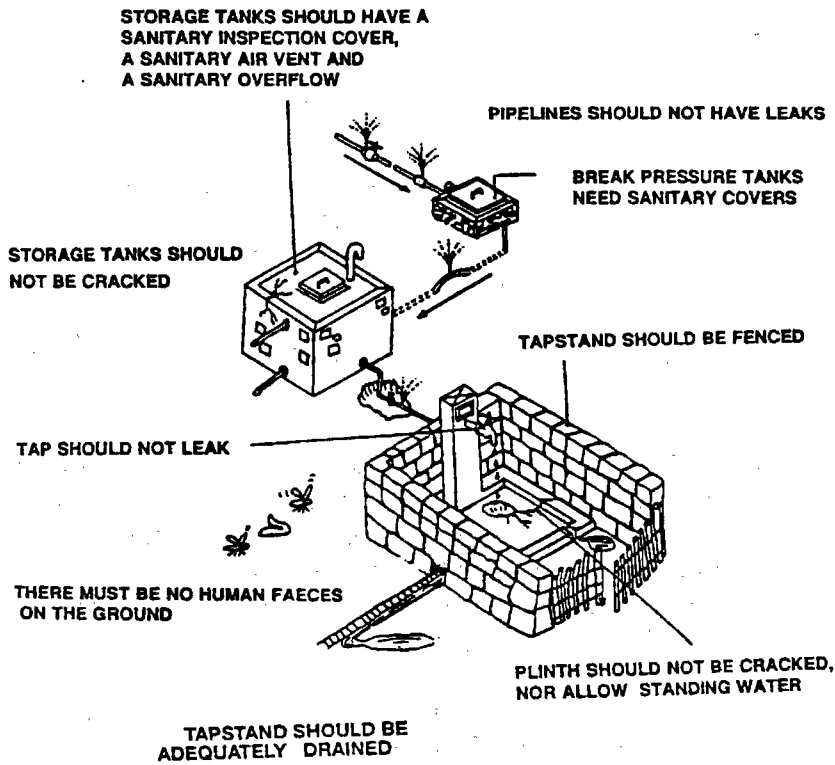
Protected spring-fed water supplies need regular monitoring to ensure an adequate and safe supply is maintained. A suggested frequency of sanitary inspections is at least twice a year conducted by the community and at least once a year by an external surveillance agency (see Fact Sheet 2.1). Sometimes the water supply agency may also conduct an annual sanitary inspection. In the inspection it is important that both the protected spring and the distribution system are checked.

Water quality testing should be carried out at least twice a year, once in the wet season and once in the dry season. The water coming from the spring and any storage tanks should be tested, and samples from outlets in the distribution system taken. In larger supplies, which serve many people, water quality tests should be undertaken more frequently and if chlorination is used residual chlorine should be analysed daily.

The key points and observations to make in a sanitary inspection of springs and distribution systems are shown in Figures 1 and 2.



**Figure 1. Sanitary inspection of a spring source**



**Figure 2. Sanitary inspection of a distribution system**

## Types of springs

There are two main types of springs : gravity springs and artesian springs.

Gravity springs occur where groundwater emerges at the surface because an impervious layer prevents it from seeping downwards, or the water table is at the same height as the land. This type of spring usually occurs on sloping ground and its flow changes with variations in the height of the water table (see Figure 3). The flow tends to vary with the time of year.

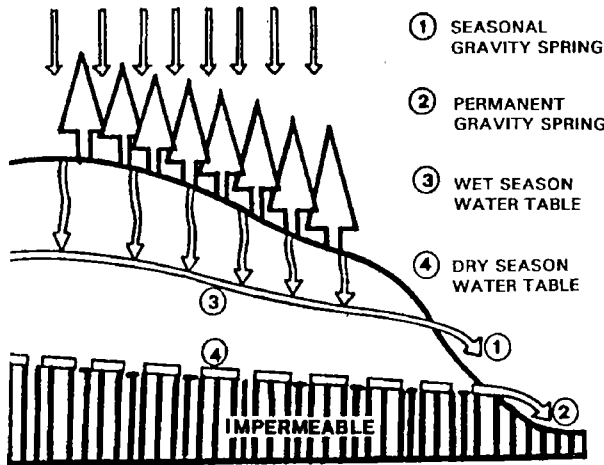


Figure 3. A gravity spring

Artesian springs occur where groundwater emerges at the surface after confinement between two impervious layers of rock. The flow is very nearly constant during the year (see Figure 4).

