

**EMERGENCY MEASURES EWP PROJECT
WITH THE COOPERATION OF THE
NATURAL RESOURCES CONSERVATION SERVICE
AND THE
MASON COUNTY FISCAL COURT**

CONSTRUCTION and MATERIAL SPECIFICATIONS



LIST OF APPLICABLE SPECIFICATIONS

Construction Specifications

<u>Number</u>	<u>Title</u>	<u>Pages</u>
3	Structural Removal	1 - 2
4	Channel Clearing and Shaping	1 - 3
5	Pollution Control	1 - 3
6	Seeding, Sprigging, and Mulching	1 - 4
8	Mobilization and Demobilization	1 - 2
9	Traffic Control	1 - 3
11	Removal of Water	1 - 3
14	Grouting	1- 11
21	Excavation	1 - 5
61	Rock Riprap	1 - 4
81	Metal Fabrication and Installation	1 - 3
95	Geotextile	1 - 4

Material Specifications

<u>Number</u>	<u>Title</u>	<u>Pages</u>
523	Rock for Riprap	1 - 3
531	Cement	1 - 1
592	Geotextile	1 - 3

Construction Drawings

See drawing sheets for:
Springdale Road, 5 sheets,
Kansas Creek, 7 sheets.

Construction Specification 4—Channel Clearing and Shaping

1. Scope

The work consists of clearing designated areas by the removal and disposal of trees, logs, stumps, shrubs, brush, and rubbish, and the shaping of the channel.

2. Protection of existing vegetation

Trees and other vegetation designated to remain undisturbed shall be protected from damage throughout the duration of the construction period. Any damages resulting from the contractor's operations or neglect shall be repaired by the contractor.

Earthfill, stockpiling of materials, vehicle or equipment parking, and excessive foot or vehicle traffic shall not be allowed within the drip line of vegetation designated to remain in place. Vegetation damaged by any of these or similar actions shall be replaced with viable vegetation of the same species, similar condition, and like size unless otherwise approved by the contracting officer.

Any cuts, skins, scrapes, or bruises to the bark of the vegetation shall be carefully trimmed and local nursery accepted procedures used to seal damaged bark.

Any limbs or branches 0.5 inch or larger in diameter that are broken, severed, or otherwise seriously damaged during construction shall be cut off at the base of the damaged limb or branch flush with the adjacent limb or tree trunk.

All roots 1 inch or larger in diameter that are cut, broken, or otherwise severed during channel shaping shall have the end smoothly cut perpendicular to the root. Roots exposed during channel shaping operations shall be covered with moist soil as soon as possible to prevent roots from drying out.

3. Marking

The limits of the area(s) to be cleared and shaped are marked by stakes, flags, paint, tree markings, or other suitable methods or as specified in section 8 of this specification, or they will be shown on the drawings. Trees to remain standing, undisturbed, and uninjured are designated by special markings.

4. Clearing

Trees and other vegetation marked for clearing shall be cut off as near the ground surface as conventional tools and equipment normally permit. All trees not marked for preservation and all snags, logs, brush, shrubs, stumps, and rubbish shall be cleared from within the area limits identified.

5. Disposal

All woody material, vegetation, and rubbish resulting from clearing from designated areas shall be disposed of at the locations and in a manner shown on the drawings, or as specified in section 8 of this specification.

6. Shaping

The channel bottom and side slopes shall be shaped as shown on the drawings. The resulting shaped channel surface shall be reasonably smooth. Material excavated during the channel shaping operation shall be removed from the channel and disposed of as specified in section 8 of this specification.

7. Measurement and payment

Method 1—For items of work for which specific unit prices are established by the contract, the designated cleared and shaped area is measured and the area determined to the nearest 0.1 acre. Payment for clearing and shaping is made at the contract unit price for the item and shall constitute full compensation for all labor, equipment, tools, applicable permits and associated fees for burning and disposal of refuse, and all other items necessary and incidental to the satisfactory completion of the work.

Method 2—For items of work for which specific unit prices are established by the contract, the length of the cleared and shaped channel designated is measured to the nearest 100 feet. Payment for clearing and shaping is made at the contract unit price for the item and shall constitute full compensation for all labor, equipment, tools, applicable permits and associated fees for burning and disposal of refuse, and all other items necessary and incidental to the satisfactory performance of the work.

Method 3—For items of work for which specific unit prices are established by the contract, the cleared and shaped area(s) is measured and the area determined to the nearest 0.1 acre. The designated cleared and shaped area(s) is determined from the measured width at representative sections and the distance between the sections. Payment for clearing and shaping is made at the contract unit price for the item and shall constitute full compensation for all labor, equipment, tools, applicable permits and associated fees for burning and disposal of refuse, and all other items necessary and incidental to the satisfactory completion of the work.

Method 4—For items of work for which specific lump sum prices are established by the contract, the extent of clearing and shaping is not measured or determined for payment. Payment for clearing and shaping is made at the contract lump sum price for the item and shall constitute full compensation for all labor, equipment, tools, applicable permits and associated fees for burning and disposal of refuse, and all other items necessary and incidental to the satisfactory completion of the work.

All Methods—The following provisions apply to all methods of measurement and payment. Compensation for any item of work described in the contract, but not listed in the bid schedule is included in the payment for the item of work to which it is made subsidiary. Such items and items to which they have been made subsidiary are identified in section 8 of this specification.

8. Items of work and construction details.

The item of work to be performed in conformance with this specification and construction details is:

(A) Bid Item 1, Debris Removal.

(1) This item shall consist of removing debris from the stream as shown on the plans and as located by the engineer during construction.

(2) Marking – The upper and lower ends of the work will be marked with flagging. The width varies as shown on the plans and as located by the COR.

(3) Clearing.

(a) Standing trees with a Diameter-At-Breast-Height (DBH) of less than 9 inches or trees with a height less than 8 feet may be removed as needed during project implementation. Standing trees with a DBH greater than 9 inches cannot be removed unless they are first reviewed by NRCS or an NRCS representative to determine if the trees are suitable for Indiana Bat utilization. Trees determined to be suitable for Indiana Bat utilization will not be felled, removed, or otherwise disturbed during project implementation.

(b) Standing trees with a DBH of greater than 9 inches with the following characteristics will not be bumped during project implementation; (a) trees that have exfoliating bark, such as, but not limited to, shellbark hickory, shagbark hickory, and white oak species, (b) trees that are dead and dying with exfoliating or sloughing bark, or (c) have broken tree tops with cracks or split areas on limbs that are greater than 5” in diameter.

(c) NRCS will lay out any needed access roads, access points, or work areas in woodland to ensure trees suitable for Indiana Bat utilization will be protected. Access roads and work areas must be installed as laid out and/or directed by NRCS or NRCS representative. If during installation of access roads, access points, or work area limits, and it is identified that additional tree removal is needed, items 1 and 2 above must be followed.

(4) Disposal – Manmade debris disposal shall conform to any Kentucky and local regulations.

(5) Shaping – The areas disturbed as access routes shall be re-graded to slopes and grades that are consistent with the surrounding area.

(6) In Section 7, Measurement and Payment, Method 4 shall apply.

(7) Items subsidiary to this bid item:

(a) Construction Specification 3, Structure Removal

(b) Construction Specification 5, Pollution Control

(c) Construction Specification 9, Traffic Control

(d) Construction Specification 11, Removal of Water

(e) Construction Specification 21, Excavation

Construction Specification 6—Seeding, Sprigging, and Mulching

1. Scope

The work consists of preparing the area for treatment; furnishing and placing seed, sprigs, mulch, fertilizer, inoculant, lime, and other soil amendments; and anchoring mulch in designated areas as specified.

The following BioPreferred® product categories are applicable to this specification:

- mulch and compost materials
- erosion control materials
- fertilizers
- agricultural spray adjuvants

2. Material

Seed—All seed shall conform to the current rules and regulations of the state where it is being used and shall be from the latest crop available. It shall meet or exceed the standard for purity and germination listed in section 7.

Seed shall be labeled in accordance with the state laws and the U.S. Department of Agriculture rules and regulations under the Federal Seed Act in effect on the date of invitations for bids. Bag tag figures are evidence of purity and germination. No seed will be accepted with a test date of more than 9 months before the delivery date to the site.

Seed that has become wet, moldy, or otherwise damaged in transit or storage will not be accepted. The percent of noxious weed seed allowable shall be as defined in the current State laws relating to agricultural seeds. Each type of seed shall be delivered in separate sealed containers and fully tagged unless exception is granted in writing by the contracting officer.

Fertilizer—Unless otherwise specified, the fertilizer shall be a commercial grade fertilizer. It shall meet the standard for grade and quality specified by State law. Where fertilizer is furnished from bulk storage, the contractor shall furnish a supplier's certification of analysis and weight. When required by the contract, a representative sample of the fertilizer shall be furnished to the contracting officer for chemical analysis.

Inoculants—The inoculant for treating legume seeds shall be a pure culture of nitrogen-fixing bacteria prepared specifically for the species and shall not be used later than the date indicated on the container or as otherwise specified. A mixing medium, as recommended by the manufacturer, shall be used to bond the inoculant to the seed. Two times the amount of the inoculant recommended by the manufacturer shall be used except four times the amount shall be used when seed is applied using a hydraulic seeder. Seed shall be sown within 24 hours of treatment and shall not remain in the hydraulic seeder longer than 4 hours.

Lime and other soil amendments—Lime shall consist of standard ground agriculture limestone, or approved equivalent. Standard ground agriculture limestone is defined as ground limestone meeting current requirements of the State Department of Agriculture. Other soil amendments shall meet quality criteria and application requirements specified in section 7.

Mulch tackifiers—Asphalt emulsion tackifiers shall conform to the requirements of ASTM D 977, Specification for Emulsified Asphalt. The emulsified asphalt may be rapid setting, medium setting, or slow setting. Nonasphaltic tackifiers required because of environmental considerations shall be as specified in section 7.

Straw mulch material—Straw mulch shall consist of wheat, barley, oat or rye straw, hay, grass cut from native grasses, or other plants as specified in section 7. The mulch material shall be air-dry, reasonably light in color, and shall not be musty, moldy, caked, or otherwise of low quality. The use of mulch that contains noxious weeds is not permitted. The contractor shall provide a method satisfactory to the contracting officer for determining weight of mulch furnished.

Other mulch materials—Mulching materials, such as wood cellulose fiber mulch, mulch tackifiers, synthetic fiber mulch, netting, and mesh, are other mulching materials that may be required for specialized locations and conditions. These materials, when specified, must be accompanied by the manufacturer's recommendations for methods of application.

3. Seeding mixtures, sod, sprigs, and dates of planting

The application rate per acre for seed mixtures, sprigs, or sod and date of seeding or planting shall be as shown on the plans or as specified in section 7.

4. Seedbed preparation and treatment

Areas to be treated shall be dressed to a smooth, firm surface. On sites where equipment can operate on slopes safely, the seedbed shall be adequately loosened (4 to 6 inches deep) and smoothed. Depending on soil and moisture conditions, disking or cultipacking, or both, may be necessary to properly prepare a seedbed. Where equipment cannot operate safely, the seedbed shall be prepared by hand methods by scarifying to provide a roughened soil surface so that broadcast seed will remain in place.

If seeding is to be accomplished immediately following construction operations, seedbed preparation may not be required except on a compacted, polished, or freshly cut soil surface.

Rocks larger than 6 inches in diameter, trash, weeds, and other debris that will interfere with seeding or maintenance operations shall be removed or disposed of as specified in section 7.

Seedbed preparation shall be discontinued when soil moisture conditions are not suitable for the preparation of a satisfactory seedbed as determined by the contracting officer's technical representative (COTR).

5. Seeding, sprigging, fertilizing, mulching, and stabilizing

All seeding or sprigging operations shall be performed in such a manner that the seed or sprigs are applied in the specified quantities uniformly in the designated areas. The method and rate of seed application shall be as specified in section 7. Unless otherwise specified, seeding or sprigging shall be accomplished within 2 days after final grading is completed and approved.

Fertilizer, lime, and other soil amendments shall be applied as specified in section 7. When specified, the fertilizer and soil amendments shall be thoroughly incorporated into the soil immediately following surface application.

The rate, amount, and kind of mulching or mesh shall be as specified in section 7. Mulches shall be applied uniformly to the designated areas. They shall be applied to areas seeded not later than 2 working days after seeding has been performed. Straw mulch material shall be stabilized within 24 hours of application using a mulch crimper or equivalent anchoring tool or by a suitable tackifier. When the mulch crimper or equivalent anchoring tool is used, it shall have straight blades and be the type manufactured expressly for and capable of firmly punching the mulch into the soil. Where the equipment can be safely operated, it shall be operated on the contour. Hand methods shall be used where equipment cannot safely operate to perform the work required.

