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PURCHASING DEPARTMENT

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VOLUME 2 – TECHNICAL SPECIFICATIONS

BID NO. 2017-149

**PROJECT MANUAL
FOR
ECHO LAKE PROJECT PHASE 3**

**BIDS DUE JULY 20, 2017
2:00 P.M.**

Technical Specifications Prepared by

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RFB NO. 2017-149

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I. GENERAL.

- A. Tarrant County shall have an Engineer/Inspector control over all aspects of this project.
- B. The order of precedence in case of conflicts or discrepancies between various parts of the Contract Documents subject to the ruling of the Engineer shall generally, but not necessarily, follow the guidelines listed below:
 - 1. Plans
 - 2. General Notes
 - 3. Specifications and Contract Documents
 - 4. Temporary Easement Agreement
 - 5. TPDES General Permit
- C. It shall be the responsibility of the prospective bidder to visit the project site and make such examinations and explorations as may be necessary to determine all conditions which may affect construction of this project. Particular attention should be given to methods of providing ingress and egress to adjacent private and public properties, procedures for protecting existing improvements and disposition of all materials to be removed. Proper consideration should be given to these details during the preparation of the Bid and all unusual conditions, which may give rise to later contingencies should be brought to the attention of the Owner prior to the submission of the Bid.

II. ADDITIONAL GENERAL NOTES.

- A. The Specifications noted in this project will follow the 2014 Tx.DOT Standard Specifications for Construction and Maintenance of Highways, Streets and Bridges.
- B. This project will be bid with two (2) alternates:
 - 1. Alternate No. 1 – Temporary Construction Pad. Refer to the drawings.
 - 2. Alternate No. 2 – Temporary Construction Dam. Refer to the drawings.
- C. Once a contract is awarded, a sequence of work will be required.
- D. A 48 hour advance notice to Transportation Services will be required prior to any work performed.
- E. This location is subject to the US Corps of Engineers Section 404 permitting requirements. Tarrant County has hired TranSystems to handle the Section 404 permitting requirements. The Contractor will be required to follow all Section 404 permitting requirements as detailed by TranSystems.
- F. Provide estimated access areas with potential fill (in cubic feet) and work areas (in square feet) not to exceed ½ acre for each structure location, preferably less than 0.1 acre per site.
- G. The awarded Contractor and Transportation Services will discuss additional work required to comply with Section 404 permitting.

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- H. If necessary Tarrant County will obtain temporary easements for access purposes for all locations.
- I. All Lab Testing will be completed by and paid for by Tarrant County.
- J. Blasting of any kind or character is strictly prohibited.
- K. For dimensions of R.O.W. not shown on the plans, see R.O.W. Map on file at Tarrant County Transportation Office.
- L. Tarrant County is responsible for all easements.
- M. Plugging of pipes or culverts will not be paid for directly, but shall be considered subsidiary to the various bid items, unless otherwise shown on the plans.
- N. Remove any obstructions to existing drainage due to the Contractor's operations, as required, at the Contractor's expense.
- O. The County will perform certain preliminary work and will complete the work in such sequence and manner that the Contractor will be able to begin his work at the specified time.
- P. Contractor personnel performing job control (QC) testing on concrete must be ACI certified. Provide a copy of all personnel certification papers to the Engineer at the preconstruction meeting. The Engineer may require the Contractor's testers to provide the certification papers upon arrival and before testing at the job site. Furnish a hard copy of all testing equipment calibration reports at the preconstruction meeting when non-TxDOT equipment is used to test concrete. Furnish updated reports as equipment is calibrated through the project contract. The calibration frequency will match TxDOT's and will apply for each piece of equipment as follows:
 - Slump Cone – Annual
 - Air Meter – Every 3 months
 - Compression Tester – Annual
 - Beam breaker – AnnualThe compression testing equipment for concrete will be capable of producing an electronic printout of the test results.
- Q. Railroad Flagging: The Contractor will be responsible for securing and maintaining RR flagging. Tarrant County will be responsible for the payment of the flagmen, per the railroad requirements. The invoice shall be mailed to Joe Trammel, P.E., CFM, Tarrant County, 100 E. Weatherford, Suite 401, Fort Worth, Texas 76196. Prior to payment of the flagging and prior to construction commencing, the Contractor shall provide a schedule that indicates the approximate days of need for the flagger, including regular hours worked as well as any additional overtime hours needed per day, as described in the flagging request form.

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- R. Abatement: Tarrant County is required by the State of Texas Public Health Department to abate any asbestos issues that arise on the project. No abatement for asbestos is anticipated; however, should the need arise, Tarrant County's Environmental Specialist, Robert Berndt, shall be contacted.
- S. Project Survey: It is the Contractor's responsibility to survey as indicated on the construction plans in order to provide the product.
- T. Railroad Safety Requirements: The Contractor is required/responsible to complete the Railroad Course "Orientation for Contractor's Safety" and maintain current registration prior to working on Railroad property. This orientation is available at www.contractororientation.com. This course is required to be completed annually by Contractor and Subcontractor personnel working on site. The Contractor/Subcontractor is also required/responsible for personnel to complete any additional safety training requirements for working on property owned or leased by Union Pacific Railroad and Fort Worth and Western Railroad.

Item 496. Removing Structures

The structure(s) to be removed have surface coatings which may contain hazardous materials. Provide for the safety and health of employees and abide by all OSHA Standards and Regulations.

Item 110. Evacuation

Review proposed waste sites to determine if any site is placed in a "Base Floodplain" or "Floodway" as defined by the Federal Emergency Management Agency (FEMA).

If waste material from this project is placed in a base floodplain as defined by FEMA, a permit will have to be obtained from the local community responsible for enforcing National Flood Insurance Program (NFIP) regulations. The Contractor is responsible for ensuring that the owner of the property receiving the waste has obtained the necessary permit.

Item 162. Sodding for Erosion Control

Furnish and replace Bermudagrass sod.

Item 164. Seeding for Erosion Control

Apply seeding required between December 1 and January 31 using seed types and mixtures as shown in item 164.2.1, Table 3. If, in the opinion of the Engineer, this does not provide an effective vegetative cover, apply "straw or hay mulch" as specified in Article 164.3.2, "Straw or Hay Mulch Seeding" as soon as possible. After February 1 apply warm season seeding in order to establish a permanent protective vegetative cover.

III. SUBSTANTIAL COMPLETION INSPECTION/FINAL INSPECTION

- A. Tarrant County shall have an Engineer/Inspector control over all aspects of this project.
- B. Prior to the final inspection being conducted for the project, the Contractor shall contact the Inspector in writing when the entire project or a designated portion of the project is substantially complete.
- C. The Inspector along with appropriate County staff shall make an inspection of the substantially completed work and prepare and submit to the Contractor a list of items needing to be completed or corrected.
- D. The Contractor shall take immediate steps to rectify the listed deficiencies and notify the Owner in writing when all the items have been completed or corrected.
- E. Payment for substantial completion inspection as well as final inspection shall be subsidiary to the project price. Contractor shall still be required to address all other deficiencies, which are discovered at the time of final inspection.

IV. PROJECT CLEANUP AND FINAL ACCEPTANCE

- A. The Contractor shall be aware that keeping the project site in a neat and orderly condition is considered an integral part of the contracted work and as such shall be considered subsidiary to the appropriate bid items. Clean up work shall be done as directed by the Inspector as the work progresses or as needed in accordance with Easement and/or Temporary Easement Agreements. If, in the opinion of the Inspector, it is necessary, clean-up shall be done on a daily basis. Clean up work shall include, but not be limited to:
 - 1. Sweeping the street clean of dirt or debris
 - 2. Storing excess material in appropriate and organized manner
 - 3. Keeping trash of any kind off of adjacent property
- B. If the Inspector does not feel that the jobsite has been kept in an orderly condition, on the next estimate payment (and all subsequent payments until completed) of the appropriate bid item(s) will be reduced by 25%.
- C. Final cleanup work shall be done for this project as soon as all construction has been completed. No more than seven (7) days shall elapse after completion of construction before the roadway, right-of-way, or easement is cleaned up to the satisfaction of the Inspector. The Contractor shall make a final cleanup of all parts of the work before acceptance by the County or its representative. This cleanup shall include removal of all objectionable rocks, pieces of asphalt or concrete and other construction materials, and in general preparing the site of the work in an orderly manner and appearance. Tarrant County Transportation Services Department shall give final acceptance of the completed project work.

V. EXISTING UTILITIES AND IMPROVEMENTS

- A. The plans show the locations of all known surface and subsurface structures. However, the Owner assumes no responsibility for failure to show any or all of these structures on the Plans, or to show them in their exact location. It is mutually agreed that such failure shall not be considered sufficient basis for claims for additional compensation for extra work or for increasing the pay quantities in any manner whatsoever.
- B. The Contractor shall be responsible for verifying the locations of and protecting all existing utilities, service lines, or other property exposed by his construction operations. Contractor shall make all necessary provisions (as approved or authorized by the applicable utility company) for the support, protection and/or temporary relocation of all utility poles, gas lines, telephone cables, utility services, water mains, sanitary sewer lines, electrical cables, drainage pipes, and all other utilities and structures both above and below ground during construction. It is understood that the Contractor is not responsible for the permanent relocation of existing utilities in direct conflict with the proposed construction. The Contractor is liable for all damages done to such existing facilities as a result of his operations and any and all cost incurred for the protection and/or temporary relocation of such facilities are deemed subsidiary work. **NO ADDITIONAL COMPENSATION WILL BE ALLOWED.**
- C. Where existing utilities or service lines are cut, broken or damaged, the Contractor shall replace or repair the utilities or service lines with the same type of original material and construction, or better, unless otherwise shown or noted on the plans, at his own cost and expense. The Contractor shall immediately notify the Owner of the damaged utility or service line. He shall cooperate with the Owners of all utilities to locate existing underground facilities and notify the Engineer of any conflicts in grades and alignment.
- D. In case it is necessary to change or move the property of any owner of a public utility, such property shall not be moved or interfered with until ordered to do so by the Engineer. The right is reserved to the owner of public utilities to enter upon the limits of the project for the purpose of making such changes or repairs of their property that may be made necessary by performance of this contract.
- E. The utility lines and conduits shown on the plans are for information only and are not guaranteed by the County or the Engineer to be accurate as to extent, location, and depth; they are shown on the plans as the best information available at the time of design, from the owners of the utilities involved and from evidences found on the ground.

VI. SAFETY RESTRICTIONS - WORK NEAR HIGH VOLTAGE LINES

- A. The following procedures will be followed regarding the subject item on this contract:
1. A warning sign not less than five (5) inches by seven (7) inches, painted yellow with black letters that are legible at twelve(12) feet shall be placed inside and outside vehicles such as cranes, derricks, power shovels, drilling rigs, pile drivers, hoisting equipment or similar apparatus. The warning sign shall read as follows: "WARNING - UNLAWFUL TO OPERATE THIS EQUIPMENT WITHIN SIX FEET OF HIGH VOLTAGE LINES."
 2. Equipment that may be operated within ten (10) feet of high voltage lines shall have insulating cage-type of guard about the boom or arm, except back hoes or dippers, and insulator links on the lift hook connections.
 3. When necessary to work within six feet of high voltage electric lines, notification shall be given the power company (ONCOR) who will erect temporary mechanical barriers, deenergize the lines, or raise or lower the lines. The work done by the power company shall not be at the expense of the Tarrant County. The notifying department shall maintain an accurate log of all such calls to ONCOR, and shall record action taken in each case.
 4. The Contractor is required to make arrangements with the power company for the temporary relocation or raising of high voltage lines at the Contractor's sole cost and expense.
 5. No person shall work within six (6) feet of a high voltage line without protection having been taken as outlined in Paragraph (3).

VII. SAMPLES AND QUALITY CONTROL TESTING

- A. Contractor shall provide Tarrant County a copy of the trip ticket for each load of fill material delivered to the job site. The ticket shall specify the source of the fill material.
- B. Tarrant County shall receive certifications by contractor for all materials proposed to be used on the project, including a mix design for any Portland cement concrete to be used, and gradation analysis for sand and crushed stone to be used along with the name of the pit from which the material was taken. Contractor shall provide manufacturer's certifications for all manufactured items to be used in the project.
- C. Concrete designs shall be finished by concrete supplier at least nine (9) days prior to the placing of concrete using the same aggregate, cement, and mortar which are to be used later in the concrete.

- D. Quality control testing of in-place material on this project will be performed by the County. Any retesting required as a result of failure of the material to meet project specifications will be the responsibility of Tarrant County. The failure of the County to make any tests of materials shall in no way relieve the Contractor of his responsibility to furnish materials and equipment conforming to the requirements of the contract.
- E. Not less than twenty-four (24) hours' notice shall be provided to the County by the Contractor for operations requiring testing. The Contractor shall provide access and trench safety system (if required) for the site to be tested, and any work effort involved is deemed to be included in the unit price for the item being tested.

VIII. TPDES GENERAL PERMIT NUMBER TXR150000 - STORM WATER POLLUTION PREVENTION PLAN (FOR DISTURBED AREAS GREATER THAN 1 ACRE)

- A. **REQUIREMENT:** The Contractor will be required to obtain a TPDES General Permit Number TXR150000 (Permit) as a Primary Operator for a small construction activity site. The Contractor will provide and furnish all materials, continuing actions and documents (including but not limited to: Written SWPPP, Perform regular inspections, cleaning and maintenance of erosion control materials) needed to stay in compliance with the Permit. The Contractor will be solely responsible for any enforcement actions or fines due to non-compliance with the Permit from TCEQ or the City of Fort Worth.

IX. PERMIT

- A. As defined by Texas Commission on Environmental Quality (TCEQ) regulations, a Texas Pollutant Discharge Elimination System (TPDES) General Construction Permit is required for all construction activities that result in the disturbance of one to five acres (Small Construction Activity) or five or more acres of total land (Large Construction Activity). The Contractor is defined as a "primary operator" by state regulations and is required to obtain a permit. Information concerning the permit can be obtained through the Internet at <http://www.tceq.texas.gov/permitting/stormwater/construction>. Tarrant County requests that the SWPPP be prepared following Best Management Practices (BMPs) found in the City of Fort Worth's integrated Stormwater Management (iSWM) Program) Not all of the structural and erosion controls discussed in the (iSWM) will necessarily apply to this project. Best Management Practices are construction management techniques that, if properly utilized, can minimize the need for physical controls and possible reduce costs. The methods of control shall result in minimum sediment retention of not less than 70%.

X. TCEQ SMALL CONSTRUCTION SITE NOTICE (CSN)

A. The project will result in a total land disturbance greater than one (1) acre and less than five (5) acres, the Contractor shall sign a TCEQ form prepared by the Contractor. It serves as a notification to Tarrant County of construction activity as well as a commitment that the Contractor understands the requirements of the permit for storm water discharges from construction activities and that measures will be taken to implement and maintain storm water pollution prevention at the site. The Contractor shall submit the CSN to Tarrant County and City of Fort Worth at least seven (7) days prior to the Contractor moving on site.

B. The CSN shall be mailed to:

Robert Berndt
Tarrant County Transportation Services
100 E Weatherford, Suite 401
Fort Worth, Texas 76196

City of Fort Worth
Attn: Construction Stormwater
Program
200 Texas Street
Fort Worth, Texas 76102

XI. LETTER OF TERMINATION (LOT)

A. A Letter of Termination (LOT) form shall be submitted within five (5) days after the contractor has finished their portion of the project and all contractor equipment has been removed from the site. Since this site will qualify as Small Construction Activity, the Contractor shall sign, prior to final payment, a Letter of Termination (LOT) prepared by the Contractor. It serves as a notice that the site is no longer under the control of the Contractor.

B. The LOT shall be mailed to:

Robert Berndt
Tarrant County Transportation Services
100 E Weatherford, Suite 401
Fort Worth, Texas 76196

City of Fort Worth
Attn: Construction Stormwater
Program
200 Texas Street
Fort Worth, Texas 76102

XII. STORM WATER POLLUTION PREVENTION PLAN (SWPPP)

A. The Contractor will be required to prepare a document consisting of an erosion control and waste management plan and a narrative defining site parameters and techniques to be employed to reduce the release of sediment and pollution from the construction site. The selected Contractor shall provide Tarrant County with one copy of the SWPPP before physical work begins at the site. Tarrant County recommends using the iSWM Program to write the SWPPP.

XIII. SMALL CONSTRUCTION ACTIVITY - DISTURBED AREA EQUAL TO OR GREATER THAN ONE ACRE BUT LESS THAN FIVE ACRES

- A. A SWPPP that meets all TCEQ requirements prepared by the Contractor shall be prepared and implemented at least forty-eight (48) hours before the commencement of construction activities. The SWPPP is not warranted to meet all the conditions of the permit since the actual construction activities may vary from those anticipated during the preparation of the SWPPP. Modifications may be required to fully conform to the requirements of the Permit. The Contractor must keep a copy of the most current SWPPP at the construction site. Any alterations to the SWPPP proposed by the Contractor must fully conform to the requirements of the Permit.

- B. TCEQ Construction Site Notice form must be completed and posted at the site. The Contractor will provide space on the storm water signage area for Tarrant County's Construction Site Notice sign. The SWPPP must include descriptions of control measures necessary to prevent and control soil erosion, and prevent sedimentation and water pollution. The control measures shall be installed and maintained throughout the construction to assure effective and continuous water pollution control. The controls may include, but not be limited to, silt fences, rock berms, sediment logs, diversion dikes, interceptor swales, sediment traps and basins, pipe slope drain, inlet protection, stabilized construction entrances, seeding, sodding, mulching, soil retention blankets, or non-structural storm water pollution controls. ***(NO HAY BALES.)*** The method of control shall result in minimum sediment retention of 70% as defined by the iSWM Program. Deviations from the proposed control measures must fully conform to the requirements of the Permit.

XIV. FINAL PROJECT COMPLETION

- A. The Contractor must complete final stabilization at the site. Final stabilization is defined as: All soil disturbing activities at the site have been completed and a uniform (that is, evenly distributed, without large bare areas) perennial vegetative cover with a density of at least 70% of the native background vegetative cover for the area has been established on all unpaved areas and areas not covered by permanent structures, or equivalent permanent stabilization measures (such as the use of riprap, gabions, or geotextiles) have been employed.

XVI. AIR POLLUTION WATCH DAYS

- A. The Contractor shall be required to observe the following guidelines relating to working on County construction sites on days designated as "AIR POLLUTION WATCH DAYS". Typically, the OZONE SEASON, within the Metroplex area, runs from May 1, through OCTOBER 31, with 6:00 a.m. - 10:00 a.m. being critical BECAUSE EMISSIONS FROM THIS TIME PERIOD HAVE ENOUGH TIME TO BAKE IN THE HOT ATMOSPHERE THAT LEADS TO EARLY AFTERNOON OZONE FORMATION. .

- B. The Texas Commission on Environmental Quality (TCEQ), in coordination with the National Weather Service, will issue the Air Pollution Watch by 3:00 p.m. on the afternoon prior to the WATCH day. On designated Air Pollution Watch Days, the Contractor shall bear the responsibility of being aware that such days have been designated Air Pollution Watch Days and as such shall not begin work until 10:00 a.m. whenever construction phasing requires the use of motorized equipment for periods in excess of 1 hour. However, the Contractor may begin work prior to 10:00 a.m. if use of motorized equipment is less than 1 hour, or if equipment is new and certified by EPA as "Low Emitting", or equipment burns Ultra Low Sulfur Diesel (ULSD), diesel emulsions, or alternative fuels such as CNG. If the Contractor is unable to perform continuous work for a period of at least seven hours between the hours of 7:00 a.m. - 6:00 p.m., on a designated Air Pollution Watch Day, that day will be considered as a weather day and added onto the allowable weather days of a given month.

**The following pages have been extracted
from
Texas Department of Transportation**

**Standard Specifications
for Construction
and Maintenance of
Highways, Streets,
and Bridges**

**Adopted by the
Texas Department of Transportation**

November 1, 2014

Item 100

Preparing Right of Way

1. DESCRIPTION

Prepare the right of way and designated easements for construction operations by removing and disposing of all obstructions when removal of such obstructions is not specifically shown on the plans to be paid by other Items.

