NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

UNDERGROUND OUTLET

(Ft.)

CODE 620

DEFINITION

A conduit installed beneath the surface of the ground to collect surface water and convey it to a suitable outlet.

PURPOSE

To dispose of excess water from terraces, diversions, subsurface drains, surface drains, trickle tubes, principal spillways from dams (outside the dam area only), or other concentrations without causing damage by erosion or flooding.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies where:

- Excess surface water needs to be disposed of
- A buried outlet is needed for Conservation Practice Standards 362, Diversion; 600, Terrace; 350, Sediment Basin; 638, Water and Sediment Control Basin; or similar practices
- An underground outlet can be installed that will safely dispose of excess water
- Surface outlets are impractical because of stability problems, climatic conditions, land use, or equipment traffic

CRITERIA

General Criteria Applicable to All Purposes

Laws, rules, and regulations. This practice shall conform to all federal, state, and local laws, rules, and regulations. Laws, rules, and regulations of particular concern include those involving water rights, land use, pollution control, property easements, wetlands, preservation of cultural resources, and endangered species.

Capacity. The underground outlet shall be designed alone or in combination with other practices with adequate capacity to ensure the terrace, diversion, or other practice will function in accordance with the standard for that practice.

The outlet for terraces and diversions will have capacity to discharge the runoff from a 10-year frequency, 24-hour duration rainfall in 60 hours or less. Release rates will be determined by the procedure in the Kansas Supplement to Chapter 8 of National Engineering Handbook (NEH) Part 650, Engineering Field Handbook. The Storage Terrace Program (or equivalent) may be used and is found in the electronic Field Office Technical Guide (eFOTG), Section IV.

Inlet. An inlet may be a perforated riser, canopy inlet, or other appropriate device installed on the main conduit or offset to one side. The inlet shall be of durable material(s), structurally sound, and resistant to damage by rodents or other animals. If burning of vegetation is a hazard, the inlet shall be fire-resistant.

Perforated risers will be a minimum diameter of 4 inches. Minimum capacity shall be 1.2 times the release rate for the terrace or diversion. Intake holes shall be no smaller than 1 inch in diameter. See the Kansas Supplement to Chapter 8 of NEH Part 650, Engineering Field Handbook, or the Storage Terrace Program for capacity of perforated risers.

The discharge into the main conduit shall be controlled by an orifice located in the inlet. The orifice plate may be eliminated where full pipe flow is allowed in the main conduit.

Orifices used to control the discharge shall be round, smooth, and burr-free. Orifice plates will fit tightly against the seat to minimize leakage.

Access to the orifice, offset lateral, or main conduit shall be provided by a removable, durable cap on the top of the riser; a removable riser; or other approved means.

Flexible risers will be supported by a wood, metal, or plastic post capable of supporting the riser in an upright position. Risers made from rigid materials and set in the ground 2 or more feet need not have supporting posts but may require a marker post to indicate the riser location that can be seen from machinery.

Main conduit. The conduit shall have a minimum diameter of 3 inches. The conduit will be continuous, non-perforated pipe except that, when subsurface drainage is needed, a perforated conduit may be used outside the terrace or diversion ridge.

The maximum permissible velocity for perforated conduit shall be 3.5 feet per second for sand and sandy loam; 5 feet per second for silt and silt loam; and 7 feet per second for silty clay loam, clay, and clay loam.

Conduit capacity will be determined using a Manning's equation roughness coefficient "n" value as follows.

Pipe Material	Diameter (inches)	"n" Value
Smooth wall polyethylene (PE); smooth wall polyvinyl chloride (PVC); and corrugated PVC, smooth interior	all	.009
Smooth wall metal and dual wall corrugated PE, smooth interior	all	.012
Concrete	all	.013
Single wall corrugated PE pipe	3-6 8-10 12-15 18-24	.015 .017 .018 .020
Corrugated metal pipe annular helical	all 6-18 21-24	.025 .014 .017

Conduits shall be sized to carry the design flow with the hydraulic grade line parallel to the grade of the conduit and with the conduit flowing full or nearly full (non-pressure flow) except the outlet pipe below the bottom terrace may be designed for pressure flow providing corrugated plastic pipe or a perforated conduit is not used. See Chapter 3 of NEH Part 650, Engineering Field Handbook, or the Storage Terrace Program for discharge in circular pipes.

When the conduit size needs to be increased because of additional inflow volume or reduced grade, the change shall be made at or slightly upstream from the feature causing the increase. Joints shall be made with standard couplers recommended by the manufacturer and be hydraulically smooth. Fittings that reduce conduit area will not be used.

The conduit shall be buried to a depth where the dead load due to the backfill and the live load due to farm equipment will not overstress the pipe. The trench shall be wide enough to provide room for compaction around the conduit and a minimum of 8 inches wider than the pipe diameter. The conduit shall be bedded in a circular groove in the bottom of the trench shaped to fit the lower 120 degrees of circumference.