The tackifier shall be applied uniformly over the mulch material at the specified rate, or it shall be injected into the mulch material as it is being applied. Mesh or netting stabilizing materials shall be applied smoothly, but loosely on the designated areas. The edges of these materials shall be buried or securely anchored using spikes or staples as specified in section 7.

The contractor shall maintain the mesh or netting areas until all work under the contract has been completed and accepted. Maintenance shall consist of the repair of areas damaged by water erosion, wind, fire, or other causes. Such areas shall be repaired to reestablish the intended condition and to the design lines and grades required by the contract. The areas shall be refertilized, reseeded, and remulched before the new application of the mesh or netting.

6. Measurement and payment

Method 1—For items of work for which specific unit prices are established in the contract, each area treated is measured as specified in section 7 and the area calculated to the nearest 0.1 acre. Payment for treatment is made at the contract unit price for the designated treatment, which will constitute full compensation for completion of the work.

When specified as an item of work, mesh or netting is measured to the nearest square yard of surface area covered and accepted. Payment is made at the contract unit price and will constitute full compensation for completion of the work.

Method 2—For items of work for which specific lump sum prices are established in the contract, the quantity of work will not be measured for payment. Payment for this item is made at the contract lump sum price for the item and will constitute full compensation for the completion of the work.

Method 3—For items of work for which lump sum prices are established in the contract, payment is made as the work proceeds. Progress payments will be determined as specified in section 7. Payment of the lump sum contract price will constitute full compensation for completion of the work.

All Methods—The following provisions apply to all methods of measurement and payment. Compensation for any item of work described in the contract, but not listed in the bid schedule is included in the payment for the item of work to which it is made subsidiary. Such items and the item(s) to which they are made subsidiary are identified in section 7.

7. Items of work and construction details

The items of work to be performed in conformance with this specification and the construction details is:

(A) Bid Item 2, Seeding and Mulching.

(1) This item shall consist of seeding and mulching areas disturbed by construction. All necessary grading and filling of rills and gullies shall be incidental to seedbed preparation.

(2) In Section 2, Materials, no fertilizer shall be applied.

(3) In Section 2, Materials, no agricultural lime shall be approved.

(4) In Section 3, Seeding Mixtures, Sod, Sprigs, and Date of Planting, the designated areas will be seeded in accordance with the following:

Species	Minimum % Purity	Minimum % Germination	* Seeding Rates - lbs/acre [Pure Live Seed (PLS)]	
			03/01 to 10/31	11/01 to 02/28
Tall Fescue (KY-31) <i>(festuca arundinacea)</i>	96	80	50	75
Annual Ryegrass <i>(lolium multiflorum)</i>	90	70	10	0
Winter Wheat <i>(triticum aestivum)</i>	90	80	0	90

* Seeding Rates (lbs/acre) = PLS x 10000 / % Purity x % Germination

(5) In Section 4, Seedbed Preparation and Treatment, following final grading and removal of debris and rocks larger than 3 inches in any dimension, the seedbed shall be shaped to a reasonably smooth surface. Immediately prior to the seeding operation, the fertilizer and lime shall be broadcast evenly over the area and then the seedbed shall be rotary tilled or otherwise mixed to a depth of four inches. On areas where equipment cannot operate, the seedbed shall be prepared by hand scarifying with a rake or other suitable method to provide a rough surface to keep the broadcast seed in place

(6) In Section 5, Seeding, Sprigging, Fertilizing, Mulching, and Stabilizing, immediately following seedbed preparation, all seed shall be evenly distributed over the area by broadcasting or drilled methods. Immediately following seeding, the seed shall be pressed into the soil (if not done during seeding) by use of a cultipacker or by equipment tracking or other approved method. Immediately following seeding, the mulch will be applied evenly over the area at a rate of two tons per acre. No tackifier or netting shall be applied.

(7) In Section 6, Measurement and Payment, Method 2 shall apply.

Construction Specification 8—Mobilization and Demobilization

1. Scope

The work consists of the mobilization and demobilization of the contractor's forces and equipment necessary for performing the work required under the contract. It does not include mobilization and demobilization for specific items of work for which payment is provided elsewhere in the contract. Mobilization will not be considered as work in fulfilling the contract requirements for commencement of work.

2. Equipment and material

Mobilization shall include all activities and associated costs for transportation of contractor's personnel, equipment, and operating supplies to the site; establishment of offices, buildings, and other necessary general facilities for the contractor's operations at the site; premiums paid for performance and payment bonds including coinsurance and reinsurance agreements as applicable; and other items specified in section 4 of this specification.

Demobilization shall include all activities and costs for transportation of personnel, equipment, and supplies not required or included in the contract from the site; including the disassembly, removal, and site cleanup of offices, buildings, and other facilities assembled on the site specifically for this contract.

This work includes mobilization and demobilization required by the contract at the time of award. If additional mobilization and demobilization activities and costs are required during the performance of the contract as a result of changed, deleted, or added items of work for which the contractor is entitled to an adjustment in contract price, compensation for such costs will be included in the price adjustment for the item or items of work changed or added.

3. Payment

Payment will be made as the work proceeds, after presentation of paid invoices or documentation of direct costs by the contractor showing specific mobilization and demobilization costs and supporting evidence of the charges of suppliers, subcontractors, and others. When the total of such payments is less than the lump sum contract price, the balance remaining will be included in the final contract payment. Payment of the lump sum contract price for mobilization and demobilization will constitute full compensation for completion of the work.

Payment will not be made under this item for the purchase costs of materials having a residual value, the purchase costs of materials to be incorporated in the project, or the purchase costs of operating supplies.

4. Items of work and construction details

The items of work to be performed in conformance with this specification and construction details is:

(A) Bid Item 3, Mobilization and Demobilization.

(1) This item shall consist of the Mobilization and Demobilization of the Contractor's forces and equipment necessary for performing the work required under the contract.

Construction Specification 14—Pressure Grouting

1. Scope

The work consists of drilling grout holes, exploratory holes, and check holes; pressure testing, pressure washing, and injecting suspension grout under pressure; and includes furnishing of all materials, labor, and equipment as described and specified.

2. Material

Portland Cement—Portland cement shall conform to the requirements of Material Specification 531, Portland Cement, for the specified type. If the cement contains lumps or foreign material that would clog the grouting equipment or interfere with grout injection, it shall be screened through a 100-mesh screen. Cement shall be furnished in bags (94 lb) unless special equipment is provided for storing, handling, and weighing bulk cement as specified in section 3 of this specification.

Water—Water used shall be clean and free from injurious amounts of oil, acid, organic matter, or other deleterious substances.

Sand—Sand for grout shall conform to Material Specification 522, Aggregates for Portland Cement Concrete, and, unless otherwise specified, the gradation shall be within the numerical limits as follows:

Sieve designation (U.S. std. square mesh)	Percent passing by weight
16	100
50	20 – 50
100	10 – 30
200	0 – 5

Sand included in the mix shall be measured in cubic-foot boxes or other volumetric method approved by the engineer, or by dry unit weight with correction for moisture content.

Bulk fillers—Bulk fillers other than sand shall be of the type and quality specified in section 18 of this specification. Bulk fillers included in the mix shall be measured in cubic-foot boxes or by dry unit weight with correction for moisture content, if applicable.

Admixtures—Admixtures shall be the type and quality specified in section 18 of this specification.

Storage and supply—A sufficient quantity of all materials shall be on hand to ensure that grouting operations will not be interrupted or delayed. Materials shall be stored and protected at all times and at all locations so that the quality of the materials is maintained.

3. Equipment

All drilling and grouting equipment shall be of a type and capacity and in condition to perform the work described.

Drilling equipment—Drilling equipment shall be capable of drilling angle holes up to 45 degrees from vertical unless otherwise specified in section 18 of this specification.

For exploratory holes, all drilling equipment used in rock shall be the rotary type and shall be equipped with hydraulic feed.

Cores shall be drilled with standard ballbearing, swivel type, N-size, double or triple tube split inner core barrels or equivalent size wire-line coring equipment.

Equipment for drilling grout and check holes shall be rotary, percussion, or rotary-percussion type as specified in section 18 of this specification. No core recovery will be required, and the type of bit used shall be optional. Equipment using air alone for flushing cuttings shall not be used. When percussion drilling equipment using water for flushing cuttings is used, the lifting rate of the flushing water shall be not less than 18 inches per second.

Grouting equipment—The equipment shall be capable of mixing and pumping grout having a mix ratio, by volume, of one part water, one part cement, and two parts bulk filler, such as sand or fly ash.

Mixers—Unless otherwise specified, mixers shall be high speed colloidal type and capable of thoroughly mixing water, cement, and bulk fillers to produce a grout of uniform texture and consistency. Mixers shall match the capacity of the pumping plant.

Holdover tank—A holdover tank shall be furnished if a single compartment mixer is used. It shall be equipped with mechanical agitators to prevent segregation of the grout and shall have sufficient capacity to temporarily store the grout and thus provide a continuous supply. The outflow shall pass through a No. 16 wire mesh screen if the grout contains particles or foreign matter that would interfere with its proper flow into the voids it is intended to fill.

Pumps—Grout pumps shall be long stroke, multiple piston or the helical screw type. The capacity shall be not less than 3 cubic feet per minute at 200 pounds per square inch for the maximum grout mix of 1:1:2 (w:c:bf), by volume.

Cement and fly ash-handling equipment—If bulk cement or fly ash is used, it shall be stored in weather tight bins or silos equipped and arranged to discharge directly into a weighing hopper, and hence, directly into the grout mixer without spillage and without intermediate handling.

Air supply—The air supply shall meet the requirement of the pumps and shall not be less than 200 cubic feet per minute per plant.

Water meter—One water meter that has a reset and is graduated in tenths of gallons or hundredths of cubic feet shall be used with each mixer.

Pressure gauges—One pressure gauge shall be installed at the pump and one at the collar of the hole. Gauges shall be nonclogging or use gauge savers or grease to prevent clogging. Spare gauges shall be available at the plant at all times.

Hoses, valves, and fittings—Hoses, valves, and fittings shall be compatible with the maximum pressures specified. Hose from pump to grout header and return shall not be smaller than 1.5-inch (ID), and the pipe between header and packer shall not be smaller than 0.75-inch (ID). Double or single packers may be required for grouting and pressure testing. Packers shall fit tightly in the holes at all testing and grouting pressures.

4. Arrangement of grouting equipment

The arrangement of grouting equipment shall provide a return line from the header back to the mixer or holdover tank. This permits continuous circulation of the grout. The grout pressure shall be controlled at the header or at the end of the return line.

The hose between the takeoff at the grout supply line to the header at the hole shall not be longer than 15 feet.

Grouting several holes simultaneously from the same grout pump (multiple header arrangement) is not permitted.

Each hole shall be equipped with a shutoff valve below the hand coupling union. This permits shutoff at refusal pressure and removal of the header to another hole while still maintaining pressure in the completed hole.

The header arrangement shall include a blowoff valve and a control valve used to check hole back pressure before header removal. It must also have a return line valve. The header shall be connected to the supply line by a U-shaped pipe arrangement or other fashion that prevents fallout of solids into the hole from the bypassing grout during low rates of grout acceptance.

5. Communications

A suitable voice communications system between individuals at the pump units and the holes shall be maintained by the contractor.

6. Grout mixtures

Composition—Grout shall consist of a mixture of portland cement, water, sand, bulk filler, and additives, as specified. Grout mixes and sequences of changes in mix ratio or composition shall be as specified in section 13 of this specification or as approved by the engineer.

Mix ratios—Grout mix ratios are expressed in cubic feet of water to a bag of cement. Bulk fillers are expressed in cubic feet to a bag of cement. Other additives are expressed in percent to a bag of cement and measured in pounds, gallons, or pints.

7. Grout caps and concrete slabs

Concrete for grout caps and slabs, if required, shall be placed as shown on the drawings. The concrete shall be a workable mixture of portland cement, fine and coarse aggregates, and water, containing not less than 6 bags of cement per cubic yard of concrete, and not more than 6 gallons of water per bag of cement, including the free moisture of the aggregates.

Portland cement shall conform to the requirements of Material Specification 531 for the type specified. Aggregates shall consist of sound and durable particles and shall conform to the limitations for deleterious substances and the grading requirements of ASTM Specification C 33. Coarse aggregates shall be size 7, 67, 57, or 467 as defined in ASTM Specification C 33.

Batching, mixing, and placing shall be conducted in a manner that produces a uniform, well-graded, and dense concrete.