CONSTRUCTION

Protect designated features on the right of way and prune trees and shrubs as directed. Do not park equipment, service equipment, store materials, or disturb the root area under the branches of trees designated for preservation. Treat cuts on trees with an approved tree wound dressing within 20 min. of making a pruning cut or otherwise causing damage to the tree when shown on the plans. Follow all local and state regulations when burning. Pile and burn brush at approved locations as directed. Coordinate work with state and federal authorities when working in state or national forests or parks. Test, remove, and dispose of hazardous materials in accordance with Article 6.10., "Hazardous Materials."

Clear areas shown on the plans of all obstructions, except those landscape features that are to be preserved. Such obstructions include remains of houses and other structures, foundations, floor slabs, concrete, brick, lumber, plaster, septic tank drain fields, basements, abandoned utility pipes or conduits, equipment, fences, retaining walls, and other items as specified on the plans. Remove vegetation and other landscape features not designated for preservation, curb and gutter, driveways, paved parking areas, miscellaneous stone, sidewalks, drainage structures, manholes, inlets, abandoned railroad tracks, scrap iron, and debris, whether above or below ground. Removal of live utility facilities is not included in this Item. Remove culverts, storm sewers, manholes, and inlets in proper sequence to maintain traffic and drainage.

Notify the Engineer in writing when items not shown on the plans and not reasonably detectable (buried with no obvious indication of presence) are encountered and required to be removed. These items will be handled in accordance with Article 4.5., "Differing Site Conditions."

Remove obstructions not designated for preservation to 2 ft. below natural ground in areas receiving embankment. Remove obstructions to 2 ft. below the excavation level in areas to be excavated. Remove obstructions to 1 ft. below natural ground in all other areas. Cut trees and stumps off to ground level when allowed by the plans or directed. Plug the remaining ends of abandoned underground structures over 3 in. in diameter with concrete to form a tight closure. Backfill, compact, and restore areas where obstructions have been removed unless otherwise directed. Use approved material for backfilling. Dispose of wells in accordance with Item 103, "Disposal of Wells."

Accept ownership, unless otherwise directed, and dispose of removed materials and debris at locations off the right of way in accordance with local, state, and federal requirements.

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MEASUREMENT

This Item will be measured by the acre; by the 100-ft. station, regardless of the width of the right of way; or by each tree removed.

PAYMENT

For "acre" and "station" measurement, the work performed in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Preparing Right of Way." For "each" measurement, the work performed in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Preparing Right of Way (Tree)" of the diameter specified. This price is full compensation for pruning of designated trees and shrubs; removal and disposal of structures and obstructions; backfilling of holes; furnishing and placing concrete for plugs; and equipment, labor, tools, and incidentals.

Total payment of this Item will not exceed 10% of the original contract amount until final acceptance. The remainder will be paid on the estimate after the final acceptance under Article 5.12., "Final Acceptance."

Item 110

Excavation

2. DESCRIPTION

Excavate areas as shown on the plans or as directed. Remove materials encountered to the lines, grades, and typical sections shown on the plans and cross-sections.

3. CONSTRUCTION

Accept ownership of unsuitable or excess material and dispose of material in accordance with local, state, and federal regulations at locations outside the right of way.

Maintain drainage in the excavated area to avoid damage to the roadway section. Correct any damage to the subgrade caused by weather at no additional cost to the Department.

Shape slopes to avoid loosening material below or outside the proposed grades. Remove and dispose of slides as directed.

3.1. **Rock Cuts.** Excavate to finish subgrade. Manipulate and compact subgrade in accordance with Section 132.3.4., "Compaction Methods," unless excavation is to clean homogenous rock at finish subgrade elevation. Use approved embankment material compacted in accordance with Section 132.3.4., "Compaction Methods," to replace undercut material at no additional cost if excavation extends below finish subgrade.

3.2. **Earth Cuts.** Excavate to finish subgrade. Scarify subgrade to a uniform depth at least 6 in. below finish subgrade elevation in areas where base or pavement structure will be placed on subgrade. Manipulate and compact subgrade in accordance with Section 132.3.4., "Compaction Methods."

Take corrective measures as directed if unsuitable material is encountered below subgrade elevations.

3.3. **Subgrade Tolerances.** Excavate to within 1/2 in. in cross-section and 1/2 in. in 16 ft. measured longitudinally for turnkey construction. Excavate to within 0.1 ft. in cross-section and 0.1 ft. in 16 ft. measured longitudinally for staged construction.

4. MEASUREMENT

This Item will be measured by the cubic yard in its original position as computed by the method of average end areas.

This is a plans quantity measurement Item. The quantity to be paid is the quantity shown in the proposal unless modified by Article 9.2., "Plans Quantity Measurement." Additional measurements or calculations will be made if adjustments of quantities are required.

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Limits of measurement for excavation in retaining wall areas will be as shown on the plans.

Shrinkage or swelling factors will not be considered in determining the calculated quantities.

5. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Excavation (Roadway)," "Excavation (Channel)," "Excavation (Special)," or "Excavation (Roadway and Channel)." This price is full compensation for authorized excavation; drying; undercutting subgrade and reworking or replacing the undercut material in rock cuts; hauling; disposal of material not used elsewhere on the project; scarification and compaction; and equipment, labor, materials, tools, and incidentals.

Drying required deeper than 6 in. below subgrade elevation will be paid for in accordance with Article 9.7., "Payment for Extra Work and Force Account Method." Excavation and replacement of unsuitable material below subgrade elevations will be performed and paid for in accordance with the applicable bid items. However, if Item 132, "Embankment," is not included in the Contract, payment for replacement of unsuitable material will be paid for in accordance with Article 9.7., "Payment for Extra Work and Force Account Method."

When a slide not due to the Contractor's negligence or operation occurs, payments for removal and disposal of the slide material will be in accordance with Article 9.7., "Payment for Extra Work and Force Account Method." Excavation in backfill areas of retaining walls will not be measured or paid for directly but will be subsidiary to pertinent Items.

Item 132

Embankment

6. DESCRIPTION

Furnish, place, and compact materials for construction of roadways, embankments, levees, dikes, or any designated section of the roadway where additional material is required.

7. MATERIALS

Furnish approved material capable of forming a stable embankment from required excavation in the areas shown on the plans or from sources outside the right of way. Provide one or more of the following types as shown on the plans:

Type A. Granular material that is free from vegetation or other objectionable material and meets the requirements of Table 1.

Table 1
Testing Requirements

Property	Test Method	Specification Limit
Liquid limit	Tex-104-E	≤ 45
Plasticity index (PI)	Tex-106-E	≤ 15
Bar linear shrinkage	Tex-107-E	≥ 2

Perform the Linear Shrinkage test only as indicated in [Tex-104-E](#).

Type B. Materials such as rock, loam, clay, or other approved materials.

Type C. Material meeting the specification requirements shown on the plans. Type C may be further designated as Type C1, C2, etc.

Type D. Material from required excavation areas shown on the plans.

Meet the requirements of the pertinent retaining wall Items for retaining wall backfill material.

8. CONSTRUCTION

Meet the requirements of Item 7, "Legal Relations and Responsibilities," when off right of way sources are used. Notify the Engineer before opening a material source to allow for required testing. Complete preparation of the right of way in accordance with Item 100, "Preparing Right of Way," for areas to receive embankment.

Backfill tree-stump holes or other minor excavations with approved material and tamp. Restore the ground surface, including any material disked loose or washed out, to its original slope. Compact the ground surface by sprinkling in accordance with Item 204, "Sprinkling," and by rolling using equipment complying with Item 210, "Rolling," when directed.

Scarify and loosen the unpaved surface areas, except rock, to a depth of at least 6 in. unless otherwise shown on the plans. Bench slopes before placing material. Begin placement of material at the toe of slopes. Do not place trees, stumps, roots, vegetation, or other objectionable material in the embankment. Simultaneously recompact scarified material with the placed embankment material. Do not exceed the layer depth specified in

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Section 132.3.4., "Compaction Methods."

Construct embankments to the grade and sections shown on the plans. Construct the embankment in layers approximately parallel to the finished grade for the full width of the individual roadway cross-sections unless otherwise shown on the plans. Ensure that each section of the embankment conforms to the detailed sections or slopes. Maintain the finished section, density, and grade until the project is accepted.

- 8.1. **Earth Embankments.** Earth embankment is mainly composed of material other than rock. Construct embankments in successive layers, evenly distributing materials in lengths suited for sprinkling and rolling.

Treat material in accordance with Item 260, "Lime Treatment (Road-Mixed)" or Item 275, "Cement Treatment (Road-Mixed)" when required. Obtain approval to incorporate rock and broken concrete produced by the construction project in the lower layers of the embankment. Place the rock and concrete outside the limits of the completed roadbed when the size of approved rock or broken concrete exceeds the layer thickness requirements in Section 132.3.4., "Compaction Methods." Cut and remove all exposed reinforcing steel from the broken concrete.

Move the material dumped in piles or windrows by blading or by similar methods and incorporate it into uniform layers. Feather edge or mix abutting layers of dissimilar material for at least 100 ft. to ensure there are no abrupt changes in the material. Break down clods or lumps of material and mix embankment until a uniform material is attained.

Apply water free of industrial wastes and other objectionable matter to achieve the uniform moisture content specified for compaction.

Roll and sprinkle each embankment layer in accordance with Section 132.3.4.1., "Ordinary Compaction," when ordinary compaction is specified. Compact the layer to the required density in accordance with Section 132.3.4.2., "Density Control," when density control is specified.

- 8.2. **Rock Embankments.** Rock embankment is mainly composed of rock. Construct rock embankments in successive layers for the full width of the roadway cross-section with a depth of 18 in. or less. Increase the layer depth for large rock sizes as approved. Do not exceed a depth of 2-1/2 ft. in any case. Fill voids created by the large stone matrix with smaller stones during the placement and filling operations.

Ensure the depth of the embankment layer is greater than the maximum dimension of any rock. Do not place rock greater than 2 ft. in its maximum dimension, unless otherwise approved. Construct the final layer with graded material so that the density and uniformity is in accordance with Section 132.3.4., "Compaction Methods." Break up exposed oversized material as approved.

Roll and sprinkle each embankment layer in accordance with Section 132.3.4.1., "Ordinary Compaction," when ordinary compaction is specified. Compact each layer to the required density in accordance with Section 132.3.4.2., "Density Control," when density control is specified. Proof-roll each rock layer as directed, where density testing is not possible, in accordance with Item 216, "Proof Rolling," to ensure proper compaction.

- 8.3. **Embankments Adjacent to Culverts and Bridges.** Compact embankments adjacent to culverts and bridges in accordance with Item 400, "Excavation and Backfill for Structures."

- 8.4. **Compaction Methods.** Begin rolling longitudinally at the sides and proceed toward the center, overlapping on successive trips by at least 1/2 the width of the roller. Begin rolling at the lower side and progress toward

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the high side on super elevated curves. Alternate roller trips to attain slightly different lengths. Compact embankments in accordance with Section 132.4.1., "Ordinary Compaction," or Section 132.3.4.2., "Density Control," as shown on the plans.

- 8.4.1. **Ordinary Compaction.** Use approved rolling equipment complying with Item 210, "Rolling," to compact each layer. Use specific equipment when required by the plans or the Engineer. Do not allow the loose depth of any layer to exceed 8 in., unless otherwise approved. Bring each layer to the moisture content directed before and during rolling operations. Compact each layer until there is no evidence of further consolidation. Maintain a level layer to ensure uniform compaction. Recompact and refinish the subgrade at no additional expense to the Department if the required stability or finish is lost for any reason.
- 8.4.2. **Density Control.** Compact each layer to the required density using equipment complying with Item 210, "Rolling." Determine the maximum lift thickness based on the ability of the compacting operation and equipment to meet the required density. Do not exceed layer thickness of 16 in. loose or 12 in. compacted material unless otherwise approved. Maintain a level layer to ensure uniform compaction.

The Engineer will use [Tex-114-E](#) to determine the maximum dry density (D_a) and optimum moisture content (W_{opt}). Meet the requirements for field density and moisture content in Table 2 unless otherwise shown on the plans.

Table 2
Field Density Control Requirements

Description	Density	Moisture Content
	Tex-115-E	
$PI \leq 15$	$\geq 98\% D_a$	
$15 < PI \leq 35$	$\geq 98\% D_a$ and $\leq 102\% D_a$	$\geq W_{opt}$
$PI > 35$	$\geq 95\% D_a$ and $\leq 100\% D_a$	$\geq W_{opt}$

Each layer is subject to testing by the Engineer for density and moisture content. During compaction, the moisture content of the soil should not exceed the value shown on the moisture-density curve, above optimum, required to achieve:

98% dry density for soils with a PI greater than 15 but less than or equal to 35 or
95% dry density for soils with PI greater than 35.

Remove small areas of the layer to allow for density tests as required. Replace the removed material and recompact at no additional expense to the Department. Proof-roll in accordance with Item 216, "Proof Rolling," when shown on the plans or as directed. Correct soft spots as directed.

- 8.5. **Maintenance of Moisture and Reworking.** Maintain the density and moisture content once all requirements in Table 2 are met. Maintain the moisture content no lower than 4% below optimum for soils with a PI greater than 15. Rework the material to obtain the specified compaction when the material loses the required stability, density, moisture, or finish. Alter the compaction methods and procedures on subsequent work to obtain specified density as directed.
- 8.6. **Acceptance Criteria.**
- 8.6.1. **Grade Tolerances.**
- 8.6.1.1. **Staged Construction.** Grade to within 0.1 ft. in the cross-section and 0.1 ft. in 16 ft. measured longitudinally.

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- 8.6.1.2. **Turnkey Construction.** Grade to within 1/2 in. in the cross-section and 1/2 in. in 16 ft. measured longitudinally.
- 8.6.2. **Gradation Tolerances.** Ensure no more than 1 of the 5 most recent gradation tests is outside the specified limits on any individual sieve by more than 5% when gradation requirements are shown on the plans.
- 8.6.3. **Density Tolerances.** Ensure no more than 1 of the 5 most recent density tests for compaction work is outside the specified density limits, and no test is outside the limits by more than 3 pcf.
- 8.6.4. **Plasticity Tolerances.** Ensure no more than 1 of the 5 most recent PI tests for material is outside the specified limit by more than 2 points.

9. MEASUREMENT

Embankment will be measured by the cubic yard. Measurement will be further defined for payment as follows:

- 9.1. **Final.** The cubic yard will be measured in its final position using the average end area method. The volume is computed between the original ground surface or the surface upon which the embankment is to be constructed and the lines, grades, and slopes of the embankment. In areas of salvaged topsoil, payment for embankment will be made in accordance with Item 160, "Topsoil." Shrinkage or swell factors will not be considered in determining the calculated quantities.
- 9.2. **Original.** The cubic yard will be measured in its original and natural position using the average end area method.
- 9.3. **Vehicle.** The cubic yard will be measured in vehicles at the point of delivery.

When measured by the cubic yard in its final position, this is a plans quantity measurement item. The quantity to be paid is the quantity shown in the proposal, unless modified by Article 9.2., "Plans Quantity Measurement." Additional measurements or calculations will be made if adjustments of quantities are required.

Shrinkage or swell factors are the Contractor's responsibility. When shown on the plans, factors are for informational purposes only.

Measurement of retaining wall backfill in embankment areas is paid for as embankment unless otherwise shown on the plans. Limits of measurement for embankment in retaining wall areas are shown on the plans.

10. PAYMENT

The work performed and materials furnished in accordance with this item and measured as provided under "Measurement" will be paid for at the unit price bid for "Embankment (Final)," "Embankment (Original)," or "Embankment (Vehicle)" of the compaction method and type specified. This price is full compensation for furnishing embankment; hauling; placing, compacting, finishing, and reworking; disposal of waste material; and equipment, labor, tools, and incidentals.

When proof rolling is directed, it will be paid for in accordance with Item 216, "Proof Rolling."

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All sprinkling and rolling, except proof rolling, will not be paid for directly but will be considered subsidiary to this Item, unless otherwise shown on the plans.

Where subgrade is constructed under this Contract, correction of soft spots in the subgrade will be at the Contractor's expense. Where subgrade is not constructed under this Contract, correction of soft spots in the subgrade will be paid in accordance with Article 9.7., "Payment for Extra Work and Force Account Method."

Item 160

Topsoil

11. DESCRIPTION

Furnish and place topsoil to the depths and on the areas shown on the plans.

12. MATERIALS

Use easily cultivated, fertile topsoil that is free from objectionable material and resists erosion. Obtain topsoil from the right of way at sites of proposed excavation or embankment when specified on the plans, or as directed. Secure additional topsoil, if necessary, from approved sources outside the right of way in accordance with the requirements of Article 7.7., "Preservation of Cultural and Natural Resources and the Environment." Ensure that the topsoil obtained from sites outside the right of way has a pH of 5.5 to 8.5, per [Tex-128-E](#). Topsoil is subject to testing by the Engineer. Furnish water in accordance with Article 168.2., "Materials."

13. CONSTRUCTION

Remove and dispose of objectionable material from the topsoil source before beginning the work. Stockpile topsoil, when necessary, in a windrow at designated locations along the right of way line or as directed. Keep source and stockpile areas drained during the period of topsoil removal and leave them in a neat condition when removal is complete. Cultivate the area to a depth of 4 in. before placing topsoil. Spread the topsoil to a uniform loose cover at the thickness specified. Place and shape the topsoil as directed. Water and roll the topsoil with a light roller or other suitable equipment.

14. MEASUREMENT

This Item will be measured by the 100-ft. station along the baseline of each roadbed, by the square yard complete in place, or by the cubic yard in vehicles at the point of delivery.

15. PAYMENT

The work performed and the materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Furnishing and Placing Topsoil" of the depth specified on the plans (except for measurement by the cubic yard). This price is full compensation for securing necessary sources and royalties; furnishing topsoil; excavation, loading, hauling, stockpiling and placing; watering; rolling; and equipment, labor, materials, tools, and incidentals. Limits of excavation and embankment for payment are shown in Figure 1.

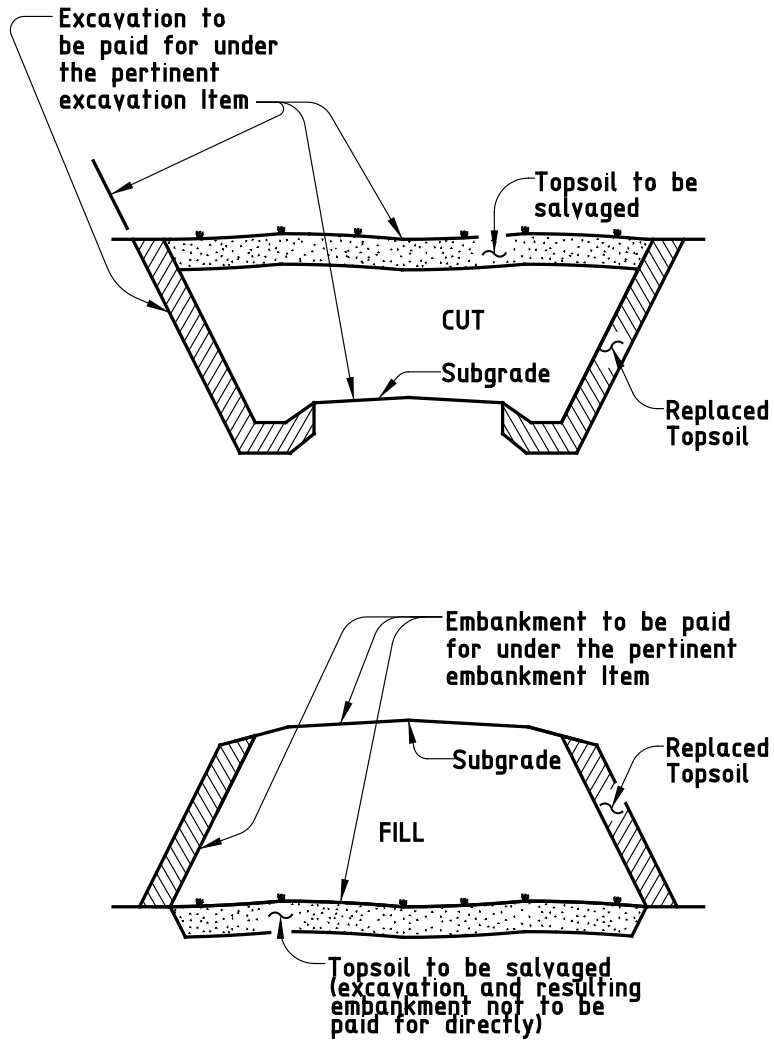


Figure 1
Roadway Cross-Sections Showing Payment for Excavation and Embankment

Item 162 Sodding for Erosion Control

16. DESCRIPTION

Provide and install grass sod as shown on the plans or as directed.

