

NATURAL RESOURCES CONSERVATION SERVICE
VIRGINIA CONSERVATION PRACTICE STANDARD

UNDERGROUND OUTLET

(Ft.)

CODE 620

DEFINITION

A conduit or system of conduits installed beneath the surface of the ground to convey surface water to a suitable outlet.

PURPOSE

To carry water to a suitable outlet from terraces, water and sediment control basins, diversions, waterways, surface drains, other similar practices or flow concentrations without causing damage by erosion or flooding.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies where:

- Disposal of surface water is necessary.
- An outlet is needed for a terrace, diversion, water and sediment control basin or similar practice and a surface outlet is impractical because of stability problems, topography, climatic conditions, land use or equipment traffic.

CRITERIA

General Criteria Applicable to All Purposes

Design and construction activities must comply with all federal, state and local laws, rules and regulations.

Fire resistant materials will be used for underground outlet components if fire is an expected hazard. All plastics must be UV resistant or protected from exposure to sunlight.

Components of underground outlets, including inlet collection boxes and conduit junction boxes, will be designed with sufficient size to permit maintenance and cleaning operations.

Perforated components of underground outlets will be designed to prevent soil particle

movement into the underground outlet. Refer to Virginia NRCS Conservation Practice Standard (CPS) *Subsurface Drain (Code 606)*, for criteria for design of filters.

Capacity. The design capacity of the underground outlet will be based on the requirements of the structure or practice it serves. The underground outlet can be designed to function as the only outlet for a structure or in conjunction with other types of outlets. The capacity of the underground outlet will be adequate for the intended purpose without causing inundation damage to crops, vegetation, or works of improvement.

The underground outlet will be designed to account for anticipated water surface conditions at the outlet during design flow.

Flood-routing techniques may be used to determine the relationship between flooding duration, underground release rate, and basin storage volume.

Underground outlets may be designed for either pressure or gravity flow. If designed as a pressure system, all pipes and joints must be adequate to withstand the design pressure, including surge pressure and vacuum conditions. To fully utilize conduit capacity, design the inlet to provide maximum flow in the conduit.

For gravity flow systems, utilize a flow restricting device such as an orifice or weir to limit flow into the conduit or choose conduit sizes that are large enough to prevent pressure flow

An underground outlet will not be designed to discharge into a structure unless the structure is designed to accommodate the additional inflow.

Pressure-relief wells may be used to allow excess flow to escape the conduit and flow over

the ground surface. Use pressure relief wells only where there is a stable outlet for the flow from the relief well. Pressure relief wells should be covered with a grate or other appropriate covering to prevent the entry of small animals and debris.

Inlet. An inlet can be a collection box, blind inlet (gravel), perforated riser, perforated conduit, or other appropriate device.

Open inlets must have a trash guard. Design the inlet to permit trash or debris entering the inlet to pass through the flow restricting device and conduit without plugging.

Perforated riser inlets will be durable, structurally sound, and resistant to damage by rodents or other animals. Perforations must be smooth, free of burrs, and have adequate capacity to prevent the riser from restricting flow in the underground outlet.

Blind inlets may be used where the installation of an open or above ground structure is impractical. Design the blind inlet with a graded granular filter around the conduit. Design the filter based on the particle size of the surrounding soil and the desired flow rate. Refer to NEH Part 65-, Engineering Field Handbook, Chapter 14, for the design of blind inlets.

Conduit. The minimum allowable diameter of conduits is 4 inches. Conduit joints will be hydraulically smooth and consistent with the manufacturer's recommendation for the conduit material and installation.

Design the underground outlet to ensure that maximum allowable loads on the conduit are not exceeded for the type and size of conduit. Depth of cover requirements will be assessed to prevent damage to the underground outlet from tillage operations and frost action.

Provide thrust blocking or anchoring where needed to prevent undesired movement of the conduit. Placement and bedding requirements for the conduit are required to ensure integrity of the installation.

The flow velocity in the conduit must not exceed the maximum allowable design velocity for the conduit materials and installation condition. Gravity flow systems must maintain a positive grade throughout the conduit length towards the outlet.