When ready-mixed concrete is furnished, the contractor shall furnish the engineer a delivery ticket showing the time of loading and the quantities of materials used for each load of concrete. Concrete shall be placed within 1.5 hours after introduction of the cement to the aggregates or within 45 minutes when the temperature of the concrete is 85 degrees Fahrenheit or greater.

Surfaces against which concrete is to be placed shall be cleaned of all soil, loose rock, and other loose material and shall be moist when the concrete is placed.

Concrete shall be placed only when the engineer is present.

The concrete shall be prevented from drying for a curing period of at least 5 days after it is placed. Exposed surfaces shall be kept continuously moist for the entire period, or shall be coated with an acceptable curing compound as soon as free water has disappeared.

8. Drilling overburden

Unless otherwise specified, holes drilled through overburden shall be cased with steel. Casings shall be removed after completion of the grouting operations unless otherwise approved by the engineer. Holes in overburden shall be backfilled with grout or a sand-cement mixture or by tamping soil into the holes to approximately the bulk density of the surrounding overburden, unless otherwise specified in Section 18 of this specification.

9. Drilling rock

The location, inclination, and depth of holes shall be as shown on the drawings or as directed by the engineer.

Rod dope, grease, and other solid or liquid lubricants are not permitted.

The contractor shall perform such exploratory drilling as may be required to determine the condition of the rock before grouting and the effectiveness of the grouting operation as the work progresses. All exploratory holes shall be cored and shall be pressure tested when directed by the engineer. Exploratory holes shall be drilled with an N-size core barrel as specified in section 3 of this specification. Rock core samples shall be carefully placed in correct sequence in labeled core boxes furnished by the contractor. The contractor shall transport the core boxes to the location designated in section 18 of this specification.

Unless otherwise specified, grout holes shall have a diameter not less than 2 15/16 inches (NX).

10. Washing grout holes

When authorized by the engineer and prior to grout injection, grout holes shall be washed with water and air to remove mud, drill cuttings, and other materials that will interfere with the grout take of the hole. Grout holes to be washed and the sequence of washing shall be approved by the engineer. Washing under pressure using packers or pressure testing shall be performed when specified. Washing time for each hole shall be approved by the engineer.

If mud is moved into a hole by grouting nearby holes after the hole has been washed, the mud

will be removed by rewashing the hole.

The air and water pressure will be adjusted to provide the maximum cleaning condition for the holes as determined by the engineer. Water and air shall be introduced simultaneously under pressure and at the same elevation in the hole. The water pump shall be capable of producing 200 gpm of water at a minimum of 100 pounds per square inch. The air supply shall be capable of furnishing a minimum of 200 cubic feet per minute at 100 pounds per square inch.

Unless approved by the engineer, no holes within 100 feet of a previously grouted hole shall be washed unless the grout has been placed for at least 48 hours.

11. Pressure testing

In holes to be pressure tested, the packer or packers shall be set at intervals as directed by the engineer. Each interval shall be tested at water pressures up to the specified design grouting pressure for that interval, unless otherwise directed by the engineer. Pressures exceeding the specified design pressures shall not be applied unless specifically authorized by the engineer.

The flow shall be read at 1 minute intervals. The test is completed when the rate of take is steady for at least 3 consecutive minutes at the maximum pressure for the section being tested. The flow readings shall be recorded on a form supplied by or approved by the NRCS.

Pressure test equipment shall be calibrated at the site to determine the pressure loss in the equipment at various flow rates and test depths. Pressure tests and calibration of pressure test equipment shall be performed in the presence of the engineer.

12. Packer and stage grouting

For packer grouting, the holes shall be drilled to the total depths and shall be grouted in lifts starting at the bottom. If the drill water is lost completely, the hole shall be grouted at that depth and drilling continued not less than 24 hours after grouting. The packer lifts and related pressures shall be as specified except as otherwise directed by the engineer.

If stage grouting becomes necessary, it shall be performed in successive depth intervals (stages) in each hole beginning at the rock surface and progressing to the deeper stages. All of the holes in a specified area shall be drilled and grouted in each stage before grouting of the succeeding stage is begun. The stages and the grouting pressures for each stage shall be as specified unless otherwise directed by the engineer.

Each stage of a hole shall be washed with water and air simultaneously and immediately before grouting. Washing under pressure or pressure testing shall be performed as specified in section 10 of this specification.

13. Grout injection

The pumping rate shall not exceed 3 cubic feet per minute unless otherwise approved by the engineer. Grout pressures shall be as specified in section 18 of this specification, but shall not exceed the refusal pressures shown as follows:

Grout refusal pressures for mix ratios

Rock cover (ft)	----- Gauge pressure at collar in PSI for the mix ratios (by volume) -----							
	1:1:2	1:1:1	1:1:3/5	1:1 W:C	2:1	3:1	5:1	water
5	1	1	1	1	1	1	2	3
10	1	1	2	2	3	3	4	5
20	1	2	3	5	7	8	9	10
40	8	12	14	17	21	23	26	30
60	22	26	28	34	40	43	46	52
80	36	41	44	52	60	64	68	75
100	50	56	60	70	80	84	90	99

- Notes:**
- (1) 1:1:3/5 = 5 water : 5 cement : 3 sand
 - (2) Overburden counts as 50% rock cover (10 feet of overburden = 5 feet of rock cover)
 - (3) For depths and mix ratios other than those shown, linear interpolation shall be made to determine maximum pressure.

Grouting, particularly in zones near the surface, shall be accomplished with extreme caution to prevent uplift of the rock or excessive leakage at the surface.

The contractor shall caulk surface cracks that allow excessive loss of grout. Cracks may be caulked by mechanical means or with fast setting mortar. If necessary, grouting shall be temporarily suspended or the pressure shall be reduced to permit the caulking of leaks. Accelerators may be added to the grout for the same purpose if approved by the engineer.

If grout injected into one hole appears in adjacent holes, the interconnected holes shall be plugged temporarily with packers set just above the level at which the grout is entering. Holes grouted by interconnection shall be split spaced.

The quantity of grout prepared in advance shall be kept to a minimum. Grout that has remained in the mixer or holdover tank with or without agitation for more than an hour shall be discarded.

Grout temperatures shall be no lower than 50 degrees Fahrenheit. The grouted soil, rock, or concrete shall be no colder than 40 degrees Fahrenheit when grout is injected and for at least 48 hours thereafter. Insulation or heat shall be applied to the surface for 24 hours before grouting and 48 hours after if required to keep the soil, rock, or concrete above the minimum required temperature.

When the hole shows signs of refusal, a thinner mix shall be used to prevent or remove clogging.

A hole shall be considered grouted when the grout take at the design pressure is less than 1 cubic foot of grout in 10 minutes.

If a hole continues to accept grout after a specified amount of the thickest workable grout mixture has been injected, the engineer may specify a reduced pump speed and/or the use of accelerators, or may direct that the pumping be halted temporarily to permit the grout to set. In which case, the hole shall be flushed with about 5 to 8 cubic feet of water and rested for at least 4 hours.

Grouting shall be discontinued in holes that do not respond to the above procedure. The holes

shall be redrilled and regouted later, or the area of high grout absorption shall be grouted from adjacent holes until the design objective has been achieved.

14. Grouting procedure

The procedures and grout mixes described below are general guidelines and may be altered in the field by the engineer to suit the conditions encountered and to meet the design objectives.

Unless on-the-site experience indicates otherwise and in lieu of pressure testing, each stage or lift of a hole to be grouted shall be started with about 15 cubic feet (three batches) of water:cement mix to be no thinner than 5:1 (w:c), by volume, unless otherwise specified in section 18 of this specification.

If the hole continues to take grout at a pumping rate not to exceed 3 cubic feet per minute and at a pressure equal to or less than specified as refusal pressure, the mix ratio shall be changed to 3:1 (w:c). If the majority of the holes accept the 3:1 without signs of slowdown in the rate of take, holes in that stage or location may be started with a 3:1 instead of the 5:1 mix. A change to a different location or stage may require a return to the 5:1 starter mix.

Grout mixes shall be thickened from 5:1 to 3:1 to 2:1 to 1:1 after which sand and/or fly ash shall be added to the mix in a graduated manner (5:5:1S, 5:5:2S, ...). The water-cement ratio shall not be less than one.

15. Records

Unless otherwise specified, the contractor shall keep drilling logs and complete records of all grouting operations. These records include time logs of grout mixes and admixtures used in each stage or lift for each hole, related pressures and pumping rates, back-pressures, and observations on excessive leakage and other nonroutine conditions. The drilling log shall include date, hole location, depth of rock, and depths to various rock features. Rock features shall be described as hard, soft, weathered, cracks, or cavities. The contractor quality control activities are outlined in Construction Specification 94, when applicable.

Unless otherwise specified, the contractor shall cooperate in providing all information related to drilling and grouting activities required by the contract.

Unless otherwise specified, one copy of the records shall be provided the engineer at the completion of each shift.

16. Cleanup

After grouting is completed, the contractor shall remove the grouting plant and all related parts, equipment, and supplies from the site. The cleanup includes unused materials and waste.

17. Measurement and payment

For items of work for which specific unit prices or lump sum prices are established in the contract, measurement and payment for pressure grouting is made as described below. Such payment will constitute full compensation for all labor, materials, equipment, and all other items necessary and incidental to the completion of the work.

Mobilization—Payment for mobilization is made at the contract lump sum price. Such payment will include compensation for moving grouting equipment and supplies to the site of the work,

assembling the plant at the site, moving on the site as work progresses, and removal from the site upon completion of the work. Sixty percent of the lump sum price will be paid when the plant is assembled at the site and grouting work is begun. The remaining 40 percent will be paid after the work is completed, the plant is removed from the site, and cleanup is complete.

Drilling overburden—Drilling overburden is measured by determining to the nearest foot the total linear feet of accepted hole drilled in the overburden. Payment for drilling overburden is made at the contract unit price, which will include compensation for placing and removing casings.

Drilling rock—Drilling rock is measured by determining to the nearest foot the total linear feet of accepted hole of each size drilled in rock without coring. Payment for drilling rock is made at the contract unit price for each size of hole.

Coring rock—Coring rock is measured by determining to the nearest foot the total linear feet of accepted hole of each size cored in rock. Payment for coring rock is made at the contract unit price for each core size, which will include compensation for furnishing and handling the core boxes, storing cores, and recording observations as specified.

Pressure tests—Pressure testing is measured by determining the total time to the nearest quarter hour that pressure is applied to the holes in making the required tests. A quarter hour will be added for setting up equipment for each testing period. No extra payment will be made for calibrating pressure test equipment. Payment for pressure tests is made at the contract unit price.

Washing grout holes—Measurement for payment is determined by the total time, to the nearest one-tenth hour, that water is actually applied to the hole. No extra payment will be made for setting up equipment. Payment for washing grout holes is made at the contract unit price.

Connections to grout holes—Connections to grout holes are measured by determining the number of connections made of the grout supply hose to the holes to be grouted. The number of connections for payment will not exceed one per hole for packer grouting or one for each stage for stage grouting. The exception is if grouting is interrupted to permit the grout to set, then one additional connection will be measured for payment each time grouting at the same elevation in the same hole is resumed. Payment for connections to grout holes is made at the contract unit price.

Placing grout—Grout placed is measured to the nearest cubic foot by counting the number of batches of each grout mixture injected in the holes as specified and multiplying by the number of cubic feet per batch. The number of cubic feet per batch for each grout mixture is determined as the average of the measured volumes of at least three batches of the mixture, or it is calculated as the sum of the absolute volumes of water, cement, sand, and bulk fillers used in the mixture. Absolute volume is defined as:

$$\frac{\text{weight (lb) of material}}{\text{bulk specific gravity of material} \times 62.4}$$

Admixtures shall not be considered in determining batch volume. The weight and specific gravity for sand shall be based on saturated surface dry conditions.

Payment for placing grout is made at the contract unit price, which includes compensation for

handling all materials for the purpose of mixing and placing grout, sealing surface leaks, and maintaining grout records. Payment is not made for grout lost by failure of the contractor to caulk surface leaks or for grout otherwise wasted because of the actions of the contractor.

Cement—Cement for grout is measured on the basis of the number of bags of cement (94 lb) or equivalent weight of bulk cement used in the grout. Cement used in concrete for capping or other purposes is not included. Payment for cement is made at the contract unit price. Payment is not made for cement in grout wasted because of mechanical failure or the actions of the contractor.

Sand and bulk fillers—Sand and bulk fillers are measured by volume or equivalent weight, adjusted for moisture content where applicable, to the nearest cubic foot of each used in the grouting operation. Payment is made at the contract unit price for sand and each type of bulk filler specified. Payment is not made for sand or bulk filler wasted because of mechanical failure or the actions of the contractor.