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17. MATERIALS

Use live, growing grass sod of the type specified on the plans. Use grass sod with a healthy root system and dense matted roots throughout the soil of the sod for a minimum thickness of 1 in. Do not use sod from areas where the grass is thinned out. Keep sod material moist from the time it is dug until it is planted. Grass sod with dried roots is unacceptable.

- 17.1. **Block Sod.** Use block, rolled, or solid sod free from noxious weeds, Johnson grass, other grasses, or any matter deleterious to the growth and subsistence of the sod.
- 17.2. **Mulch Sod.** Use mulch sod from an approved source, free from noxious weeds, Johnson grass, other grasses, or any matter deleterious to the growth and subsistence of the sod.
- 17.3. **Fertilizer.** Furnish fertilizer in accordance with Article 166.2., "Materials."
- 17.4. **Water.** Furnish water in accordance with Article 168.2., "Materials."
- 17.5. **Mulch.** Use straw mulch consisting of oat, wheat, or rice straw or hay mulch of either Bermudagrass or prairie grasses. Use straw or hay mulch free of Johnson grass and other noxious and foreign materials. Keep the mulch dry and do not use molded or rotted material.
- 17.6. **Tacking Methods.** Use a tacking agent applied in accordance with the manufacturer's recommendations or a crimping method on all straw or hay mulch operations. Use tacking agents as approved or as specified on the plans.

18. CONSTRUCTION

Cultivate the area to a depth of 4 in. before placing the sod. Plant the sod specified and mulch, if required, after the area has been completed to lines and grades as shown on the plans. Apply fertilizer uniformly over the entire area in accordance with Article 166.3., "Construction," and water in accordance with Article 168.3., "Construction." Plant between the average date of the last freeze in the Spring and 6 weeks before the average date for the first freeze in the Fall according to the Texas Almanac for the project area.

- 18.1. **Sodding Types.**
- 18.1.1. **Spot Sodding.** Use only Bermudagrass sod. Create furrows parallel to the roadway, approximately 5 in. deep and on 18-in. centers. Sod a continuous row not less than 3 in. wide in the 2 furrows adjacent to the roadway. Place 3-in. squares of sod on 15-in. centers in the remaining furrows. Place sod so that the root system will be completely covered by the soil. Firm all sides of the sod with the soil without covering the sod with soil.
- 18.1.2. **Block Sodding.** Place sod over the prepared area. Roll or tamp the sodded area to form a thoroughly compacted, solid mat filling all voids in the sodded area with additional sod. Trim and remove all visible netting and backing materials. Keep sod along edges of curbs, driveways, walkways, etc., trimmed until acceptance.
- 18.1.3. **Mulch Sodding.** Mow sod source to no shorter than 4 in., rake and remove cuttings. Disk the sod in 2 directions, cutting the sod to a minimum of 4 in. Excavate the sod material to a depth of no more than 6 in.

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Keep excavated material moist or it will be rejected. Distribute the mulch sod uniformly over the area to a depth of 6 in. loose, unless otherwise shown on the plans, and roll with a light roller or other suitable equipment.

Add or reshape the mulch sod to meet the requirements of Section 162.3.2., "Finishing."

18.2. **Finishing.** Smooth and shape the area after planting to conform to the desired cross-sections. Spread any excess soil uniformly over adjacent areas or dispose of the excess soil as directed.

18.3. **Straw or Hay Mulch.** Apply straw or hay mulch for "Spot Sodding" and "Mulch Sodding" uniformly over the area as shown on the plans. Apply straw mulch at 2 to 2-1/2 tons per acre. Apply hay mulch at 1-1/2 to 2 tons per acre. Use a tacking method over the mulched area.

19. MEASUREMENT

"Spot Sodding," "Block Sodding," and "Straw or Hay Mulch" will be measured by the square yard in its final position. "Mulch Sodding" will be measured by the square yard in its final position or by the cubic yard in vehicles as delivered to the planting site.

20. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Spot Sodding," "Block Sodding," "Straw or Hay Mulch," or "Mulch Sodding." This price is full compensation for securing a source, excavation, loading, hauling, placing, rolling, finishing, furnishing materials, equipment, labor, tools, supplies, and incidentals. Fertilizer will not be paid for directly but will be subsidiary to this Item.

Unless otherwise specified on the plans, water, except for that used for maintaining and preparing the sod before planting, will be measured and paid for in accordance with Item 168, "Vegetative Watering."

Item 164

Seeding for Erosion Control

21. DESCRIPTION

Provide and install temporary or permanent seeding for erosion control as shown on the plans or as directed.

22. MATERIALS

22.1. **Seed.** Provide seed from the previous season's crop meeting the requirements of the Texas Seed Law, including the testing and labeling for pure live seed (PLS = Purity × Germination). Furnish seed of the designated species, in labeled unopened bags or containers to the Engineer before planting. Use within 12 mo. from the date of the analysis. When Buffalograss is specified, use seed that is treated with KNO₃ (potassium nitrate) to overcome dormancy.

Use Tables 1–4 to determine the appropriate seed mix and rates as specified on the plans. If a plant species is not available by the producers, the other plant species in the recommended seed mixture will be increased proportionally by the PLS/acre of the missing plant species.

Table 1
Permanent Rural Seed Mix

District and Planting Dates	Clay Soils		Sandy Soils	
	Species and Rates (lb. PLS/acre)		Species and Rates (lb. PLS/acre)	
1 (Paris) Feb. 1–May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (Haskell)	3.2	Bermudagrass	1.5
	Bermudagrass	1.8	Bahiagrass (Pensacola)	6.0
	Little Bluestem (Native)	1.7	Sand Lovegrass	0.6
	Illinois Bundleflower	1.0	Weeping Lovegrass (Ermelo)	0.8
			Partridge Pea	1.0
2 (Ft. Worth) Feb. 1–May 15	Green Sprangletop (Van Horn)	1.0	Green Sprangletop (Van Horn)	1.0
	Sideoats Grama (Haskell)	1.0	Hooded Windmillgrass (Mariah)	0.2
	Texas Grama (Atascosa)	1.0	Shortspike Windmillgrass (Welder)	0.2
	Hairy Grama (Chaparral)	0.4	Hairy Grama (Chaparral)	0.4
	Shortspike Windmillgrass (Welder)	0.2	Slender Grama (Dilley)	1.0
	Little Bluestem (OK Select)	0.8	Sand Lovegrass (Mason)	0.2
	Purple Prairie Clover (Cuero)	0.6	Sand Dropseed (Borden County)	0.2
	Engelmann Daisy (Eldorado)	0.75	Partridge Pea (Comanche)	0.6
	Illinois Bundleflower	1.3	Little Bluestem (OK Select)	0.8
	Awnless Bushsunflower (Plateau)	0.2	Englemann Daisy (Eldorado)	0.75
		Purple Prairie Clover	0.3	
3 (Wichita Falls) Feb. 1–May 15	Green Sprangletop (Van Horn)	0.6	Green Sprangletop (Van Horn)	1.0
	Sideoats Grama (Haskell)	1.0	Hooded Windmillgrass (Mariah)	0.2
	Texas Grama (Atascosa)	1.0	Shortspike Windmillgrass (Welder)	0.2
	Hairy Grama (Chaparral)	0.4	Hairy Grama (Chaparral)	0.4
	Shortspike Windmillgrass (Welder)	0.2	Sand Lovegrass (Mason)	0.2
	Little Bluestem (OK Select)	0.8	Sand Dropseed (Borden County)	0.2
	Blue Grama (Hachita)	0.4	Partridge Pea (Comanche)	0.6
	Western Wheatgrass (Barton)	1.2	Little Bluestem (OK Select)	0.8
	Galleta Grass (Viva)	0.6	Englemann Daisy (Eldorado)	0.75
	Engelmann Daisy (Eldorado)	0.75	Purple Prairie Clover (Cuero)	0.3
	Awnless Bushsunflower (Plateau)	0.2		

Table 1 (continued)
Permanent Rural Seed Mix

District and Planting Dates	Clay Soils		Sandy Soils	
	Species and Rates (lb. PLS/acre)		Species and Rates (lb. PLS/acre)	
4 (Amarillo) Feb. 15–May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (Haskell)	3.6	Weeping Lovegrass (Ermelo)	0.8
	Blue Grama (Hachita)	1.2	Blue Grama (Hachita)	1.0
	Buffalograss (Texoka)	1.6	Sand Dropseed (Borden Co.)	0.3
	Illinois Bundleflower	1.0	Sand Bluestem	1.8
			Purple Prairie Clover	0.5
5 (Lubbock) Feb. 15–May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (El Reno)	3.6	Weeping Lovegrass (Ermelo)	0.8
	Blue Grama (Hachita)	1.2	Blue Grama (Hachita)	1.0
	Buffalograss (Texoka)	1.6	Sand Dropseed (Borden Co.)	0.3
	Illinois Bundleflower	1.0	Sand Bluestem	1.8
			Purple Prairie Clover	0.5
6 (Odessa) Feb. 1–May 15	Green Sprangletop (Van Horn)	1.0	Green Sprangletop (Van Horn)	1.0
	Sideoats Grama (South Texas)	1.0	Hooded Windmillgrass (Mariah)	0.2
	Blue Grama (Hachita)	0.4	Blue Grama (Hachita)	0.4
	Galleta Grass (Viva)	0.6	Hairy Grama (Chaparral)	0.4
	Shortspike Windmillgrass (Welder)	0.2	Sand Lovegrass (Mason)	0.2
	Pink Pappusgrass (Maverick)	0.6	Sand Dropseed (Borden County)	0.2
	Alkali Sacaton (Saltalk)	0.2	Indian Ricegrass (Rim Rock)	1.6
	Plains Bristlegrass (Catarina Blend)	0.2	Sand Bluestem (Cottle County)	1.2
	False Rhodes Grass (Kinney)	0.1	Little Bluestem (Pastura)	0.8
	Whiplash Pappusgrass (Webb)	0.6	Purple Prairie Clover (Cuero)	0.3
	Arizona Cottontop (La Salle)	0.2		
7 (San Angelo) Feb. 1–May 1	Green Sprangletop (Van Horn)	1.0	Green Sprangletop (Van Horn)	1.0
	Sideoats Grama (Haskell)	1.0	Hooded Windmillgrass (Mariah)	0.2
	Texas Grama (Atascosa)	1.0	Shortspike Windmillgrass (Welder)	0.2
	Hairy Grama (Chaparral)	0.4	Hairy Grama (Chaparral)	0.4
	Shortspike Windmillgrass (Welder)	0.2	Sand Lovegrass (Mason)	0.2
	Little Bluestem (OK Select)	0.4	Sand Dropseed (Borden County)	0.2
	Blue Grama (Hachita)	0.4	Sand Bluestem (Cottle County)	1.2
	Western Wheatgrass (Barton)	1.2	Partridge Pea (Comanche)	0.6
	Galleta Grass (Viva)	0.6	Little Bluestem (OK Select)	0.8
	Engelmann Daisy (Eldorado)	0.75	Engelmann Daisy (Eldorado)	0.75
	Illinois Bundleflower (Sabine)	1.0	Purple Prairie Clover (Cuero)	0.3
8 (Abilene) Feb. 1–May 15	Green Sprangletop (Van Horn)	1.0	Green Sprangletop (Van Horn)	1.0
	Sideoats Grama (Haskell)	1.0	Hooded Windmillgrass (Mariah)	0.2
	Texas Grama (Atascosa)	1.0	Shortspike Windmillgrass (Welder)	0.2
	Hairy Grama (Chaparral)	0.4	Hairy Grama (Chaparral)	0.4
	Shortspike Windmillgrass (Welder)	0.2	Sand Lovegrass (Mason)	0.2
	Little Bluestem (OK Select)	0.4	Sand Dropseed (Borden County)	0.2
	Blue Grama (Hachita)	0.4	Sand Bluestem (Cottle County)	1.2
	Western Wheatgrass (Barton)	1.2	Partridge Pea (Comanche)	0.6
	Galleta Grass (Viva)	0.6	Little Bluestem (OK Select)	0.8
	Engelmann Daisy (Eldorado)	0.75	Engelmann Daisy (Eldorado)	0.75
	Illinois Bundleflower (Sabine)	1.0	Purple Prairie Clover (Cuero)	0.3
9 (Waco) Feb. 1–May 15	Green Sprangletop (Van Horn)	1.0	Green Sprangletop (Van Horn)	1.0
	Sideoats Grama (Haskell)	1.0	Hooded Windmillgrass (Mariah)	0.2
	Texas Grama (Atascosa)	1.0	Shortspike Windmillgrass (Welder)	0.2
	Hairy Grama (Chaparral)	0.4	Hairy Grama (Chaparral)	0.4
	Shortspike Windmillgrass (Welder)	0.2	Slender Grama (Dilley)	1.0
	Little Bluestem (OK Select)	0.8	Sand Lovegrass (Mason)	0.2
	Purple Prairie Clover (Cuero)	0.6	Sand Dropseed (Borden County)	0.2
	Engelmann Daisy (Eldorado)	0.75	Partridge Pea (Comanche)	0.6
	Illinois Bundleflower	1.3	Little Bluestem (OK Select)	0.8
	Awnless Bushsunflower (Plateau)	0.2	Engelmann Daisy (Eldorado)	0.75
			Purple Prairie Clover	0.3

Table 1 (continued)
Permanent Rural Seed Mix

District and Planting Dates		Clay Soils		Sandy Soils	
		Species and Rates (lb. PLS/acre)		Species and Rates (lb. PLS/acre)	
10 Feb. 1–May 15	(Tyler)	Green Sprangletop	0.3	Green Sprangletop	0.3
		Bermudagrass	1.8	Bermudagrass	1.8
		Bahiagrass (Pensacola)	9.0	Bahiagrass (Pensacola)	9.0
		Sideoats Grama (Haskell)	2.7	Weeping Lovegrass (Ermelo)	0.5
		Illinois Bundleflower	1.0	Sand Lovegrass	0.5
				Lance-Leaf Coreopsis	1.0
11 Feb. 1–May 15	(Lufkin)	Green Sprangletop	0.3	Green Sprangletop	0.3
		Bermudagrass	1.8	Bermudagrass	2.1
		Bahiagrass (Pensacola)	9.0	Bahiagrass (Pensacola)	9.0
		Sideoats Grama (Haskell)	2.7	Sand Lovegrass	0.5
		Illinois Bundleflower	1.0	Lance-Leaf Coreopsis	1.0
12 Jan. 15–May 15	(Houston)	Green Sprangletop	0.3	Green Sprangletop	0.3
		Bermudagrass	2.1	Bermudagrass	2.4
		Sideoats Grama (Haskell)	3.2	Bahiagrass (Pensacola)	10.5
		Little Bluestem (Native)	1.4	Weeping Lovegrass (Ermelo)	1.0
		Illinois Bundleflower	1.0	Lance-Leaf Coreopsis	1.0
13 Jan. 15–May 15	(Yoakum)	Green Sprangletop (Van Horn)	1.0	Green Sprangletop (Van Horn)	1.0
		Sideoats Grama (South Texas)	1.0	Hooded Windmillgrass (Mariah)	0.4
		Texas Grama (Atascosa)	1.5	Slender Grama (Dilley)	1.0
		Slender Grama (Dilley)	1.0	Hairy Grama (Chaparral)	0.8
		Shortspike Windmillgrass (Welder)	0.3	Shortspike Windmillgrass (Welder)	0.2
		Halls Panicum (Oso)	0.2	Purple Prairie Clover (Cuero)	0.6
		Plains Bristlegrass (Catarina Blend)	0.2	Partridge Pea (Comanche)	0.6
		Canada Wildrye (Lavaca)	2.0	Englemann Daisy (Eldorado)	1.0
		Illinois Bundleflower (Sabine)	1.3		
		Purple Prairie Clover (Cuero)	0.6		
14 Feb. 1–May 15	(Austin)	Green Sprangletop (Van Horn)	1.0	Green Sprangletop (Van Horn)	1.0
		Sideoats Grama (South Texas)	1.0	Hooded Windmillgrass (Mariah)	0.2
		Texas Grama (Atascosa)	1.0	Shortspike Windmillgrass (Welder)	0.2
		Hairy Grama (Chaparral)	0.4	Hairy Grama (Chaparral)	0.4
		Shortspike Windmillgrass (Welder)	0.2	Slender Grama (Dilley)	1.0
		Little Bluestem (OK Select)	0.8	Sand Lovegrass (Mason)	0.2
		Purple Prairie Clover (Cuero)	0.6	Sand Dropseed (Borden County)	0.2
		Engelmann Daisy (Eldorado)	0.75	Partridge Pea (Comanche)	0.6
		Illinois Bundleflower (Sabine)	1.3	Little Bluestem (OK Select)	0.8
		Awnless Bushsunflower (Plateau)	0.2	Englemann Daisy (Eldorado)	0.75
		Purple Prairie Clover	0.3		
15 Feb. 1–May 1	(San Antonio)	Green Sprangletop (Van Horn)	1.0	Green Sprangletop (Van Horn)	1.0
		Sideoats Grama (South Texas)	1.0	Slender Grama (Dilley)	2.0
		Texas Grama (Atascosa)	1.0	Hairy Grama (Chaparral)	0.6
		Slender Grama (Dilley)	1.0	Shortspike Windmillgrass (Welder)	0.4
		Shortspike Windmillgrass (Welder)	0.2	Pink Pappusgrass (Maverick)	0.6
		Pink Pappusgrass (Maverick)	0.6	Plains Bristlegrass (Catarina Blend)	0.2
		Halls Panicum (Oso)	0.2	Hooded Windmillgrass (Mariah)	0.3
		Plains Bristlegrass (Catarina Blend)	0.2	Multi-flowered False Rhodes Grass	0.1
		False Rhodes Grass (Kinney)	0.1	(Hidalgo)	0.2
		Hooded Windmillgrass (Mariah)	0.2	Arizona Cottontop (La Salle)	
Arizona Cottontop (La Salle)	0.2				
16 Jan. 1–May 1	(Corpus Christi)	Green Sprangletop (Van Horn)	1.0	Green Sprangletop (Van Horn)	1.0
		Sideoats Grama (South Texas)	1.0	Slender Grama (Dilley)	2.0
		Texas Grama (Atascosa)	1.0	Hairy Grama (Chaparral)	0.6
		Slender Grama (Dilley)	1.0	Shortspike Windmillgrass (Welder)	0.4
		Shortspike Windmillgrass (Welder)	0.2	Pink Pappusgrass (Maverick)	0.6
		Pink Pappusgrass (Maverick)	0.6	Plains Bristlegrass (Catarina Blend)	0.2
		Halls Panicum (Oso)	0.2	Hooded Windmillgrass (Mariah)	0.3
		Plains Bristlegrass (Catarina Blend)	0.2	Multi-flowered False Rhodes Grass	0.1
		False Rhodes Grass (Kinney)	0.1	(Hidalgo)	0.2
		Hooded Windmillgrass (Mariah)	0.2	Arizona Cottontop (La Salle)	
Arizona Cottontop (La Salle)	0.2				

