Water Facts #4

Spring Development and Protection

Springs occur wherever groundwater flows out from the earth's surface. Springs typically occur along hillsides, low-lying areas, or at the base of slopes. A spring is formed when natural pressure forces groundwater above the land surface. This can occur at a distinct point or over a large seepage area. Springs are sometimes used as water supplies and can be a reliable and relatively inexpensive source of drinking water if they are developed and maintained properly.

Spring Development Considerations

When considering using a spring as your source of drinking water, it is important to ensure that the rate of flow is reliable during all seasons of the year. Spring flow that fluctuates greatly throughout the year is an indication that the source is unreliable or may have the potential for contamination. It may be possible to learn about historical spring flow from the previous owner or a neighbor.

Water quality is also important to consider before using a spring as a water supply. Before developing the spring, collect a sample of water and have it analyzed at a local water testing laboratory to ensure that it can be efficiently and economically treated to make it safe for human consumption (see *Water Facts #10: Testing Your Drinking Water* for a list of tests to have run). Springs are highly susceptible to contamination since they are fed by shallow groundwater, which usually flows through the ground for only a short period of time and may interact with surface water. For this reason, most springs will need some treatment before the water is considered a safe source of drinking water. Testing will help determine exactly how much treatment will be necessary and may help determine if other sources of water would be more economical.

Preparing for Spring Development

Since springs are usually fed by shallow groundwater, water quantity may be an issue during certain times of the year. If possible, the flow rate for your spring should be monitored for an entire year, but it is most critical to measure the flow rate during late summer and fall when groundwater levels and spring flows are usually at their lowest. Springs used for drinking water supplies should yield at least 2 gallons per minute throughout the entire year unless water storage is going to be used. The amount of water you will need from your spring depends entirely on your household's daily water needs. Water needs for an individual home vary depending on water use, water storage, and water-saving devices within the home. However, the average home will require approximately 50 to 75 gallons of water a day per person. To determine your household water needs, consult *Water Facts #2: Water System Planning—Estimating Water Needs*, located at **http://water.cas.psu.edu/**.

