NATURAL RESOURCES CONSERVATION SERVICE
VIRGINIA ENGINEERING DESIGN NOTE #574 (DN-574)
SPRING DEVELOPMENT

A Spring Development is a way of utilizing springs and seeps to provide water for a conservation need.

Design Aids:

Virginia Standard Drawing VA-SO-900 – Spring Development

Types of Springs

Fracture and Tubular Springs. This type of spring is associated with cavernous rock. If water issues from rock fractures, the individual openings should be cleaned and enlarged, as needed, to improve flow. The water from these individual openings should be collected by means of tile or perforated pipeline, or by a gravel-filled ditch. The collection works shall be constructed below the elevation of the openings to permit free discharge.

If water issues from a single opening, such as a solution channel in a soluble rock formation, the opening shall be cleaned or enlarged as needed. A collection system usually is not required.

A spring box shall be installed at an elevation low enough so that water will not pond into the spring opening.

Perched or Contact Springs. Perched or contact springs occur when an impermeable layer lies beneath a water-bearing permeable layer. These springs shall be developed by intercepting and collecting the flow from the water-bearing formation. Collection trenches shall be used for developing these types of springs.

Artesian Springs. Artesian springs normally occur at a fissure or break in the impervious stratum where the water source is an underlying pervious water-bearing layer so positioned that the water surface elevation (water table) is always above the outlet of the spring. Artesian springs shall be developed by removing obstructions, cleaning or enlarging joints or fractures, or by lowering the outlet elevation as needed to improve flow. Spring boxes shall be located as needed. Free outlet discharge or minimum restriction to the spring flow is required to protect and maintain yield.

Collection Systems

If a collection trench is used, the trench shall be excavated so that it extends into the impervious layer. Minimum length of the trench shall be based on site conditions. Preferably, it will extend the entire length of the water-bearing outcrop.

A cutoff wall shall be constructed along the downstream side of the trench if needed to ensure that the flow enters the collection system. The cutoff wall may be constructed of plastic sheeting, well-tamped clay, masonry, concrete, or other impervious materials.

The collection system shall consist of subsurface drainage tubing or perforated pipe that is not less than 4 inches in diameter. A suitable manufactured system may also be used. Enclose the collection system in a sand-gravel filter on sites where there is the potential for sediment accumulation in the pipes. A geotextile fabric envelope may be used as a filter on suitable sites. The type of filter selected will be dependent on the soils of the site. The designer must ensure that the filter system will not become clogged and cause the collection system to fail. Cleanouts are recommended for all collection systems.

Crushed rock or gravel backfill, not less than one foot thick, may be used as a collection system if site conditions warrant, in lieu of other materials.

Sand, gravel, and crushed rock shall be composed of clean, hard, durable particles. Use of these materials must be appropriate for their purpose and compatible with the soils on site.

Spring Boxes

Spring boxes shall be made of plastic, concrete, galvanized steel, untreated wood, or other durable material, and have a tight access cover. A "shoebox" type access cover or manhole attachment, with gasket, is recommended for tightness. Spring boxes located below the cutoff wall shall be watertight and have an imperious bottom. Concrete well casing is an example of a commonly used material. Spring boxes located above the cutoff wall shall have a permeable bottom and/or porous walls to allow water to enter. Holes (3/8" diameter) or slits can be cut into impermeable materials to meet this requirement. An example of a porous bottom is six inches of gravel placed over an impermeable soil layer.

The box shall have a minimum cross-sectional area of 1 ½ ft^2. Typical heights of spring boxes range from 30" to 36" inches.

Outlets

The outlet pipe from a spring box shall be placed not less than six inches above the floor to provide a sediment trap. The spring box outlet pipe should be lower than the inlet from the collection system to avoid causing head on the spring that may reduce spring flow. If necessary, the inlet and outlet pipes can be set at the same elevation. The intake to the outlet pipe shall be screened as necessary. For spring boxes installed below the cutoff wall, the pipe will have a watertight connection through the spring box wall. The connection does not have to be watertight if the spring box is above the cutoff wall.

An outlet pipe can be installed through the wall as shown on the Standard Drawing. It may also be installed vertically through the bottom using a solid pipe at least 6" high above the floor. In either case, the outlet pipe must have positive grade away from the spring box or collection system unless vent pipe(s) are added to prevent air locks.

The outlet pipe shall have a minimum 1 ¼ inch diameter. In lieu of site-specific spring flow and pipe vent calculations, the outlet pipe shall have the following minimum size based on the line grades:

1. 1 ¼ inches inside diameter for line grades greater than 1.0 percent.

2. 1 ½ inches inside diameter for line grades greater than or equal to 0.5 percent but less than or equal to 1.0 percent.
3. 2 inches inside diameter for line grades less than 0.5 percent.

Minimum outlet pipe material and strength requirements shall equal those found in Virginia Conservation Practice Standard *Pipeline (Code 516)*. It is generally preferred that the pipe be placed underground. However, steel pipe can be placed on the ground surface when it is not practical or economical to bury the pipeline. This method may be used because running water does not freeze. Pipe materials that need protection from crushing or sun damage must be installed underground in accordance with the *Pipeline* Standard unless they are fenced out or otherwise protected. Caution should be used when installing roll pipe in a gravity system due to the potential for airlocks.

Overflow Pipes

An overflow pipe should be installed in the spring box if there is any chance that the flow of the spring will be greater than the capacity of the outlet pipe. If water backs up over the inlet pipe, the flow from the spring will be reduced and there is the possibility that sediment in the water could drop out and clog the intake system.

Clues that an overflow pipe is needed include:

1. Is the spring at the head of the creek?
2. Is there concentrated flow?
3. Was the ground disturbed by cows earlier in year (indicating a high water table)?
4. Is the wet area greater than a half acre?
5. Does the spring flow vary significantly during the year?

The overflow pipe shall be placed through the spring box wall at an elevation lower than the water inlet but higher than the outlet to the watering trough. If the spring box is below the cutoff wall, the overflow pipe must pass through the cutoff wall with a tight seal. The overflow pipe is typically sized at least one to two pipe diameter sizes larger than the outlet pipe. For example, a 3” or 4” overflow pipe would be used if the outlet pipe is 2” or smaller. The overflow pipe will have a positive grade away from the spring box. To the extent possible, the overflow pipe outlet shall be directed into the original watercourse. Where there are fairly flat slopes on the site, it may be necessary to extend the overflow pipe for a hundred or more feet to achieve the needed gradient.

The overflow pipe will be protected from freezing and ice damage. A rodent guard shall be installed, if needed.

Reminder: The capacity of the watering trough that will be supplied by this spring must be large enough to meet the entire water need of the animals without waiting. See the Virginia Engineering Design Note #614, Watering Facility to identify storage needs.