Table 1 (continued)
Permanent Rural Seed Mix

District and Planting Dates		Clay Soils Species and Rates (lb. PLS/acre)		Sandy Soils Species and Rates (lb. PLS/acre)	
17 Feb. 1–May 15	(Bryan)	Green Sprangletop	0.3	Green Sprangletop	0.3
		Bermudagrass	1.5	Bermudagrass	1.5
		Sideoats Grama (Haskell)	3.6	Bahiagrass (Pensacola)	7.5
		Little Bluestem (Native)	1.7	Weeping Lovegrass (Ermelo)	0.6
		Illinois Bundleflower	1.0	Sand Lovegrass	0.6
				Lance-Leaf Coreopsis	1.0
18 Feb. 1–May 15	(Dallas)	Green Sprangletop (Van Horn)	1.0	Green Sprangletop (Van Horn)	1.0
		Sideoats Grama (Haskell)	1.0	Hooded Windmillgrass (Mariah)	0.2
		Texas Grama (Atascosa)	1.0	Shortspike Windmillgrass (Welder)	0.2
		Hairy Grama (Chaparral)	0.4	Hairy Grama (Chaparral)	0.4
		Shortspike Windmillgrass (Welder)	0.2	Slender Grama (Dilley)	1.0
		Little Bluestem (OK Select)	0.8	Sand Lovegrass (Mason)	0.2
		Purple Prairie Clover (Cuero)	0.6	Sand Dropseed (Borden County)	0.2
		Engelmann Daisy (Eldorado)	0.75	Partridge Pea (Comanche)	0.6
		Illinois Bundleflower	1.3	Little Bluestem (OK Select)	0.8
		Awnless Bushsunflower (Plateau)	0.2	Engelmann Daisy (Eldorado)	0.75
				Purple Prairie Clover	0.3
19 Feb. 1–May 15	(Atlanta)	Green Sprangletop	0.3	Green Sprangletop	0.3
		Bermudagrass	2.4	Bermudagrass	2.1
		Sideoats Grama (Haskell)	4.5	Bahiagrass (Pensacola)	7.5
		Illinois Bundleflower	1.0	Sand Lovegrass	0.6
				Lance-Leaf Coreopsis	1.0
20 Jan. 15–May 15	(Beaumont)	Green Sprangletop	0.3	Green Sprangletop	0.3
		Bermudagrass	2.7	Bermudagrass	2.1
		Sideoats Grama (Haskell)	4.1	Bahiagrass (Pensacola)	7.5
		Illinois Bundleflower	1.0	Sand Lovegrass	0.6
				Lance-Leaf Coreopsis	1.0
21 Jan. 15–May 15	(Pharr)	Green Sprangletop (Van Horn)	1.0	Green Sprangletop (Van Horn)	1.0
		Sideoats Grama (South Texas)	1.0	Slender Grama (Dilley)	2.0
		Texas Grama (Atascosa)	1.0	Hairy Grama (Chaparral)	0.6
		Slender Grama (Dilley)	1.0	Shortspike Windmillgrass (Welder)	0.4
		Shortspike Windmillgrass (Welder)	0.2	Pink Pappusgrass (Maverick)	0.6
		Pink Pappusgrass (Maverick)	0.6	Plains Bristlegrass (Catarina Blend)	0.2
		Halls Panicum (Oso)	0.2	Hooded Windmillgrass (Mariah)	0.3
		Plains Bristlegrass (Catarina Blend)	0.2	Multi-flowered False Rhoades Grass	0.1
		False Rhodes Grass (Kinney)	0.1	(Hidalgo)	0.2
		Hooded Windmillgrass (Mariah)	0.2	Arizona Cottontop (La Salle)	
Arizona Cottontop (La Salle)	0.2				
22 Jan. 15–May 1	(Laredo)	Green Sprangletop (Van Horn)	1.0	Green Sprangletop (Van Horn)	1.0
		Sideoats Grama (South Texas)	1.0	Slender Grama (Dilley)	2.0
		Texas Grama (Atascosa)	1.0	Hairy Grama (Chaparral)	0.6
		Slender Grama (Dilley)	1.0	Shortspike Windmillgrass (Welder)	0.4
		Shortspike Windmillgrass (Welder)	0.2	Pink Pappusgrass (Maverick)	0.6
		Pink Pappusgrass (Maverick)	0.6	Plains Bristlegrass (Catarina Blend)	0.2
		Halls Panicum (Oso)	0.2	Hooded Windmillgrass (Mariah)	0.3
		Plains Bristlegrass (Catarina Blend)	0.2	Multi-flowered False Rhoades Grass	0.1
		False Rhodes Grass (Kinney)	0.1	(Hidalgo)	0.2
		Hooded Windmillgrass (Mariah)	0.2	Arizona Cottontop (La Salle)	
Arizona Cottontop (La Salle)	0.2				
23 Feb. 1–May 15	(Brownwood)	Green Sprangletop (Van Horn)	0.6	Green Sprangletop (Van Horn)	1.0
		Sideoats Grama (Haskell)	1.0	Hooded Windmillgrass (Mariah)	0.2
		Texas Grama (Atascosa)	1.0	Shortspike Windmillgrass (Welder)	0.2
		Hairy Grama (Chaparral)	0.4	Hairy Grama (Chaparral)	0.4
		Shortspike Windmillgrass (Welder)	0.2	Sand Lovegrass (Mason)	0.2
		Little Bluestem (OK Select)	0.8	Sand Dropseed (Borden County)	0.2
		Blue Grama (Hachita)	0.4	Partridge Pea (Comanche)	0.6
		Western Wheatgrass (Barton)	1.2	Little Bluestem (OK Select)	0.8
		Galleta Grass (Viva)	0.6	Engelmann Daisy (Eldorado)	0.75
		Engelmann Daisy (Eldorado)	0.75	Purple Prairie Clover (Cuero)	0.3
Awnless Bushsunflower (Plateau)	0.2				

Table 1 (continued)
Permanent Rural Seed Mix

District and Planting Dates	Clay Soils		Sandy Soils	
	Species and Rates (lb. PLS/acre)		Species and Rates (lb. PLS/acre)	
24 (El Paso) Feb. 1–May 15	Green Sprangletop (Van Horn)	1.0	Green Sprangletop (Van Horn)	1.0
	Sideoats Grama (South Texas)	1.0	Hooded Windmillgrass (Mariah)	0.2
	Blue Grama (Hachita)	0.4	Blue Grama (Hachita)	0.4
	Galleta Grass (Viva)	0.6	Hairy Grama (Chaparral)	0.4
	Shortspike Windmillgrass (Welder)	0.2	Sand Lovegrass (Mason)	0.2
	Pink Pappusgrass (Maverick)	0.6	Sand Dropseed (Borden County)	0.2
	Alkali Sacaton (Saltalk)	0.2	Indian Ricegrass (Rim Rock)	1.6
	Plains Bristlegrass (Catarina Blend)	0.2	Sand Bluestem (Cottle County)	1.2
	False Rhodes Grass (Kinney)	0.1	Little Bluestem (Pastura)	0.8
	Whiplash Pappusgrass (Webb)	0.6	Purple Prairie Clover (Cuero)	0.3
Arizona Cottontop (La Salle)	0.2			
25 (Childress) Feb. 1–May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (El Reno)	2.7	Weeping Lovegrass (Ermelo)	1.2
	Blue Grama (Hachita)	0.9	Sand Dropseed (Borden Co.)	0.5
	Western Wheatgrass	2.1	Sand Lovegrass	0.8
	Galleta	1.6	Purple Prairie Clover	0.5
	Illinois Bundleflower	1.0		

Table 2
Permanent Urban Seed Mix

District and Planting Dates	Clay Soils		Sandy Soils	
	Species and Rates (lb. PLS/acre)		Species and Rates (lb. PLS/acre)	
1 (Paris) Feb. 1–May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Bermudagrass	2.4	Bermudagrass	5.4
	Sideoats Grama (Haskell)	4.5		
2 (Ft. Worth) Feb. 1–May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (El Reno)	3.6	Sideoats Grama (El Reno)	3.6
	Bermudagrass	2.4	Bermudagrass	2.1
	Buffalograss (Texoka)	1.6	Sand Dropseed (Borden Co.)	0.3
3 (Wichita Falls) Feb. 1–May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (El Reno)	4.5	Sideoats Grama (El Reno)	3.6
	Bermudagrass	1.8	Bermudagrass	1.8
	Buffalograss (Texoka)	1.6	Sand Dropseed (Borden Co.)	0.4
4 (Amarillo) Feb. 15–May 15	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (El Reno)	3.6	Sideoats Grama (El Reno)	2.7
	Blue Grama (Hachita)	1.2	Blue Grama (Hachita)	0.9
	Buffalograss (Texoka)	1.6	Sand Dropseed (Borden Co.)	0.4
5 (Lubbock) Feb. 15–May 15	Green Sprangletop	0.3	Buffalograss (Texoka)	1.6
	Sideoats Grama (El Reno)	3.6	Green Sprangletop	0.3
	Blue Grama (Hachita)	1.2	Sideoats Grama (El Reno)	2.7
	Buffalograss (Texoka)	1.6	Blue Grama (Hachita)	0.9
6 (Odessa) Feb. 1–May 15	Green Sprangletop	0.3	Sand Dropseed (Borden Co.)	0.4
	Sideoats Grama (Haskell)	3.6	Blue Grama (Hachita)	0.9
	Blue Grama (Hachita)	1.2	Buffalograss (Texoka)	1.6
	Buffalograss (Texoka)	1.6		
7 (San Angelo) Feb. 1–May 1	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (Haskell)	7.2	Sideoats Grama (Haskell)	3.2
	Buffalograss (Texoka)	1.6	Sand Dropseed (Borden Co.)	0.3
			Blue Grama (Hachita)	0.9
8 (Abilene) Feb. 1–May 15			Buffalograss (Texoka)	1.6
	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (Haskell)	3.6	Sand Dropseed (Borden Co.)	0.3
	Blue Grama (Hachita)	1.2	Sideoats Grama (Haskell)	3.6
		Blue Grama (Hachita)	0.8	
		Buffalograss (Texoka)	1.6	

Table 2 (continued)
Permanent Urban Seed Mix

District and Planting Dates		Clay Soils		Sandy Soils	
		Species and Rates (lb. PLS/acre)		Species and Rates (lb. PLS/acre)	
9 Feb. 1–May 15	(Waco)	Green Sprangletop	0.3	Green Sprangletop	0.3
		Bermudagrass	1.8	Buffalograss (Texoka)	1.6
		Buffalograss (Texoka)	1.6	Bermudagrass	3.6
		Sideoats Grama (Haskell)	4.5	Sand Dropseed (Borden Co.)	0.4
10 Feb. 1–May 15	(Tyler)	Green Sprangletop	0.3	Green Sprangletop	0.3
		Bermudagrass	2.4	Bermudagrass	5.4
		Sideoats Grama (Haskell)	4.5		
11 Feb. 1–May 15	(Lufkin)	Green Sprangletop	0.3	Green Sprangletop	0.3
		Bermudagrass	2.4	Bermudagrass	5.4
		Sideoats Grama (Haskell)	4.5		
12 Jan. 15–May 15	(Houston)	Green Sprangletop	0.3	Green Sprangletop	0.3
		Sideoats Grama (Haskell)	4.5	Bermudagrass	5.4
		Bermudagrass	2.4		
13 Jan. 15–May 15	(Yoakum)	Green Sprangletop	0.3	Green Sprangletop	0.3
		Sideoats Grama (South Texas)	4.5	Bermudagrass	5.4
		Bermudagrass	2.4		
14 Feb. 1–May 15	(Austin)	Green Sprangletop	0.3	Green Sprangletop	0.3
		Bermudagrass	2.4	Bermudagrass	4.8
		Sideoats Grama (South Texas)	3.6	Buffalograss (Texoka)	1.6
		Buffalograss (Texoka)	1.6		
15 Feb. 1–May 1	(San Antonio)	Green Sprangletop	0.3	Green Sprangletop	0.3
		Sideoats Grama (South Texas)	3.6	Bermudagrass	4.8
		Bermudagrass	2.4	Buffalograss (Texoka)	1.6
		Buffalograss (Texoka)	1.6		
16 Jan. 1–May 1	(Corpus Christi)	Green Sprangletop	0.3	Green Sprangletop	0.3
		Sideoats Grama (South Texas)	3.6	Bermudagrass	4.8
		Bermudagrass	2.4	Buffalograss (Texoka)	1.6
		Buffalograss (Texoka)	1.6		
17 Feb. 1–May 15	(Bryan)	Green Sprangletop	0.3	Green Sprangletop	0.3
		Bermudagrass	2.4	Bermudagrass	5.4
		Sideoats Grama (Haskell)	4.5		
18 Feb. 1–May 15	(Dallas)	Green Sprangletop	0.3	Green Sprangletop	0.3
		Sideoats Grama (El Reno)	3.6	Buffalograss (Texoka)	1.6
		Buffalograss (Texoka)	1.6	Bermudagrass	3.6
		Bermudagrass	2.4	Sand Dropseed (Borden Co.)	0.4
19 Feb. 1–May 15	(Atlanta)	Green Sprangletop	0.3	Green Sprangletop	0.3
		Bermudagrass	2.4	Bermudagrass	5.4
		Sideoats Grama (Haskell)	4.5		
20 Jan. 15–May 15	(Beaumont)	Green Sprangletop	0.3	Green Sprangletop	0.3
		Bermudagrass	2.4	Bermudagrass	5.4
		Sideoats Grama (Haskell)	4.5		
21 Jan. 15–May 15	(Pharr)	Green Sprangletop	0.3	Green Sprangletop	0.3
		Sideoats Grama (South Texas)	3.6	Buffalograss (Texoka)	1.6
		Buffalograss (Texoka)	1.6	Bermudagrass	3.6
		Bermudagrass	2.4	Sand Dropseed (Borden Co.)	0.4
22 Jan. 15–May 1	(Laredo)	Green Sprangletop	0.3	Green Sprangletop	0.3
		Sideoats Grama (South Texas)	4.5	Buffalograss (Texoka)	1.6
		Buffalograss (Texoka)	1.6	Bermudagrass	3.6
		Bermudagrass	1.8	Sand Dropseed	0.4
23 Feb. 1–May 15	(Brownwood)	Green Sprangletop	0.3	Green Sprangletop	0.3
		Sideoats Grama (Haskell)	3.6	Buffalograss (Texoka)	1.6
		Bermudagrass	1.2	Bermudagrass	3.6
		Blue Grama (Hachita)	0.9	Sand Dropseed (Borden Co.)	0.4
24 Feb. 1–May 15	(El Paso)	Green Sprangletop	0.3	Green Sprangletop	0.3
		Sideoats Grama (South Texas)	3.6	Buffalograss (Texoka)	1.6
		Blue Grama (Hachita)	1.2	Sand Dropseed (Borden Co.)	0.4
		Buffalograss (Texoka)	1.6	Blue Grama (Hachita)	1.8

District and Planting Dates	Clay Soils		Sandy Soils	
	Species and Rates (lb. PLS/acre)		Species and Rates (lb. PLS/acre)	
25 Feb. 1–May 15 (Childress)	Green Sprangletop	0.3	Green Sprangletop	0.3
	Sideoats Grama (El Reno)	3.6	Sand Dropseed (Borden Co.)	0.4
	Blue Grama (Hachita)	1.2	Buffalograss (Texoka)	1.6
	Buffalograss (Texoka)	1.6	Bermudagrass	1.8

Table 3
Temporary Cool Season Seeding

Districts	Dates	Seed Mix and Rates (lb. PLS/acre)
Paris (1), Amarillo (4), Lubbock (5), Dallas (18)	September 1–November 30	Tall Fescue 4.5 Western Wheatgrass 5.6 Wheat (Red, Winter) 34
Odessa (6), San Angelo (7), El Paso (24)	September 1–November 30	Western Wheatgrass 8.4 Wheat (Red, Winter) 50
Waco (9), Tyler (10), Lufkin (11), Austin (14), San Antonio (15), Bryan (17), Atlanta (19)	September 1–November 30	Tall Fescue 4.5 Oats 24 Wheat 34
Houston (12), Yoakum (13), Corpus Christi (16), Beaumont (20), Pharr (21), Laredo (22)	September 1–November 30	Oats 72
Ft. Worth (2), Wichita Falls (3), Abilene (8), Brownwood (23), Childress (25)	September 1–November 30	Tall Fescue 4.5 Western Wheatgrass 5.6 Cereal Rye 34

Table 4
Temporary Warm Season Seeding

Districts	Dates	Seed Mix and Rates (lb. PLS/acre)
All	May 1–August 31	Foxtail Millet 34

- 22.2. **Fertilizer.** Use fertilizer in conformance with Article 166.2., "Materials."
- 22.3. **Vegetative Watering.** Use water that is clean and free of industrial wastes and other substances harmful to the growth of vegetation.
- 22.4. **Mulch.**
- 22.4.1. **Straw or Hay Mulch.** Use straw or hay mulch in conformance with Section 162.2.5., "Mulch."
- 22.4.2. **Cellulose Fiber Mulch.** Use only cellulose fiber mulches that are on the Approved Products List, *Erosion Control Approved Products*. (<http://www.txdot.gov/business/resources/erosion-control.html>) Submit one full set of manufacturer's literature for the selected material. Keep mulch dry until applied. Do not use molded or rotted material.
- 22.5. **Tacking Methods.** Use a tacking agent applied in accordance with the manufacturer's recommendations or a crimping method on all straw or hay mulch operations. Use tacking agents as approved or as specified on the plans.

23. CONSTRUCTION

Cultivate the area to a depth of 4 in. before placing the seed unless otherwise directed. Use approved equipment to vertically track the seedbed as shown on the plans or as directed. Cultivate the seedbed to a depth of 4 in. or mow the area before placement of the permanent seed when performing permanent seeding after an established temporary seeding. Plant the seed specified and mulch, if required, after the area has been completed to lines and grades as shown on the plans.

- 23.1. **Broadcast Seeding.** Distribute the seed or seed mixture uniformly over the areas shown on the plans using hand or mechanical distribution or hydro-seeding on top of the soil unless otherwise directed. Apply the mixture to the area to be seeded within 30 min. of placement of components in the equipment when seed and water are to be distributed as a slurry during hydro-seeding. Roll the planted area with a light roller or other suitable equipment. Roll sloped areas along the contour of the slopes.

- 23.2. **Straw or Hay Mulch Seeding.** Plant seed according to Section 164.3.1., "Broadcast Seeding." Apply straw or hay mulch uniformly over the seeded area immediately after planting the seed or seed mixture. Apply straw mulch at 2 to 2.5 tons per acre. Apply hay mulch at 1.5 to 2 tons per acre. Use a tacking method over the mulched area.
- 23.3. **Cellulose Fiber Mulch Seeding.** Plant seed in accordance with Section 164.3.1., "Broadcast Seeding." Apply cellulose fiber mulch uniformly over the seeded area immediately after planting the seed or seed mixture at the following rates.
Sandy soils with slopes of 3:1 or less—2,500 lb. per acre.
Sandy soils with slopes greater than 3:1—3,000 lb. per acre.
Clay soils with slopes of 3:1 or less—2,000 lb. per acre.
Clay soils with slopes greater than 3:1—2,300 lb. per acre.
- Cellulose fiber mulch rates are based on dry weight of mulch per acre. Mix cellulose fiber mulch and water to make a slurry and apply uniformly over the seeded area using suitable equipment.
- 23.4. **Drill Seeding.** Plant seed or seed mixture uniformly over the area shown on the plans at a depth of 1/4 to 1/3 in. using a pasture or rangeland type drill unless otherwise directed. Plant seed along the contour of the slopes.
- 23.5. **Straw or Hay Mulching.** Apply straw or hay mulch uniformly over the area as shown on the plans. Apply straw mulch at 2 to 2.5 tons per acre. Apply hay mulch at 1.5 to 2 tons per acre. Use a tacking method over the mulched area.

Apply fertilizer in conformance with Article 166.3., "Construction." Seed and fertilizer may be distributed simultaneously during "Broadcast Seeding" operations, provided each component is applied at the specified rate. Apply half of the required fertilizer during the temporary seeding operation and the other half during the permanent seeding operation when temporary and permanent seeding are both specified for the same area.

Water the seeded areas at the rates and frequencies as shown on the plans or as directed.

