NATURAL RESOURCES CONSERVATION SERVICE
VIRGINIA TECHNICAL NOTE

ENGINEERING # 8

SINKHOLE CLOSING

DEFINITION

A method of filling sinkholes to improve farm safety, to stabilize the site, or to protect the groundwater resource.

CONDITIONS WHERE PRACTICE APPLIES

On any land surface where geologic conditions resulted in the development of sinkholes and where safety and/or stability is a concern. All designs must be site-specific, have the approval of the State Conservation Engineer, and have concurrence from the Virginia Department of Conservation and Recreation, Division of Natural Heritage, Karst Program Office. This technical note does not apply to sinkholes within 100 feet of a structure or a water supply for human consumption.

TREATMENTS

The type of treatment selected is based upon the site-specific conditions and the resource to be protected. Sinkhole treatment using an inverted filter should not result in surface water ponding or high soil moisture conditions over an extended period of time. Inverted filters are designed to allow water to drain through. However, since percolation rates vary among different soils, ponding and soil moisture conditions may also vary.

Plugging a sinkhole for groundwater protection will require provisions for removal of ponded water.

This Technical Note applies to sinkholes with excavated depths between 5 and 25 feet. (Most sinkholes can be excavated to 5 feet to allow for filter installation.) For sinkholes requiring excavated depths greater than 25 feet, adjustments to the inverted filter and/or surface water control measures may be required.

CASE 1 – TREATING SINKHOLES FOR FARM SAFETY AND/OR SITE STABILIZATION

Treat sinkhole using Inverted Filter #1 Specification and Figure 1.

CASE 2 – PLUGGING A SINKHOLE FOR GROUNDWATER PROTECTION

A site-specific solution shall be developed.

Install a surface water control measure to divert runoff away from the sinkhole to a safe outlet. A safe outlet is one which does not erode, divert surface water to another sinkhole, or cause flood damage to crops, property or buildings.

The selected measure is based upon specific site conditions and the appropriate Virginia Conservation Practice Standards and Specifications should be followed.

PLANS AND SPECIFICATIONS

The following engineering plans, specifications, and reports shall be included as a supplement to the Plans and Specifications listed in the Virginia Conservation Practice Standard *Sinkhole and Sinkhole Area Treatment (Code 370-I)*:

a. Type of filter selected

b. Type and volume of filter material needed

c. Design of surface water control, if needed

d. Special safety requirements

INVERTED FILTER #1

1. Remove and properly dispose of debris and other materials dumped in and around the sinkhole.

2. Excavate loose material from the sinkhole and try to expose the solution void(s) in the bottom. Enlarge the sinkhole, as necessary, to allow for installation of the filter materials (Figure 1).

3. Stone used for the filters shall meet the following criteria. Individual rock fragments shall be dense, sound, and free from cracks, seams, and other defects conducive to accelerated weathering. Except as otherwise specified, the rock fragments shall be angular to subrounded. The least dimension of an individual rock fragment shall be not less than one-third the greatest dimension of the fragment.

Additional criteria can be found in NEH, Part 642, Material Specification 523 – Rock for Riprap.

DESIGN AND CHECK DATA REQUIREMENTS

Basic Data

1. Drainage area of sinkhole

2. Availability of safe outlet for surface water, if applicable

3. Estimated depth and volume of sinkhole

4. Plan view showing sinkhole and, if applicable, any associated surface water control measure(s) or filter strip.

5. Drawing of inverted filter or plug showing thickness of each type of material used.

Check Data

1. Seeding performed

2. Operation and maintenance requirements

3. As-built drawings and material quantities.

OPERATION AND MAINTENANCE

The owner/operator shall be responsible for maintaining the treated sinkhole and sinkhole area according to the plan and design provided.

Inspection of the treatment should be made after periods of heavy runoff, since some material may run further into sinkhole voids causing a surface depression. For sites treated using an Inverted Filter, maintenance will include adding rock material at the surface.

REFERENCES

1. *Estimating Runoff and Peak Discharges*, USDA-NRCS, Engineering Field Manual, Chapter 2, August 1987.

2. *Urban Hydrology for Small Watersheds,* USDA-NRCS, Technical Release 55, June 1986.

3. *Graded Riprap Stone, Quarried Stone for Erosion and Sediment Control*, National Crushed Stone Association, June 1978.

4. Specifications, Section 703 –*Aggregates,* Publication 408, Department of Transportation, Commonwealth of Pennsylvania, 1987.

