# SECTION 612 UNDERDRAINS

## 612.1 Description

(1) This section describes providing necessary subsurface drainage by constructing trenches, placing designated pipes or drainage devices within, if required, and backfilling the trenches with granular or other engineer-approved backfill material.

## 612.2 Materials

### 612.2.1 General

(1) Furnish and use materials conforming to the following requirements. Furnish all pipe as perforated unless the plans show or the special provisions specify unperforated pipe.

(2) The contractor may furnish, unless the contract specifies otherwise, one of the materials specified in 612.2, except drain tile under the Pipe Underdrain or Pipe Underdrain Unperforated bid items.

### 612.2.2 Corrugated Steel Pipe

(1) Provide corrugated steel pipe for underdrains conforming to type III culverts of AASHTO M 36. Provide perforations conforming to class I. Use sheets not less than 0.052 inch (1.32 mm) thick for 6-inch (150 mm) underdrains or 0.064 inch (1.62 mm) for 8 inch to 21 inch (200 to 525 mm), inclusive, diameter underdrains.

(2) If installing the pipes underground, the contractor may furnish coupling bands that have engineer-approved wedging, clamping, or other fasteners, instead of bolts.

### 612.2.3 Drain Tile

(1) Unless the plans or contract provide otherwise, use drain tile for underdrains that is type II, extra-quality drain tile, and conforms to AASHTO M 179, or use extra-quality concrete drain tile, and conform to AASHTO M 178.

### 612.2.4 Corrugated Aluminum Alloy Pipe

(1) Use corrugated aluminum alloy pipe for underdrains conforming to type III pipes of AASHTO M 196. Use a sheet not less than 0.060 inch (1.52 mm) thick. Provide perforations conforming to the requirements for class I.

(2) If installing the pipes underground, the contractor may furnish coupling bands that have engineer-approved wedging, clamping, or other fasteners, instead of bolts.

### 612.2.5 Corrugated Polyethylene Drainage Pipe

(1) Use corrugated polyethylene drainage pipe for underdrains conforming to AASHTO M 252, type CP and AASHTO M 294, type CP with class 2 perforations.

### 612.2.6 Polyvinyl Chloride Drainage Pipe

(1) Use polyvinyl chloride drainage pipe for underdrains conforming to AASHTO M 278.

### 612.2.7 Acrylonitrile-Butadiene-Styrene Drainage Pipe

(1) Use acrylonitrile-butadiene-styrene drainage pipe for underdrains conforming to ASTM D 2751, except do not apply the requirements for joint tightness. The contractor may use pipe with a Standard Dimensional Ratio (SDR) wall thickness of SDR 35 for sizes 6 inches (150 mm) or smaller. Use pipe perforated according to AASHTO M 278, if perforated pipe is required.

### 612.2.8 Geotextile Fabric

(1) Use a geotextile fabric of knitted, woven, or non-woven fibers of polyester, polypropylene, stabilized nylon, polyethylene, or polyvinylidene chloride. Do not use slit film woven fabrics for this work. The fabric must conform to the following requirements:

| TEST | METHOD | VALUE[1] |
|---|---|---|
| Minimum grab tensile strength | ASTM D-4632 | 35 lb. (155 N) |
| Apparent opening size | ASTM D-4751 | No. 30 - 200 (600 µm - 75 µm) |
| Minimum permittivity | ____ | 1.35 $s^{-1}$ |

[1] All numerical values represent minimum/maximum average roll values (i.e., the average of minimum test results on any roll in a lot should conform to or exceed the minimum values in the table).

(2) Use knitted fabrics constructed from continuous yarn. Non-woven fabrics may be needle-punched, heat-bonded, resin-bonded, or combinations of these 3 types. Use woven fabrics constructed from monofilament or multifilament yarns.

(3) Use geotextile wraps of knitted construction that form a seamless sleeve and fit tightly over the pipe. If using geotextile wraps constructed from woven or non-woven fabric then tightly wrap and securely fix to the pipe.

(4) Clearly mark the geotextile fabric rolls to identify the type of fabric.

(5) If the engineer determines it is necessary, he can obtain fabric samples for testing from the job site.

(6) If wrapping pipe underdrain, then the pipe shall conform to 612.2.5 for perforated underdrain.