24. MEASUREMENT

This Item will be measured by the square yard or by the acre.

25. PAYMENT

The work performed and the materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Broadcast Seeding (Perm)" of the rural or urban seed mixture and sandy or clay soil specified, "Broadcast Seeding (Temp)" of warm or cool season specified, "Straw or Hay Mulch Seeding (Perm)" of the rural or urban seed mixture and sandy or clay soil specified, "Straw or Hay Mulch Seeding (Temp)" of warm or cool season specified, "Cellulose Fiber Mulch Seeding (Perm)" of the rural or urban seed mixture and sandy or clay soil specified, "Cellulose Fiber Mulch Seeding (Temp)" of warm or cool season specified, "Drill Seeding (Perm)" of the rural or urban seed mixture and sandy or clay soil specified, "Drill Seeding (Temp)" of warm or cool season specified, and "Straw or Hay Mulching." This price is full compensation for furnishing materials, including water for hydro-seeding and hydro-mulching operations, mowing, labor, equipment, tools, supplies, and incidentals. Fertilizer will not be paid for directly but will be subsidiary to this Item. Water for irrigating the seeded area, when specified, will be paid for under Item 168, "Vegetative Watering."

Item 168

Vegetative Watering

26. DESCRIPTION

Provide and distribute water to promote growth of vegetation as directed.

27. MATERIALS

Use water that is clean and free of industrial wastes and other substances harmful to the growth of vegetation.

28. CONSTRUCTION

Apply water when directed. Furnish and operate equipment to distribute water at a uniform and controllable rate. Ensure that watering does not erode soil or plantings. Apply water in the required quantity where shown on the plans or as directed.

29. MEASUREMENT

This Item will be measured by the 1,000 gal. as applied.

30. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Vegetative Watering." This price is full compensation for furnishing and operating watering equipment and measuring devices and for furnishing and applying water, including hauling, equipment, labor, and incidentals.

Item 400

Excavation and Backfill for Structures

31. DESCRIPTION

Excavate for placement and construction of structures and backfill structures. Cut and restore pavement.

32. MATERIALS

Use materials that meet the requirements of the following Items.

Item 401, "Flowable Backfill,"

Item 421, "Hydraulic Cement Concrete," and

[DMS-4600](#), "Hydraulic Cement."

33. CONSTRUCTION

33.1. Excavation.

33.1.1. **General.** Excavate to the lines and grades shown on the plans or as directed. Provide slopes, benching, sheeting, bracing, pumping, and bailing as necessary to maintain the stability and safety of excavations up to 5 ft. deep. Excavation protection for excavations deeper than 5 ft. are governed by Item 402, "Trench Excavation Protection," and Item 403, "Temporary Special Shoring." Use satisfactory excavated material as backfill or as embankment fill in accordance with Item 132, "Embankment." Dispose of material not incorporated into the final project off the right of way in accordance with federal, state, and local regulations.

Keep any topsoil that has been removed separate, and replace it, as nearly as feasible, in its original position when excavating for installation of structures across private property or beyond the limits of the embankment. Restore the area to an acceptable condition.

Excavate drilled shafts in accordance with Item 416, "Drilled Shaft Foundations."

33.1.1.1. **Obstructions.** Remove obstructions to the proposed construction, including trees and other vegetation, debris, and structures, over the width of the excavation to a depth of 1 ft. below the bottom of excavation. Remove as required to clear the new structure and plug in an approved manner if abandoned storm drains, sewers, or other drainage systems are encountered. Restore the bottom of the excavation to grade by backfilling after removing obstructions in accordance with this Item. Dispose of surplus materials in accordance with federal, state, and local regulations.

33.1.1.2. **Excavation in Streets.** Cut pavement and base to neat lines when structures are installed in streets, highways, or other paved areas. Restore pavement structure after completion of excavation and backfilling.

Maintain and control traffic in accordance with the approved traffic control plan and the TMUTCD.

33.1.1.3. **Utilities.** Comply with the requirements of Article 7.15., "Responsibility for Damage Claims." Conduct work with minimum disturbance of existing utilities, and coordinate work in or near utilities with the utility owners. Inform utility owners before work begins, allowing them enough time to identify, locate, reroute, or make other adjustments to utility lines.

Avoid cutting or damaging underground utility lines that are to remain in place. Promptly notify the utility company if damage occurs. Provide temporary flumes across the excavation while open if an active sanitary sewer line is damaged during excavation, and restore the lines when backfilling has progressed to the original bedding lines of the cut sewer.

33.1.1.4. **De-Watering.** Construct or place structures in the presence of water only if approved. Place precast members, pipe, and concrete only on a dry, firm surface. Remove water by bailing, pumping, well-point installation, deep wells, underdrains, or other approved method.

Remove standing water in a manner that does not allow water movement through or alongside concrete being placed if structures are approved for placement in the presence of water. Pump or bail only from a suitable sump separated from the concrete work while placing structural concrete or for a period of at least 36 hr. thereafter. Pump or bail during placement of seal concrete only to the extent necessary to maintain a static head of water within the cofferdam. Pump or bail to de-water inside a sealed cofferdam only after the seal has aged at least 36 hr.

Place a stabilizing material in the bottom of the excavation if the bottom of an excavation cannot be de-watered to the point the subgrade is free of mud or it is difficult to keep reinforcing steel clean. Use flexible base, cement-stabilized base or backfill, lean concrete, or other approved stabilizing material. Provide concrete with at least 275 lb. of cement per cubic yard, if lean concrete is used, and place to a minimum depth of 3 in. Stabilizing material placed for the convenience of the Contractor will be at the Contractor's expense.

33.1.2.

Bridge Foundations and Retaining Walls. Do not disturb material below the bottom of footing grade. Do not backfill to compensate for excavation that has extended below grade. Fill the area with concrete at the time the footing is placed if excavation occurs below the proposed footing grade. Additional concrete placed will be at the Contractor's expense.

Take core samples to determine the character of the supporting materials if requested. Provide an intact sample adequate to judge the character of the founding material. Take these cores when the excavation is close to completion. Cores should be approximately 5 ft. deeper than the proposed founding grade.

Remove loose material if the founding stratum is rock or another hard material, and clean and cut it to a firm surface that is level, stepped, or serrated, as directed. Clean out soft seams, and fill with concrete at the time the footing is placed.

Place the foundation once the Engineer has inspected the excavation and authorized changes have been made to provide a uniform bearing condition if the material at the footing grade of a retaining wall, bridge bent, or pier is a mixture of compressible and incompressible material.

33.1.3.

Cofferdams. The term "cofferdam" designates any temporary or removable structure constructed to hold surrounding earth, water, or both out of the excavation whether the structure is formed of soil, timber, steel, concrete, or a combination of these. Use pumping wells or well points for de-watering cofferdams if required.

Submit details and design calculations for sheet-pile or other types of cofferdams requiring structural members bearing the seal of a licensed professional engineer for review before constructing the cofferdam. The Department reserves the right to reject designs. Design structural systems to comply with the AASHTO *Standard Specifications for Highway Bridges* or AASHTO LRFD *Bridge Design Specifications*. Interior dimensions of cofferdams must provide enough clearance for the construction, inspection, and removal of required forms and, if necessary, enough room to allow pumping outside the forms. Extend sheet-pile cofferdams well below the bottom of the footings, and make concrete seals as well braced and watertight as practicable.

Use Class E concrete for foundation seals unless otherwise specified. Place concrete foundation seals in accordance with Item 420, "Concrete Substructures." Seals placed for the convenience of the Contractor will be at the Contractor's expense.

Make the excavation deep enough to allow for swelling of the material at the base of the excavation during pile-driving operations when the Engineer judges it to be impractical to de-water inside a cofferdam and a concrete seal is to be placed around piling driven within the cofferdam. Remove swelling material to the bottom of the seal grade after driving the piling. Remove the foundation material to exact footing grades where it is possible to de-water inside the cofferdam without placing a seal after driving piling. Do not backfill a foundation to compensate for excavation that has been extended below grade; fill such areas below grade with concrete at the time the seals or footings are placed.

Remove cofferdams after completing the substructure without disturbing or damaging the structure unless otherwise provided.

33.1.4.

Culverts and Storm Drains. When the design requires special bedding conditions for culverts or storm drains, an excavation diagram will be shown on the plans. Do not exceed these limits of excavation.

Construct pipe structures in an open cut with vertical sides extending to a point 1 ft. above the pipe unless otherwise shown on the plans. When site conditions or the plans do not prohibit sloping the cut, the excavation may be stepped or laid back to a stable slope beginning 1 ft. above the pipe. Maintain the stability of the excavation throughout the construction period.

Construct the embankment for pipe to be installed in fill above natural ground to an elevation at least 1 ft. above

the top of the pipe, and then excavate for the pipe.

- 33.1.4.1. **Unstable Material.** Remove the material to a depth of no more than 2 ft. below the grade of the structure when unstable soil is encountered at established footing grade, unless the Engineer authorizes additional depth. Replace soil removed with stable material in uniform layers no greater than 8 in. deep (loose measurement). Each layer must have enough moisture to be compacted by rolling or tamping as required to provide a stable foundation for the structure.

Use special materials such as flexible base, cement-stabilized base, cement-stabilized backfill, or other approved material when it is not feasible to construct a stable foundation as outlined above.

- 33.1.4.2. **Incompressible Material.** Remove the incompressible material to 6 in. below the footing grade, backfill with an approved compressible material, and compact in accordance with Section 400.3.3., "Backfill," if rock, part rock, or other incompressible material is encountered at established footing grade while placing prefabricated elements.

- 33.2. **Shaping and Bedding.** Place at least 2 in. of fine granular material for precast box sections on the base of the excavation before placing the box sections. Use bedding as shown in Figure 1 for pipe installations. Use Class C bedding unless otherwise shown on the plans. The Engineer may require the use of a template to secure reasonably accurate shaping of the foundation material. Undercut the excavation at least 4 in. where cement-stabilized backfill is indicated on the plans and backfill with stabilized material to support the pipe or box at the required grade.

B_c - Outside diameter or horizontal dimension
 D - Inside diameter of pipe
 d - Min. bedding material below pipe

D	d
$\leq 27''$	3''
30'' to 60''	4''
$\geq 66''$	6''

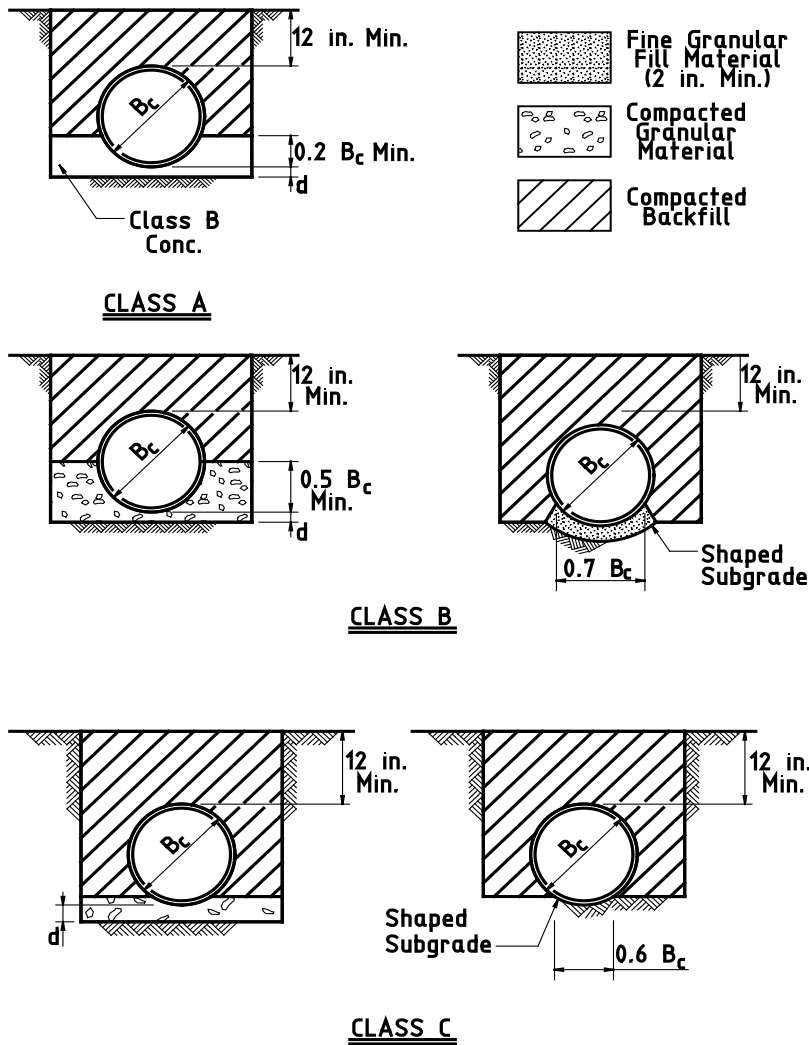


Figure 1
Bedding Diagrams

33.3. Backfill.

33.3.1. **General.** Backfill the excavation after placement of the permanent structure as soon as practical. Use backfill free from stones large enough to interfere with compaction; large or frozen lumps that will not break down readily under compaction; and wood or other extraneous material. Obtain backfill material from excavation or from other sources.

Place backfill in layers no greater than 10 in. deep (loose measurement) in areas not supporting a completed roadbed, retaining wall, or embankment. Place backfill in uniform layers no greater than 8 in. deep (loose measurement) in areas supporting a portion of a roadbed, retaining wall, or embankment. Compact each layer to meet the density requirements of the roadbed, retaining wall, embankment material, or as shown on the plans.

Bring each layer of backfill material to the moisture content needed to obtain the required density. Use

mechanical tamps or rammers to compact the backfill. Rollers may be used to compact backfill if feasible.

Cohesionless materials may be used for backfilling. Use cohesionless materials that conform to the requirements of Table 1.

Table 1
Cohesionless Material Gradation Limits

Sieve Size	Percent Retained
3"	0
#10	Note 1
#200	90-100

1. No. 10 sieve requirements are 0 to 30% retained when used as aggregate for cement-stabilized backfill.

Compact cohesionless materials using vibratory equipment, water-ponding, or a combination of both.

33.3.2.

Bridge Foundations, Retaining Walls, Manholes/Inlets, and Box Culverts. Place backfill against the structure only after the concrete has reached the design strength required in Item 421, "Hydraulic Cement Concrete."

Backfill retaining walls with material meeting the requirements of Item 423, "Retaining Walls." Backfill around bridge foundations, manholes/inlets and culverts using material with particles no more than 4 in. in greatest dimension and a gradation that permits thorough compaction. Use rock or gravel mixed with soil if the percentage of fines is enough to fill all voids and ensure a uniform and thoroughly compacted mass of proper density.

Use mechanical tamps and rammers to avoid damage to the structure where backfill material is being placed too close to the structure to permit compaction with blading and rolling equipment.

Avoid wedging action of backfill against structures. Step or serrate slopes bounding the excavation to prevent such action. Place backfill uniformly around bridge foundations. Place backfill equally and in uniform layers along both sides of manholes/inlets and culverts.

The Engineer may require backfilling of structures excavated into hard, erosion-resistant material, and subject to erosive forces, with stone or lean concrete.

Box culverts may be opened to traffic as soon as enough backfill and embankment has been placed over the top to protect culverts against damage from heavy construction equipment. Repair damage to culvert caused by construction traffic at no additional expense to the Department.

33.3.3.

Pipe. Bring backfill material to the proper moisture condition after installing bedding and pipe as required and place it equally along both sides of the pipe in uniform layers no greater than 8 in. deep (loose measurement). Compact each lift mechanically. Thoroughly compact materials placed under the haunches of the pipe to prevent damage or displacement of the pipe. Place backfill in this manner to the top-of-pipe elevation. Place and compact backfill above the top of the pipe in accordance with Section 400.3.3.1., "General."

The Engineer may reject backfill material containing more than 20% by weight of material retained on a 3 in. sieve with large lumps not easily broken down or that cannot be spread in loose layers. Material excavated by a trenching machine will generally meet the requirements of this Section as long as large stones are not present.

Place and compact additional material where pipe extends beyond the toe of slope of the embankment and the depth of cover provided by backfill to the original ground level is less than the minimum required by the specifications for the type of pipe involved until the minimum cover has been provided.

33.3.4. **Cement-Stabilized Backfill.** Backfill the excavation to the elevations shown with cement-stabilized backfill when shown on the plans. Use cement-stabilized backfill that contains aggregate conforming to the gradation limits shown in Table 1, water, and a minimum of 7% hydraulic cement based on the dry weight of the aggregate, in accordance with [Tex-120-E](#).

Place cement-stabilized backfill equally along the sides of structures to prevent strain on or displacement of the structure. Fill voids when placing cement-stabilized backfill. Use hand-operated tampers if necessary to fill voids.

33.3.5. **Flowable Backfill.** Backfill the excavation with flowable backfill to the elevations indicated when shown on the plans. Prevent the structure from being displaced during the placement of the flowable fill, and prevent flowable fill from entering manholes/inlets and culverts, and drainage structures.

34. MEASUREMENT

This is a plans quantity measurement item. The quantity to be paid is the quantity shown in the proposal, unless modified by Article 9.2., "Plans Quantity Measurement." Additional measurements or calculations will be made if adjustments of quantities are required.

34.1. **Structural Excavation.** Unless shown on the plans as a pay item, structural excavation quantities shown are for information purposes only.

When structural excavation is specified as a pay item, structural excavation for pipe headwalls, inlets, manholes, culvert or storm drain extensions less than 15 ft. long, bridge abutments, retaining walls, and side road and private entrance pipe culverts will not be measured. No allowance will be made for variance from plans quantity incurred by an alternate bid.

When specified as a pay item, structural excavation will be measured by the cubic yard as computed by the average end areas method. Excavation diagrams on the plans take precedence over the provisions of this Article.

34.1.1. **Boundaries of Measurement.**

34.1.1.1. **Pipe.**

34.1.1.1.1. **Pipe up to 42 Inches.** For pipe up to 42 in. nominal or equivalent diameter, no material outside of vertical planes 1 ft. beyond and parallel to the horizontal projection of the outside surfaces of the pipe will be included.

34.1.1.1.2. **Pipe Larger than 42 Inches.** For pipes larger than 42 in. nominal or equivalent diameter, no material outside of vertical planes located 2 ft. beyond and parallel to the horizontal projection of the outside surfaces of the pipe will be included.

Quantities for excavation in fill above natural ground include 1 ft. above the top of the pipe regardless of the height of completed fill. Excavation for pipe will be measured between the extreme ends of the completed structure including end appurtenances as shown on the plans and from centerline to centerline of inlets, manholes, etc.

34.1.1.2. **Structural Plate Structures.** No material outside of vertical planes 3 ft. beyond and parallel to the horizontal projection of the outside surfaces of the structure will be included. When the quality of the existing soil or embankment is less than that of the proposed backfill material, the limits of measurement will be extended to vertical planes located 1/2 of the span beyond the horizontal projection of the outside surfaces of the structure.

- 34.1.1.3. **Footings, Walls, Boxes, and Other Excavation.** No material outside of vertical planes 1 ft. beyond and parallel to the edges of the footings or outside walls will be included whether or not a cofferdam or shoring is used. When plans provide the option of cast-in-place or precast boxes, measurement will be based on the cast-in-place option.
- Where excavation in addition to that allowed for the footings is required for other portions of the structure, measurement for the additional excavation will be limited laterally by vertical planes 1 ft. beyond the face of the member and parallel to it, and vertically to a depth of 1 ft. below the bottom of the member.
- 34.1.1.4. **Excavation near Roadways and Channels.** At structure sites other than culverts and pipe excavations, the measurement of structural excavation will include only material below or outside the limits of the completed road or channel excavation. Roadway and channel excavation will be paid under Item 110, "Excavation." For culverts except side road and private entrance culverts, excavation within the limits of the structure and below or outside the limits of the completed roadway excavation will be measured as structural excavation.
- 34.1.2. **Falsework.** No measurement will be made for excavation necessary for placing forms or falsework that exceeds the limits given in Section 400.4.1.1., "Boundaries of Measurement."
- 34.1.3. **Swelling.** Measurement will not include materials removed below footing grades to compensate for anticipated swelling due to pile-driving, nor will it include material required to be removed due to swelling beyond the specified limits during pile-driving operations.
- 34.1.4. **Cave-Ins.** Measurement will not include additional volume caused by slips, slides, cave-ins, silting, or fill material resulting from the action of the elements or the Contractor's operation.
- 34.1.5. **Undercut.** Where rock or other incompressible or unstable material is undercut to provide a suitable foundation for pipe or box sections, such material below grade directed to be removed will be measured for payment.
- 34.1.6. **Grade Change.** Additional measurement will be made of the volume of excavation involved in the lowering or raising of the elevation of a footing, foundation, or structure unit, when such grade change is authorized.
- 34.2. **Cement-Stabilized Backfill.** Cement-stabilized backfill will be measured by the cubic yard as shown on the plans.
- 34.3. **Cutting and Restoring Pavement.** Cutting and restoring pavement will be measured by the square yard as shown on the plans. Excavation below pavement or base will be measured as structural excavation of the pertinent type.