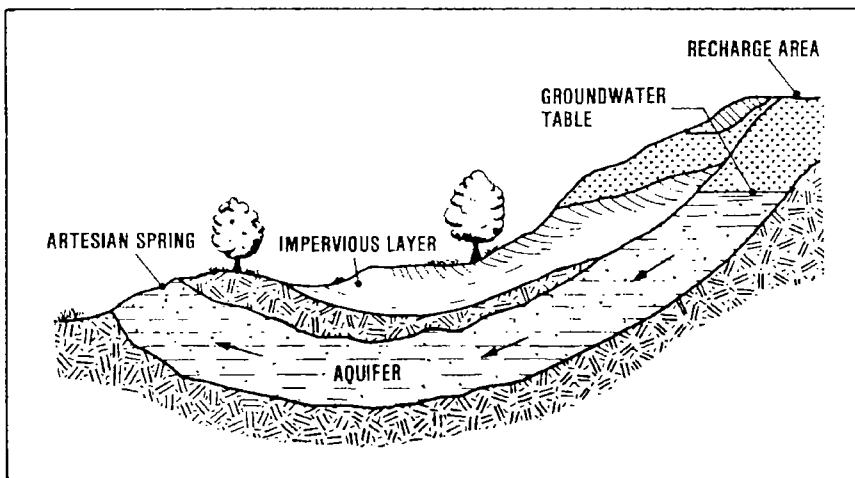


Figure 4. An artesian spring

## Why protect a spring ?

After being filtered through soil and rock, groundwater is generally free from microbes and often safe to drink. However, spring water may be rapidly contaminated when it emerges at the surface, for example by contaminated surface water nearby or by wild or domestic animals, as well as by people who collect or use the water from the spring.

## Protecting a spring

Springs are protected against contamination by construction of a spring catchment box and other protective measures.

The most important features of the spring catchment box itself are :

- The spring water does not emerge at the surface but flows directly into a covered box. The water is then collected by the consumers either directly from a pipe running from the box or from taps if the spring is connected to a distribution network.
- The box needs a lid which can be opened to enable cleaning. This should be mounted so as to prevent animals or leaves from entering, and should be kept locked.
- The space behind the box, above the eye of the spring, should be sealed with impermeable material such as puddled clay or a concrete plinth.
- The recharge area or source of water for a spring may require protection. Protection may consist of restricting land uses or ensuring proper disposal of human and animal waste in the recharge area.

Figure 5 shows a typical spring protection box.

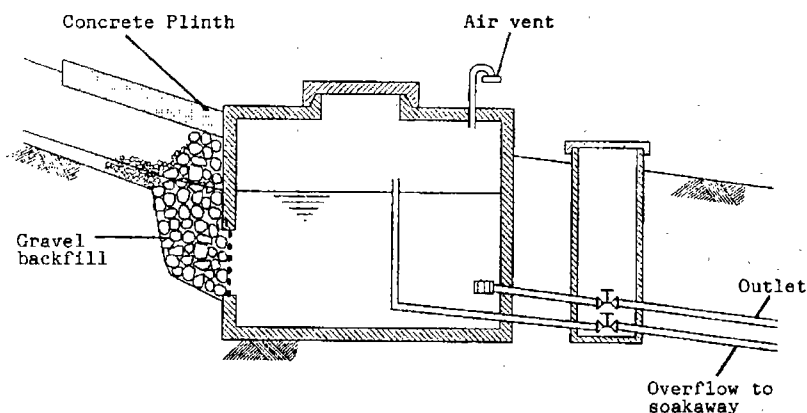


Figure 5. Spring catchment box

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**As well as the box itself, it is also important that :**

- There are no latrines nearby (within 30 metres) or uphill of the box.
- There are no sources of severe contamination in the vicinity.
- Infants and animals should be excluded from the area of the spring, by means of a fence constructed around it.
- A surface water diversion ditch should be dug above and around the area of the spring, because water running across the surface, especially during the rainy season, may carry contamination to the spring.

