Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

UNDERGROUND OUTLET

CODE 620

(ft)

DEFINITION

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

PURPOSE

This practice is used to accomplish one or more of the following purposes:

- Prevent concentrated flow erosion
- Manage flooding and ponding

CONDITIONS WHERE PRACTICE APPLIES

This practice applies where—

- Disposal of surface water is needed.
- An outlet is needed for a terrace, diversion, water and sediment control basin, or similar practices.
- Disposal of stormwater collected by roof runoff structures or similar practices is needed.
- A surface outlet is impractical because of stability problems, topography, climatic conditions, land use, or equipment traffic.

CRITERIA

General Criteria Applicable to All Purposes

Plan, design, and construct the underground outlet to meet all Federal, State, Tribal, and local regulations.

Capacity

Base the design capacity of the underground outlet on the requirements of the structure or practice it serves. Design the underground outlet to function as the only outlet for a structure or in conjunction with other types of outlets. Ensure that the capacity of the underground outlet is adequate for the intended purpose without causing unplanned inundation damage to crops, vegetation, or works of improvement.

Design the underground outlet 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. Base the design of the underground outlet on the anticipated water surface conditions at the outlet during design flow.

Design underground outlets for either pressure or gravity flow. Gravity flow systems must maintain a positive grade throughout the conduit length towards the outlet. If designed as a pressure system, all

pipes and joints must be adequate to withstand the design pressure, including surge pressure and vacuum conditions.

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. Design the orifice to be compatible with the inlet. Size the orifice based on the inundation time and potential crop residue.

If necessary, use pressure relief wells 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. Cover pressure relief wells with a grate or other appropriate covering to prevent injury to animals and entry of debris.

Inlet
An inlet can be a collection box, blind inlet (gravel), perforated riser, perforated conduit, or other appropriate device. Design components of underground outlets, including inlet collection boxes and conduit junction boxes, with sufficient size to facilitate maintenance and cleaning operations.

Open inlets must have a trash guard. Design the inlet so any trash or debris entering the inlet will pass through the flow-restricting device and conduit without plugging.

Perforated riser inlets must 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 aboveground structure is impractical. Design the blind inlet to prevent soil particle movement into the conduit.

Conduit
The minimum allowable diameter of conduits is 4 inches. Conduit joints must 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. Assess the depth of cover requirements to prevent damage to the underground outlet from traffic, tillage operations, and frost action. Design perforated components of underground outlets to prevent soil particle movement into the underground outlet. Refer to NRCS Conservation Practice Standard (CPS) Subsurface Drain (Code 606) for criteria for filters, design loading, placement, and bedding requirements.

Provide thrust blocking or anchoring where needed to prevent undesired movement of the conduit. Evaluate placement, bedding, and backfill requirements for the conduit to ensure integrity of the installation. In the absence of manufacturer's data, design thrust blocks in accordance with NRCS National Engineering Handbook (Title 210), Part 636, Chapter 52, "Structural Design of Flexible Conduits."

Minimum velocity and grade
In areas where sedimentation of fine sands and silts is not a hazard, design the minimum grade based on site conditions and a velocity of not less than 0.8 feet per second. If a sedimentation potential exists, either use a velocity of not less than 1.4 feet per second to establish the minimum grade or include provisions for preventing sedimentation. Use filters, collect and periodically remove sediment from installed traps, or periodically clean the lines with high-pressure jetting systems or cleaning solutions to address sedimentation. Prior to using high-pressure jetting systems, verify that the jetting system will not damage the pipe or the pipe embedment.

Maximum velocity
Limit the design velocities in perforated, high-density polyethylene (HDPE) pipe under open channel flow to 12 feet per second or the manufacturer's recommended limit. Limit design velocities for nonperforated pipe to manufacturer's recommended limits applicable to the pipe diameter, material and joint type, and site condition.

Materials
All materials specified in 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 outlet conduits may be continuous tubing, tile, or pipe sections and may be perforated or nonperforated. Ensure any couplers joining pipe sections are compatible with the pipe and withstand all required loads.

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

Outlet
The outlet must be stable and protected against erosion and undermining for the range of design flow conditions. Do not discharge an underground outlet into a structure unless the structure is designed to accommodate the additional inflow.

Underground outlet shall not outlet directly into rivers, streams, lakes, or other water bodies. The outlet shall be at least 25 feet from water bodies and vegetation shall be established between the outlet and water body. An NPDES permit may be required.

The outlet must consist of a continuous ***rigid*** 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. Table 1 shows minimum lengths for the outlet section of the conduit.

Table 1. Minimum Length of Outlet Pipe Sections

Pipe Diameter (inches)	Minimum Section Length (feet)
8 and smaller	10
10 to 12	12
15 to 18	16
Larger than 18	20

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

All outlets must 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.

Use a vertical outlet 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. Design the vertical outlet to allow the system to drain during periods when not in use.

Pressure relief wells and vertical outlets, if not properly identified, 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.

Stabilization
Reshape and regrade all disturbed areas so they blend with the surrounding land features and conditions. For areas that will not be farmed, refer to NRCS CPS Critical Area Planting (Code 342) for establishment of vegetation criteria. Establish permanent vegetation on all noncrop disturbed areas as soon as possible after construction.

CONSIDERATIONS

Consideration should be given to the effects 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.

Where wetlands may be affected, advise the cooperator that current USDA wetland policy will apply.

Seasonal water sources can be beneficial for migratory waterfowl and other wildlife. Consider the use of a water control structure at the inlet of an underground outlet to provide water for wildlife during noncropping periods. Refer to 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. Install underground outlets and the accompanying structures or practices 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 chemical properties on areas 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.

When revegetation is needed, consider revegetating using species or diverse mixes that are native or adapted to the site and have multiple benefits. In addition, where appropriate, consider a diverse mixture of forbs and wildflowers to support pollinator and other wildlife habitat.

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. As a minimum include—

- A plan view of the layout of the underground outlet.
- Typical cross sections and bedding requirements for the underground outlet.
- Profile of the underground outlet.
- Details of the inlet, pipe, and outlet.
- Seeding requirements if needed.

Prepare construction specifications describing site-specific installation requirements of the underground outlet.

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, especially immediately following significant runoff events, to keep inlets, trash guards, and collection boxes and structures clean and 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.
- Maintenance of the permeability of surface materials of blind inlets by periodic scouring or removal and replacement of the surface soil layer.

REFERENCES

USDA NRCS. 1984. National Engineering Handbook (Title 210), Part 650, Chapter 6, Structures. Washington, D.C. https://directives.sc.egov.usda.gov/.

USDA NRCS. 2011. National Engineering Handbook (Title 210), Part 650, Chapter 8, Terraces. Washington, D.C. https://directives.sc.egov.usda.gov/.

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USDA NRCS. 2008. National Engineering Handbook (Title 210), Part 636, Chapter 52, Structural Design of Flexible Conduits. Washington, D.C. https://directives.sc.egov.usda.gov/.

USDA NRCS. 2019. Web Soil Survey. Accessed June 14, 2019. https://websoilsurvey.sc.egov.usda.gov/.