35. PAYMENT

- 35.1. **Structural Excavation.** Unless specified as a pay item, structural excavation and backfill performed, and material furnished in accordance with this Item will not be paid for directly but are subsidiary to pertinent Items.
- When structural excavation is specified as a pay item, the excavation and backfill work performed, and materials furnished will be paid for at the unit price bid for "Structural Excavation," "Structural Excavation (Box)," "Structural Excavation (Pipe)," and "Structural Excavation (Bridge)." This price includes concrete to compensate for excavation that has extended below grade for bridge foundations and retaining walls, and backfilling and compacting areas that were removed as part of structural excavation.
- Cofferdams or other measures necessary for supporting excavations less than 5 ft. deep will not be measured or

paid for directly but will be subsidiary to the Contract.

Foundation seal concrete for cofferdams, when required, will be paid for as provided in the pertinent Items. If no direct method of payment is provided in the Contract, the work will be measured and paid for in accordance with Article 9.7., "Payment for Extra Work and Force Account Method." Seal placed for the convenience of the Contractor will not be paid for.

Unless otherwise provided, stone or lean concrete backfill around structures as provided for in Section 400.3.3.2., "Bridge Foundations, Retaining Walls, Manholes/Inlets, and Box Culverts," will be measured and paid for as extra work in accordance with Article 9.7., "Payment for Extra Work and Force Account Method."

When structural excavation is specified as a pay item, a partial payment of 50% of the bid price will be made for structural excavation completed to the satisfaction of the Engineer but not backfilled. The remaining amount will be paid upon completion of backfilling. When the Contractor elects to excavate beyond plan requirements, no measurement will be made of the additional volume.

35.2. **Removal and Replacement of Unsuitable or Incompressible Material.** Removal and replacement of material will be paid for if directed. Removal and replacement of material or placement of special material made necessary by the softening of founding material due to the Contractor's sequence of work or operation, will be at the Contractor's expense. Special material used or additional excavation made for the Contractor's convenience will not be paid for.

35.2.1. **Structural Excavation as a Pay Item.** Where special materials are not required or specified, payment for the removal and replacement of unstable or incompressible material will be made at a price equal to 200% of the unit price bid per cubic yard for Structural Excavation. When the Contractor elects to remove and replace material deeper than directed, no measurement will be made on that portion below the directed elevation. This price is full compensation for removing the unstable or incompressible material; furnishing, hauling, placing, and compacting suitable replacement material; and equipment, labor, tools, and incidentals.

When the plans specify or when directed, the use of special materials such as flexible base, cement-stabilized base, cement-stabilized backfill, or other special material, payment for excavation below footing grades will be made at the unit price bid for Structural Excavation. Payment for furnishing, hauling, placing, and compacting the flexible base, cement-stabilized base, cement-stabilized backfill, or other special materials will be made at the unit price bid for these items in the Contract, or, if the required material is not a bid item, in accordance with Article 9.7., "Payment for Extra Work and Force Account Method."

35.2.2. **Structural Excavation Not a Pay Item.** Where special materials for backfill are not required or specified, payment for the authorized removal and replacement of unstable or incompressible material will be measured and paid for at \$15 per cubic yard of material removed. This price is full compensation for removing the unstable or incompressible material; furnishing, hauling, placing, and compacting suitable replacement material; and equipment, labor, tools, and incidentals.

When the plans specify or when directed, the use of special materials such as flexible base, cement-stabilized base, cement-stabilized backfill, or other special material, excavation below the footing grades will be paid for at \$10 per cubic yard. Payment for furnishing, hauling, placing, and compacting the flexible base, cement-stabilized base, cement-stabilized backfill, or other special materials will be made at the unit price bid for these items, or, if the required material is not a bid item, in accordance with Article 9.7., "Payment for Extra Work and Force Account Method."

35.3. **Lowering of a Structure Foundation.** If the Engineer requires a structure foundation to be lowered to an elevation below the grade shown on the plans, overexcavation will be paid in accordance with Table 2.

Table 2
Payment for Required Overexcavation

Variance of Revised Footing Grade from Plan Grade	Payment Terms	Variance of Revised Footing Grade from Plan Grade
	"Structural Excavation" is a Bid Item	"Structural Excavation" is not a Bid Item
Up to and including 5 ft.	Unit price equal to 115% of unit price bid for "Structural Excavation"	\$10 per cubic yard
Over 5 ft. up to 10 ft.	Unit price equal to 125% of unit price bid for "Structural Excavation"	\$12 per cubic yard
Over 10 ft.	In accordance with Article 9.7., "Payment for Extra Work and Force Account Method."	

35.4. **Cement-Stabilized Backfill.** Cement-stabilized backfill will be paid for at the unit price bid for "Cement-Stabilized Backfill."

35.5. **Cutting and Restoring Pavement.** Cutting and restoring pavement will be paid for at the unit price bid for "Cutting and Restoring Pavement" of the type specified.

Work done to repair damage to base or pavement incurred outside the limits shown on the plans, or the limits authorized, will not be measured for payment.

The unit prices bid are full compensation for excavation including removing obstructions and plugging drainage systems; bedding and backfilling including placing, sprinkling and compaction of material; soundings; cleaning and filling seams; constructing and removing cofferdams; de-watering, sheeting, or bracing excavations up to and including 5 ft. deep; pumps; drills; explosives; disposition of surplus material; cutting pavement and base to neat lines; and materials, hauling, equipment, labor, tools, and incidentals.

Flowable backfill will be paid for as provided in Item 401, "Flowable Backfill." Protection methods for open excavations deeper than 5 ft. will be measured and paid for as required under Item 402, "Trench Excavation Protection," or Item 403, "Temporary Special Shoring."

Item 403

Temporary Special Shoring

36. DESCRIPTION

Furnish and install temporary shoring to hold the surrounding earth, water, or both out of the work area.

37. MATERIALS

Furnish new or used materials. Furnish materials that meet the requirements of Item 423, "Retaining Walls," when using temporary Mechanically Stabilized Earth (MSE) walls. Furnish materials that meet the requirements of Item 410, "Soil Nail Anchors," or Item 411, "Rock Nail Anchors," when using temporary nailed walls (rock or soil).

38. CONSTRUCTION

The Contractor is responsible for the temporary special shoring design unless complete details are included on the plans. Submit details and design calculations bearing the seal of a licensed professional engineer before constructing the shoring. The Department reserves the right to reject designs. Design the shoring to comply with

OSHA Standards and Interpretations, 29 CFR Part 1926, Subpart P, "Excavations." Design structural systems to comply with AASHTO *Standard Specifications for Highway Bridges* or AASHTO LRFD *Bridge Design Specifications*. Design shoring subject to railroad loading to comply with the AREMA *Manual for Railway Engineering* and any additional requirements of the railway being supported.

Provide vertical or sloped cuts, benches, shields, support systems, or other systems to provide the necessary protection in accordance with the approved design. Construct temporary MSE walls, when used, in accordance with Item 423, "Retaining Walls." Construct temporary nailed walls (rock or soil), when used, in accordance with Item 410, "Soil Nail Anchors," or Item 411, "Rock Nail Anchors."

39. **MEASUREMENT**

This Item will be measured by the square foot of surface area of a vertical plane at the face of the shoring between the top of the ground being supported and the minimum protection grade line shown on the plans. If no minimum protection grade is shown on the plans, the lowest required excavated elevation will be used. Shoring projecting above the level of the ground being supported will not be measured. When excavation techniques (e.g., sloped cuts or benching) are used to provide the necessary protection, the surface area for payment will be calculated based on the area described by a vertical plane adjacent to the structure.

40. **PAYMENT**

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Temporary Special Shoring." This price is full compensation for excavation and backfill; furnishing, placing and removing shoring, sheeting, or bracing; dewatering or diversion of water; jacking and jack removal; and equipment, labor, materials, tools, and incidentals.

No payment will be made for special shoring made necessary by the selection of an optional design or sequence of work that creates the need for shoring.

Item 459

Gabions and Gabion Mattresses

41. **DESCRIPTION**

Furnish and install gabions and gabion mattresses.

42. **MATERIALS**

This Item uses the following Items:

Gabion. A wire fabric or mesh container, filled with stone, with a height of 1 ft. or greater.

Gabion Mattress. A wire fabric or mesh container filled with stone and with a height of 6, 9, or 12 in. Referred to as "revet mattress" in ASTM A975.

Furnish welded wire gabions and gabion mattresses in accordance with ASTM A974. Furnish Style 1 or 2 when galvanized wire coating is specified or Style 5 when PVC wire coating is specified.

Furnish twisted wire gabions and gabion mattresses in accordance with ASTM A975. Furnish Style 1 when galvanized wire coating is specified or Style 3 when PVC wire coating is specified.

Furnish producer or supplier certification that wire baskets, stiffeners, lacing wire, and spiral connectors conform to the applicable ASTM specification.

Furnish producer or supplier certification that any alternative wire fasteners that are proposed conform to the strength requirements in Table 1 when tested in accordance with the applicable ASTM specification. Submit certification for approval before beginning work.

Table 1
Minimum Panel-to-Panel Connection Strength

Application	Strength (lb./ft.)
Gabions, galvanized	1,400
Gabions, PVC-coated	1,200
Gabion mattress, galvanized and PVC-coated	700

Provide filler stone consisting of clean, hard, durable stone that does not contain shale, caliche, or other soft particles. Stone appearing to contain such particles will be tested for soundness. Stone with 5-cycle magnesium sulfate soundness of more than 18% when tested in accordance with [Tex-411-A](#) will be rejected. Use stones that are between 4 and 8 in. in their least dimension for gabions and between 3 and 6 in. for gabion mattresses. Prevent contamination when storing and handling stone. Use stone with a minimum bulk specific gravity of 2.50 as determined by [Tex-403-A](#).

Provide Type 2 filter fabric when required in accordance with [DMS-6200](#), "Filter Fabric."

Provide filter material when required consisting of hard, durable, clean sand or gravel with a maximum particle size of 3/8 in.

43. CONSTRUCTION

At the start of construction, the gabion and gabion mattress manufacturer must have a qualified representative available for consultation as needed throughout the gabion and gabion mattress construction.

- 43.1. **Foundation Preparation.** Excavate the foundation to the extent shown on the plans or as directed. Remove all loose or otherwise unsuitable materials. Carefully backfill all depressions to grade with suitable materials from adjacent required excavation or another approved source, and compact the backfill to a density at least equal to the adjacent foundation. Remove any buried debris protruding from the foundation that will impede the proper installation and final appearance of the gabion or gabion mattress, and carefully backfill and compact voids as specified above. Have the Engineer inspect the prepared foundation surface immediately before gabion placement.
- 43.2. **Filter Placement.** Spread filter material, when required, uniformly on the prepared foundation surface to the slopes, lines, and grades indicated on the plans. Do not place filter material by methods that tend to segregate particle sizes. Repair all damage to the foundation surface that occurs during filter placement before proceeding with the work. Compaction of the filter material is not required; but, finish the material to present a reasonably even surface without mounds or windrows.
- 43.3. **Filter Fabric Placement.** Place filter fabric as shown on the plans when required. Any defects, rips, holes, flaws, or damage to the material may be cause for rejection. Place the material with the long axis parallel to the centerline of the structure, highway, or dam. Place securing pins in the lapped longitudinal joints, spaced on approximately 10-ft. centers. Keep the fabric material free of tension, stress, folds, wrinkles, or creases. Lap the material at least 3 ft. along the longitudinal joint of material, or lap the joints 1 ft. and sew them. Lap the ends of rolls at joints by at least 3 ft. Repair torn or punctured fabric by placing a layer of fabric over the damaged area, overlapping at least 3 ft. beyond the damaged area in all directions.

Place securing pins through both strips of material at lapped joints at approximately the midpoint of the overlap. Place additional securing pins as necessary to hold filter fabric in position. Store filter fabric out of direct sunlight.

Cover filter fabric as soon as possible after placing, but within 3 days.

- 43.4. **Assembly and Installation.** Place PVC-coated materials, if wire coating is specified, when the ambient temperature and the temperature of the coated wire are more than 15°F above the brittleness temperature of the PVC.

Assemble empty gabion or gabion mattress units individually, and place them on the approved surface to the lines and grades shown on the plans with the sides, ends, and diaphragms erected to ensure all creases are in the correct position, the tops of all sides are level, and all sides that are to remain exposed are straight and plumb. Fill the basket units after transporting them to their final position in the work.

Place the front row of gabion or gabion mattress units first and successively construct units toward the top of the slope or the back of the structure. Place the initial line of basket units on the prepared surface, and partially fill them to provide anchorage against deformation and displacement during subsequent filling operations. Stretch and hold empty basket units as necessary to remove kinks and provide a uniform alignment. Connect all adjoining empty gabion or gabion mattress units with lacing, wire spiral binders, or approved fasteners along the perimeter of their contact surface to obtain a monolithic structure before filling. Provide continuous stitching with alternating single and double loops at intervals of no more than 5 in. if lacing wire is used. Securely fasten all lacing wire terminals.

Provide connections meeting the joint strength requirements of Article 459.2., "Materials." These requirements apply to all connections including attachment of end panels, diaphragms, and lids.

Join twisted wire baskets through selvage-to-selvage or selvage-to-edge wire connection; do not use mesh-to-mesh or selvage-to-mesh wire connection except where baskets are offset or stacked, in which case join each mesh opening where mesh wire meets selvage or edge wire.

Carefully fill the basket units with stone, using hand placement to avoid damaging wire coating, to ensure as few voids as possible between the stones and to maintain alignment. Machine placement of stone will be allowed if approved. Correct excessive deformation and bulging of the mesh before further filling. Fill the basket units in a row in stages consisting of maximum 12 in. courses to avoid localized deformation. Do not at any time fill a cell to a depth exceeding 1 ft. more than its adjoining cell. Do not drop stones into the basket units from a height greater than 36 in.

Place 2 uniformly spaced internal connecting wires between each stone layer in all front and side gabion units, connecting the back and the front faces of the compartments for gabion units more than 2 ft. high. Loop connecting wires or preformed stiffeners around 2 twisted wire-mesh openings or a welded wire joint at each basket face, and securely twist the wire terminals to prevent loosening.

Place the outer layer of stone carefully along all exposed faces and arrange it by hand to ensure a neat and compact appearance. Overfill the last layer of stone uniformly by 1 to 2 in. for gabions and 1 in. for gabion mattresses to compensate for future settlement in rock while still allowing for the proper closing of the lid and providing an even surface with a uniform appearance. Make final adjustments for compaction and surface tolerance by hand. Stretch lids tight over the stone fill, using an approved lid-closing tool, until the lid meets the perimeter edges of the front and end panels. Do not use crowbars or other single-point leverage bars for lid closing. Close the lid tightly along all edges, ends, and internal-cell diaphragms with spiral binders or lacing wire or with other wire fasteners if approved. Ensure all projections or wire ends are turned into the baskets. Cut, fold, and wire the basket unit together to suit site conditions where a complete gabion or gabion mattress unit cannot be installed because of space limitations, as shown on the plans, or as directed. Fold the mesh back and neatly wire it to an adjacent basket face. Complete the assembling, installation, filling, lid closing, and lacing of the reshaped gabion or gabion mattress units in accordance with this Section.

44. MEASUREMENT

Gabions will be measured in place by the cubic yard of stone-filled gabions. Gabion mattresses will be measured in place by the square yard of surface area or by the cubic yard.

45. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Gabions" of the basket-wire coating specified, and per square yard of "Gabion Mattresses" of the thickness and basket-wire coating specified or per cubic yard of "Gabion Mattresses" of the basket-wire coating specified.

The price bid is full compensation for wire baskets, stone fill, lacing and fasteners, filter fabric, filter material, excavation, grading and backfill, materials, tools, equipment, labor, and incidentals. Filter fabric and filter material, if used, will not be paid for directly but will be considered subsidiary to this Item.

Item 460

Corrugated Metal Pipe

46. DESCRIPTION

Furnish and install corrugated metal pipes, materials for constructing corrugated metal pipe culverts, or corrugated metal storm drain mains, laterals, stubs, and inlet leads.

47. MATERIALS

47.1. **Fabrication.** Furnish corrugated metal pipe in accordance with Table 1.

Table 1
Specifications for Corrugated Metal Pipe

Pipe Type	AASHTO Specification
Galvanized steel and aluminized steel	M 36
Aluminized Type 2	M 36
Polymer Coated	M 36 & M 245
Asphalt Coated	M 36
Aluminum	M 196

The pipe type and corresponding AASHTO designations are shown in Table 2.

Table 2
Corrugated Metal Pipe Types

Pipe Type	AASHTO Classification
Circular	Type I
Circular, smooth-lined	Type IA
Circular, spiral rib	Type IR
Arch	Type II
Arch, smooth-lined	Type IIA
Arch, spiral rib	Type IIR

Provide corrugated metal pipe of all types with annular corrugations, helical corrugations, or spiral ribs (corrugations) projecting outward. Provide pipe with helical end corrugations only when necessary to join new pipe to existing pipe with helical end corrugations.

Provide a minimum polymer coating thickness of 10 mils on each side for pre-coated galvanized steel pipe. Galvanized metal sheets and coils used for galvanized corrugated metal pipe may be sampled and tested in accordance with [Tex-708-I](#).

Repair damaged galvanized coating in accordance with Section 445.3.5., "Repairs." Repair damaged aluminized or polymer coating in accordance with AASHTO M 36 and M 245 respectively.

47.2. **Protective Coating.** Furnish bituminous coating, when required, that meets AASHTO M 190 and that tightly adheres to the metal, does not chip off in handling, and protects the pipe from deterioration as evidenced by samples prepared from the coating material successfully meeting the Shock Test and Flow Test in accordance with Tex-522-C.

Coat the pipe uniformly inside and out to a minimum thickness of 0.05 in. measured on the crests of the corrugations. Coat the pipe with additional material applied to the full inner circumference to form a smooth inside lining with a minimum thickness of 1/8 in. above the crest of the corrugations when smooth lining is specified.

Design. The diameter, permissible corrugations, and required gauges for full-circle pipe will be shown. The design size and permissible corrugations for pipe arch will be shown. The required gauges of the shell and the liner for smooth lined pipe will also be shown. Furnish the shape and minimum gauge for steel pipe arch in accordance with Tables 3, 4, 5, or 6 for the specified design size and corrugation. Use Table 7 or 8 for aluminum pipe arch. Refer to U.S. Standard Gauge for uncoated sheets where reference is made to gauge of metal.

Measure dimensions from the inside crests of the corrugations. A tolerance of ± 1 in. or 2% of the equivalent circular diameter, whichever is greater, is allowed for span and rise.