### 612.2.9 Reinforced Concrete Apron Endwalls for Underdrain

(1) Use material for endwalls conforming to section 504.

## 612.3 Construction

### 612.3.1 Excavation

(1) Construct trenches for the underdrain as near as possible to the locations, lines, and grades the plans show. However, if necessary, the engineer may alter the locations, lines and grades to fit existing conditions.

(2) Begin trench excavation at the outlet end of the underdrain and proceed towards the upper end. Make trenches wide enough to provide adequate free working space on each side of the pipe and to allow compacting the backfill around the pipe. Restore all areas excavated below the established grade by adequately compacting and shaping a layer of suitable material.

### 612.3.2 Wrapping Pipe

(1) Under the Pipe Underdrain Wrapped bid items, furnish and install pipe underdrain wrapped with geotextile fabric.

(2) Wrap the geotextile fabric securely around the pipe underdrain along its entire length in a manner that allows no water to enter the underdrain without first passing through the fabric.

(3) Furnish geotextile fabric in a cover that protects the fabric from exposure to sunlight and abrasion due to shipping and hauling. The contractor shall not expose the fabric to the direct rays of the sun for more than 48 hours before covering.

(4) Cover torn or punctured fabric with suitable geotextile fabric extending at least 12 inches (300 mm) in all directions from the edge of the damaged fabric.

(5) Overlap all joints or splices in the fabric a minimum of 18 inches (450 mm).

### 612.3.3 Laying Pipe

(1) In general, start laying pipe in the trench at the outlet end and proceed toward the upper end, true to line and grade. Lay pipe with riveted lap joints so the flow is over the lap of the sheets. Make joints between sections by fitting the ends as tightly as possible. For tile pipe, cover all joints that do not close with less than 1/4 inch (6 mm) opening, with sections of broken tile. Use connecting bands to link the joints of corrugated steel or aluminum alloy pipe, and bolt or clamp firmly in place.

(2) Securely connect sections of corrugated polyethylene pipe with fittings conforming to AASHTO M 252 or M 294. The contractor may use solvent-cement joints, or gasketed joints, to join smooth plastic pipe. Secure corrugated polyethylene pipe as necessary to prevent displacement during laying and backfilling.

(3) Unless the engineer directs otherwise, lay perforated drainage pipe with the perforations on the underside of the pipe.

(4) Close the dead ends of pipe securely with concrete plugs, or engineer-approved caps, or plugs fabricated from the same material used in the pipe.

(5) Protect discharge ends of pipes with securely fastened engineer-approved gratings or screens.

(6) For tile lines, use corrugated steel pipe conforming to 612.2.2 to make the underdrain for a distance of 10 feet (3 m) from the outlet end.

(7) Furnish and place engineer-approved connectors to make lateral connections.

### 612.3.4 Plowing In Pipe

(1) Under the Pipe Underdrain Wrapped and Plowed bid items, place the wrapped pipe underdrain by plowing and replacing the displaced materials in a single operation. Place a wrapped underdrain in one continuous line except as the plans show or the engineer directs. Connect the pipe underdrain with plastic pipe couplers.

(2) Construct the underdrain at the location the plans show, and in a relatively straight line. Make the grade line follow as near as possible the grades the plans show or as the engineer directs to fit existing conditions.

(3) Use equipment capable of installing the underdrains to the required grade and location by plowing and replacing the displaced materials, as determined in the field, all in a single operation. Use equipment that will not damage the existing pavement. Compact materials disturbed by the plowing operations to the engineer's satisfaction.

(4) Reshape and re-compact the existing shoulder materials to the engineer's satisfaction. Use compaction equipment conforming to 301.3.

(5) If using a tracked pull unit, then use rack pads on the track on both pavement and shoulder.

(6) Close upgrade ends of the pipe with suitable caps to prevent trench backfill from entering.

(7) Install all couplings, tees, and other fittings to prevent the infiltration of trench backfill material and ensure compatibility with the pipe.

### 612.3.5 Backfilling

(1) Under the Underdrain Trench bid item, excavate and backfill underdrain trenches.

(2) Unless specified otherwise, cover perforated pipe or drain tile immediately after laying with granular material, as the plans specify, or as the engineer approves, to one foot (300 mm) above the top of the tile or pipe. Make the granular fill a uniform depth on both sides of the tile or pipe, and a minimum of 8 inches (200 mm) wider than the outside diameter of the tile or pipe. Backfill the remainder of the trench with granular backfill.

