SECTION 02510

UNDERDRAINS

02510.01 GENERAL

A. Description

Underdrain installation shall include, but not necessarily be limited to, constructing underdrains using pipe, filter fabric, and granular filter material; and underdrain pipe outlets and blind drains using granular material in accordance with the Contract Documents.

B. Related Work Included Elsewhere

1. Protection of the environment; Section 01500.

2. Porous backfill; Section 02246.

3. Trench excavation, backfill, and compaction; Section 02250.

C. Quality Assurance

1. Materials

   a. The Engineer will inspect all materials before and/or after installation to ensure compliance with the Contract Documents. When specific material tests are called for in the referenced standards and specifications, the Engineer will have the option of requiring that any or all of these tests be performed for materials furnished for a specific project. When testing is required, it will be specified herein or in the "Special Provisions".

   b. Corrugated polyethylene drainage tubing and fittings shall be homogeneous throughout and free from foreign inclusions, cracks, creases, or uneven pigmentation.

   c. Class PS 50 polyvinyl chloride (PVC) pipe and fittings shall be homogeneous throughout and free from foreign inclusions, cracks, creases, flaws, or other injurious defects. Pipe and fittings shall be as uniform as commercially practical in color, opacity, and other physical properties.

   d. Concrete drain tile shall be free from cracks that extend through the wall and other visible defects.

   e. Nonreinforced concrete pipe shall be free from fractures and excessive interior surface roughness. The planes of the ends of the pipe shall be perpendicular to the longitudinal axis so that the length of two opposite sides

of any section of pipe shall not vary more than 1/4 inch or 2% of the designated diameter, whichever is larger.

f. Perforated concrete pipe shall be free from any spall more than 3/4 inch in diameter or 3/16 inch in depth caused by making perforations or slots.

g. Porous concrete pipe shall be free from fractures or cracks passing through the wall or joints, except that a single crack not exceeding 2 inches in length at either end of a pipe or a single fracture in the joints not exceeding 3 inches in width and not more than 2 inches in length shall not be considered cause for rejection unless these defects exist in more than 5% of the entire shipment or delivery, or any cracks sufficient to impair the strength, durability, or serviceability of the pipe.

h. Clay drain tile shall be free from cracks, checks, or chips extending into the body of the tile in such a manner as would decrease the strength. There shall be no breaks in the tile that would admit earth into the drain. Drain tile shall be reasonably smooth on the inside and shall be approximately circular in cross-section.

i. Corrugated metal underdrains shall be free from defects of uneven laps; elliptical shaping; variation from a straight center line; ragged or diagonal sheared edges; loose, unevenly lined or spaced rivets or spot welds; poorly formed rivet heads or lock seams; unfinished ends; illegible brand; lack of rigidity; bruised, scaled, or broken metallic coating; or dents or bends in the metal itself.

j. Cast iron soil pipe and fittings shall be sound and without defects that might impair its service. Repair of defects by welding or other methods will not be allowed if such repairs adversely affect the serviceability of the pipe or fitting.

2. Field Tests

No testing will be conducted on underdrains installed in accordance with this section; however, the work will be visually inspected. The underdrain lines shall be installed true to line and grade and shall not contain any debris, silt, earth, gravel, rock, or other foreign material. All equipment necessary for the inspection will be furnished by the County. The Contractor shall provide assistance as may be required to enable the County to perform the inspection.

D. Submittals

1. Shop Drawings

Shop drawings shall be submitted as specified in the "General Provisions" for the various types of pipe and fittings intended to be supplied. The shop drawings shall

include the following information: product information; material strength, "type", or "class"; joint type; and storage, handling, and installation recommendations.

2. Certificates of Compliance

Certificates of compliance shall be submitted in accordance with the "General Provisions" for the various types of pipe and fittings intended to be supplied. The certificates shall state that the pipe and/or fitting has been manufactured in accordance with the standard referenced.

02510.02 MATERIALS

A. Materials Furnished by the County

The County will not furnish any materials for underdrain installation.

B. Contractor's Options

None.

C. Detailed Material Requirements

1. Coarse aggregate for use in constructing underdrains shall meet the gradation requirements of AASHTO M 43, size number 57 as specified in Section 02651.02.

2. Fine aggregate for use in constructing underdrains shall meet the gradation requirements of AASHTO M 6 as specified in Section 02651.02.

3. Filter fabric shall be a nonwoven fabric consisting of long chain polymeric filaments or yarns, such as polypropylene, polyethylene, polyester, polyamide, or polyvinylidene-chloride, formed into a stable network.

   a. The fabric shall be inert to chemicals commonly encountered in soil and to hydrocarbons.

   b. The fabric shall be resistant to mildew, rot, and ultraviolet light exposure.