Admixtures—Liquid admixtures are measured by volume to the nearest gallon. Dry admixtures are measured by weight to the nearest pound. Payment for admixtures is made at the contract unit price for each type of admixture specified. Payment is not made for admixtures wasted because of mechanical failure or the actions of the contractor.

Grout caps and concrete slabs—Capping and slab concrete are measured to the nearest 0.1 cubic yard by determining the combined weights of cement, aggregates, and water used in concrete mixed and placed as specified, and dividing by a unit weight of 4,000 pounds per cubic yard. Payment for capping concrete is made at the contract unit price, which includes compensation for furnishing and handling all materials (including cement) and for mixing, transporting, placing, and curing the concrete.

Subsidiary items—Compensation for any item of work described in the contract, but not listed in the bid schedule is included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in section 18 of this specification.

18. Items of work and construction details

A. Bid Item 4, Grouting

(1) This item shall consist of pumping grout into the annulus of 9 to 12 inch diameter vertically drilled holes with railroad rails centered inside them with water-cement grout for the full depth of the hole.

(2) Section 2, Material, no bulk fillers or admixtures are required.

(3) Section 7, Concrete shall be placed only when NRCS representative is present.

(4) Section 9, Drilling rock, drilled holes shall be 9 to 12 inch diameter.

(5) Section 10, Washing grout holes.

a. Auger clean out of bore holes will be the method.

b. Holes within 2.5 feet of a previously grouted hole maybe shall be washed if dewatering measures are in place around the hole.

(6) Section 11, Pressure testing, no pressure water washing will be required.

(7) Section 12, Packer and stage grouting, no caulking of surface cracks is required.

(8) Section 14, Grouting procedure.

a. Grout shall be placed only when NRCS representative is present.

b. Site shall be adequately dewatered before grout placement.

c. Water cement mix shall be no thinner than 5:1 (w:c), by volume.

d. Drilled holes shall be dewatered then grout may be placed. Tremie method of allowing grout to displace water from the drilled holes is not allowed.

e. Straw bale/plastic berm or other equivalent method will be used to berm the drilled holes during grouting.

(9) Section 17, Measurement and payment.

a. Grout placed is measured to the nearest 0.1 cubic yard (CY).

b. Payment for placing grout is made at the contract unit price, which includes compensation for handling all materials for the purpose of mixing and placing grout.

c. Payment is not made for grout otherwise wasted because of the actions of the Contractor.

B. Subsidiary Item, Cement

- (1) This item shall consist of furnishing and supplying cement to batch grout used to backfill drill holes with railroad rails inserted in them.
- (2) In Section 6, Measurement and Payment, no separate payment will be made for cement used to batch grout. Compensation for cement shall be included in the payment for Bid Item 4, Grouting.

C. Subsidiary Item, Water

- (1) This item shall consist of furnishing and supplying water to batch grout used to backfill drill holes with railroad rails inserted in them.
- (2) In Section 6, Measurement and Payment, no separate payment will be made for water used to batch grout. Compensation for water shall be included in the payment for Bid Item 4, Grouting.

D. Subsidiary Item, Removal of Water

- (1) Construction Specification 11—Removal of Water.

Construction Specification 61—Rock Riprap

1. Scope

The work shall consist of the construction of rock riprap revetments and blankets, including filter or bedding where specified.

2. Material

Rock riprap shall conform to the requirements of Material Specification 523, Rock for Riprap, or if so specified, shall be obtained from designated sources. It shall be free from dirt, clay, sand, rock fines, and other material not meeting the required gradation limits.

At least 30 days before rock is delivered from other than designated sources, the contractor shall designate in writing the source from which rock material will be obtained and provide information satisfactory to the contracting officer that the material meets contract requirements. The contractor shall provide the contracting officer's technical representative (COR) free access to the source for the purpose of obtaining samples for testing. The size and grading of the rock shall be as specified in section 8.

Rock from approved sources shall be excavated, selected, and processed to meet the specified quality and grading requirements at the time the rock is installed.

Based on a specific gravity of 2.65 (typical of limestone and dolomite) and assuming the individual rock is shaped midway between a sphere and a cube, typical size/weight relationships are:

Sieve size of rock	Approx. weight of rock	Weight of test pile
16 inches	300 pounds	6,000 pounds
11 inches	100 pounds	2,000 pounds
6 inches	15 pounds	300 pounds

When specified in Section 8 or when it is necessary to verify the gradation of the rock riprap, a particle size analysis shall be performed in accordance with ASTM D5519, Test Method A or B. The analysis shall be performed at the work site on a test pile of representative rock. The mass of the test pile shall be at least 20 times the mass of the largest rock in the pile. The results of the test shall be compared to the gradation required for the project. Test pile results that do not meet the construction specifications shall be cause for the rock to be rejected. The test pile that meets contract requirements shall be left on the job site as a sample for visual comparison. The test pile shall be used as part of the last rock riprap to be placed.

Filter or bedding aggregates when required shall conform to Material Specification 521, Aggregates for Drainfill and Filters, unless otherwise specified. Geotextiles shall conform to Material Specification 592, Geotextile.

3. Subgrade preparation

The subgrade surface on which the rock riprap, filter, bedding, or geotextile is to be placed shall be cut or filled and graded to the lines and grades shown on the drawings. When fill to subgrade lines is required, it shall consist of approved material and shall conform to the requirements of the specified class of earthfill.

Rock riprap, filter, bedding, or geotextile shall not be placed until the foundation preparation is completed and the subgrade surface has been inspected and approved.

4. Equipment-placed rock riprap

The rock riprap shall be placed by equipment on the surface and to the depth specified. It shall be installed to the full course thickness in one operation and in such a manner as to avoid serious displacement of the underlying material. The rock for riprap shall be delivered and placed in a manner that ensures the riprap in place is reasonably homogeneous with the larger rocks uniformly distributed and firmly in contact one to another with the smaller rocks and spalls filling the voids between the larger rocks. Some hand placing may be required to provide a neat and uniform surface.

Rock riprap shall be placed in a manner to prevent damage to structures. Hand placing is required as necessary to prevent damage to any new and existing structures.

5. Hand placed rock riprap

The rock riprap shall be placed by hand on the surface and to the depth specified. It shall be securely bedded with the larger rocks firmly in contact one to another without bridging. Spaces between the larger rocks shall be filled with smaller rocks and spalls. Smaller rocks shall not be grouped as a substitute for larger rock. Flat slab rock shall be laid on its vertical edge except where it is laid like paving stone and the thickness of the rock equals the specified depth of the riprap course.

6. Filter or bedding

When the contract specifies filter, bedding, or geotextile beneath the rock riprap, the designated material shall be placed on the prepared subgrade surface as specified. Compaction of filter or bedding aggregate is not required, but the surface of such material shall be finished reasonably smooth and free of mounds, dips, or windrows.

7. Measurement and payment

Method 1—For items of work for which specific unit prices are established in the contract, the quantity of each type of rock riprap placed within the specified limits is computed to the nearest ton by actual weight. The volume of each type of filter or bedding aggregate is measured within the specified limits and computed to the nearest cubic yard by the method of average cross-sectional end areas. For each load of rock riprap placed as specified, the contractor shall furnish to the COR a statement-of-delivery ticket showing the weight to the nearest 0.1 ton.

Payment is made at the contract unit price for each type of rock riprap, filter, or bedding. Such payment is considered full compensation for completion of the work.

Method 2—For items of work for which specific unit prices are established in the contract, the quantity of each type of rock riprap placed within the specified limits is computed to the nearest 0.1 ton by actual weight. The quantity of each type of filter or bedding aggregate delivered and placed within the specified limits is computed to the nearest 0.1 ton. For each load of rock riprap placed as specified, the contractor shall furnish to the engineer a statement-of-delivery ticket showing the weight to the nearest 0.1 ton. For each load of filter or bedding aggregate, the contractor shall furnish to the COR a statement-of-delivery ticket showing the weight to the nearest 0.1 ton.

Payment is made at the contract unit price for each type of rock riprap, filter, or bedding. Such payment is considered full compensation for completion of the work.

Method 3—For items of work for which specific unit prices are established by the contract, the volume of each type of rock riprap and filter or bedding aggregate is measured within the specified limits and computed to the nearest cubic yard by the method of average cross-sectional end areas.

Payment is made at the contract unit price for each type of rock riprap, filter, or bedding. Such payment is considered full compensation for completion of the work.

Method 4—For items of work for which specific unit prices are established by the contract, the volume of each type of rock riprap, including filter and bedding aggregate, is measured within the specified limits and computed to the nearest cubic yard by the method of average cross-sectional end areas.

Payment is made at the contract unit price for each type of rock riprap, including filter and bedding. Such payment is considered full compensation for completion of the work.

Method 5—For items of work for which specific unit prices are established by the contract, the quantity of each type of rock riprap placed within the specified limits is computed to the nearest ton by actual weight. For each load of rock for riprap placed as specified, the contractor shall furnish to the COTR a statement-of-delivery ticket showing the weight to the nearest 0.1 ton.

Payment is made at the contract unit price for each type of rock riprap, and includes compensation for any aggregate or geotextile installed as specified for filter or bedding. Such payment is considered full compensation for completion of the work.

Method 6—For items of work for which specific unit prices are established by the contract, the volume of each type of rock riprap is measured within the specified limits and computed to the nearest cubic yard by the method of average cross-sectional end areas.

Payment is made at the contract unit price for each type of rock riprap, and includes compensation for any aggregate or geotextile installed as specified for filter or bedding. Such payment is considered full compensation for completion of the work.

All methods—The following provision applies to all methods of measurement and payment. Compensation for any item of work described in the contract, but not listed in the bid schedule, is included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in section 8.

No separate payment is made for testing the gradation of the test pile. Compensation for testing is included in the appropriate bid item for riprap.

8. Items of work and construction details. The item of work to be performed in conformance with this specification and construction details is:

(A) All Bid Items in this specification.

(1) In Section 2, Materials, the rock shall be furnished from a KY DOH approved aggregate source.

(2) In Section 4, Equipment - Placed Rock Riprap, the rock riprap shall be equipment placed and no stockpiling of rock riprap will be allowed unless approved during construction. The maximum height of drop when placing the rock riprap shall be five feet.

(3) In Section 7, Measurement and Payment, method 2 will apply. No filter or bedding aggregate will be required.

(B) Bid Item 5, Rock Riprap, Class II channel lining.

(1) This item shall consist of all rock riprap necessary to install works of improvements shown on the plans and as located by the engineer during construction.

(2) In Section 2, Materials, rock riprap gradation shall meet the requirements of KY DOH Class II channel lining.

(C) Subsidiary Item, DOH No 8's

(1) In Section 2, Materials, rock riprap gradation shall meet the requirements of KY DOH, No 8's.

(2) In Section 7, Measurement and Payment, separate payment will not be made for this item. Compensation will be considered as included in the payment for:

(a) Bid Item 6, Steel, Railroad Rail Piling.

Construction Specification 81—Metal Fabrication and Installation

1. Scope

The work consists of furnishing, fabricating, and erecting metalwork, including the metal parts and fasteners of the composite structures.

2. Material

Unless otherwise specified, material shall conform to the requirements of Material Specification 581, Metal. Steel shall be structural quality unless otherwise specified. Castings shall be thoroughly cleaned and subjected to careful inspection before installation. Finished surfaces shall be smooth and true to assure proper fit. Galvanizing shall conform to the requirements of Material Specification 582, Galvanizing.

3. Fabrication

Fabrication of structural steel shall conform to the requirements of Specification for the Design, Fabrication and Erection of Structural Steel for Buildings (Riveted, Bolted and Arc-Welded Construction), American Institute of Steel Construction.

Fabrication of structural aluminum shall conform to the requirements in the Aluminum Design Manual available from The Aluminum Association.

4. Erection

The frame of metal structures shall be installed true and plumb. Temporary bracing shall be placed wherever necessary to resist all loads to which the structure may be subjected, including those applied by the installation and operation of equipment. Such bracing shall be left in place as long as may be necessary for safety.

As erection progresses the work shall be securely bolted up, or welded, to resist all dead load, wind, and erection stresses. The contractor shall furnish such installation assisting bolts, nuts, and washers as may be required.

No riveting or welding shall be performed until the structure is stiffened and properly aligned.

Rivets driven in the field shall be heated and driven with the same care as those driven in the shop.

All field welding shall be performed in conformance to the requirements for shop fabrication except those that expressly apply to shop conditions only.

5. Protective coatings

Items specified to be galvanized shall be completely fabricated for field assembly before the application of the zinc coatings. Galvanized items shall not be cut, welded, or drilled after the zinc coating is applied.

