NATURAL RESOURCES CONSERVATION SERVICE

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

Fire resistant materials shall 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, shall be designed with sufficient size to permit maintenance and cleaning operations.

Perforated components of underground outlets shall be designed to prevent soil particle movement into the underground outlet. Refer to Conservation Practice Standard 606, Subsurface Drain, 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 shall be adequate for the intended purpose without causing inundation damage to crops, vegetation, or works of improvement.

The underground outlet shall 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.

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 shall 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.

Conservation practice standards are reviewed periodically and updated if needed. To obtain the current version of this standard, contact your Natural Resources Conservation Service State Office or visit the Field Office Technical Guide.

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 shall 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 to prevent soil particle movement into the conduit.

Conduit. The minimum allowable diameter of conduits is 4 inches. Conduit joints shall 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 shall be assessed to prevent damage to the underground outlet from tillage operations and frost action.

Thrust blocking or anchoring shall be provided 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 Conservation Practice 606, Subsurface Drain, for criteria for design loading, thrust blocking, placement and bedding requirements, and minimum and maximum design velocity in the conduit.

Materials. All materials specified in Conservation Practice Standard 606, Subsurface Drain, 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 shall be conduits of continuous tubing, tile or pipe and may be perforated or non-perforated. Perforated outlets shall be designed to prevent soil particle movement into the conduit.

Outlet. The outlet must be stable and protected against erosion and undermining for the range of 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.

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

All outlets shall 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) shall be adequately perforated and placed in an envelope of coarsely graded aggregate to allow the system to drain during periods when not in use.

Stabilization. Reshape and regrade all disturbed areas so that they blend with the surrounding land features and conditions. For areas that will not be farmed, refer to Conservation Practice Standard 342, Critical Area Planting, for establishment of vegetation criteria. Permanent vegetation shall be established on all disturbed areas as soon as possible after construction.

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.

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 Conservation Practice Standard 554, Drainage Water Management, for criteria on flow restriction from natural basins.

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

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 Conservation Practice Standard 646, Shallow Water Development and Management, 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.

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 the plans and specifications shall 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 and outlet.
- Seeding requirements if needed.
- Construction specifications that describe in writing the 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 insure 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/

NATURAL RESOURCES CONSERVATION SERVICE

Construction Specification

UNDERGROUND OUTLET

1. SCOPE

Work shall consist of installing the conduits, inlet and outlet features, and associated appurtenances to the lines and grades shown on the drawings or as staked in the field. The location of the underground outlet shall be as shown on furnished drawings or as staked in the field.

2. SITE PREPARATION

All trash, debris, brush and vegetation shall be removed from the conduit trench area that will be located under a terrace, diversion or other embankment area. In non-embankment areas, the conduit trench pathway shall be cleared and any root or other obstructions removed that would interfere with proper installation of conduit. All brush, logs, stumps or other debris must be removed from the conduit installation area and disposed of by burning, burying, or removal from the work site.

3. MATERIAL

Conduit material (metal pipe, plastic pipe or other) shall be new and of good quality to meet the intended use and life of the practice. Material shall meet the requirements of Subsurface Drains (606) or other applicable standards.

4. TRENCHING

Trenches shall be excavated deep enough to provide a minimum 2 feet of cover over top of conduit after backfilling is complete. Trench bottom should be shaped to conform to the exterior of the conduit surface. Bedding the conduit with a thin layer of moist, loose soil will improve its support and strength. Trenches may be:

a. Vee shaped. This is recommended for conduits installed under an embankment. Side slopes of 2 horizontal to 1 vertical will allow adequate compaction and uniform fill settlement.

b. Vertical sides (backhoe or trenches). This is not recommended for conduits installed under an embankment. Some additional backfill may be needed after initial trench settling has taken place.

Underground conduit installation shall be considered satisfactory when the trench and conduit are within ± 0.3 foot of design grade have a positive slope toward the outlet, and the conduit has 2 feet or more of earth cover.

5. BACKFILL

Backfill in the conduit trench under the embankment shall have adequate compaction to prevent water movement along the pipe and to minimize settlement. Mechanical compacting, water packing, using a vee-shaped trench, and using very moist soil are methods of achieving adequate compaction. Embankments constructed over the conduit shall also be compacted by passage of earthmoving equipment over fill as it is being placed. The ends of the conduit and all appurtenances shall be protected during installation.

Backfill around the conduit shall be loose, granular soil material to provide a good contact with the conduit. The material shall not contain stones or lumps of dry soil that could strike or damage the conduit during backfilling and compaction operations.

Conservation practice standards are reviewed periodically, and updated if needed. To obtain the current version of this standard, contact the Natural Resource Conservation Service.

6. MEASUREMENT

Measurement of the underground conduit shall be the field laying length from the inlet end to the outlet end. No separate accounting of or payment for appurtenances (band, tee, ell, reducer, etc.) shall be made. The length of each riser and underground conduit pipe size used shall be identified for payment quantities.