

**NATURAL RESOURCES CONSERVATION SERVICE  
CONSERVATION PRACTICE STANDARD**

**SINKHOLE AND SINKHOLE AREA TREATMENT**

(No.)

**CODE 527**

**DEFINITION**

The treatment of sinkholes and/or sinkhole areas to reduce contamination of groundwater resources, and/or improve farm safety.

**PURPOSE**

This practice may be applied as part of a conservation management system to support one or more of the following purposes:

- Improve water quality.
- Improve farm safety.

**CONDITIONS WHERE PRACTICE APPLIES**

On any land surface or existing practice where the soils and geologic conditions have led to the development of sinkholes.

**CRITERIA**

**General Criteria Applicable to all Purposes**

The installation and operation of sinkhole treatment(s) will comply with all federal, state, and local laws, rules, and regulations.

A geologic investigation of the potential impact of the treatment on ground water, surface water, and the karst features will be conducted by a qualified person.

Trash and other material will be removed from the sinkhole and disposed of in an environmentally sound manner.

Excess surface water caused by construction activities will be diverted from the sinkhole area.

Nutrient and pest management plans will be developed for the drainage area of the sinkhole controlled by the landowner.

**Vegetative Treatment.** All sinkholes treated will have a vegetated buffer a minimum of 25 feet

wide measured from the rim of the sinkhole. The buffer area may be extended to control concentrated flow channels entering the sinkhole. The width of the vegetated buffer will be established and maintained in accordance with the type of buffer chosen. The sinkhole and surrounding buffer will be fenced.

Livestock will be excluded from the vegetative buffer except where applicable for maintenance purposes.

Nutrients, herbicides, pesticides, and animal waste will not be applied within an established buffer. Only mechanical treatments shall be used for weed control.

Appropriate erosion and sediment control measures will be used to reduce the amount of sediment entering sinkhole openings during the establishment of the vegetative buffer.

**Surface Water Control.** Changes to the volume of surface water that enters a sinkhole may disturb the underground hydrology. To the extent possible, the surface water flow should be maintained at historic (or predevelopment) volumes.

Pre-existing concentrated flow channels will be stabilized but should not otherwise be altered. If a plug or inverted filter is used, the area to be protected will be characterized by a qualified person. Concentrated flow caused by the construction activities will be dispersed with a suitable spreading structure.

**Sinkhole Treatment/Closing.** Adequate protection of most sinkhole and sinkhole areas can be achieved by the use of vegetative buffers and livestock exclusion. However, if an open sinkhole is a safety hazard, it may be treated with a rock filter, gabions, or other methods approved by the State Conservation Engineer.

NRCS-Minnesota  
June 2008

Conservation practice standards are reviewed periodically and updated if needed. To obtain the current version of this standard, contact the MN Natural Resources Conservation Service in your area, or download it from the electronic Field Office Technical Guide for Minnesota

Sinkholes that open into caves shall not be filled under any circumstances. Gated openings may be used for safety reasons.

Backfill Preparation. Overburden shall be removed as needed to provide a stable foundation for the backfill. Ideally, enough overburden should be removed to expose sound bedrock around the void(s).

Initial Backfill. Initial backfill material shall be placed directly on material that does not have the ability to migrate into the identified bedrock void. Non-woven Class I Geotextile may be used as a filter layer where applicable. Initial backfill shall be of such material that it also will not have the ability to migrate into the void. Concrete can also be used by itself or in conjunction with rocks to bridge the void. Initial backfill shall be free draining into the void and not intended to seal the void. Internal conduits through bedrock shall not be blocked or sealed.

Backfill when preventing inflow of surface runoff. Backfill above the initial backfill shall be in layers of suitably graded material so as not to migrate into the previous layer. Compaction of backfill shall be by tamping rollers or loaded rubber tired earthmoving equipment. When the sinkhole is backfilled to field elevations, a 1 to 2 feet or more crown of the backfill shall be provided to allow for settlement and provide surface water drainage. It may be necessary to construct conservation practices to control this surface water to an adequate outlet.

Sealing. For those sites requiring a sealing layer the sealing layer of backfill shall extend a minimum of 3 feet on all sides of the sinkhole opening. Consideration should be given to sealing a wider area when soil will be saturated above the sinkhole. The sealing layer shall be a minimum of 2 ft. thick. The backfill immediately beneath the sealing layer shall be graded to prevent the migration of the sealing layer material into underlying material. The sealing layer should comprise of compacted plastic soils with PI's greater than 5.

When plastic soils are not available, geomembranes may be used. The installation of geomembranes shall follow the manufactures recommendations. A minimum of 4 feet of backfill shall be placed over the top

geomembrane. All sealing layers shall be crowned 2 feet in the center and graded outward in all directions.

## CONSIDERATIONS

The practice should work in conjunction with conservation cropping systems, pest and nutrient management, and practices that control sheet, rill and gully erosion.

Current and planned land use should be considered. In particular, structures, septic fields, wells, feedlots, ponds, and animal waste storage systems should not be located over a sinkhole site or within the impact area.

For a sinkhole receiving contaminated overland flow, every effort should be made to first treat the source of the contamination. Although it is important to maintain the hydrology of the karst system, it may be more beneficial to the ground water quality to divert the contaminated water away from the sinkhole. In some cases, it may be necessary to completely plug a sinkhole with sealing materials rather than treat it with a filter. Acceptable sealing materials are provided in ASTM D 5299, part 6.4. An example of this would be a sinkhole in a feedlot or a site that is difficult to protect by any other method.

The sinkhole treatment should not result in excessive surface water ponding or high soil moisture conditions over an extended period.

Treatment of one sinkhole may have an effect on other sinkholes or solution features in the vicinity.

The use of a Conservation Easement for the buffer and sinkhole should be considered.

## PLANS AND SPECIFICATIONS

Plans and specifications for Sinkhole and Sinkhole Area Treatment will be in keeping with this standard and will describe the requirements for applying the practice to achieve its intended purpose.

- Plan view showing sinkhole and sinkhole area. Include topographic information and photographs.
- The geologic investigation will include a study of potential impacts on the Karst resource.

- Planned treatment measures.
- Delineate the drainage area of sinkhole on a topographic map.
- Availability of safe outlet for surface water, if applicable.
- Operation and Maintenance requirements.
- Special safety requirements.
- Environmental Assessment.

#### **OPERATION AND MAINTENANCE**

An operation and maintenance (O&M) plan will provide specific instructions for maintaining the sinkhole and sinkhole area treatment, including reference to periodic inspections and the prompt repair and/or replacement of damaged components.

#### **REFERENCES**

- Koerner, R. M., *Designing with Geosynthetics*, Prentice-Hall, Englewood Cliffs, NJ, 1985.
- National Crushed Stone Association. *Graded Riprap Stone, Quarried Stone for Erosion and Sediment Control*, June 1978.
- USDA-NRCS. *Estimating Runoff and Peak Discharges*, *Engineering Field Handbook*, Chapter 2, August 1987.
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- USDA-NRCS, *Field Office Technical Guide*, Section IV.
- USDA-NRCS. *Urban Hydrology for Small Watersheds*, Technical Release 55, June 1986.
- White, W.B. *Geomorphology and Hydrology of Karst Terrains*, Oxford University Press, Inc., New York, New York, 1988