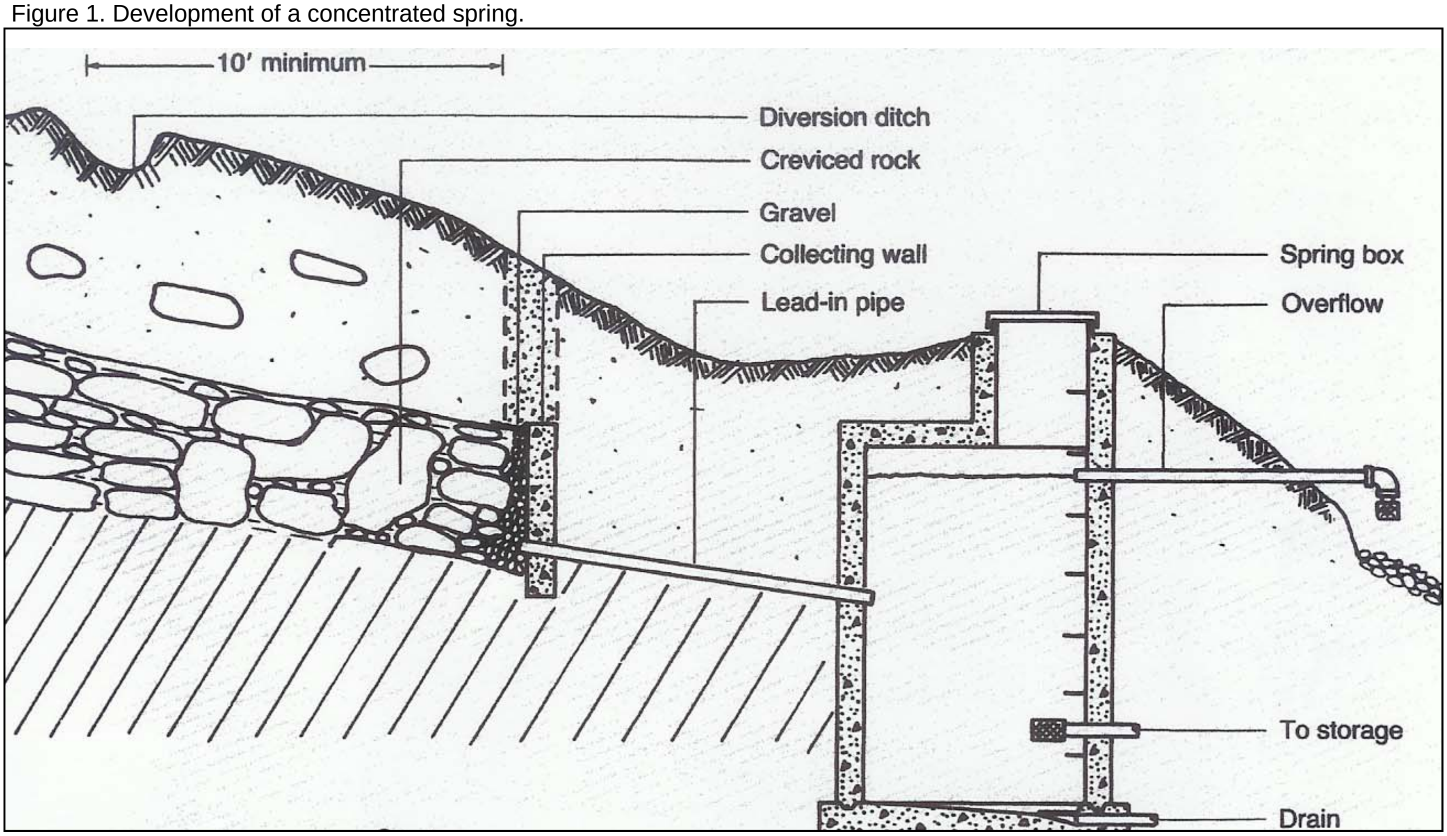
The flow rate of a spring can be tested by digging a 5-gallon bucket into the slope of the spring and allowing the water to flow into the bucket. Determine the flow rate by timing how long it takes the water to fill the bucket. Obtain a sample collection container from a certified water lab and send a sample of the spring water to the lab for water quality testing. A list of labs is available at **http://water.cas.psu.edu/** or from your local county cooperative extension office. You can start development of your spring once your determine that the quantity and quality are acceptable.

Spring Development
A spring can be developed into a drinking water supply by collecting the discharged water using tile or pipe and running the water into some type of sanitary storage tank. Protecting the spring from surface contamination is essential during all phases of spring development. Springs can be developed in two different ways and the method you choose will depend on whether it is a concentrated spring or a seepage spring. The general procedures for spring development are outlined in the following pages. Some of the methods for spring development outlined in this fact sheet are adapted from the Midwest Planning Service publication titled *Private Water Systems Handbook*. This publication (MWPS-14) is available for purchase at **http://www.nraes.org/** or by calling NRAES at 607-255-7654.

Spring Development Procedures: Concentrated Springs
A concentrated spring typically occurs when groundwater emerges from one defined discharge in the earth's surface. Concentrated springs are visible and are often found along hillsides where groundwater is forced through openings in fractured bedrock. This type of spring is relatively easy to develop (see Figure 1) and is usually less contaminated than other types of springs.

Steps for Developing a Concentrated Spring
- Excavate the land upslope from the spring discharge until three feet of water is flowing.
- Install a rock bed to form an interception reservoir.
- Build a collecting wall of concrete or plastic down slope from the spring discharge.
- Install a pipe low in the collecting wall to direct the water from the interception reservoir to a concrete or plastic spring box. (*Note: problems with spring flow can occur if water is permitted to back up behind the wall.)*
- Remove potential sources of contamination and divert surface water away from the spring box or collection area.
- Alternative types of interception reservoirs and collecting walls can be constructed as shown in Figure 2 on the following page.