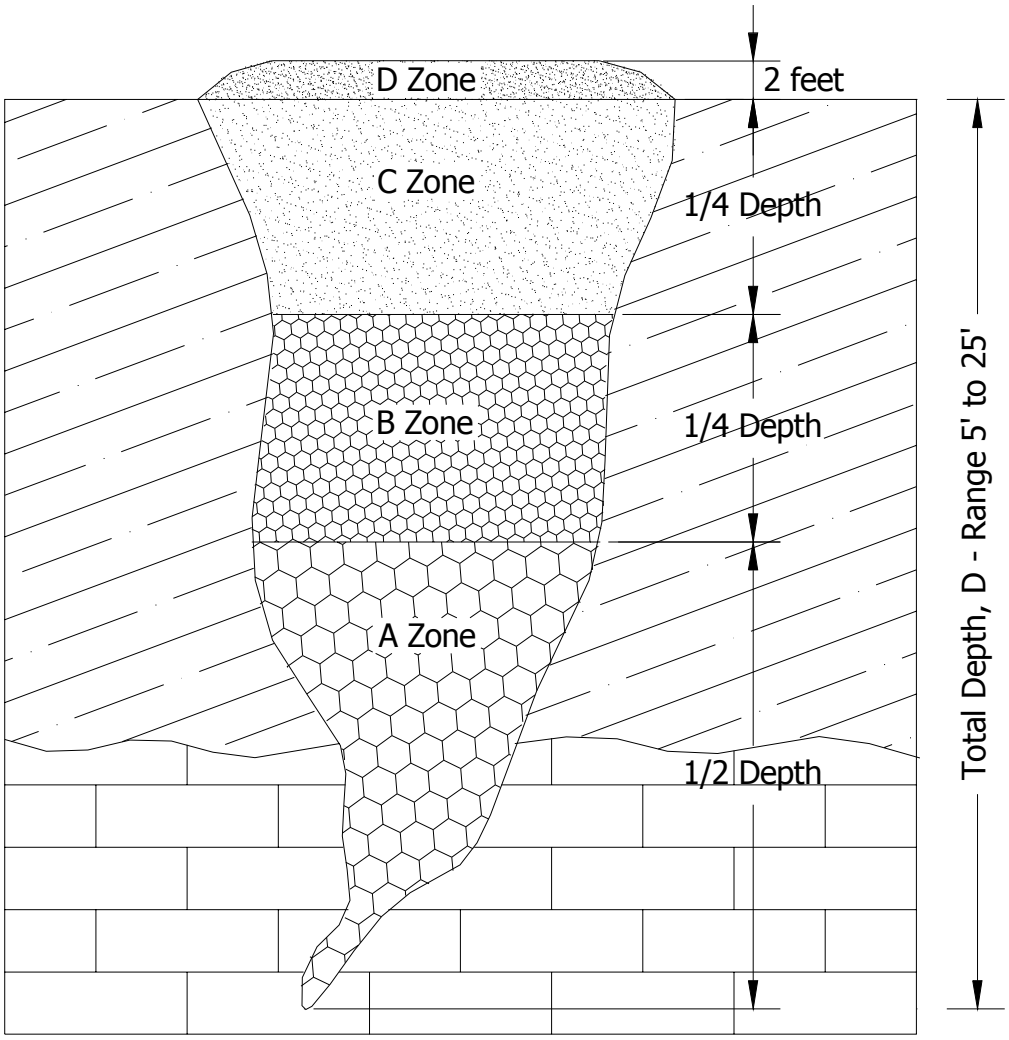
5. Koerner, R. M., *Designing with Geosynthetics,* Prentice-Hall, Englewood Cliffs, NJ, 1985.

6. *Engineering Geology*, USDA-NRCS, National Engineering Handbook, Part 531, Section 8, Chapter 1, 1978.

7. NRCS, Virginia Field Office Technical Guide, Section IV.

8. NRCS, National Engineering Handbook (NEH), Part 523, Construction Specifications.

Figure 1. Typical Inverted Filter for farm safety and site stabilization



Zone A is ½ of the depth of the sinkhole. The stone D_{50} = 1 foot or ¾ of the opening size, whichever is larger.

Zone B is ¼ of the depth of the sinkhole. The stone D_{50} = ½ D_{50} of A zone stone. Minimum D_{50} shall be 6 inches.

Zone C is ¼ of the depth of the sinkhole. The stone D_{50} = ½ D_{50} of B zone stone. Minimum D_{50} shall be 3 inches.

Zone D is 2 feet high. The D_{50} of the stone used for this zone is 6 inches.