Ideally the construction of a spring catchment box should be undertaken by a qualified person. The other protective measures described above may easily and rapidly be installed by persons with limited experience.

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**Construction of a spring protection box**

The general procedure for constructing a spring protection box is described below.

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**Excavation**

- Dig back until you can see a clear point from which the spring emerges (the eye of the spring). Do not dig down into the impervious layer. If there is more than one point then dig back further to see if they converge. If the points do not converge, then separate spring boxes will have to be constructed for each, or a seep collector with drains will have to be built.
- Dig a temporary drainage channel that will take the water away from the spring during construction, as shown in Figure 6.

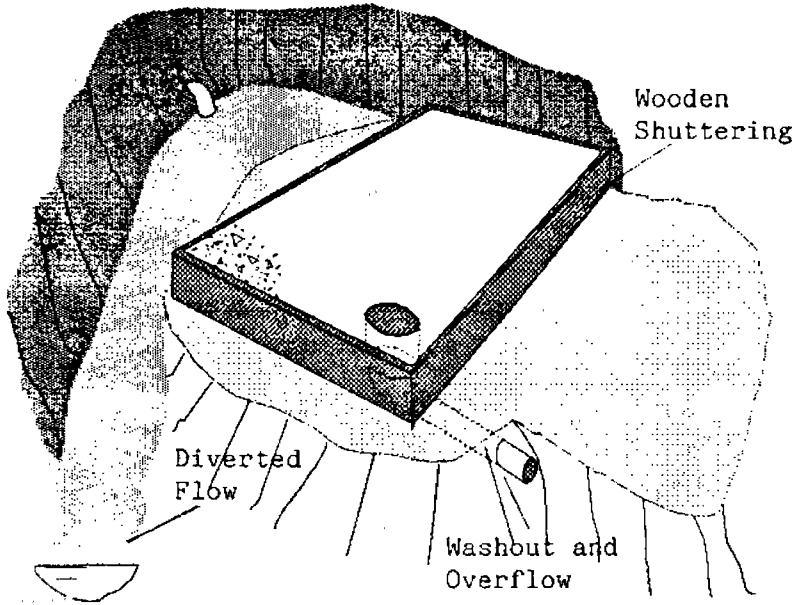


Figure 6. Drainage channel

### Concrete base

- Mark the edges of the base with wooden shuttering so that the base is close to the eye of the spring, extends at least one metre forward from the eye and across its full width (see Figure 6).
- The spring box will need both an overflow pipe and a cleaning pipe. These can be made cheaply and without valves if a female connector leading to an overflow pipe is built flush into the base. This is shown in Figure 7.

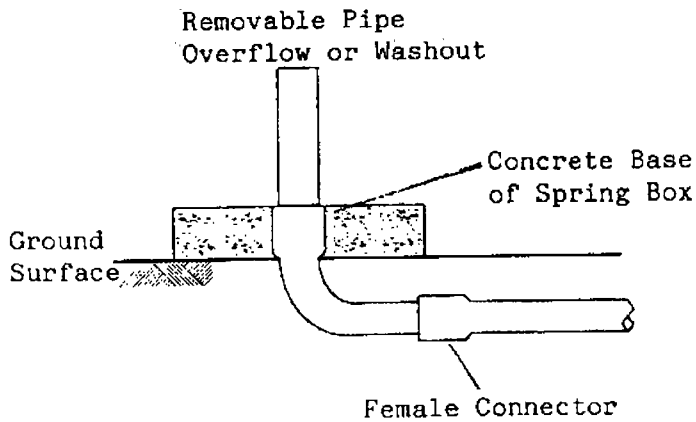
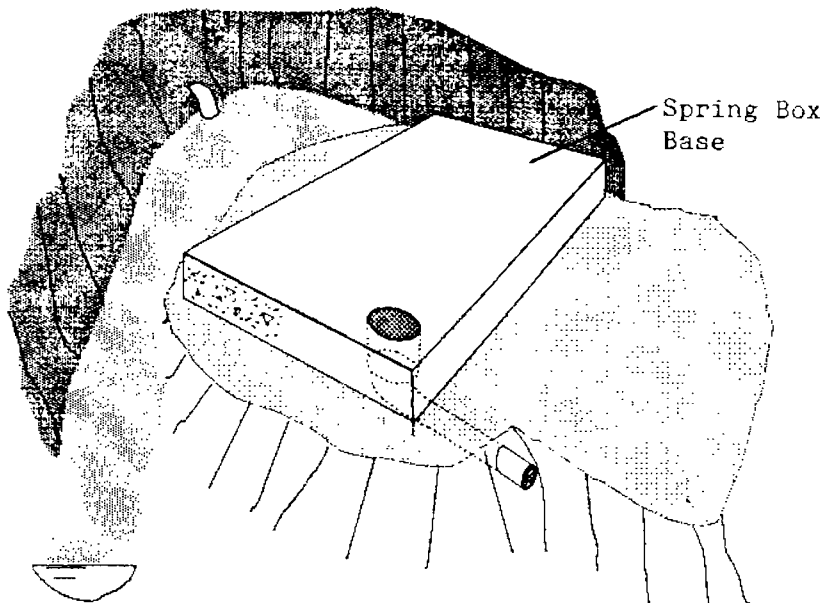