(3) The contractor may backfill unperforated pipe with suitable material from trench or roadway excavation unless granular backfill is specified.

(4) Use coarse aggregate conforming to size No. 2 of 501.2.5.4 to backfill trench underdrain. Place the geotextile fabric in the trench according to plan details before backfilling.

(5) If excavating for installing underdrains across private property, or within the right-of-way beyond the roadway limits, salvage the upper tillable or agricultural soil suitable for supporting vegetation and keep separate from other excavated material. Place this salvaged material in the top layer or layers of the backfill. Restore the entire area involved in the construction in a skilled and satisfactory manner.

(6) Use open-graded material required for trench backfill in the edgedrain system for concrete pavements as the plans show.

### 612.3.6 Drain Tile Exploration

(1) Under the Drain Tile Exploration bid item, excavate an exploratory trench to locate existing farm drain tile.

(2) Perform the exploratory trenching in sufficient advance of the grading operations to allow uninterrupted progress of these operations.

(3) Construct the trench a minimum 12 inches (300 mm) wide and deep enough to intercept all existing tile lines. Keep the trench open until the engineer orders it backfilled. Use the material obtained from the trench excavation for backfill.

### 612.3.7 Delivery

(1) Do not order and deliver the pipe underdrains required until the engineer verifies sizes and lengths.

### 612.3.8 Reinforced Concrete Apron Endwalls for Underdrain

(1) Under the Apron Endwalls for Underdrain Reinforced Concrete bid items, furnish and install reinforced concrete apron endwalls at underdrain outlets.

(2) Install endwalls according to plan details, at the locations the plans show.

### 612.4 Measurement

(1) The department will measure the Pipe Underdrain bid items by the linear foot acceptably completed. The department will measure along the centerline of the pipe, center to center of junctions and fittings.

(2) The department will measure Underdrain Trench by the linear foot acceptably completed, measured along the bottom of the trench. The department will measure geotextile fabric separately.

(3) The department will measure Drain Tile Exploration by the linear foot acceptably completed. The measured quantity equals the number of linear feet of trench opened at the engineer's direction.

(4) The department will measure the Apron Endwalls for Underdrain Reinforced Concrete bid items as each individual unit acceptably completed.

### 612.5 Payment

(1) The department will pay for measured quantities at the contract unit price under the following bid items:

| ITEM NUMBER | DESCRIPTION | UNIT |
|---|---|---|
| 612.0100 - 0199 | Pipe Underdrain (inch) | LF |
| 612.0200 - 0299 | Pipe Underdrain Unperforated (inch) | LF |
| 612.0300 - 0399 | Pipe Underdrain Drain Tile (inch) | LF |
| 612.0400 - 0499 | Pipe Underdrain Wrapped (inch) | LF |
| 612.0500 - 0599 | Pipe Underdrain Wrapped and Plowed (inch) | LF |
| 612.0600 | Underdrain Trench | LF |
| 612.0700 | Drain Tile Exploration | LF |
| 612.0800 - 0899 | Apron Endwalls for Underdrain Reinforced Concrete (inch) | EACH |

(2) Payment for the Pipe Underdrain bid items is full compensation for providing, transporting, handling, and placing all materials, including pipe, geotextile wrapping, connections, fittings, rodent screens, and caps or plugs; for all excavating, plowing, and re-compacting, salvaging, and placing upper tillable or agricultural soil suitable for supporting vegetation, disposing of surplus material, and restoring the work site; and for backfill, except as specified below. The department will pay separately for open-graded material required for trench backfill in the edgedrain system for concrete pavements under the Base Aggregate Open Graded bid item.

(3) Payment for Underdrain Trench is full compensation for excavating the trench, and for providing and placing all the backfill necessary to fill the trench. The department will pay for geotextile fabric separately.

(4) Payment for Drain Tile Exploration is full compensation for all excavating, backfilling, and for restoring the work site.

(5) Payment for the Apron Endwalls for Underdrain Reinforced Concrete bid items is full compensation for all excavating and backfilling; for providing, hauling and placing all materials, including concrete, and reinforcement at each unit; and for disposing of all surplus material.