Items specified to be painted shall be painted in conformance to the requirements of Construction Specification 82 for the specified paint systems.

6. Measurement and payment

Method 1—The work is not measured. Payment for metal fabrication and installation is made at the contract lump sum price in the contract. Such payment constitutes full compensation for all labor, equipment, material, and all other items necessary and incidental to the completion of the work including connectors and appurtenances, such as rivets, bolts, nuts, pins, studs, washers, hangers, and weld metal.

Method 2—The weight of metal installed complete in place shall be determined to the nearest pound. Unless otherwise specified, the weight of metal shall be computed by the method specified in section 3 of the Code of Standard Practice for Steel Buildings and Bridges, American Institute of Steel Construction, except that the following unit weights shall also be used, as appropriate, as the basis of computation:

Material	Unit weight (lb/ft ³)
Aluminum alloy	173
Bronze or copper alloy	536
Iron, malleable	470
Iron, wrought	487

Payment for furnishing, fabricating, and installing metalwork is made at the contract unit price for the specified types of labor, material, equipment, and all other items necessary and incidental to the completion of the work.

Method 3—The work is not measured. Payment for furnishing, fabricating, and installing each item of metalwork is made at the contract price for that item. Such payment constitutes full compensation for all labor, equipment, material, and all other items necessary and incidental to the completion of the work including connectors and appurtenances, such as rivets, bolts, nuts, pins, studs, washers, hangers, and weld metal.

All methods—The following provisions apply to all methods of measurement and payment. Compensation for any item of work described in the contract, but not listed in the bid schedule, is included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in section 7 of this specification.

7. Items of work and construction details

The item of work to be performed in conformance with this specification and construction details is:

(A) Bid Item 6, Steel, Railroad Rail Piling.

(1) This item shall consist of furnishing and placing steel piling as shown on the drawings and as determined during construction.

(2) In Section 2, Materials, steel piling shall be used railroad rails with a minimum nominal weight of 130 pounds per yard shall be used. All rails shall be straight and structurally sound. Rails shall not be spliced.

(3) In Section 4, Erection. The railroad rails shall be installed in drilled sockets into bedrock. Each hole shall serve as a sounding for the rail installed into it. The drilled socket shall be of adequate size to allow free insertion of the rail road rail, but shall be no more than 12 inches diameter.

(4) In Section 4, Erection. After each hole is filled, the steel piling shall immediately be installed with the flanges positioned perpendicular to the direction of the slope failure. The drilled auger hole shall then be backfilled. The hole shall be free from auger tailings or other material before grouting.

(5) In Section 6, Measurement and Payment, Payment shall be by the nearest linear foot installed. Such Payment shall constitute full compensation for the related subsidiary items.

(B) Bid Item 7, Steel, Guard Rail Lagging.

(1) This item shall consist of furnishing and placing the steel lagging as shown on the drawings and as determined during construction.

(2) In Section 2, Materials, steel lagging shall consist of used steel "W" beam- single faced guardrail as specified in Kentucky Department of Highways Standards Specifications for Road and Bridge Construction, section 814.

(3) In Section 4, Erection. The steel lagging shall extend one foot below existing channel bottom unless solid rock is encountered, then steel lagging shall extend to solid rock only.

(4) In Section 4, Erection. The steel lagging shall be attached to the piling before any backfilling with a maximum of a 2" horizontal gap between steel lagging.

(5) In Section 6, Measurement and Payment, Payment shall be by the nearest linear foot (L/F/) installed. Such Payment shall constitute full compensation for the related subsidiary items.

(C) Items subsidiary to these bid items:

- (1) Construction Specification 3 Structure Removal
- (2) Construction Specification 5, Pollution Control
- (3) Construction Specification 9, Traffic Control
- (4) Construction Specification 11, Removal of Water
- (5) Construction Specification 21, Excavation
- (6) Construction Specification 61, DOH No 8's

Construction Specification 95—Geotextile

1. Scope

This work consists of furnishing all material, equipment, and labor necessary for the installation of geotextiles.

2. Quality

Geotextiles shall conform to the requirements of Material Specification 592 and this specification.

3. Storage

Before use, the geotextile shall be stored in a clean, dry location out of direct sunlight, not subject to extremes of either hot or cold temperatures, and with the manufacturer's protective cover undisturbed. Receiving, storage, and handling at the job site shall be in accordance with the requirements listed in ASTM D 4873.

4. Surface preparation

The surface on which the geotextile is to be placed shall be graded to the neat lines and grades as shown on the drawings. It shall be reasonably smooth and free of loose rock and clods, holes, depressions, projections, muddy conditions, and standing or flowing water (unless otherwise specified in section 7 of this specification).

5. Placement

Before the geotextile is placed, the soil surface will be reviewed for quality assurance of the design and construction. The geotextile shall be placed on the approved prepared surface at the locations and in accordance with the details shown on the drawings and specified in section 7 of this specification. It shall be unrolled along the placement area and loosely laid, without stretching, in such a manner that it conforms to the surface irregularities when material or gabions are placed on or against it. The geotextile may be folded and overlapped to permit proper placement in designated area(s).

Method 1—The geotextile shall be joined by machine sewing using thread material meeting the chemical requirements for the geotextile fibers or yarn. Thread shall be polypropylene, polyester, or Kevlar™ aramid thread, unless a specific thread type is specified. The thread shall consist of two parallel stitched rows at a spacing of about 1 inch and shall not cross (except for any required re-stitching). The stitching shall be a lock-type stitch. Each row of stitching shall be located a minimum of 2 inches from the geotextile edge. Unless otherwise specified, the seam tensile strength as measured according to ASTM D4884 shall be a minimum of 90 percent of the geotextile tensile strength in the weakest principal direction as measured according to ASTM D4632.

The geotextile shall be temporarily secured during placement of overlying material to prevent slippage, folding, wrinkling, or other displacement of the geotextile. Unless otherwise specified, methods of securing shall not cause punctures, tears, or other openings to be formed in the geotextile.

Method 2—The geotextile shall be joined by overlapping a minimum of 18 inches (unless otherwise specified) and secured against the underlying foundation material. Securing pins, approved and provided by the geotextile manufacturer, shall be placed along the edge of the panel or roll material to adequately hold it in place during installation. Pins shall be steel or fiberglass formed as a **U**, **L**, or **T** shape or contain "ears" to prevent total penetration through the geotextile. Steel washers shall be provided on all but the U-shaped pins. The upstream or upslope geotextile shall overlap the abutting downslope geotextile. At vertical laps, securing pins shall be inserted through the bottom layers along a line through approximately the mid-point of the overlap. At horizontal laps and across slope laps, securing shall be inserted through the bottom layer only. Securing pins shall be placed along a line about 2 inches in from the edge of the placed geotextile at intervals not to exceed 12 feet unless otherwise specified. Additional pins shall be installed as necessary and where appropriate to prevent any undue slippage or movement of the geotextile. The use of securing pins will be held to the minimum necessary. Pins are to remain in place unless otherwise specified.

Should the geotextile be torn or punctured, or the overlaps or sewn joint disturbed, as evidenced by visible geotextile damage, subgrade pumping, intrusion, or grade distortion, the backfill around the damaged or displaced area shall be

removed and restored to the original approved condition. The repair shall consist of a patch of the same type of geotextile being used and overlaying the existing geotextile. When the geotextile seams are required to be sewn, the overlay patch shall extend a minimum of 1 foot beyond the edge of any damaged area and joined by sewing as required for the original geotextile except that the sewing shall be a minimum of 6 inches from the edge of the damaged geotextile. Geotextile panels joined by overlap shall have the patch extend a minimum of 2 feet from the edge of any damaged area.

Geotextile shall be placed in accordance with the following applicable specification according to the use indicated in section 7:

Slope protection—The geotextile shall not be placed until it can be anchored and protected with the specified covering within 48 hours or protected from exposure to ultraviolet light. In no case shall material be dropped on uncovered geotextile from a height of more than 3 feet.

Subsurface drains—The geotextile shall not be placed until drainfill or other material can be used to provide cover within the same working day. Drainfill material shall be placed in a manner that prevents damage to the geotextile. In no case shall material be dropped on uncovered geotextile from a height of more than 5 feet.

Road stabilization—The geotextile shall be unrolled in a direction parallel to the roadway centerline in a loose manner permitting conformation to the surface irregularities when the roadway fill material is placed on its surface. In no case shall material be dropped on uncovered geotextile from a height of more than 5 feet. Unless otherwise specified, the minimum overlap of geotextile panels joined without sewing shall be 24 inches. The geotextile may be temporarily secured with pins recommended or provided by the manufacturer, but they shall be removed before the permanent covering material is placed.

6. Measurement and payment

Method 1—For items of work for which specific unit prices are established in the contract, the quantity of geotextile for each type placed within the specified limits is determined to the nearest specified unit by measurements of the covered surfaces only, disregarding that required for anchorage, seams, and overlaps. Payment is made at the contract unit price. Such payment constitutes full compensation for the completion of the work.

Method 2—For items of work for which specific unit prices are established in the contract, the quantity of geotextile for each type placed with the specified limits is determined to the nearest specified unit by computing the area of the actual roll size or partial roll size installed. The computed area will include the amount required for overlap, seams, and anchorage as specified. Payment is made at the contract unit price. Such payment constitutes full compensation for the completion of the work.

Method 3—For items of work for which specific lump sum prices are established in the contract, the quantity of geotextile is not measured for payment. Payment for geotextiles is made at the contract lump sum price and constitutes full compensation for the completion of the work.

All methods—The following provisions apply to all methods of measurement and payment. Compensation for any item of work described in the contract, but not listed in the bid schedule, is included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in section 7 of this specification.

7. Items of work and construction details

The items of work to be performed in conformance with this specification and the construction details is:

(A) Bid Item 8, Geotextile.

(1) This item shall consist of furnishing and placing the non-woven geotextile fabric for French drain as shown on the drawings and as determined during construction.

(2) In Section 5, Placement, joining of sections of geotextile shall be by method 2.

(3) In Section 5, Placement, geotextile shall be placed by the Subsurface drains method except maximum drop height is 6”.

(4) In Section 2, Quality, the geotextile shall be non-woven, needle punched, class I geotextile, in accordance Material Specification 592, "Geotextile".

(5) In Section 6, Measurement and Payment, Method 2 will apply.

Construction Specification 3—Structure Removal

1. Scope

The work shall consist of the removal, salvage, and disposal of structures (including fences) from the designated areas.

2. Marking

Method 1—Each structure or structure part to be removed will be marked with stakes, flags, paint, or other suitable method.

Method 2—The area boundaries from which structures must be removed will be marked using stakes, flags, paint, or other suitable method. Structures to remain undisturbed or to be salvaged will be designated by special markings.

3. Removal

Method 1—All structures designated for removal in the contract shall be removed to the specified extent and depth.

Method 2—Within the areas so marked, all visible and buried structures identified shall be removed to the specified extent and depth.

4. Salvage

Structures or structure parts that are designated to be salvaged shall be carefully removed and neatly placed in the specified or approved storage location. Salvaged structures that are capable of being disassembled shall be dismantled into individual members or sections. Such structures shall be neatly and systematically match marked with paint before disassembly. All connectors and other parts shall be marked to indicate their proper location within the structure and shall be fastened to the appropriate structural member or packed in suitable containers.

Material from fences designated to be salvaged shall be placed outside the work area on the property on which the fence was originally located. Fence wire shall be rolled into uniform rolls of suitable size and neatly piled with other salvaged materials. Posts and rails shall be neatly stacked.

5. Disposal of refuse materials

Refuse materials resulting from structure removal shall be disposed of in a manner and at locations specified in section 7 of this specification or in an acceptable manner and at locations approved by the contracting officer. Disposal by burning shall be in accordance with local rules and regulations.

6. Measurement and payment

Method 1—For items of work for which specific unit prices are established by the contract, payment for the removal of each structure unit, except fences, is made at the contract unit price. Fences removed or removed and salvaged are measured to the nearest linear foot. Payment for fence removal or removal and salvage is made at the contract unit prices for each type and size of fence.

Such payment will constitute full compensation for all labor, equipment, tools, applicable permits and associated fees for burning and disposal of refuse, and all other items necessary and incidental to the completion of the work.

Method 2—For items of work for which specific lump sum prices are established by the contract, payment for structure removal is made at the contract lump sum price.

Such payment will constitute full compensation for all labor, equipment, tools, applicable permits and associated fees for burning and disposal of refuse, and all other items necessary and incidental to the completion of the work.

All Methods—The following provisions apply to all methods of measurement and payment. Compensation for any item of work described in the contract, but not listed as a contract line item number in the bid schedule, is included in the payment for the item of work to which it is made subsidiary. Such items and items to which they are made subsidiary are identified in section 7 of this specification.