Refer to Virginia NRCS CPS *Subsurface Drain (Code 606)* for criteria for design loading, thrust blocking, placement and bedding requirements, and minimum and maximum design velocity in the conduit. To prevent sediment from collecting in the conduit, underground outlets should be designed with a minimum velocity of 1.4 ft/sec.

If junction boxes and other structures are needed, design them to allow for cleaning and other maintenance activities. Maintain a downward grade towards the outlet in all sections of the underground outlet.

Materials. Plastic, concrete, aluminum, and steel pipe will meet the requirements specified in the applicable ASTM standard. All materials specified in Virginia NRCS CPS *Subsurface Drain (Code 606)* may be used for underground outlets. Materials must meet applicable site specific design requirements for leakage, external loading, and internal pressure including vacuum conditions.

Underground outlets will be conduits of continuous tubing, tile or pipe and may be perforated or non-perforated. Design perforated outlets to prevent soil particle movement into the conduit.

Use a geotextile wrap (sock) or appropriately designed granular filter if migration of soil particles into the conduit is anticipated. Design the filter based on particle size of the surrounding soil to prevent rapid clogging of the filter. Refer to Virginia NRCS CPS *Subsurface Drain (Code 606)* for criteria for the design of filter media.

Outlet. The outlet must be stable and protected against erosion and undermining for the anticipated design flow conditions.

The outlet must consist of a continuous section of pipe, 10 feet or longer, without open joints or perforations, and with stiffness necessary to withstand expected loads, including those caused by ice. Do not design outlets to be placed in areas of active erosion.

A shorter section of closed conduit may be used if a headwall is used at the outlet of the conduit.

All outlets will have animal guards to prevent the entry of rodents or other animals. Design animal guards to allow passage of debris while

blocking the entry of animals large enough to restrict the flow in the conduit.

A vertical outlet may be used to discharge water to the ground surface where topography does not allow adequate conduit cover using a horizontal outlet, or where it is practical to discharge over a vegetated filter strip.

The vertical outlet (relief well) will be adequately perforated and placed in an envelope of coarsely graded aggregate to allow the system to drain during periods when not in use.

Protection. Place markers, visible from farm equipment, at all inlets and appurtenant structures to protect them from damage by farming operations.

Stabilization. Reshape and re-grade all disturbed areas so that they blend with the surrounding land features and conditions. For areas that will not be farmed, refer to the criteria in Virginia NRCS CPS *Critical Area Planting (Code 342)* for establishment of vegetation criteria. Permanent vegetation will be established on all disturbed areas as soon as possible after construction.

Seedbed preparation, seeding, fertilizing and mulching will be appropriate for the site-specific conditions. Refer to the *NRCS Plant Establishment Guide for Virginia* for allowable species, seeding mixtures, and recommended seeding dates.

CONSIDERATIONS

Pressure relief wells and vertical outlets, if not properly covered, can present a safety hazard for people or animals and may be damaged by field equipment. Pressure relief wells and vertical outlet locations should be identified with a high visibility marker.

The rapid removal of water through an underground outlet will affect the water budget where it is installed. It can reduce infiltration. It can increase or decrease peak flows to receiving waters and reduce long term flows into the same waters.

Consideration should be given to the effects that the underground outlet may have on water quantity downstream. Consider these long term environmental, social, and economic effects when making design decisions for the underground outlet and the structure or practice

it serves. Refer to Virginia NRCS CPS *Drainage Water Management (Code 554)*, for criteria on flow restriction from natural basins.

If perforated pipe is used for the subsurface conduit, locate the practice so that it has a minimal effect to the hydrology of wetlands.

Where wetlands may be affected, the cooperators will be advised and current NRCS wetland policy will apply.

Where perforated risers are used, often the risers are perforated below the surface of the ground to facilitate drainage. In this situation, if soil entry into the riser perforations is a problem, use an appropriately designed gravel or geotextile filter around the buried portion of the riser.