Figure 1. Development of a concentrated spring.

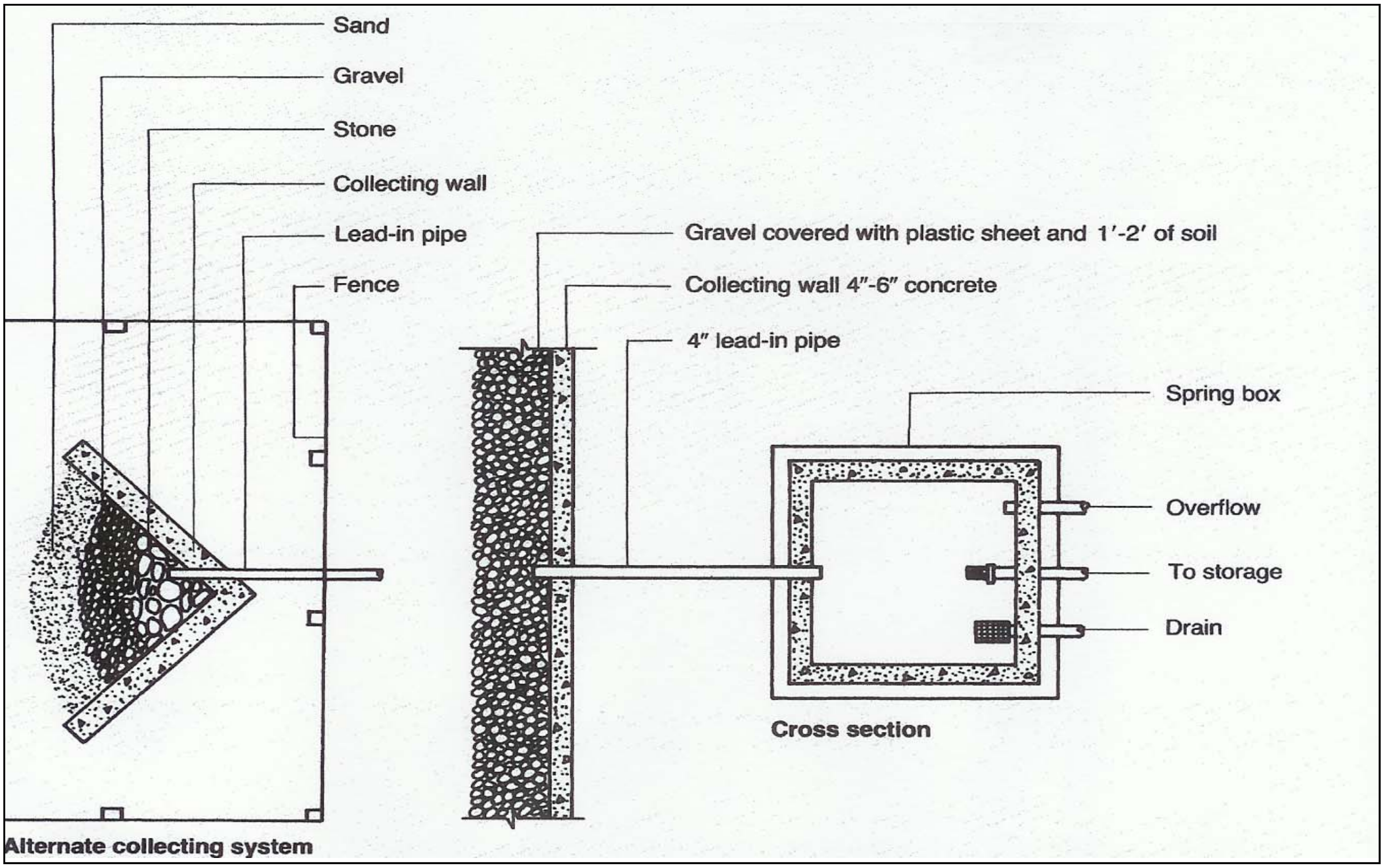


Adapted from *Safeguarding Wells and Springs from Bacterial Contamination,* Department of Agricultural and Biological Engineering, The Pennsylvania State University.