Figure 7. Overflow pipe

- Pour the concrete base from a mixture of 1 :4 :8 (cement :sand :gravel). Compact (tamp) the concrete and allow it to cure. The base is shown in Figure 8 below. Curing will need 7 days and the concrete should be kept damp all this time by covering it with old cement bags, rags, sacks or similar items. Moisten them at least once a day. When it is very hot, the sacks or bags etc will dry out quickly and should be checked and moistened, if necessary, two or three times a day.



**Figure 8. Base of the spring box**

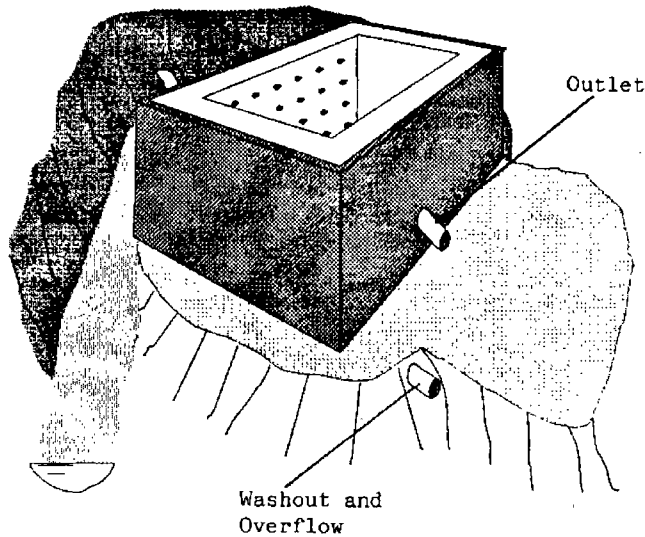
### **Build the back wall**

- The back wall is partly open so that water from the spring can get into the box. It can be a dry stone wall, a perforated concrete wall (from cast concrete with small pieces of plastic tube passing through it) or a wall made by using no-fines concrete (that is, a mixture in which no sand is used).
- The walls of the box can be made either like a mortared wall (using local stone) or by pouring a stiff mixture of 1 :2 :4 (cement :sand :gravel) into shuttering. In either case the walls should be at least 100 mm thick. Note that the minimum amount of water should be used to make the mixture cohesive - if the mixture is too wet, the strength of the dried concrete will be reduced.

If the walls of the box are made as a mortared wall then the inside of the box (except the back wall) should be made waterproof by rendering. The box need not be very large for a small spring (that is, up to one litre per second). A box of about 800 mm square is adequate.

- An outlet pipe must be incorporated into one of the walls, as shown in Figure 9. If water is to be collected directly from the spring, then this outlet pipe should be of galvanized iron and be well supported. In this case a concrete apron should be built around the spring with a kerb and drainage for spilt water.