      The fabric shall conform to the test requirements shown in the table below:

Drainage Fabric Test Requirements

Test and Method	Specification Limits
ASTM D 1682 Grab Tensile Strength, min.	90 lbs.
ASTM D 1682 Tensile Elongation, min.	20%
ASTM D 3786 Burst Strength, min.	140 psi
ASTM D 1117 Trapezoid Tear Strength, min.	45 psi
CW-02215 Corps. of Engineers Equivalent Opening Size	40-100 U.S. Standard Sieve size
AASHTO M 288 Appendix Coef. of Permeability, min	0.05 cm/sec
Flow Rate AASHTO M 288 Appendix, min.	40 gal/min/ft^2

4. Pipe and/or fittings shall meet the material requirements of the referenced standards or specifications:

   a. Corrugated polyethylene drainage tubing - AASHTO M 252.

   b. Class PS 50 polyvinyl chloride pipe - AASHTO M 278.

   c. Concrete drain tile - AASHTO M 178.

   d. Nonreinforced concrete pipe - AASHTO M 86, Class 3 with bell and spigot joints and rubber gaskets meeting ASTM C443.

   e. Perforated concrete pipe - AASHTO M 86, Class 3, and AASHTO M 175, Type1.

   f. Porous concrete pipe - AASHTO M 176, Standard Strength.

   g. Clay drain tile - AASHTO M 179.

   h. Vitrified clay pipe - AASHTO M 65, Standard Strength with an additional requirement that the first and last perforations be 3 inches from the spigot ends.

   i. Corrugated steel pipe - AASHTO M 36.

   j. Precoated galvanized steel pipe - AASHTO M 245.

   k. Corrugated aluminum alloy pipe - AASHTO M 196.

   l. Cast iron soil pipe - ASTM M A 74, Class as specified in the Contract Documents.

5. Spring wire clips used with double spigot pipe shall be designed to maintain a taut but elastic connection between the sections of pipe when laid. The spring clips shall be constructed of No. 9 gage spring wire.

02510.03 EXECUTION

A. General

Where necessary, the precise pattern of the underdrains shall be ascertained from the Engineer. Trenches shall then be excavated to the dimensions and grade indicated on the Plans.

B. Pipe Assembly

1. Metal pipes shall be connected with metal bands especially made for this purpose, which shall be of the same quality as the pipe.

2. Bell and spigot pipe shall be installed with the bell upgrade. Plain (nonperforated) bell and spigot pipe shall be installed with open joints.

3. Plain pipe furnished with other types of ends, such as double spigots, etc., shall be installed with open joints; but for these types of pipe, clips or other approved devices to hold the pipes in line are required.

4. Perforated bell and spigot pipes, other than metal, shall be installed with approved sealed joints, or the bell section shall have self-centering lugs to keep the flow line in correct alignment. On perforated pipe, perforations shall be placed down and arranged symmetrically about the vertical axis.

C. Outlets

Outlets shall be trenched, installed, and constructed generally of the same size and type of material and in the same manner as for the underdrain except that all outlet pipes shall be plain (nonperforated) and the entire depth of the trench backfilled with material equal to embankment in quality as specified in Section 02260. The outlet trench backfill shall generally be constructed to be in accordance with the embankment with mechanical tamping required. Where underdrain pipes of other than round sections are connected to circular outlet pipes and at the ends of trunk lines, wye, tee, or ell laterals, the openings shall be plugged with especially prepared vitrified clay plugs mortared in place. The joints of clay and concrete pipe outlets shall be cemented with mortar, and corrugated metal pipe sections of outlets shall be joined with standard connecting bands.

An acceptable alternate to mortared joints for clay pipe underdrain shall be the use of complementary asphaltic rings precast around the spigot and inside of the bell of the pipe which by tapered design and wedging action when joined will seal the joint. Before joining the sections, a solvent recommended by the manufacturer of the pipe shall be brush applied to the asphaltic rings in the bell and on the spigot. No pipe shall be used when the jointing material

has been deformed or when there is adhering foreign material, which will prevent a close and totally sealed joint.

D. Installation

After completion of the excavation, the trench shall be lined with filter fabric and a 4 to 6-inch deep layer of aggregate installed on top of the fabric. The pipe shall then be installed as previously specified, aggregate backfill installed to the depth indicated in the Contract Documents, and the filter fabric lapped across the top of the aggregate for a minimum width of 12 inches. In the longitudinal direction filter fabric shall be overlapped at least 18 inches.

E. Backfill

In addition to the requirements of Section 02250, the following shall apply: Trenches shall be backfilled to the dimensions and grade indicated on the Plans. The aggregate backfills shall be screeded or raked to proper thickness and grade, but they shall not be tamped. The placing of the embankment material over the sand will depend upon conditions, depths and position with respect to the road. In general, this portion of the backfill shall meet the requirements for embankments. The embankment material portion of the backfills shall be tamped.

02510.04 METHOD OF MEASUREMENT

Measurement for furnishing and installing underdrains and outlets will be made for each size of pipe installed. Measurement will be made of the actual length of underdrain or outlet installed, complete in place and accepted, measured horizontally along the centerline of pipe, from end to end, excluding structures. In measuring the length of special manufactured connections exclusive of coupling bands, the actual linear foot measurement for each special manufactured connection will be doubled and payment made accordingly.

02510.05 BASIS OF PAYMENT

A. General

1. Payment will be made at the unit prices bid. The prices bid shall include furnishing of all labor, tools, equipment, and materials necessary to complete the work as shown and specified in strict accordance with the Contract Documents, and accepted by the Engineer.

2. The price bid for furnishing and installing underdrains and outlets shall include the following:

    a. Trench excavation, backfill, compaction, and incidental items as specified herein and in Section 02250.

b. Furnishing and installing aggregate backfills and filter fabric as shown on the Plans and required elsewhere in the Contract Documents.

3. Payment will be made for contingent items when ordered by the Engineer. Payment will be made as specified in Sections 02951, 02952, 02953, O2954, O2955, 02956, and 02957.

B. Underdrains and Outlets

Payment for furnishing and installing underdrains and outlets, complete and operational, will be made per linear foot of pipe for each size and type of pipe installed. The price bid shall include furnishing and installing all pipe, couplings, and bands, and all other incidental work necessary to make the underdrains operational.