Concentrated Springs in Lowland Areas

Some concentrated springs emerge in valleys or lowland areas. A spring that forms in a low area may be very difficult to safeguard from bacterial contamination since surface water will tend to flow toward these valleys. For this reason, it is critical that water collected from these areas is regularly tested and, if necessary, receives disinfection treatment. To develop a lowland spring, follow the steps described above for the development of a concentrated spring, but a collecting wall may not be needed.

Figure 2. Alternative collecting system and cross sectional view of concentrated spring.

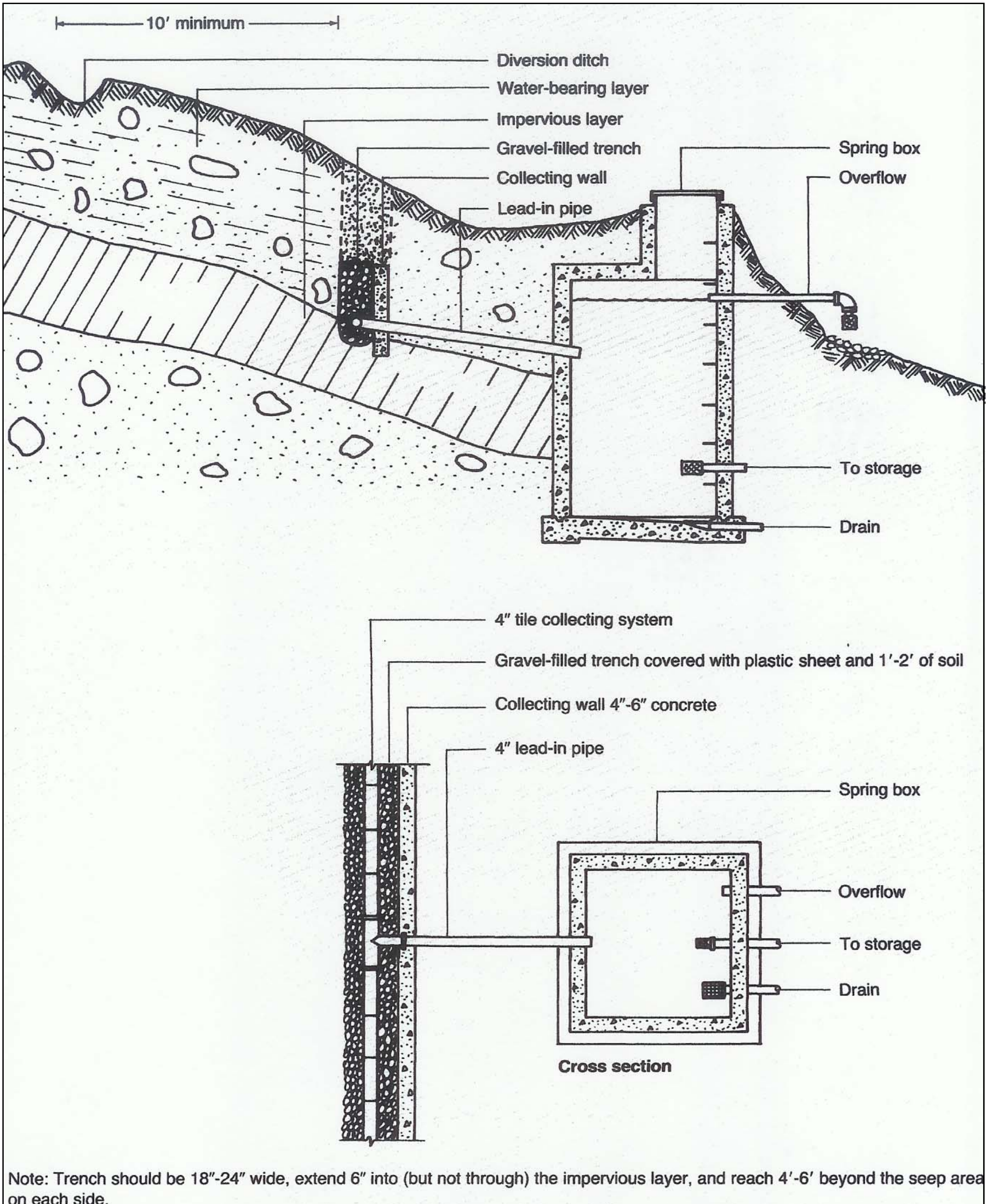


Adapted from *Safeguarding Wells and Springs from Bacterial Contamination,* Department of Agricultural and Biological Engineering, The Pennsylvania State University.

Spring Development Procedures: Seepage Springs

Seepage springs occur when shallow groundwater oozes or “seeps” from the ground over a large area and has no defined discharge point. This type of spring usually occurs when a layer of impervious soil redirects groundwater to the surface. Seepage springs can be difficult to develop (see Figure 3). They are also highly susceptible to contamination from surface sources and they need to be monitored before development to ensure that they will provide a dependable source of water during the entire year. Flow is often lower from seepage springs, making them less dependable.