7. Items of work and construction details

The item of work to be performed in conformance with this specification and construction details is:

(A) Subsidiary Item, Structure Removal

- (1) This item shall consist of the removal man made debris in the excavation area as shown on the drawings and as determined in the field during construction.
- (2) In Section 2, Marking, marking shall be by Method 1, and as detailed on the drawings.
- (3) In Section 3, Removal, removal shall be by Method 1, and as detailed on the drawings.
- (4) In Section 4, Salvage, salvage will not be required.
- (5) In Section 5, Disposal of Refuse Materials, the contractor shall remove refuse materials resulting from debris removal from the construction site and shall dispose of them at sites of his own choosing away from the work site in a manner that satisfies state and local regulations.
- (6) In Section 6, Measurement and Payment, separate payment will not be made for this item. Compensation will be considered as included in the payment for:
 - (a) Bid Item 1, Debris Removal
 - (b) Bid Item 6, Steel, Railroad Rail Piling
 - (c) Bid Item 7, Steel, Guard Rail Lagging

Construction Specification 5—Pollution Control

1. Scope

The work consists of installing measures or performing work to control erosion and minimize the production of sediment and other pollutants to water and air from construction activities.

The following BioPreferred® product categories are applicable to this specification: — mulch and compost materials

erosion control materials

fertilizers

dust suppressants

agricultural spray adjuvants

2. Material

Silt fence shall conform to the requirement of Materials Specification 592, Geotextile. All other material furnished shall meet the requirements of the material specifications listed in section 8 of this specification.

3. Erosion and sediment control measures and works

The measures and works shall include, but are not limited to, the following:

Staging of earthwork activities—The excavation and moving of soil materials shall be scheduled to minimize the size of areas disturbed and unprotected from erosion for the shortest reasonable time.

Seeding—Seeding to protect disturbed areas shall occur as soon as reasonably possible following completion of that earthwork activity.

Mulching—Mulching to provide temporary protection of the soil surface from erosion.

Diversions—Diversions to divert water from work areas and to collect water from work areas for treatment and safe disposition. They are temporary and shall be removed and the area restored to its near original condition when the diversions are no longer required or when permanent measures are installed.

Stream crossings—Culverts or bridges where equipment must cross streams. They are temporary and shall be removed and the area restored to its near original condition when the crossings are no longer required or when permanent measures are installed.

Sediment basins—Sediment basins collect, settle, and eliminate sediment from eroding areas from impacting properties and streams below the construction site(s). These basins are temporary and shall be removed and the area restored to its original condition when they are no longer required or when permanent measures are installed.

Sediment filters—Straw bale filters or geotextile silt fences trap sediment from areas of limited runoff. Sediment filters shall be properly anchored to prevent erosion under or around them. Silt fences shall be installed and maintained in accordance with ASTM D6462. These filters are temporary and shall be removed and the area restored to its original condition when they are no longer required or when permanent measures are installed.

Waterways—Waterways for the safe disposal of runoff from fields, diversions, and other structures or measures. These works are temporary and shall be removed and the area restored to its original condition when they are no longer required or when permanent measures are installed.

Other—Additional protection measures as specified in section 8 of this specification or required by Federal, State, or local government.

4. Chemical pollution

The contractor shall provide watertight tanks or barrels or construct a sump sealed with plastic sheets to collect and temporarily contain chemical pollutants, such as drained lubricating or transmission fluids, grease, soaps, concrete mixer washwater, or asphalt, produced as a by-product of the construction activities. Pollutants shall be disposed of in accordance with appropriate state and Federal regulations. At the completion of the construction work, tanks, barrels, and sumps shall be removed and the area restored to its original condition as specified in section 8 of this specification. Sump removal shall be conducted without causing pollution.

Sanitary facilities, such as chemical toilets, or septic tanks shall not be located next to live streams, wells, or springs. They shall be located at a distance sufficient to prevent contamination of any water source. At the completion of construction activities, facilities shall be disposed of without causing pollution as specified in section 8 of this specification.

5. Air pollution

The burning of brush or slash and the disposal of other materials shall adhere to state and local regulations.

Fire prevention measures shall be taken to prevent the start or spreading of wildfires that may result from project activities. Firebreaks or guards shall be constructed and maintained at locations shown on the drawings.

All public access or haul roads used by the contractor during construction of the project shall be sprinkled or otherwise treated to fully suppress dust. All dust control methods shall ensure safe construction operations at all times. If chemical dust suppressants are applied, the material shall be a commercially available product specifically designed for dust suppression and the application shall follow manufacturer's requirements and recommendations. A copy of the product data sheet and manufacturer's recommended application procedures shall be provided to the engineer 5 working days before the first application.

6. Maintenance, removal, and restoration

All pollution control measures and temporary works shall be adequately maintained in a functional condition for the duration of the construction period. All temporary measures shall be removed and the site restored to near original condition.

7. Measurement and payment

Method 1—For items of work for which specific unit prices are established in the contract, each item is measured to the nearest unit applicable. Payment for each item is made at the contract unit price for that item. For water or chemical suppressant items used for dust control for which items of work are established in section 8 of this specification, measurement for payment will not include water or chemical suppressants that are used inappropriately or excessive to need. Such payment will constitute full compensation for the completion of the work.

Method 2—For items of work for which lump sum prices are established in the contract, payment is made as the work proceeds and supported by invoices presented by the contractor that reflect actual costs. If the total of all progress payments is less than the lump sum contract price for this item, the balance remaining for this item will be included in the final contract payment. Payment of the lump sum contract price will constitute full compensation for completion of the work.

Method 3—For items of work for which lump sum prices are established in the contract, payment will be prorated and provided in equal amounts on each monthly progress payment estimate. The number of months used for prorating shall be the number estimated to complete the work as outlined in the contractor's approved construction schedule. The final month's prorate amount will be provided with the final contract payment. Payment as described will constitute full compensation for completion of the work.

All Methods—The following provisions apply to all methods of measurement and payment. Compensation for any item of work described in the contract, but not listed in the bid schedule is included in the payment for the item of work to which it is made subsidiary. Such items, and the items to which they are made subsidiary, are identified in section 8 of this specification.

8. Items of work and construction details

Items of work to be performed in conformance with this specification and the construction details therefore is:

(A) Subsidiary Item, Pollution Control

- (1) This item shall consist of all work necessary to control erosion and sediment pollution, chemical pollution and air pollution.
- (2) The Contractor's scheduling shall be made in a manner that will reduce adverse environmental effects. Construction scheduling shall be revised when significant pollution can result due to his planned construction schedule.
- (3) The Contractor shall perform his work in a manner that will reduce erosion and minimize sediments and other pollutants to the water and streams and create a minimum of air pollution consistent with standard construction operations.
- (4) To the maximum extent practicable, all in stream work under this contract shall be performed during conditions of low flow.
- (5) Measures shall be taken to prevent and control spills of fuels, lubricants, or other materials used in construction from entering the stream, drainage way, or water body.
- (6) Should evidence of stream use or jurisdictional wetland impairment and/ or violations of water quality standards occur as a result of this activity either from a spill or other forms of water pollution the Kentucky Division of Water shall be notified immediately and physical, chemical, or biological examination of the water course shall be conducted and reported. In such case(s), additional facilities or alternative measures may be required.
- (7) In Section 5, Air Pollution, as necessary to control dust, water or other dust suppressors shall be applied to prevent excessively dusty conditions along haul and access roads.
- (8) In Section 7, Measurement and Payment, no separate payment will be made for this item. Compensation will be considered as included in the payment for:
 - (a) Bid Item 1, Debris Removal
 - (b) Bid Item 6, Steel, Railroad Rail Piling
 - (c) Bid Item 7, Steel, Guard Rail Lagging

Construction Specification 9—Traffic Control

1. Scope

The work shall consist of establishing traffic control and maintaining safe, convenient use of public roads and rights-of-way.

2. Traffic and access

The contractor's operations shall cause no unnecessary inconvenience to the public. The public rights-of-way shall be maintained at all times unless interruption is authorized by proper local authority. Contractor's authorized closing or detour plans shall be provided to the engineer for approval.

Safe and adequate access shall be provided and maintained to all public protection devices and to all critical utility control locations. Facility access shall be continuous and unobstructed unless otherwise approved.

3. Storage of equipment and material in public streets

Construction materials and equipment shall not be stored or parked on public streets, roads, or highways. During any material or equipment loading or unloading activities that may temporarily interfere with traffic, an acceptable detour shall be provided for the duration of the activity. Any associated expense for this activity is the responsibility of the contractor.

Excavated material, including suitable material that is intended for adjacent trench backfill or other earth backfill as specified in section 5 of this specification, shall not be stored on public streets, roads, or highways that remain in service for the public. Any waiver of this requirement must be obtained from the proper local authority and approved by the engineer. All excess and unsuitable material shall be removed from the site as soon as possible. Any spillage shall be removed from roadways before they are used by the public.

4. Street closures, detours, and barricades

The contractor shall comply with the requirements of all applicable responsible units of government for closure of any street, road, or highway. The contractor shall provide the required barriers, guards, lights, signs, temporary bridges, and flaggers together with informing the public of any detours and construction hazards by the most suitable means available, such as local newspapers or radio stations. The contractor is also responsible for compliance with additional public safety requirements that may arise during construction. The contractor shall furnish, install, and, upon completion of the work, promptly remove all signs, warning devices, and other materials used in the performance of this work.

Unless otherwise specified, the contractor shall notify, in writing, the fire chief, police chief, county sheriff, state patrol, schools that operate school buses, or any other government official as may be appropriate no less than 7 days before closing, partly closing, or reopening any street, road, or highway.

Unless otherwise specified, the contractor shall furnish to the engineer a written plan showing the proposed method of signing, barricading for traffic control, and safety for street detours and closures.

All temporary detours will be maintained to ensure use of public rights-of-way is provided in a safe manner. This may include dust control, grading, and graveling as required in section 7 of this specification.

5. General and specific references

All signs, signals, barricades, use of flaggers, and other traffic control and public safety devices shall conform to the general requirements set forth in the Manual of Uniform Traffic Control Devices (MUTCD) and the latest edition of *Standard Highway Signs and Standard Alphabets for Highway Signs* and/or OSHA *Construction Industry Standards (29 CFR Part 1926), Subpart G, Signs, Signals, and Barricades* unless otherwise specified in section 7 of this specification.

6. Measurement and payment

For items of work for which specific lump sum prices are established in the contract, payment for the work is made at the contract lump sum price. Progress payments will be made based upon the percentage of estimated total time that traffic control will be required unless otherwise specified in section 7 of this specification. Payment will constitute full compensation for all flaggers, labor, materials, equipment, and all other items necessary and incidental to completion of the work.

Compensation for any item of work described in the contract, but not listed in the bid schedule will be included in the payment for the item of work to which it is made subsidiary. Such items and items to which they are made subsidiary are identified in section 7 of this specification.

7. Items of work and construction details

The item of work to be performed in conformance with this specification and construction details is:

A. Subsidiary Item, Traffic Control

- (1) This item shall consist of traffic control as needed to install works of improvement.
- (2) The publication **Guidelines for Traffic Control in Work Zones** shall be followed. This can be obtained at:
 - Kentucky Transportation Center
 - College of Engineering
 - Lexington, KY 40506-0043
- (3) In Section 4, Street Closures, Detours, Barricades, no written plan is required.
- (4) In Section 6, Measurement and Payment, no separate payment will be made for this item. Compensation will be considered as included in the payment for:
 - (a) Bid Item 1, Debris Removal
 - (b) Bid Item 6, Steel, Railroad Rail Piling
 - (c) Bid Item 7, Steel, Guard Rail Lagging

Construction Specification 11—Removal of Water

1. Scope

The work consists of the removal of surface water and ground water as necessary to perform the construction required by the contract in accordance with the specifications. It shall include: (1) constructing, installing, building, and maintaining all necessary temporary water containment facilities, channels, and diversions; (2) furnishing, installing, and operating all necessary pumps, piping, and other facilities and equipment; and (3) removing all such temporary works and equipment after their intended function is no longer required.

2. Diverting surface water

The contractor shall install, maintain, and operate all cofferdams, channels, flumes, sumps, and all other temporary diversion and protective works needed to divert streamflow and other surface water through or around the construction site. Control of surface water shall be continuous during the period that damage to construction work could occur. Unless otherwise specified and/or approved, the diversion outlet shall be into the same drainageway that the water would have reached before being diverted.

The contractor shall furnish the contracting officer, in writing, a proposed plan for diverting surface water before beginning any construction activities for which a diversion is required, unless waived in section 8 of this specification. Acceptance of this plan or the waiving of the plan requirement will not relieve the contractor of the responsibilities related to this activity during the process of completing the work as specified.