Table 3
Steel Pipe Arch
2-2/3 × 1/2-in. Corrugations

Design Size	Span (in.)	Rise (in.)	Min Cover (in.)	Min Gauge Required	Coated Thickness (in.)	Equivalent Diameter Full-Circle Pipe (in.)
1	17	13	12	16	0.064	15
2	21	15	12	16	0.064	18
2A	23	19	12	16	0.064	21
3	28	20	12	16	0.064	24
4	35	24	12	16	0.064	30
5	42	29	12	14	0.079	36
6	49	33	12	14	0.079	42
7	57	38	12	12	0.109	48
8	64	43	12	12	0.109	54
9	71	47	12	10	0.138	60

Table 4
Steel Pipe Arch
3 × 1-in. Corrugations

Design Size	Span (in.)	Rise (in.)	Min Cover (in.)	Min Gauge Required	Coated Thickness (in.)	Equivalent Diameter Full-Circle Pipe (in.)
7	53	41	12	14	0.079	48
8	60	46	12	14	0.079	54
9	66	51	12	14	0.079	60
10	73	55	12	14	0.079	66
11	81	59	12	14	0.079	72
12	87	63	12	14	0.079	78
13	95	67	12	12	0.109	84
14	103	71	18	12	0.109	90
15	112	75	18	12	0.109	96
16	117	79	18	12	0.109	102
17	128	83	24	10	0.138	108
18	137	87	24	10	0.138	114
19	142	91	24	10	0.138	120

Table 5
Steel Pipe Arch
5 × 1-in. Corrugations

Design Size	Span (in.)	Rise (in.)	Min Cover (in.)	Min Gauge Required	Coated Thickness (in.)	Equivalent Diameter Full-Circle Pipe (in.)
11	81	59	12	12	0.109	72
12	87	63	12	12	0.109	78
13	95	67	12	12	0.109	84
14	103	71	18	12	0.109	90
15	112	75	18	12	0.109	96
16	117	79	18	12	0.109	102
17	128	83	24	10	0.138	108
18	137	87	24	10	0.138	114
19	142	91	24	10	0.138	120

Table 6
Steel Pipe Arch, Spiral Rib
7-1/2 × 3/4 × 3/4-in. Corrugations

Design Size	Span (in.)	Rise (in.)	Min Cover (in.)	Min Gauge Required	Coated Thickness (in.)	Equivalent Diameter Full-Circle Pipe (in.)
2	20	16	12	16	0.064	18
2A	23	19	12	16	0.064	21
3	27	21	12	16	0.064	24
4	33	26	12	16	0.064	30
5	40	31	12	14	0.064	36
6	46	36	12	12	0.064	42
7	53	41	12	12	0.079	48
8	60	46	12	12	0.079	54
9	66	51	15	12	0.079	60

Table 7
Aluminum Pipe Arch
2-2/3 × 1/2-in. Corrugations

Design Size	Span (in.)	Rise (in.)	Min Cover (in.)	Min Gauge Required	Coated Thickness (in.)	Equivalent Diameter Full-Circle Pipe (in.)
1	17	13	12	16	0.060	15
2	21	15	12	16	0.060	18
2A	23	19	12	16	0.060	21
3	28	20	12	14	0.075	24
4	35	24	12	14	0.075	30
5	42	29	18	12	0.105	36
6	49	33	18	12	0.105	42
7	57	38	18	10	0.135	48
8	64	43	18	10	0.135	54
9	71	47	18	8	0.164	60

Table 8
Aluminum Pipe Arch, Spiral Rib
7-1/2 × 3/4 × 3/4-in. Corrugations

Design Size	Span (in.)	Rise (in.)	Min Cover (in.)	Min Gauge Required	Coated Thickness (in.)	Equivalent Diameter Full-Circle Pipe (in.)
2	20	16	12	16	0.064	18
2A	23	19	12	16	0.064	21
3	27	21	15	16	0.064	24
4	33	26	18	16	0.064	30
5	40	31	18	14	0.075	36
6	46	36	18	12	0.105	42
7	53	41	21	12	0.105	48
8	60	46	18	10	0.135	54
9	66	51	21	10	0.135	60

- 47.4. **Coupling Bands.** Furnish coupling bands and other hardware for galvanized or aluminized steel pipe in accordance with AASHTO M 36 for steel pipe and AASHTO M 196 for aluminum pipe. Use coupling bands that are no more than 3 nominal sheet thicknesses lighter than the thickness of the pipe to be connected or no lighter than 0.052 in. for steel or 0.048 in. for aluminum. Provide coupling bands made of the same base metal and coating as the pipe.

48. CONSTRUCTION

- 48.1. **Designation of Type.** The types of pipes will be indicated on the plans by the following descriptions:
- Pipe type: Corrugated metal pipe (CMP), corrugated metal pipe arch (CMP ARCH), spiral rib corrugated metal pipe (SRCMP), or spiral rib corrugated metal pipe arch (SRCMP ARCH);
 - Type of material: Galvanized steel, aluminum-coated (Type 2), or aluminum;
 - Pipe coating: Bituminous coated or polymer coated;
 - Special requirements: Paved invert or smooth lining; and
 - Pipe size: Diameter or design number.

Furnish any of the material types specified above when pipe is designated as "Corrugated Metal Pipe" without a type of material or pipe coating designation.

- 48.2. **Excavation, Shaping, Bedding, and Backfill.** Excavate, shape, bed, and backfill in accordance with Item 400, "Excavation and Backfill for Structures," except where jacking, boring, or tunneling methods are shown on the plans or permitted. Jack, bore, or tunnel in accordance with Item 476, "Jacking, Boring, or Tunneling Pipe or Box."

Provide uniform backfill material and uniformly compacted density throughout the length of the structure so equal pressure is provided. Allow no heavy earth-moving equipment over the structure until a minimum of 4 ft. of compacted fill (permanent or temporary) has been placed over the top of the structure unless otherwise shown on the plans or permitted in writing. Inspect the inside periphery of the structure for local or unequal deformation caused by improper construction methods before adding each new layer of loose backfill material. Continue inspections until a minimum of 24 in. of cover is obtained. Evidence of such deformation will be reason for corrective measures as directed. Remove and replace pipe damaged by the Contractor at no additional cost to the Department.

- 48.3. **Laying Pipe.** Lay pipes on the bedding from the outlet end and join the separate sections firmly together with outside laps of annular joints pointing upstream and longitudinal laps on the sides unless otherwise authorized. Coat any metal in joints not protected by galvanizing or aluminizing with a suitable asphalt paint. Lower sections of pipe into the trench without damaging the pipe or disturbing the bedding and

the sides of the trench. Remove and re-lay, without extra compensation, pipe that is not in alignment or shows excessive settlement after laying.

Lay multiple installations of corrugated metal pipe and pipe arches with the centerlines of individual barrels parallel. Maintain the clear distances between outer surfaces of adjacent pipes given in Table 9 unless otherwise indicated on the plans.

Table 9
Required Pipe Clear Distances

Diameter Full-Circle Pipe (in.)	Pipe Arch Design Size	Clear Distance Between Pipes (Full-Circle Pipe and Pipe Arch)
18	2	1 ft. 2 in.
21	2A	1 ft. 3 in.
24	3	1 ft. 5 in.
30	4	1 ft. 8 in.
36	5	1 ft. 11 in.
42	6	2 ft. 2 in.
48	7	2 ft. 5 in.
54	8	2 ft. 10 in.
60 to 84	9	3 ft. 2 in.
90 to 120	10 and over	3 ft. 5 in.

48.4. **Jointing.** Provide field joints that maintain pipe alignment during construction and prevent infiltration of side material during the life of the installation. Provide one of the following jointing systems unless otherwise shown on the plans.

48.4.1. **Coupling Bands.** Use coupling bands with annular corrugations only with pipe with annular corrugations or with helical pipe or spiral rib pipe in which the ends have been rerolled to form annular corrugations. Provide bands with corrugations that have the same dimensions as the corrugations in the pipe end or are designed to engage the first or second corrugation from the end of each pipe. The band may also include a U-shaped channel to accommodate upturned flanges on the pipe.

Field-join pipe with helically corrugated bands or bands with projections (dimples) when helical end corrugations are allowed.

Coupling bands with projections may be used with pipe that has annular or helical end corrugations or spiral ribs. Provide bands formed with the projections in annular rows with 1 projection for each corrugation of helical pipe or spiral rib pipe. Provide 2 annular rows for bands 10-1/2 in. or 12 in. wide and 4 annular rows of projections for bands 16-1/2 in. or 22 in. wide.

Use a coupling band width that conforms to Table 10. Connect the bands using suitable galvanized devices in accordance with AASHTO M 36. Lap coupling bands equally on each of the pipes to form a tightly closed joint after installation. Provide at least the minimum coupling band width recommended by the manufacturer for corrugations not shown in Table 10.

Table 10
Coupling Band Width Requirements

Nominal Corrugation Size ¹ (in.)	Nominal Pipe Inside Diameter ² (in.)	Minimum Coupling Band Width (in.)		
		Annular Corrugated Bands	Helically Corrugated Bands	Bands with Projections
2-2/3 by 1/2	12 to 36	7	12	10-1/2
	42 to 72	10-1/2	12	10-1/2
	78 to 84 ³	10-1/2	12	16-1/4
3 by 1	36 to 72	12	14	10-1/2
	78 to 120	12	14	16-1/4
5 by 1	36 to 72	20	22	12
	78 to 120	20	22	22
7-1/2 by 3/4 by 3/4	18 to 60	10-1/2	12	10-1/2
	66 to 102	10-1/2	12	16-1/4

2. For helically corrugated pipe or spiral rib pipe with rerolled ends, the nominal size refers to the dimensions of the end corrugations in the pipe.
3. Equivalent circular diameter for Type II pipe.
4. Diameter through 120 in. for annular corrugated bands used on rerolled ends of helically corrugated pipe or spiral rib pipe.

The minimum diameter of bolts for coupling bands is 3/8 in. for pipe diameters 18 in. and less and 1/2 in. for pipe diameters 21 in. and greater. Provide at least 2 bolts for bands 12 in. wide or less. Provide at least 3 bolts for bands wider than 12 in.

Provide galvanized hardware in accordance with Item 445, "Galvanizing."

48.4.2. **Bell and Spigot.** Attach the bell to one end of the corrugated metal pipe at the manufacturing plant before shipment. Provide a bell with a minimum 6-in. stab depth. Install the gasket on the spigot end and apply lubricant in accordance with the manufacturer's recommendations. Provide gaskets that meet ASTM F477 with Type A Shore durometer hardness of 45 ±5. Do not use thermoplastic elastomer as the basic polymer. Push the spigot end of the pipe into the bell end of the previously laid pipe during laying of the pipe.

48.4.3. **Pipe Connections and Stub Ends.** Make connections of pipe to existing pipe or appurtenances as shown on the plans or as directed. Mortar or concrete the bottom of the existing structure, if necessary, to eliminate any drainage pockets created by the new connection.

Insulate portions of aluminum pipe that are to be in contact with metal other than aluminum by a coating of bituminous material meeting the requirements of Section 460.2.2., "Protective Coating." Extend the coating a minimum of 1 ft. beyond the area of contact.

Restore any damage that results from making the connection when connecting pipe into existing structures that will remain in service. Seal stub ends for connections to future work not shown on the plans by installing watertight plugs into the free end of the pipe.

49. MEASUREMENT

This Item will be measured by the foot. Pipe will be measured between the ends of the barrel along the flow line, not including safety end treatments. Safety end treatments will be measured in accordance with Item 467, "Safety End Treatment." Pipe that is required to be jacked, bored, or tunneled will be measured in accordance with Item 476, "Jacking, Boring, or Tunneling Pipe or Box." Where spurs, branches, or connections to existing pipe lines are involved, measurement of the spur or new connecting pipe will be made from the intersection of the flow line with the outside surface of the pipe into which it connects. Where inlets, headwalls, catch basins, manholes, junction chambers, or other structures are included in lines of pipe, the length of pipe tying into the structure wall will be included for measurement but no other portion of the structure length or width will be included.

For multiple pipes, the measured length will be the sum of the lengths of the barrels.

This is a plans quantity measurement Item. The quantity to be paid is the quantity shown in the proposal, unless modified by Article 9.2., "Plans Quantity Measurement." Additional measurements or calculations will be made if adjustments of quantities are required.

50. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Corrugated Metal Pipe," "Corrugated Metal Pipe Arch," "Spiral Rib Corrugated Metal Pipe," or "Spiral Rib Corrugated Metal Pipe Arch" of the type, size, and coating specified. This price is full compensation for furnishing, hauling, placing, and joining of pipes; jointing materials; all connections to new or existing structures; breaking back, removing, and disposing of portions of the existing structure; replacing portions of the existing structure; cutting pipe ends on skew or slope; and equipment, labor, tools, and incidentals.

Protection methods for excavations greater than 5 ft. deep will be measured and paid for as required under Item 402, "Trench Excavation Protection," or Item 403, "Temporary Special Shoring." Excavation, shaping, bedding, and backfill will be paid for in accordance with Item 400, "Excavation and Backfill for Structures." When jacking, boring, or tunneling is used at the Contractor's option, payment will be made under this Item. When jacking, boring, or tunneling is required, payment will be made under Item 476, "Jacking, Boring, or Tunneling Pipe or Box."

Item 466

Headwalls and Wingwalls

51. DESCRIPTION

Furnish, construct, and install concrete headwalls and wingwalls for drainage structures and underpasses.

52. MATERIALS

52.1. **General.** Furnish materials in accordance with the following.

Item 420, "Concrete Substructures,"
Item 421, "Hydraulic Cement Concrete," and
Item 440, "Reinforcement for Concrete."

Use Class C concrete for cast-in-place and precast concrete units unless otherwise shown on the plans. Furnish cast-in-place or precast headwalls and wingwalls unless otherwise shown on the plans.

52.2. **Fabrication.**

52.2.1. **General.** Fabricate cast-in-place concrete units and precast units in accordance with Item 420 "Concrete Substructures." Use the following definitions for headwalls and wingwalls:

"Headwalls" refers to all walls, including wings, at the ends of single-barrel and multiple-barrel pipe culvert structures.

"Wingwalls" refers to all walls at the ends of single-barrel or multiple-barrel box culvert structures.

52.2.2. **Lifting Holes.** Provide no more than 4 lifting holes in each section for precast units. Lifting holes may be cast, cut into fresh concrete after form removal, or drilled. Provide lifting holes large enough for adequate

lifting devices based on the size and weight of the section. The maximum hole diameter is 3 in. at the inside surface of the wall and 4 in. at the outside surface. Cut no more than 1 longitudinal wire or 2 circumferential wires per layer of reinforcing steel when locating lift holes. Repair spalled areas around lifting holes.

- 52.2.3. **Marking.** Clearly mark each precast unit before shipment from the casting or fabrication yard with the following:
the date of manufacture,
the name or trademark of the manufacturer, and
the type and size designation.
- 52.2.4. **Storage and Shipment.** Store precast units on a level surface. Do not place any loads on precast concrete units until design strength is reached. Do not ship units until design strength requirements have been met.
- 52.2.5. **Causes for Rejection.** Precast units may be rejected for not meeting any one of the specification requirements. Individual units may also be rejected for fractures or cracks passing through the wall or surface defects indicating honeycombed or open texture surfaces. Remove rejected units from the project, and replace them with acceptable units meeting the requirements of this Item.
- 52.2.6. **Defects and Repairs.** Occasional imperfections in manufacture or accidental damage sustained during handling may be repaired. The repaired units will be acceptable if they conform to the requirements of this Item and the repairs are sound, properly finished, and cured in conformance with pertinent specifications.

53. CONSTRUCTION

- 53.1. **General.** Remove portions of existing structures and drill, dowel, and grout in accordance with Item 420, "Concrete Substructures."
- 53.2. **Excavation, Shaping, Bedding, and Backfill.** Excavate, shape, bed, and backfill in accordance with Item 400, "Excavation and Backfill for Structures." Take special precautions in placing and compacting the backfill to avoid any movement or damage to the units. Bed precast units on foundations of firm and stable material accurately shaped to conform to the bases of the units.
- 53.3. **Placement of Precast Units.** Provide adequate means to lift and place the precast units. Fill lifting holes with mortar or concrete and cure. Precast concrete or mortar plugs may be used.
- 53.4. **Connections.** Make connections to new or existing structures in accordance with the details shown on the plans. Furnish jointing material in accordance with Item 464, "Reinforced Concrete Pipe," or as shown on the plans.
- Remove a length of the existing pipe from the headwall to the joint when removing existing headwalls as shown on the plans or as approved. Re-lay the removed pipe if approved, or furnish and lay a length of new pipe.

54. MEASUREMENT

This is a plans quantity measurement item. The quantity to be paid is the quantity shown in the proposal unless modified by Article 9.2., "Plans Quantity Measurement." Additional measurements or calculations will be made if adjustments of quantities are required.

- 54.1. **Headwalls.** Headwalls will be measured by each end of a structure.
- 54.2. **Wingwalls.** Wingwalls will be measured by one of the following methods:

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54.2.1. **Square Foot.** Wingwalls will be measured by the square foot of the front surface area of the wall of each type. The area will be measured from the top of the footing or apron to the top of the wall unless otherwise shown on the plans. If there is no footing or apron, then measurement is from the bottom of the wall.

54.2.2. **Each.** Wingwalls will be measured by each end of a structure.

55. **PAYMENT**

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the price bid for "Headwalls" of the type and pipe size (diameter or design) specified, "Wingwalls" of the type specified when measurement is by the square foot, or "Wingwalls" of the type and wall height specified when measurement is by each. For payment purposes, the wingwall height will be rounded to the nearest foot. All wingwalls and headwalls of the same type will be paid for equally when skew does not affect the type. This price is full compensation for constructing, furnishing, transporting, and installing the headwalls or wingwalls; connecting to existing structure; breaking back, removing and disposing of portions of the existing structure, and replacing portions of the existing structure as required to make connections; excavation and backfill; and concrete, reinforcing steel, corrugated metal pipe or reinforced concrete pipe, equipment, labor, tools, and incidentals.

Apron concrete or riprap between or around the wingwalls of single- or multiple-barrel box culvert structures will be measured and paid for in accordance with Item 432, "Riprap."

The removal and re-laying of existing pipe or the furnishing of new pipe to replace existing pipe will not be paid for directly but will be considered subsidiary to this Item.

Item 476

Jacking, Boring, or Tunneling Pipe or Box

56. DESCRIPTION

Furnish and install pipe or box by jacking, boring, or tunneling.

57. MATERIALS

Use the following types of pipe or box:

corrugated metal pipe meeting Item 460, "Corrugated Metal Pipe," of the size, type, design, and dimension shown on the plans;

reinforced concrete pipe meeting the special requirements for jacking, boring, or tunneling of Item 464, "Reinforced Concrete Pipe," of the size, strength, and dimension shown on the plans;

reinforced concrete box meeting Item 462, "Concrete Box Culverts and Drains," of the size and type shown on the plans; or

other types specified by the plans.

58. CONSTRUCTION

Excavate suitable shafts or trenches for conducting the jacking, boring, or tunneling operations and for placing end joints of the pipe or box if the grade at the jacking, boring, or tunneling end is below the ground surface. Maintain a 3:1 slope from edge of pavement on the shaft side of the road unless otherwise shown or directed. Provide a positive barrier when the shaft location is within the clear zone of the roadway. Protect excavations deeper than 5 ft. as specified in Item 402, "Trench Excavation Protection," or Item 403, "Temporary Special Shoring."

Install pipe or box so there is no interference with the operation of street, highway, railroad, or other facility and no embankment or structure is weakened or damaged.

Repair any pipe or box damaged in jacking, boring, or tunneling. Remove and replace any pipe or box damaged beyond repair at the Contractor's expense.

Backfill shafts or trenches excavated to facilitate jacking, boring, or tunneling immediately after installation of pipe or box.

- 58.1. **Jacking.** Provide jacks suitable for forcing the pipe or box through the embankment. Use even pressure to all jacks during operation. Provide a suitable jacking head and suitable bracing between the jacks and the jacking head to apply uniform pressure around the ring of the pipe or circumference of the box. Use joint cushioning of plywood or other approved material. For plywood cushioning material, use 1/2-in. minimum thickness for pipe diameter 30 in. or less, and use 3/4-in. minimum thickness for pipe diameter greater than 30 in. Use 3/4-in. minimum thickness for all boxes. Use cushioning rings of single or multiple pieces. Provide a suitable jacking frame or backstop. Set the pipe or box to be jacked on guides that support the section of the pipe or box, and direct it on the proper line and grade. Place the entire jacking assembly in line with the direction and grade of the pipe or box. In general, excavate the embankment material just ahead of the pipe or box, remove the material through the pipe or box, and force the pipe or box through the embankment with jacks into the space bored or tunneled.