Figure 3. Spring development in a seep area.



Note: Trench should be 18″-24″ wide, extend 6″ into (but not through) the impervious layer, and reach 4′-6′ beyond the seep area on each side.

Adapted from *Safeguarding Wells and Springs from Bacterial Contamination,* Department of Agricultural and Biological Engineering, The Pennsylvania State University.

Steps for Developing a Seepage Spring (see Figure 3 for details)

- Dig test holes upslope from the seep until you locate the point where the impervious layer is 3 feet under ground.
- Create a trench approximately 18 to 24 inches wide across the slope. Trench should be extended 6 inches into the impervious layer (below the water-bearing layer) and should extend 4 to 6 feet beyond the seepage area. Install 4 inches of collection tile and surround the tile with gravel.
- Installation of a collecting wall will help prevent water from escaping the collection tile. This collecting wall should be constructed of 4 to 6 inches of concrete.
- Collection tile should be connected to 4-inch pipe that leads to the spring box. Box inlet must be below the elevation of the collector tile.
- Remove potential sources of contamination and divert surface water away from spring box or collection area.

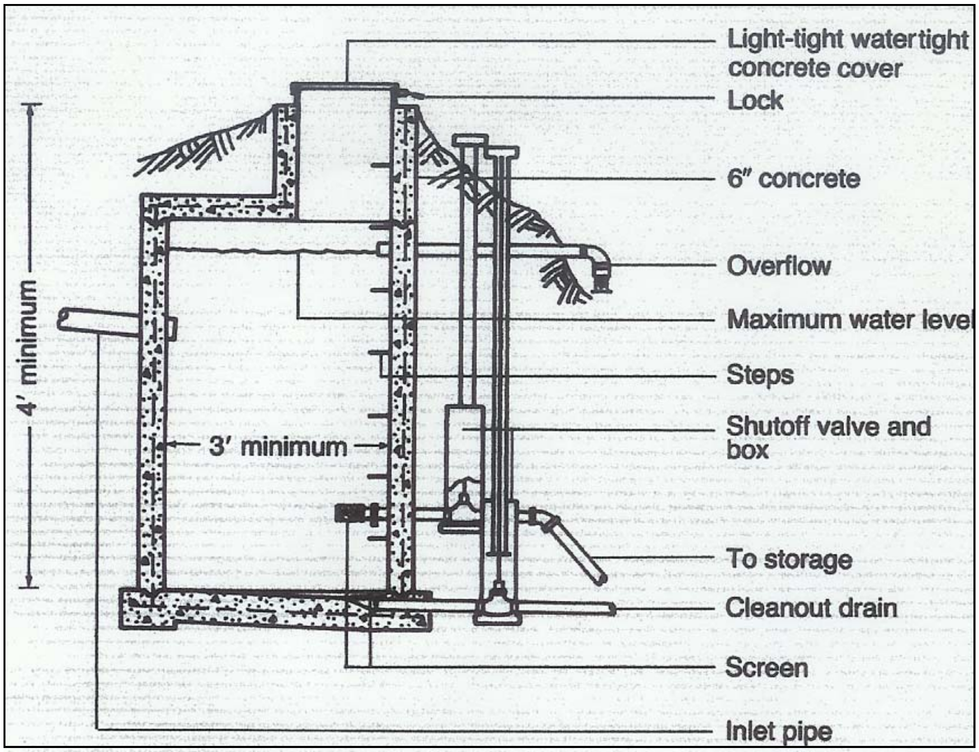
Spring Development Procedures: Spring Box Considerations