More than 1 conduit may be placed in a trench. The conduits shall be placed side by side with a minimum of 4 inches clearance between them.

Materials. Materials shall meet or exceed the design requirements against leakage and shall withstand internal pressure or vacuum and external loading. Plastic, concrete, aluminum, and steel shall meet the requirements specified in the applicable American Society for Testing and Materials (ASTM), American Association of State Highway Transportation Officials (AASHTO), or American Water Works Association (AWWA) standard listed in Table 1, "Fill height for pipe types." Conduits can be perforated or nonperforated, depending on the design requirements. A filter fabric wrap (sock) or equivalent shall be used if migration of soil particles around the conduit is anticipated.

Loading. The allowable loads on the conduits shall be based on the trench and bedding conditions specified for the job. Appropriate design procedures shall be used to determine the maximum allowable depth of cover for a particular type of conduit. Table 1 can be used where the stated conditions apply.

Table 1 - Fill height for pipe types

Pipe Type		Use	Fill Height Over Pipe	
Material	Reference Specification	Soil Type	Minimum (feet)	Maximum[1/] (feet)
Single wall corrugated PE pipe				
3" through 6" dia.	ASTM F 405	non-rocky	2	15[2/]
8" through 24" dia.	ASTM F 667	non-rocky	2	13[2/]
Dual wall corrugated PE pipe, smooth interior				
4" through 10" dia.	AASHTO M 252	non-rocky	2	15[2/]
12" through 30" dia.	AASHTO M 294	non-rocky	2	13[2/]
36" through 48" dia.	AASHTO M 294	non-rocky	2	10[2/]
Corrugated PVC pipe, smooth interior Pipe stiffness = 46				
4" through 36" dia.	ASTM F 949	non-rocky	2	22
Smooth wall PVC pipe, gasket or glue joints				
4" through 24" dia., SDR 41	ASTM D 2241	any	2	6
4" through 15" dia., SDR 35	ASTM D 3034	any	2	8
18" through 24" dia., SDR 35	ASTM F 679	any	2	7
4" through 24" dia., SDR 32.5	ASTM D 2241	any	2	9
4" through 18" dia., SDR 26	ASTM D 2241	any	2	13
4" through 15" dia., SDR 21	ASTM D 2241	any	2	18
4" through 12" dia., DR 25	AWWA C 900	any	2	13
4" through 12" dia., DR 18	AWWA C 900	any	2	22
14" through 24" dia., DR 25	AWWA C 905	any	2	13
14" through 24" dia., DR 18	AWWA C 905	any	2	22
Smooth wall iron or steel				
4" through 24" dia., 3/16” min.	----	any	2	12
Corrugated iron or steel				
4" through 48" dia., 16 ga. min.	ASTM A 760	any	2	25
Corrugated aluminum				
4" through 48" dia., 16 ga. min.	ASTM B 745	any	2	25

[1/] Based on NEH Part 636, Structural Engineering, Chapter 52 with values of E' = 200 psi, 7.5% deflection, a soil unit weight of 120 pcf, and a 10,000-pound wheel load for allowable deflection. For allowable buckling pressure, E = 140,000 psi

[2/] Indicates manufacturer’s recommendation for maximum fill over pipe.

Outlet. The outlet pipe shall be a rigid, non-perforated, smooth or corrugated, metal pipe with a minimum length of 10 feet. It shall be buried a minimum of 2 feet at the connection with the main conduit. Where fire or crushing hazard does not exist or other means of protection is installed, the metal outlet section is not required.

Animal guards shall be used on all drain outlets smaller than 15 inches in diameter. Outlets discharging into a waste storage pond or utilizing a canopy inlet do not require an animal guard. Each flap gate shall be an internal or external, gravity-closing, hinged gate with a loose pin that cannot rust tight.

Sufficient excavation and backsloping should be done around the outlet end of the main conduit and outlet channel to prevent any blockage of the outlet or the hinged gate by sloughing or siltation.

Visual resource design. All disturbed areas shall be reshaped and regraded to blend with the surrounding land features. Visual resources must be given the same consideration as other design features.

Vegetation. Areas not to be farmed shall be established to vegetation or protected from erosion by other means as soon as practicable after construction. Seedbed preparation, seeding, fertilizing, and mulching shall comply with Conservation Practice Standard 342, Critical Area Planting.

CONSIDERATIONS

Consider effects on the water budget, especially on volumes and rates of runoff, infiltration, evaporation, transpiration, deep percolation, and ground water recharge.

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.

OPERATION AND MAINTENANCE

Underground outlets shall be maintained by:

- Keeping inlets, trash guards, and collection boxes and structures clean and free of materials that can reduce the flow
- Repairing leaks and broken or crushed lines to ensure proper functioning of the conduit
- Checking outlet conduit and animal guards to ensure proper functioning of the conduit
- Keeping adequate backfill over the conduit
- Repairing any eroded areas at the pipe outlet