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 diversions, waterways, subsurface drains or other similar practices without causing damage by erosion or flooding.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies where:

- Disposal of excess surface water is necessary to reduce ponding or flooding.
- A buried outlet is needed for Diversions (362), Subsurface Drain (606), or similar practice.
- A surface outlet is considered impractical due to site specific conditions.

CRITERIA

Capacity. The design capacity of the underground outlet is based on structure requirements or the practice it serves. The underground outlet can be designed to function as the principal outlet for the structure or can be designed to function with other types of outlets. The capacity of the underground outlet for natural or constructed basins shall provide adequate drainage for the intended purpose without causing soil sedimentation, or crop damage.

Underground outlets may be designed for either pressure or gravity flow. If a pressure system is designed, all pipe and joints must adequately withstand design pressure, surges, and vacuum. Thrust blocks shall be designed and installed as needed. To fully utilize conduit capacity, design the inlet to provide maximum flow in the conduit. To prevent pressure flow or conduit overloading, a flow restricting device such as an orifice or weir can be used.

Pressure-relief wells may be used to allow excess flow to escape the conduit and flow over the surface. Only use pressure relief wells 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 the entry of small animals and debris.

If there are multiple structures flowing into an underground outlet, design the system so that upstream structures do not discharge into those downstream, unless the downstream structure is designed to accommodate the additional flow.

Inlet. An inlet can be a collection box, a perforated riser, or other appropriate device. Inlets must have an appropriate trash guard to ensure that trash or other debris entering the inlet passes through the conduit without plugging.

Design collection boxes large enough to allow maintenance and cleaning operations. Use blind inlets 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 desired flow rate and particle size of the surrounding soil. Refer to NEH Part 650, Engineering Field Handbook, Chapter 14 for the design of blind inlets

For perforated risers, use durable, structurally sound material that is fire resistant and resistant to damage by rodents or other

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animals.

Conduit. Underground outlets shall be conduits of tubing, tile or pipe. The minimum allowable conduit diameter is 4 inches. Design hydraulically smooth joints using materials and methods recommended by the manufacturer of the conduit. All conduits shall have a 2 foot minimum cover.

The maximum design velocity must not exceed the safe velocity for the conduit materials and installation according to the conduit manufacturer's recommendation. Refer to Conservation Practice 606, Subsurface Drainage for design criteria for safe velocity.

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

Materials. Plastic, concrete, aluminum, and steel pipe shall meet the requirements specified in the applicable ASTM standard. All materials specified in Conservation Practice Standard (606), Subsurface Drains can be used for underground outlets. Materials must meet applicable site specific design requirements for leakage, external loading, internal pressure or vacuum.

Underground outlet conduits can be perforated or nonperforated, as specified by the design requirements. Use a filter fabric wrap (sock) or appropriately designed granular filter if migration of soil particles into the conduit is anticipated. Design the filter based on the particle size of the surrounding soil to prevent rapid clogging of the filter. Refer to Conservation Practice 606, Subsurface Drainage for criteria for the design of filter media. Protect all exposed plastic materials from degradation with a metal pipe stub or sleeve.

Outlet. The outlet must be stable enough to handle anticipated design flow conditions from the underground outlet. Design the underground outlet for water surface conditions at the outlet expected during the design flow conditions.

The outlet must consist of a continuous 10 foot section or longer of closed conduit or a headwall at the outlet. If a closed conduit is used, the material must be durable and strong enough to withstand anticipated loads, including those caused by ice. Do not design outlets to be placed in areas of active erosion. Use fire resistant materials if fire is an expected hazard. 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 that cannot easily escape from the conduit.

Stabilization. Reshape and regrade all disturbed areas to blend with the surrounding land features and conditions. Revegetate and protect disturbed areas that will not be farmed from erosion, as soon as possible following construction.

CONSIDERATIONS

Mark the location of pressure relief wells with a high visibility marker to prevent accidents or well damage. Pressure relief wells, can present a safety hazard for people or animals stepping into the well, if not properly covered.

The rapid removal of water through an underground outlet will affect the water budget where it is installed. It can reduce infiltration, increase or decrease peak flows to receiving waters and reduce long term flows into the same waters. Consider these long term environmental, social, and economic effects when planning and damaging underground outlet and the structure or practice it serves.