A spring box is a water-tight structure built around your spring to isolate it from contaminated surface runoff. It is critical that this box be built properly to ensure that surface water, insects, or small animals cannot enter the structure. If designed properly, it can provide reserve storage during a situation when the spring flow rate is below normal. It is important to keep surface water away from the spring box, and animals should be fenced out of the spring's drainage area. All activities should be kept to at least 100 feet from the spring box.

Figure 4. Spring box example.

- Size of the spring box depends on the amount of storage required. The box should be at least 4 feet deep and should extend at least 1 foot above the ground.
- Most spring boxes are made of concrete.
- A properly constructed spring box will have a watertight cover that fits like a shoebox lid. This will prevent insects, animals, and surface water from entering the spring.
- Create both an overflow pipe and an outlet pipe. Drain installation will allow the box to be cleaned periodically.

Figure 5. Spring box construction.



Adapted from *Safeguarding Wells and Springs from Bacterial Contamination,* Department of Agricultural and Biological Engineering, The Pennsylvania State University.

Proper Management of Springs

Remove Sources of Contamination. No matter what type of spring you have developed, it is critical that you remove potential sources of contamination from the spring's drainage area (the area upslope of the spring discharge point). Surface water draining into that area should be redirected and all activities should be limited within the drainage area. If livestock are present, fences should be used to keep animals from contaminating the drinking water supply.

Water Testing and Disinfection. Once the spring is developed and nearby sources of contamination are eliminated, it is important to disinfect the entire water system and then submit a water sample to a state-certified water testing laboratory for water quality analysis. If a water test indicates bacterial contamination, check the water supply location and construction of the system for potential pollution pathways. If improvements can be made, the system should then be shock chlorinated. After two weeks, the water should be retested by a state-certified water testing laboratory. If the water again tests positive for bacterial contamination, the owner has the option of finding a new source of water or installing a continuous disinfection system, such as an ultraviolet light. Most springs used for drinking water will require some type of continuous disinfection system to make certain that the water is safe for consumption. For more information on treatment of water supplies with coliform bacteria, consult *Water Facts #13: Coliform Bacteria in Drinking Water* and *Water Facts #14: Shock Chlorination of Wells and Springs,* which are both available at **http://water.cas.psu.edu/***.*

Drinking Water from Roadside Springs

In Pennsylvania it is not uncommon for roadside springs to be used by rural residents for drinking water. However, it is important to understand that roadside springs are just as vulnerable to bacterial contamination as other privately owned springs. In fact, many roadside springs that are located on public property may already undergo disinfection to ensure that the source is safe for consumption. Any roadside spring that is being used as a drinking water supply should be tested for total coliform bacteria. These springs should only be used as a source of drinking water if they have been tested and found to be bacteria free. When it comes to the health and safety of your family, never assume that a water supply is safe for drinking.

More Information

For additional information on the management of all types of private water systems, contact your local Penn State Cooperative Extension office or consult the Water Resources Extension Web site:
http://water.cas.psu.edu/

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