Seasonal water sources can be beneficial for migratory waterfowl and other wildlife. Consider the use of a water control structure on the inlet of an underground outlet during non-cropping periods to provide water for wildlife. Refer to Virginia NRCS CPS *Shallow Water Development and Management (Code 646)*, for information on managing seasonal water sources for wildlife.

Underground outlets can provide a direct conduit to receiving waters for contaminated runoff from crop land. Underground outlets and the accompanying structure or practice should be installed as part of a conservation system that addresses issues such as nutrient and pest management, residue management and filter areas.

The construction of an underground outlet in a riparian corridor can have an adverse effect on the visual resources of the corridor. Consider the visual quality of the riparian area when designing the underground outlet.

Consider potential effects of soil physical and soil chemical properties influence on area where a conduit or system of conduits are installed to convey surface water. Refer to soil survey data as a preliminary planning tool for assessment of areas. Consult the Web Soil Survey to obtain soil properties and qualities information.

If an installation in a crop field is too shallow, tillage equipment can damage an underground outlet. Consider the type and depth of tillage that will likely occur when designing the depth of

an underground outlet. A minimum of 2 feet of cover is recommended over all conduits.

PLANS AND SPECIFICATIONS

Prepare plans and specifications for underground outlets that describe the requirements for applying this practice according to this standard. The plans and specifications for an underground outlet may be incorporated into the plans and specifications for the structure or practice it serves.

Record all required information in an engineer field book, on a plan sheet or design computation sheet, or in another appropriate location.

DESIGN DATA

1. Completed Environmental Evaluation and subsequent requirements.
2. Soils investigation.
3. Survey and plot data: profile, cross-sections, topography, as needed.
4. Design computations, including purpose of practice and references used.
 - a. Drainage area.
 - b. Design capacity.
 - c. Design velocity.
5. Plan view of site with existing and planned features, including dimensions, distances, etc.
6. Standard Cover Sheet (VA-SO-100A).
7. Bedding requirements.
8. Details of the inlet and outlet.
9. Materials and quantities needed. Identify borrow material and/or spoil area, as needed.
10. Vegetation and/or ground cover requirements.
11. Identification of needed Erosion & Sediment Control measures.
12. Supplemental practices required.
13. Virginia Conservation Practice Specifications (700 Series).
14. Operation and Maintenance Plan.

CHECK DATA

1. As-built survey.
2. As-built plans including dimensions, types and quantities of materials installed, and variations from design. Include justification for variations.
3. Locations of appurtenant practices.
4. Adequacy of vegetation and/or ground cover.
5. Complete as-built section of Cover Sheet.

OPERATION AND MAINTENANCE

Prepare an operation and maintenance plan for the operator. The minimum requirements to be addressed in a written operation and maintenance plan are:

- Periodic inspections and clean-out, especially immediately following significant runoff events, of inlets, trash guards, collection boxes and structures to keep them free of materials that can reduce flow.
- Prompt repair or replacement of damaged components.
- Repair or replacement of inlets damaged by farm equipment.
- Repair of leaks and broken or crushed lines to ensure proper functioning of the conduit.
- Periodic Inspection of the outlet and animal guards to ensure proper functioning.
- Repair of eroded areas at the pipe outlet.
- Maintenance of adequate backfill over the conduit.
- To maintain the permeability of surface materials on blind inlets, periodic scouring or removal and replacement of the surface soil layer may be necessary.

REFERENCES

USDA, NRCS. National Engineering Handbook, Part 650 Engineering Field Handbook, Chapters 6, 8 & 14.

Web Soil Survey:

<http://websoilsurvey.nrcs.usda.gov/app/>

USDA-Natural Resources Conservation Service.
Electronic Field Office Technical Guide
(eFOTG), Section IV [Online]. Available at
<http://efotg.sc.egov.usda.gov/>

USDA-Natural Resources Conservation Service.
Virginia 700 Series Construction Specifications.
[On-line]. Available at
<http://efotg.sc.egov.usda.gov/>

USDA is an equal opportunity provider and employer.