When perforated pipe is used for the subsurface conduit, locate the practice so it has a minimal effect on the wetland hydrology.

To prevent sedimentation in the conduit, underground outlets should be designed with a minimum velocity of 1.4 ft/sec.

Where perforated risers are used, the risers are often perforated below the surface of the ground to facilitate drainage. In this situation, use an appropriately designed gravel or

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geotextile filter around the buried portion of the riser to prevent soil entry into the riser perforations.

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 can disturb large areas and potentially affect cultural resources. Follow state cultural resource protection policies before construction begins.

If an installation in a crop field is too shallow, tillage equipment can damage an underground outlet. Consider the tillage type and depth 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. As a minimum the plans and specifications shall include:

- A plan view of the layout of the underground outlet.
- Typical cross sections or bedding requirements for the underground outlet.
- Profile of the underground outlet with grades.
- Details of the inlet and outlet.
- Seeding requirements and specifications.
- Construction specifications that describe 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, immediately following significant runoff events, and keeping inlets, trash guards, collection boxes and structures free from flow inhibiting materials or debris.
- 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 checking of the outlet and animal guards to ensure proper functioning.
- Repair of eroded areas at the pipe outlet.
- Maintain adequate backfill over conduit.
- Maintain permeability of surface materials on blind inlets by periodic scouring or removal and replacement of the surface soil layer.

REFERENCES

USDA, NRCS. National Engineering Handbook, Part 650

USDA, NRCS. Engineering Field Handbook, Chapters 6, 8, 14.

Rhode Island NRCS Conservation Practice Standards
Critical Area Planting, Code 342
Subsurface Drains (606)

NRCS RI

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to limit flow into the conduit

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PURPOSE

DISPOSE OF EXCESS

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terraces, water and sediment control basins,

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subsurface drains

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concentrations

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CONDITIONS WHERE PRACTICE APPLIES

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needs to be disposed of; (2) a buried outlet is needed for Diversions (362), Terraces (600), or similar practices; (3) an underground outlet can be installed that will safely dispose of excess water; and (4) surface outlets are impractical because of stability problems, climatic conditions, land use, or equipment traffic.

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design

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CRITERIA

Capacity. The underground outlet shall be designed, alone or in combination with other practices, with adequate capacity to insure that the terrace, diversion, or other practices function according to the standard for the specific practice. For example,

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An outlet is needed for a terrace, diversion, water and sediment control basin or similar practice but a

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Pressure-relief wells may be used to allow excess flow to escape the conduit and flow over the surface. Only use pressure relief wells 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 the entry of small animals and debris.

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ic restrictions, climatic conditions, land use or equipment traffic.

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THE SITE IS SUITABLE FOR AN UNDERGROUND OUTLET

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CAN BE USED IN COMBINATION WITH A GRASSED WATERWAY OR A SURFACE DRAIN TO CARRY PART OF THE DESIGN FLOW. AS A MINIMUM, THE DESIGN CAPACITY OF THE UNDERGROUND OUTLET (WITH SURFACE WATER CONVEYANCE SUPPLEMENT, IF APPLICABLE) SHALL BE THE PEAK FLOW FROM A 10 YEAR 24 HOUR TYPE III RAINFALL EVENT. FOR URBAN / SUBURBAN APPLICATIONS, THE MINIMUM CAPACITY SHALL BE A 25 YEAR FREQUENCY.

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to crops, vegetation, or works of improvements.

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Outlet capacities for basins shall be sized using routing procedures.

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

er, or other appropriate device. Its capacity shall be adequate to provide the maximum design flow in the conduit. Flow-control devices shall be installed as necessary. Perforated risers must be of durable material, structurally sound, and resistant to damage by rodents or other animals. If burning of vegetation is likely to create a fire hazard, the inlet shall be fire resistant. Blind inlets can be used where they are effective. Collection boxes must be large enough to facilitate maintenance and cleaning operations. The inlet must have an appropriate trash guard to insure that trash or other debris entering the inlet passes through the conduit without plugging. For pipes less than 10-inch diameter, animal guards shall be considered.