3. Dewatering the construction site

Foundations, cutoff trenches, and all other parts of the construction site shall be dewatered and kept free of standing water and muddy conditions as necessary for the proper execution of the work. The contractor shall furnish, install, operate, and maintain all drains, sumps, pumps, casings, well points, and all other equipment required to properly dewater the site as specified. Dewatering systems that cause a loss of soil fines from the foundation areas will not be permitted.

The contractor shall furnish the contracting officer, in writing, a proposed plan for dewatering before commencing with any construction activity for which dewatering may be required, unless waived in section 8 of this specification. Acceptance of this plan or the waiving of the plan requirement will not relieve the contractor of the responsibilities for completing the specified work.

4. Dewatering borrow areas

The contractor shall maintain all borrow areas free of surface water or otherwise provide for timely and effective removal of surface and subsurface water that accumulates within the borrow area, unless waived in section 8 of this specification. Borrow material shall be processed as necessary to achieve proper and uniform moisture content at the time of placement.

If pumping to dewater borrow areas is included as a bid item of work in the bid schedule, each pump discharge pipe shall be equipped with a water meter. The meter shall be such that the measured quantity of water is accurate within 3 percent of the true quantity. The contractor shall provide necessary support to perform accuracy tests of the water meter when requested by the contracting officer.

5. Erosion and pollution control

Removal of water from the construction site, including the borrow areas, shall be accomplished so that erosion and the transporting of sediment and other pollutants are minimized. Dewatering activities shall be accomplished in a manner that the water table water quality is not altered. Pollution control activities shall not conflict with the requirements of Construction Specification 5, Pollution Control, if it is a part of this contract.

6. Removal of temporary works

When temporary works are no longer needed, the contractor shall remove and return the area to a condition similar to that which existed before construction. Areas where temporary works were located shall be graded for sightly appearance with no obstruction to natural surface waterflows or the proper functioning and access to the works of improvement installed. The contractor shall exercise extreme care during the removal stages to minimize the loss of soil sediment and debris that was trapped during construction.

Pipes, casings, and any other material used to dewater the site shall be removed from temporary wells. The wells shall be filled to ground level with clean gravel or other suitable material approved by the contracting officer. The contractor shall exercise extreme care to prevent pollution of the ground water by these actions.

7. Measurement and payment

Method 1—Items of work listed in the bid schedule for removal of water, diverting surface water, and dewatering construction sites and borrow areas are paid for at the contract lump sum prices. Such payment will constitute full compensation for all labor, equipment, tools, and all other items necessary and incidental to the completion of the work.

Method 2—Items of work listed in the bid schedule for removal of water, diverting surface water, dewatering construction sites, and dewatering borrow areas are paid for at the contract lump sum prices. Such payment will constitute full compensation for furnishing, installing, operating, and maintaining the necessary trenches, drains, sumps, pumps, and piping and for all labor, equipment, tools, and all other items necessary and incidental to the completion of the work. The exception is that additional payment for pumping to dewater borrow areas and the removal of water will be made as described in the following paragraph.

If pumping to dewater borrow areas is a contract bid item, payment is made at the contract unit price, which shall be the price per 1,000 gallons shown in the bid schedule. Such payment will constitute full compensation for pumping only. Compensation for equipment and preparation and for other costs associated with pumping is included in the lump sum payment for removal of water or the lump sum payment for dewatering the borrow areas. Payment is made only for pumping that is necessary to dewater borrow areas that cannot be effectively drained by gravity or that must have the water table lowered to be usable as a suitable borrow source. Pumping for other purposes will not be included for payment under this item.

All Methods—The following provisions apply to all methods of measurement and payment. Compensation for any item of work described in the contract, but not listed in the bid schedule is included in the payment for the contract line item to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in section 8 of this specification.

8. Items of work and construction details

The item of work to be performed in conformance with this specification and construction details is:

(A) Subsidiary Item, Removal of Water.

(1) This item shall consist of removal of water from the structure sites and the diversion of surface water in order to perform the necessary work as shown on the drawings or as located during construction.

(2) In Section 7, Measurement and Payment, no separate payment will be made for this item. Compensation will be considered as included in the payment for:

(a) Bid Item 1, Debris Removal

(b) Bid Item 4, Grouting

(c) Bid Item 6, Steel, Railroad Rail Piling

(d) Bid Item 7, Steel, Guard Rail Lagging

Construction Specification 21—Excavation

1. Scope

The work shall consist of the excavation required by the drawings and specifications and disposal of the excavated materials.

2. Classification

Excavation is classified as common excavation, rock excavation, or unclassified excavation in accordance with the following definitions.

Common excavation is defined as the excavation of all materials that can be excavated, transported, and unloaded using heavy ripping equipment and wheel tractor-scraper with pusher tractors or that can be excavated and dumped into place or loaded onto hauling equipment by excavators having a rated capacity of one cubic yard or larger and equipped with attachments (shovel, bucket, backhoe, dragline, or clam shell) appropriate to the material type, character, and nature of the materials.

Rock excavation is defined as the excavation of all hard, compacted, or cemented materials that require blasting or the use of ripping and excavating equipment larger than defined for common excavation. The excavation and removal of isolated boulders or rock fragments larger than 1 cubic yard encountered in materials otherwise conforming to the definition of common excavation shall be classified as rock excavation. The presence of isolated boulders or rock fragments larger than 1 cubic yard is not in itself sufficient cause to change the classification of the surrounding material.

For the purpose of these classifications, the following definitions shall apply:

Heavy ripping equipment is a rear-mounted, heavy duty, single-tooth, ripping attachment mounted on a track type tractor having a power rating of at least 250 flywheel horsepower unless otherwise specified in section 10.

Wheel tractor-scraper is a self-loading (not elevating) and unloading scraper having a struck bowl capacity of at least 12 cubic yards.

Pusher tractor is a track type tractor having a power rating of at least 250 flywheel horsepower equipped with appropriate attachments.

Unclassified excavation is defined as the excavation of all materials encountered, including rock materials, regardless of their nature or the manner in which they are removed.

3. Blasting

The transportation, handling, storage, and use of dynamite and other explosives shall be directed and supervised by a person(s) of proven experience and ability who is authorized and qualified to conduct blasting operations.

Blasting shall be done in a manner as to prevent damage to the work or unnecessary fracturing of the underlying rock materials and shall conform to any special requirements in section 10 of this specification. When specified in section 10, the contractor shall furnish the engineer, in writing, a blasting plan before blasting operations begin.

4. Use of excavated material

Method 1—To the extent they are needed, all suitable material from the specified excavations shall be used in the construction of required permanent earthfill or rockfill. The suitability of material for specific purposes is determined by the engineer. The contractor shall not waste or otherwise dispose of suitable excavated material.

Method 2—Suitable material from the specified excavations may be used in the construction of required earthfill or rockfill. The suitability of material for specific purposes is determined by the engineer.

5. Disposal of waste materials

Method 1—All surplus or unsuitable excavated materials are designated as waste and shall be disposed of at the locations shown on the drawings.

Method 2—All surplus or unsuitable excavated materials are designated as waste and shall be disposed of by the contractor at sites of his own choosing away from the site of the work. The disposal shall be in an environmentally acceptable manner that does not violate local rules and regulations.

6. Excavation limits

Excavations shall comply with OSHA Construction Industry Standards (29CFR Part 1926) Subpart P, Excavations, Trenching, and Shoring. All excavations shall be completed and maintained in a safe and stable condition throughout the total construction phase. Structure and trench excavations shall be completed to the specified elevations and to the length and width required to safely install, adjust, and remove any forms, bracing, or supports necessary for the installation of the work. Excavations outside the lines and limits shown on the drawings or specified herein required to meet safety requirements shall be the responsibility of the contractor in constructing and maintaining a safe and stable excavation.

7. Borrow excavation

When the quantities of suitable material obtained from specified excavations are insufficient to construct the specified earthfills and earth backfills, additional material shall be obtained from the designated borrow areas. The extent and depth of borrow pits within the limits of the designated borrow areas shall be as specified in section 10 or as approved by the engineer.

Borrow pits shall be excavated and finally dressed to blend with the existing topography and sloped to prevent ponding and to provide drainage.

8. Overexcavation

Excavation in rock beyond the specified lines and grades shall be corrected by filling the resulting voids with portland cement concrete made of materials and mix proportions approved by the engineer. Concrete that will be exposed to the atmosphere when construction is completed shall meet the requirements of concrete selected for use under Construction Specification 31, Concrete for Major Structures, or 32, Structure Concrete, as appropriate.

Concrete that will be permanently covered shall contain not less than five bags of cement per cubic yard. The concrete shall be placed and cured as specified by the engineer.

Excavation in earth beyond the specified lines and grades shall be corrected by filling the resulting voids with approved, compacted earthfill. The exception to this is that if the earth is to become the subgrade for riprap, rockfill, sand or gravel bedding, or drainfill, the voids may be filled with material conforming to the specifications for the riprap, rockfill, bedding, or drainfill. Before correcting an overexcavation condition, the contractor shall review the planned corrective action with the engineer and obtain approval of the corrective measures.

9. Measurement and payment

For items of work for which specific unit prices are established in the contract, the volume of each type and class of excavation within the specified pay limits is measured and computed to the nearest cubic yard by the method of average cross-sectional end areas or by methods outlined in section 10 of this specification. Regardless of quantities excavated, the measurement for payment is made to the specified pay limits except that excavation outside the specified lines and grades directed by the engineer to remove unsuitable material is included. Excavation required because unsuitable conditions result from the contractor's improper construction operations, as determined by the engineer, is not included for measurement and payment.

Method 1—The pay limits shall be as designated on the drawings.

Method 2—The pay limits shall be defined as follows:

- a. The upper limit shall be the original ground surface as it existed before the start of construction operations except that where excavation is performed within areas designated for previous excavation or earthfill, the upper limit shall be the modified ground surface resulting from the specified previous excavation or earthfill.
- b. The lower and lateral limits shall be the neat lines and grades shown on the drawings.

Method 3—The pay limits shall be defined as follows:

- a. The upper limit shall be the original ground surface as it existed before the start of construction operations except that where excavation is performed within areas designated for previous excavation or earthfill, the upper limit shall be the modified ground surface resulting from the specified previous excavation or earthfill.
- b. The lower and lateral limits shall be the true surface of the completed excavation as directed by the engineer.

Method 4—The pay limits shall be defined as follows:

- a. The upper limit shall be the original ground surface as it existed before the start of construction operations except that where excavation is performed within areas designated for previous excavation or earthfill, the upper limit shall be the modified ground surface resulting from the specified previous excavation or earthfill.

- b. The lower limit shall be at the bottom surface of the proposed structure.
- c. The lateral limits shall be 18 inches outside of the outside surface of the proposed structure or shall be vertical planes 18 inches outside of and parallel to the footings, whichever gives the larger pay quantity, except as provided in d below.
- d. For trapezoidal channel linings or similar structures that are to be supported upon the sides of the excavation without intervening forms, the lateral limits shall be at the underside of the proposed lining or structure.
- e. For the purposes of the definitions in b, c, and d, above, any specified bedding or drainfill directly beneath or beside the structure will be considered to be a part of the structure.

All methods—The following provisions apply to all methods of measurement and payment.

Payment for each type and class of excavation is made at the contract unit price for that type and class of excavation. Such payment will constitute full compensation for all labor, materials, equipment, and all other items necessary and incidental to the performance of the work except that extra payment for backfilling over excavation will be made in accordance with the following provisions.

Payment for backfilling over excavation, as specified in section 8 of this specification, is made only if the excavation outside specified lines and grades is directed by the engineer to remove unsuitable material and if the unsuitable condition is not a result of the contractor's improper construction operations as determined by the engineer.

Compensation for any item of work described in the contract, but not listed in the bid schedule is included in the payment for the item of work to which it is made subsidiary. Such items and the items to which they are made subsidiary are identified in section 10 of this specification.

10. Items of work and construction details

The item of work to be performed in conformance with this specification and construction details is:

(A) Subsidiary Item, Excavation.

(1) This item shall consist of all excavation necessary to install works of improvement as shown on the plans and as located by the engineer during construction.

(2) In Section 2, Excavation shall be Unclassified.

(3) In Section 3, Blasting will not be permitted.

(4) In Section 4, Use of Excavated Materials, Method 2 will apply.

(5) In Section 5, Disposal of Waste Materials, Method 2 will apply.