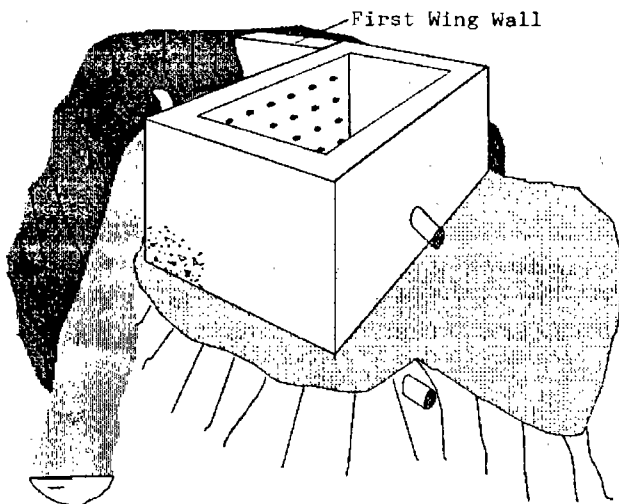
The outlet pipe should be raised slightly above the level of the spring box base. The outlet pipe should be covered with a mosquito screen on the inside.



**Figure 9. Box and outlet pipe**

### **Wing walls**

- While the spring water is diverted to one side of the box, construct a wing wall connected to the other side of the box, as shown in Figure 10. The wing wall is to ensure that all the water from the spring enters the box. The wing walls may be constructed in a similar way to the walls of the spring box.



**Figure 10. Wing wall**



- Divert the flow of the water so that it passes into the box and through the overflow pipe. Then construct the second wing wall on the other side, as shown in Figure 11.

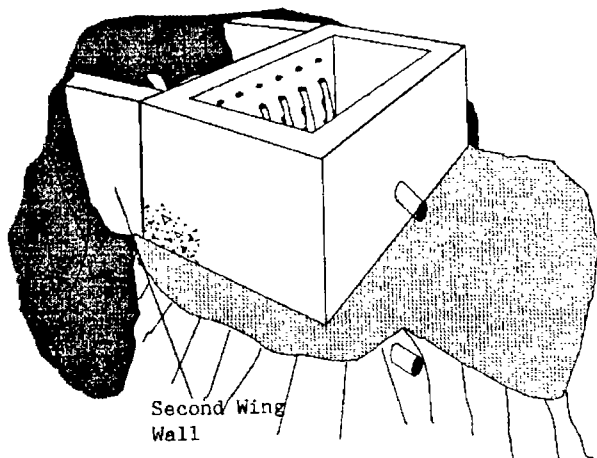


Figure 11. Second wing wall

### Finishing the construction

- The area between the eye of the spring and the back of the spring box should be filled with gravel. This gravel should then be sealed on top by pouring a concrete apron over it or by adding puddled clay. This protection should be sloped so that it carries water away from the back of the box to the sides, as shown in Figure 12.

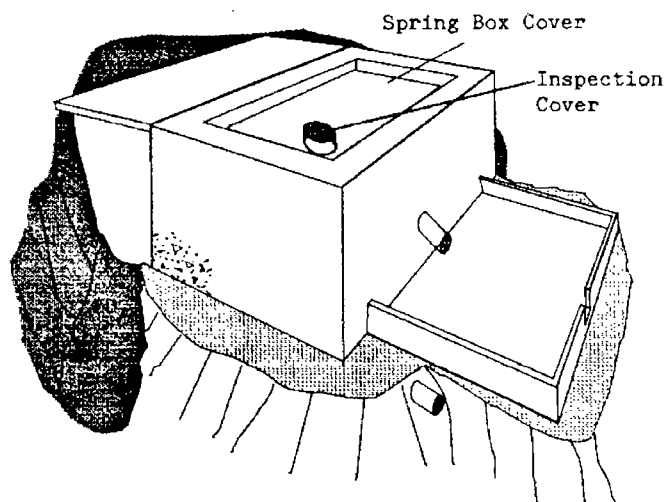


Figure 12. Finishing the box

- Cut a length of pipe to fit into the female connector incorporated into the base of the box. The top of the pipe should be at the level of the eye of the spring, no higher. Once installed it will function as an overflow and prevent water pressure back on the eye of the spring which might force the spring to divert.

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### **Lid**

- Make a lid which has handles and overlaps down the sides of the box (a sanitary lid). This can be made of metal or reinforced concrete.

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### **Protecting the surroundings**

- Excavate a surface water diversion ditch upstream of the spring box and about eight metres away from it.
- Build a wall or fence all around the spring area to exclude children and animals. It should be built about ten metres away from the spring box.