Pressure-relief wells shall be designed and installed as needed to control pressure. If junction boxes and other structures are needed, they shall be designed and installed in a manner that facilitates cleaning and other maintenance activities.

Hydraulics. Underground outlets shall be continuous conduits, or tubing. Joints shall be hydraulically smooth, and the materials and methods used shall be recommended by the manufacturer.

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used,

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. Use fire resistant materials for the inlet if fire is an expected hazard.

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non-perforated

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can be used

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Outlets shall not

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Pipe outlets shall be protected from erosion and headcutting by installing plunge pools, level spreaders, armored outlet channels, or other stabilization means. If fire is a hazard, the outlet shall be fire resistant. Outlets less than 10-inch diameter shall

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Inlets must have an appropriate trash guard to ensure that trash or other debris entering the inlet passes through the conduit without plugging.

Design collection boxes large enough to allow maintenance and cleaning operations. Use blind inlets 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 650, Engineering Field Handbook, Chapter 14 for the design of blind inlets.

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Protection. All

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shall be reshaped and regraded

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Lines shall be adequate to carry the design flow when the outlet and all inlets are operating at design capacity. Positive grade shall be maintained

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Areas that are not to be farmed or covered by structural works shall be established to vegetation

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Capacity shall be based on the pipe size or on other flow control devices to prevent water from the upper inlets from discharging through the lower inlets. The minimum conduit diameter shall be 4 inches.

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CONSIDERATIONS

CONSIDER EFFECTS ON THE WATER BUDGET, ESPECIALLY ON VOLUMES AND RATES OF RUNOFF,

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Materials shall meet or exceed the design requirements against leakage and shall withstand internal pressure or vacuum and external loading.

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Conduits, however,

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if not properly covered,

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In addition, pressure relief wells can be easily damaged by field equipment. To prevent accidents mark the location of pressure relief wells with a high visibility marker.

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, evaporation, transpiration, deep percolation, and ground water recharge

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making design decisions for the

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equivalent well-graded sand or gravel shall be used

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around perforated

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Consider effects on the volume of downstream flow that might cause undesirable environmental, social, or economic effects.

Evaluate potential use for water management.

Consider effects on erosion and the movement of sediment, pathogens, and soluble and sediment-attached substances that would be carried by runoff.

Consider effects on the visual quality of downstream water resources.

Consider the construction-related effects on the quality of downstream watercourses.

Consider effects on wetlands or water-related wildlife habitats.

Evaluate potential impact on water quality due to agri-chemicals in outflow.

Consider depth of underground outlet in regard to tillage equipment depth and maintenance, if applicable.

PLANS AND SPECIFICATIONS

Plans and specifications for installing underground outlets shall be in keeping with this standard and shall describe the requirements for installing the practice to achieve its intended purpose. Plans

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If

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locate the practice so that it has a minimal effect to the hydrology of wetlands.

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place the perforated pipe the required lateral effect distance

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to

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of wetlands.

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from degradation due to exposure to sunlight.

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Loading Conditions. Conduits shall be designed to withstand all anticipated live and dead loads. In urban / suburban applications, HS-20 live loading shall be used. The minimum depth of cover over the top of the conduit shall be 2 feet unless detailed computations permit less for the specific pipe installed

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shall

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sufficiently

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. It shall be designed for the maximum anticipated water surface at design flow. A 10-foot long

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if soil entry into the riser perforations is a problem, u

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Seasonal water sources can be very important for migratory waterfowl and other wildlife. The use of a water control structure, on the inlet of an underground outlet during non-cropping times of the year, can allow water to pond in the structure 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.

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I don't think this belongs in the standard. The Items of Work requirement is a forthcoming RI engineering policy. This requirement may change before the practice standard is revised again.

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

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that can reduce

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Repairing

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Checking outlet conduit

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of the conduit

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Keeping

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NRCS RI

July,2001

Repairing any eroded areas at the pipe outlet

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plan views, profiles, cross-sections, and other documents. To the extent practical, specifications shall conform with national engineering Handbook Sections 642 and 643 (formerly NEH, Section 20).

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if needed.

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NHCP, NRCS

September 2008