(6) In Section 9, Measurement and Payment, no separate payment will be made for this item. Compensation for this item will be included in:

(a) Bid Item 1, Debris Removal

(b) Bid Item 6, Steel, Railroad Rail Piling

(c) Bid Item 7, Steel, Guard Rail Lagging

Material Specification 523—Rock for Riprap

1. Scope

This specification covers the quality of rock to be used in the construction of rock riprap.

2. Quality

Individual rock fragments shall be dense, sound, and free from cracks, seams, and other defects conducive to accelerated weathering. Except as otherwise specified, the rock fragments shall be angular to subrounded. The least dimension of an individual rock fragment shall be not less than one-third the greatest dimension of the fragment. ASTM D4992 provides guidance on selecting rock from a source.

Except as otherwise provided, the rock shall be tested and shall have the following properties:

Rock type 1

- **Bulk specific gravity (saturated surface-dry basis)**—Not less than 2.5 when tested in accordance with ASTM D6473 on samples prepared as described for soundness testing.
- **Absorption**—Not more than 2 percent when tested in accordance with ASTM D6473 on samples prepared as described for soundness testing.
- **Soundness**—The weight loss in 5 cycles shall not be more than 10 percent when sodium sulfate is used or more than 15 percent when magnesium sulfate is used.

Rock type 2

- **Bulk specific gravity (saturated surface-dry basis)**—Not less than 2.5 when tested in accordance with ASTM D6473 on samples prepared as described for soundness testing.
- **Absorption**—Not more than 2 percent when tested in accordance with ASTM D6473 on samples prepared as described for soundness testing.

- **Soundness**—The weight loss in 5 cycles shall be not more than 20 percent when sodium sulfate is used or more than 25 percent when magnesium sulfate is used.

Rock type 3

- **Bulk specific gravity (saturated surface-dry basis)**—Not less than 2.3 when tested in accordance with ASTM D6473 on samples prepared as described for soundness testing.
- **Absorption**—Not more than 4 percent when tested in accordance with ASTM D6473 on samples prepared as described for soundness testing.
- **Soundness**—The weight loss in 5 cycles shall be not more than 20 percent when sodium sulfate is used or more than 25 percent when magnesium sulfate is used.

3. Methods of soundness testing

Rock cube soundness—The sodium or magnesium sulfate soundness test for all rock types (1, 2, or 3) shall be performed on a test sample of $5,000 \pm 300$ grams of rock fragments, reasonably uniform in size and cubical in shape, and weighing, after sampling, about 100 grams each. They shall be obtained from rock samples that are representative of the total rock mass, as noted in ASTM D4992, and that have been sawed into slabs as described in ASTM D5121. The samples shall further be reduced in size by sawing the slabs into cubical blocks. The thickness of the slabs and the size of the sawed fragments shall be determined by the size of the available test apparatus and as necessary to provide, after sawing, the approximate 100-gram samples. The cubes shall undergo five cycles of soundness testing in accordance with ASTM D1512.

Internal defects may cause some of the cubes to break during the sawing process or during the initial soaking period. Do not test any of the cubes that break during this preparatory process. Such breakage, including an approximation of the percentage of cubes that break, shall be noted in the test report.

Material Specification 523 Rock for Riprap (continued)

After the sample has been dried following completion of the final test cycle and washed to remove the sodium sulfate or magnesium sulfate, the loss of weight shall be determined by subtracting from the original weight of the sample the final weight of all fragments that have not broken into three or more fragments.

The test report shall show the percentage loss of the weight and the results of the qualitative examination.

Rock slab soundness—When specified, the rock shall also be tested in accordance with ASTM D5240. Deterioration of more than 25 percent of the number

of blocks shall be cause for rejection of rock from this source. Rock shall also meet the requirements for average percent weight loss stated below.

- For projects located north of the Number 20 Freeze-Thaw Severity Index Isoline (fig. 523–1). Unless otherwise specified, the average percent weight loss for Rock Type 1 shall not exceed 20 percent when sodium sulfate is used or 25 percent when magnesium sulfate is used. For Rock Types 2 and 3, the average percent weight loss shall not exceed 25 percent for sodium sulfate soundness or 30 percent for magnesium sulfate soundness.
- For projects located south of the Number 20 Freeze-Thaw Severity Index Isoline, unless otherwise specified, the average percent weight loss for Rock Type 1 shall not exceed 30 per-

Figure 523–1 Number 20 freeze-thaw severity index isoline (map approximates the map in ASTM D5312)



Material Specification 523 Rock for Riprap (continued)

cent when sodium sulfate is used or 38 percent when magnesium sulfate is used. For Rock Types 2 and 3, the average percent weight loss shall not exceed 38 percent for sodium sulfate soundness or 45 percent for magnesium sulfate soundness.

4. Field durability inspection

Rock that fails to meet the material requirements stated above (if specified), may be accepted only if similar rock from the same source has been demonstrated to be sound after 5 years or more of service under conditions of weather, wetting and drying, and erosive forces similar to those anticipated for the rock to be installed under this specification.

A rock source may be rejected if the rock from that source deteriorates in 3 to 5 years under similar use and exposure conditions expected for the rock to be installed under this specification, even though it meets the testing requirements stated above.

Deterioration is defined as the loss of more than one-quarter of the original rock volume, or severe cracking that would cause a block to split. Measurements of deterioration are taken from linear or surface area particle counts to determine the percentage of deteriorated blocks. Deterioration of more than 25 percent of the pieces shall be cause for rejection of rock from the source.

5. Grading

The rock shall conform to the specified grading limits after it has been placed within the matrix of the rock riprap. Grading tests shall be performed, as necessary, according to ASTM D5519, Method A, B, or C, as applicable.

Material Specification 531—Portland Cement

1. Scope

This specification covers the quality of portland cement.

2. Quality

Portland cement shall conform to the requirements of ASTM Specification C 150 for the specific types of cement. When Type I portland cement is specified, Type IS portland blast-furnace slag cement or Type IP portland-pozzolan cement conforming to the requirements of ASTM Specification C 595 may be used unless prohibited by the specifications.

When air-entraining cement is required, the contractor shall furnish the manufacturer's written statement providing the source, amount, and brand name of the air-entraining component.

3. Storage at the construction site

Cement shall be stored and protected at all times from weather, dampness, or other destructive elements. Cement that is partly hydrated or otherwise damaged will not be accepted.

Material Specification 592—Geotextile

1. Scope

This specification covers the quality of geotextile, including geotextile for temporary silt fence.

2. General requirements

Fibers (threads and yarns) used in the manufacture of geotextile shall consist of synthetic polymers composed of a minimum of 85 percent by weight polypropylenes, polyesters, polyamides, polyethylene, polyolefins, or polyvinylidene-chlorides. They shall be formed into a stable network of filaments or yarns retaining dimensional stability relative to each other. The geotextile shall be free of defects, such as holes, tears, and abrasions. The geotextile shall be free of any chemical treatment or coating that significantly reduces its porosity. Fibers shall contain stabilizers, inhibitors, or both to enhance resistance to ultraviolet light. Geotextile other than for temporary silt fence shall conform to the requirements in tables 592-1 or 592-2, as applicable. Geotextile for temporary silt fence shall conform to the requirements in table 592-3.

Thread used for factory or field sewing shall be of contrasting color to the fabric and made of high strength polypropylene, polyester, or polyamide thread. Thread shall be as resistant to ultraviolet light as the geotextile being sewn.

3. Classification

Geotextiles shall be classified based on the method used to place the threads or yarns forming the fabric. The geotextiles will be grouped into woven and nonwoven types. Geotextile for temporary silt fence may be either woven or nonwoven. Slit film woven geotextile may not be used except for temporary silt fence.

Woven—Fabrics formed by the uniform and regular interweaving of the threads or yarns in two directions. Woven fabrics shall be manufactured from monofilament yarn formed into a uniform pattern with distinct and measurable openings, retaining their position relative to each other. The edges of fabric shall be selvaged or

otherwise finished to prevent the outer yarn from unraveling.

Nonwoven—Fabrics formed by a random placement of threads in a mat and bonded by needle punching, heat-bonding, or resin-bonding. Nonwoven fabrics shall be manufactured from individual fibers formed into a random pattern with distinct, but variable small openings, retaining their position relative to each other when bonded by needle punching, heat-, or resin-bonding. The use of heat- or resin-bonded nonwovens is restricted as specified in note 2 of table 592-2.

4. Sampling and testing

The geotextile shall meet the specified requirements (tables 592-1, 592-2, or 592-3, as applicable) for the product type shown on the label. Product properties as listed in the latest edition of the "Specifiers Guide," Geosynthetics, (Industrial Fabrics Association International, 1801 County Road B, West Roseville, MN 55113-4061 or at <http://www.geosindex.com>) and that represent minimum average roll values, are acceptable documentation that the product style meets the requirements of these specifications.

For products that do not appear in the above directory or do not have minimum average roll values listed, typical test data from the identified production run of the geotextile will be required for each of the specified tests (see table 592-1, 592-2, or 592-3, as applicable) as covered under clause AGAR 452.236-76.

5. Shipping and storage

The geotextile shall be shipped and transported in rolls wrapped with a cover for protection from moisture, dust, dirt, debris, and ultraviolet light. The cover shall be maintained undisturbed to the maximum extend possible before placement.

Each roll of geotextile shall be labeled or tagged to clearly identify the brand, class, and the individual production run in accordance with ASTM D 4873.

Material Specification 592 Geotextile (continued)

Table 592-1 Requirements for woven geotextiles 1/

Property	Test Method	Units	Class I	Class II	Class III	Class IV
Grab Tensile Strength	ASTM D 4632	pounds	247 min.	180 min.	180 min.	315 min.
Elongation at Failure	ASTM D 4632	percent	< 50	<50	<50	<50
Trapezoidal Tear Strength	ASTM D 4533	pounds	90 min.	67 min.	67 min.	112 min.
Puncture Strength	ASTM D 6241	pounds	495 min.	371 min.	371 min.	618 min.
Ultraviolet Stability (retained strength)	ASTM D 4355	percent	50 min.	50 min.	50 min.	50 min.
Permittivity	ASTM D 4491	sec ⁻¹	as specified			
Apparent Opening Size (AOS) 2/	ASTM D 4751	mm	as specified			
Percent Open Area (POA)	USACE CWO-02215	percent	as specified			

1/ All values are minimum average roll values (MARV) in the weakest principal direction, unless otherwise noted.

2/ Maximum average roll value.

Note: CWO is a USACE reference.

Table 592-2 Requirements for nonwoven geotextiles 1/

Property	Test Method	Units	Class I 2/	Class II 2/	Class III 2/	Class IV 2/
Grab Tensile Strength	ASTM D 4632	pounds	202 min.	157 min.	112 min.	202 min.
Elongation at Failure	ASTM D 4632	percent	50 min.	50 min.	50 min.	50 min.
Trapezoidal Tear Strength	ASTM D 4533	pounds	79 min.	56 min.	40 min.	79 min.
Puncture Strength	ASTM D 6241	pounds	433 min.	309 min.	223 min.	433 min.
Ultraviolet Stability (retained strength)	ASTM D 4355	percent	50 min.	50 min.	50 min.	50 min.
Permittivity	ASTM D 4491	sec ⁻¹	0.7 min. or as specified			
Apparent Opening Size (AOS) 3/	ASTM D 4751	mm	0.22 max. or as specified			

1/ All values are minimum average roll values (MARV) in the weakest principal direction, unless otherwise noted.

2/ Needle punched geotextiles may be used for all classes. Heat-bonded or resin-bonded geotextiles may be used for classes III and IV only. They are particularly well suited to class IV.

3/ Maximum average roll value.

Material Specification 592 Geotextile (continued)**Table 592-3** Requirements for Temporary Silt Fence 1/

Property	Test Method	Units	Requirements, Supported Silt Fence 2/	Requirements, Unsupported Silt Fence 2/	
				Woven Geotextile (Elongation < 50% 3/)	Nonwoven Geotextile (Elongation ≥ 50% 3/)
Maximum Post Spacing		ft	4	6.5	4
Grab Tensile Strength:	ASTM D 4632	pounds			
Machine Direction			90		124
X-Machine Direction			90		101
Permittivity	ASTM D 4491	sec-1	0.05		0.05
Apparent Opening Size (AOS) 4/	ASTM D 4751	mm	0.60		0.60
Ultraviolet Stability (retained strength)	ASTM D 4335	%	70% after 500 hours of exposure		70% after 500 hours of exposure

1/ All values are minimum average roll values (MARV) in the weakest principal direction, unless otherwise noted.

2/ Silt fence support shall consist of 14-gage steel wire with a mesh spacing of 6 inches each way or prefabricated polymeric mesh of equivalent strength.

3/ As measured in accordance with ASTM D 4632.

4/ Maximum average roll value.