Furnish a plan showing the proposed method of jacking for approval. Include the design for the jacking head, jacking support or backstop (thrust block), arrangement and position of jacks, and guides in the plan.

Ensure excavation for the underside of the pipe for at least 1/3 of the circumference of the pipe conforms to the contour and grade of the pipe. Ensure the excavation for the bottom slab of the box conforms to the grade of the box. Over-excavate, if desired, to provide no more than 2 in. of clearance for the upper portion and sides of the pipe or box. Taper this clearance to zero at the point where the excavation conforms to the contour of the pipe or box. Carry out jacking without interruption to prevent the pipe from becoming firmly set in the embankment. Monitor volume of soil excavated to avoid any appreciable over excavation. Pressure-grout any over excavation of more than 1 in. Pressure-grout between the carrier pipe and casing when shown on the plans.

The distance the excavation extends beyond the end of the pipe or box must not exceed 2 ft. Decrease this distance as necessary to maintain stability of the material being excavated.

Jack the pipe or box from the low or downstream end. The final position of the pipe or box must not vary from the line and grade shown on the plans by more than 1 in. in 10 ft. Variation must be regular and in one direction, and the final flow line must be in the direction shown on the plans.

Use a shield or cutting edge of steel plate around the head end of the pipe or box extending a short distance beyond the end if desired. The minimum distance for parallel pipe or box jacking or tunneling is 3 ft. or 2 times the diameter of the pipe or width of box, whichever is greater, unless otherwise shown on the plans.

58.2. **Boring or Tunneling.** Bore from a shaft in an approved location provided for the boring equipment and workmen.

Dispose of excavated material using an approved method. Use water or other appropriate drilling fluids in connection with the boring operation only as necessary to lubricate cuttings and pipe or box; do not use jetting.

Use a gel-forming colloidal drilling fluid consisting of high-grade, carefully processed bentonite to consolidate cuttings of the bit in unconsolidated soil formations. Seal the walls of the bore hole and furnish lubrication for subsequent removal of cuttings and immediate installation of the pipe.

Allowable variations from line and grade are specified in Section 476.3.1., "Jacking." Pressure-grout any over excavation of more than 1 in.

58.2.1. **Larger Diameter Boring Methods.** Use the pilot hole or auger method for drainage and large utility borings. Pressure-grout any over excavation of more than 1 in. Pressure-grout between the carrier pipe and casing when shown on the plans.

58.2.1.1. **Pilot Hole Method.** Bore a 2-in. pilot hole the entire length of the crossing, and check it for line and grade during the boring or tunneling operation on the opposite end of the bore from the work shaft. This pilot hole will serve as centerline for the larger diameter hole to be bored.

58.2.1.2. **Auger Method.** Use a steel encasement pipe of the appropriate diameter equipped with a cutter head to mechanically perform the excavation. Use augers of large enough diameter to convey the excavated material to the work shaft.

58.2.2. **Electrical and Communication Conduit Boring.** Limit over excavation to the dimensions shown in Table 1 for electrical and communication conduit borings. Increased boring diameters will be allowed for outer diameters of casing and couplings. Pressure-grouting will not be required for electrical and communication conduit borings.

Table 1
Allowable Bore Diameter for Electrical or Communication Conduit or Casing

Single Conduit Bores		Multiple Conduit Bores	
Conduit Size (in.)	Maximum Allowable Bore (in.)	Conduit Size (in.) ¹	Maximum Allowable Bore (in.)
2	4	4	6
3	6	5	8
4	6	6	10
6	10	7	12
		8	12

5. The diameter of multiple conduits is the sum of the outside diameter of the 2 largest conduits for placement of up to 4 conduits in one bore. Submit boring diameters for the Engineer's approval when more than 4 conduits are to be placed in a bore.

58.3. **Tunneling.** Use an approved tunneling method where the characteristics of the soil, the size of the proposed pipe, or the use of monolithic pipe would make the use of tunneling more satisfactory than jacking or boring, or when shown on the plans.

Ensure the lining of the tunnel is strong enough to support the overburden when tunneling is permitted. Submit the proposed liner method for approval. Approval does not relieve the Contractor of the responsibility for the adequacy of the liner method.

Pressure-grout the space between the liner plate and the limits of excavation.

Pressure-grout between the carrier pipe and liner plate when shown on the plans.

58.4. **Joints.** Make joints by field bolting or connecting bands, whichever is feasible if corrugated metal pipe is used. Make the joints in accordance with Item 464, "Reinforced Concrete Pipe," if reinforced concrete pipe is used. Make the joints in accordance with Item 462, "Concrete Box Culverts and Drains," if reinforced concrete box is used.

59. MEASUREMENT

This Item will be measured by the foot between the ends of the pipe or box along the flow line.

This is a plans quantity measurement Item. The quantity to be paid is the quantity shown in the proposal, unless modified by Article 9.2., "Plans Quantity Measurement." Additional measurements or calculations will be made if adjustments of quantities are required.

60. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Jacking, Boring, or Tunneling Pipe" of the type, size, and class specified; or "Jacking, Boring, or Tunneling Pipe" of the type, size, and design specified; or "Jacking or Tunneling Box Culvert" of the size specified.

This price is full compensation for excavation, grouting, backfilling, and disposal of surplus material; furnishing pipe, box, and pipe liner materials required for tunnel operations; preparation, hauling, and installing of pipe, box, and pipe liner materials; and materials, tools, equipment, labor, and incidentals.

Protection methods for open excavations deeper than 5 ft. will be measured and paid for as required under Item 402, "Trench Excavation Protection," or Item 403, "Temporary Special Shoring."

Item 496

Removing Structures

61. DESCRIPTION

Remove and either dispose of or salvage structures.

62. CONSTRUCTION

- 62.1. **Demolition Plans.** Follow the demolition sequence shown on the plans for bridge structures to be removed, or submit a demolition plan if indicated on the plans. Include in the required demolition plan the type and location of equipment to be used, the method and sequence of removal of the structural elements, and a narrative indicating the stability of the partially demolished structure is maintained throughout the demolition process. Have these plans signed and sealed by a licensed professional engineer when demolished structure intersects active roadways and as otherwise shown on the plans. Submit required demolition plans at least 14 days before starting work unless otherwise directed. Department approval of these plans is not required, but the Department reserves the right to request modifications to the plans when work could affect the safety of the traveling public and when around other transportation facilities to remain in place. Notify the Department 30 days before starting any bridge demolition work to allow for required notifications to other agencies.
- 62.2. **Removal.**
- 62.2.1. **Pipes.** Avoid damaging appurtenances determined by the Engineer to be salvageable.
- 62.2.2. **Concrete, Brick, or Stone Structures.** Portions of structures that will not interfere with the proposed construction may remain in place 2 ft. or more below the permanent ground line. Square off remaining structures and cut reinforcement flush with the surface of the concrete.
- 62.2.3. **Steel Structures.** Dismantle steel to be retained by the Department or re-erected by cold-cutting fastener heads and punching or drilling the remaining portion of the fastener, air-arc gouging welded connections, and flame-cutting beams along a straight line. The Engineer may approve other methods of cutting. Cut beams at the locations shown on the plans. Match-mark steel to be re-erected with paint in accordance with the erection drawings. Remove steel piles or cut off 2 ft. or more below the permanent ground line.
- 62.2.4. **Timber Structures.** Remove all fasteners from timber determined by the engineer to be salvageable. Remove timber piles or cut off 2 ft. or more below the permanent ground line.
- 62.3. **Salvage.** Avoid damage to materials shown on the plans to be salvaged. Deliver materials to be retained by the Department to the location shown on the plans. Block up salvaged steel materials off the ground.
- 62.4. **Disposal.** Material removed that is not deemed to be salvageable is the property of the Contractor. Dispose of removed material off the right of way in accordance with federal, state, and local regulations.
- 62.5. **Backfill.** Backfill excavation and voids to the original ground line if resulting from the removal of structures. Place backfill that will support any portion of the roadbed or embankment to the same

requirements for placing embankment. Backfill other areas in 10 in. layers, loose measurement, and compact to the density of adjacent undisturbed material.

63. MEASUREMENT

This Item will be measured by each structure or by the foot.

64. PAYMENT

The work performed in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Removing Structures" of the type of structure specified. This price is full compensation for demolition plan preparation, loading, hauling, disposal, stockpiling, removal of appurtenances, excavation and backfill, equipment, labor, tools, and incidentals.

Item 500

Mobilization

65. DESCRIPTION

Establish and remove offices, plants, and facilities. Move personnel, equipment, and supplies to and from the project or the vicinity of the project site to begin work or complete work on Contract Items. Bonds and insurance are required for performing mobilization.

For Contracts with emergency mobilization, provide a person and method of contact available 24 hrs. a day, 7 days a week unless otherwise shown on the plans. The time of notice will be the transmission time of the written notice or notice provided orally by the Department's representative.

66. MEASUREMENT

This Item will be measured by the lump sum or each as the work progresses. Mobilization is calculated on the base bid only and will not be paid for separately on any additive alternate items added to the Contract.

67. PAYMENT

For this Item, the adjusted Contract amount will be calculated as the total Contract amount less the lump sum for mobilization. Except for Contracts with callout or emergency work, mobilization will be paid in partial payments as follows:

Payment will be made upon presentation of a paid invoice for the payment or performance bonds and required insurance,

Payment will be made upon verification of documented expenditures for plant and facility setup. The combined amount for all these facilities will be no more than 10% of the mobilization lump sum or 1% of the total Contract amount, whichever is less,

When 1% of the adjusted Contract amount for construction Items is earned, 50% of the mobilization lump sum bid or 5% of the total Contract amount, whichever is less, will be paid. Previous payments under this Item will be deducted from this amount,

When 5% of the adjusted Contract amount for construction Items is earned, 75% of the mobilization lump sum bid or 10% of the total Contract amount, whichever is less, will be paid. Previous payments under the Item will be deducted from this amount,

When 10% of the adjusted Contract amount for construction Items is earned, 90% of the mobilization lump sum

bid or 10% of the total Contract amount, whichever is less, will be paid. Previous payments under this Item will be deducted from this amount,
 Upon final acceptance, 97% of the mobilization lump sum bid will be paid. Previous payments under this Item will be deducted from this amount, and
 Payment for the remainder of the lump sum bid for "Mobilization" will be made after all submittals are received, final quantities have been determined and when any separate vegetative establishment and maintenance, test, and performance periods provided for in the Contract have been successfully completed.

For projects with extended maintenance or performance periods, payment for the remainder of the lump sum bid for "Mobilization" will be made 6 months after final acceptance.

For Contracts with callout or emergency work, "Mobilization," will be paid as follows:

- Payment will be made upon presentation of a paid invoice for the payment of performance bonds and required insurance,
- Mobilization for callout work will be paid for each callout work request, and
- Mobilization for emergency work will be paid for each emergency work request.

Item 550

Chain Link Fence

68. DESCRIPTION

Furnish, install, remove, repair, or replace chain link fence and gates.

69. MATERIALS

Furnish certification from the chain link fence materials manufacturer stating that all fencing materials comply with the requirements of this Item before installation of the fence. Use only new materials.

69.1. **General.** Furnish materials in accordance with the following:

Item 421, "Hydraulic Cement Concrete," Class B
 Item 445, "Galvanizing"

69.2. **Wire Fabric.** Provide wire fabric with:

9 gauge (0.148 in. diameter) steel wire with a minimum breaking strength of 1,290 lb. meeting ASTM A392 Class I or ASTM A491;
 mesh size of 2 in. ±1/8 in. between parallel wires with at least 7 meshes in a vertical dimension of 23 in. along the diagonals of the openings; and
 knuckled selvages at the top and bottom edge of the fabric, unless otherwise shown on the plans.

69.3. **Posts.** Provide posts of the size and weight shown on the plans. Do not provide rerolled or open-seam posts. Use material for all posts meeting ASTM F1043 Group 1A Regular Grade or Group 1C High Strength.

69.4. **Post Caps.** Provide malleable iron post caps designed to exclude all moisture. Furnish barbed wire support arms integral with the post caps if barbed wire is shown on the plans. Furnish post caps with an opening for the top rail if top rail is shown on the plans. Post caps must have a 2-in. skirt.

- 69.5. **Gates.** Provide gates fabricated from round sections of pipe of the size and weight shown on the plans. Use material for all gate pipes meeting ASTM F1043 Group 1A Regular Grade or Group 1C High Strength. For each gate, include:
- corner and tee fittings of malleable iron or pressed steel with means for attaching diagonal bracing members;
 - hinges of malleable iron allowing a full 180° swing, easily operated by one person;
 - ball-and-socket-type bottom hinges that do not twist or turn from the action of the gate and prevent the closed gate from being lifted off the hinges;
 - a positive stop that prevents any portion of the gate from swinging over an adjacent traffic lane;
 - malleable iron pulley systems for roll type gate (only when required);
 - diagonal braces consisting of 3/8-in. diameter cable with turnbuckles, 2 to each gate frame, and, for vehicle gates, a vertical pipe brace of the size and weight shown on the plans at the center of each gate leaf;
 - latches of malleable iron or steel for single gates with a single-fork latch and padlock eye that will keep the gate closed;
 - 2 fork latches mounted on a center plunger rod with a padlock eye for double-leaf gates;
 - holdbacks for each leaf of vehicular gates, with a semi-automatic holdback catch anchored at least 12 in. into a 12-in. diameter by 24-in. deep concrete footing; and
 - a malleable iron center rest, designed to receive the plunger rod anchored as shown on the plans for all double-leaf gates.
- 69.6. **Top Rail.** Use material meeting ASTM F1043 Group 1A or 1C for all top rail pipes. Provide 1.660 in. OD top rail manufactured from Group 1A standard weight (Schedule 40) steel pipe weighing 2.27 lb. per foot or from Group 1C high-strength pipe weighing 1.84 lb. per foot when shown on the plans. Provide pipe in sections at least 18 ft. long joined with outside steel sleeve couplings at least 6 in. long with a minimum wall thickness of 0.70 in. Use couplings designed to allow for expansion of the top rail.
- 69.7. **Tension Wire.** Use 7 gauge (0.177-in.) carbon steel wire with a minimum breaking strength of 1,950 lb. for the bottom edge of all fence fabric, and for the top edge of fence fabric when a top rail is not specified.
- 69.8. **Truss Bracing.** Provide truss bracing as shown on the plans.
- 69.9. **Cables.** Provide 7-wire strand cables manufactured of galvanized annealed steel at least 3/8 in. in diameter.
- 69.10. **Barbed Wire.** Provide 3 strands of twisted 12.5 gauge barbed wire with 2-point, 14 gauge barbs spaced approximately 5 in. apart conforming to ASTM A121 or ASTM A585 when specified on the plans.
- 69.11. **Barbed Wire Support Arms.** Provide support arms at an angle of 45° from vertical, with clips for attaching 3 strands of barbed wire to each support arm and sufficient strength to support a 200-lb. weight applied at the outer strand when barbed wire is specified on the plans.
- 69.12. **Stretcher Bars.** Provide stretcher bars made of flat steel at least 3/16 × 3/4 in. and not more than 2 in. shorter than the fabric height. Provide one stretcher bar for each gate and end post and 2 stretcher bars for each corner and pull post.
- 69.13. **Grounds.** Provide copper-clad steel rods 8 ft. long with a minimum diameter of 5/8 in., or other UL-listed ground rods.
- 69.14. **Miscellaneous Fittings and Fasteners.** Furnish enough fittings and fasteners to erect all fencing materials in a proper manner. Furnish fittings for posts from pressed or rolled steel, forged steel, malleable iron or wrought iron of good commercial quality spaced as shown on the plans.
- 69.15. **Coatings.** Hot-dip galvanize all materials unless specified otherwise in this Item or on the plans. Fabric, tension wire, and barbed wire may be aluminum-coated or alloy-coated if approved. Additionally coat all

material except bolts, nuts, washers, and pipe material with thermally fused polyvinyl chloride (PVC) in accordance with ASTM F668, Class 2b, meeting the specified color when shown on the plans.

69.15.1. **Fabric.**

69.15.1.1. **Galvanizing.** Hot-dip galvanize in accordance with ASTM A392, Class I.

69.15.1.2. **Aluminum Coating.** Aluminum-coat in accordance with ASTM A491.

69.15.1.3. **Alloy Coating.** Coat with zinc-5% aluminum-mischmetal alloy (Zn-5A1-MM) in accordance with ASTM F1345, Class I.

69.15.2. **Posts, Braces, and Gates.**

69.15.2.1. **Standard Weight (Schedule 40) Pipe.** Hot-dip galvanize inside and outside according to ASTM F1043 (1.8 oz./sq. ft. galvanized zinc weight).

69.15.2.2. **High Strength Pipe.** Hot-dip galvanize before or after forming pipe according to ASTM F1043 Group 1C and as follows:

Outside—minimum 0.9 oz./sq. ft. galvanized zinc weight with a verifiable polymer overcoat.

Inside—minimum 0.9 oz./sq. ft. galvanized zinc weight before forming, or minimum 0.3 mils zinc-based coating after forming containing a minimum 90% zinc dust, by weight.

69.15.2.3. **Optional Additional Coating.** Additionally coat all pipe material with 10 mils minimum thermally fused PVC according to ASTM F1043, meeting the specified color when shown on the plans.

69.15.3. **Fittings, Bolts, and Other Miscellaneous Hardware.** Galvanize all fittings, bolts, and miscellaneous hardware in conformance with Item 445, "Galvanizing."

69.15.4. **Tension Wire.** Zinc-coat tension wire with a minimum coating of 0.80 oz./sq. ft. or aluminum-coat with a minimum coating of 0.30 oz./sq. ft.

69.15.5. **Barbed Wire.** Zinc-coat barbed wire in accordance with ASTM A121 (0.80 oz./sq. ft.) or aluminum-coat in accordance with ASTM A585 (0.30 oz./sq. ft.).

69.15.6. **Pull Cable.** Zinc-coat pull cable with a minimum coating of 0.80 oz./sq. ft. of individual-wire surface when tested in conformance with ASTM A116.

70. CONSTRUCTION

Erect the chain link fence to the lines and grades established on the plans. Overall height of the fence when erected is the height above the grade shown.

Repair or replace damaged fence or gates. Remove and replace the post and foundation if posts cannot be repaired by straightening. Return all salvageable material to the location shown on the plans when a fence installation is to be removed in its entirety and not replaced. Backfill all postholes with suitable material. Return the salvaged fence fabric in secured rolls not more than 50 ft. long. Dispose of unsalvageable material.

70.1. **Clearing and Grading.** Clear all brush, rocks, and debris necessary for the installation of this fencing.

Stake the locations for corner posts and terminal posts unless otherwise shown on the plans. Follow the finished

ground elevations for fencing panels between corner and terminal posts. Level off minor irregularities in the path of the fencing.

70.2. **Erection of Posts.** Install posts as shown on the plans. Plumb and permanently position posts with anchorages firmly set before fabric is placed. Brace corner and pull posts as shown on the plans.

70.2.1. **Post Spacing.** Space posts as shown in Table 1.

Table 1
Post Spacing and Placement

Post Type	Required Spacing or Placement
Line posts	no more than 10 ft. apart
Pull posts	no more than 500 ft. apart and at each change in direction exceeding 20° vertically
Corner posts	at each horizontal angle point

Install cables on all terminal posts and extend to adjacent posts. Install cables on each side of corner and pull posts with a 3/8-in. drop-forged eye-and-eye or eye-and-clevis turnbuckle unless otherwise shown on the plans.

70.2.2. **Postholes.** Drill holes for concrete footings for all posts to provide footings of the dimensions shown on the plans.

Penetrate solid rock by at least 12 in. (18 in. for end, corner, gate, and pull posts) or to plan depth where the rock is encountered before reaching plan depth. Drill holes in the solid rock with a diameter at least 1 in. greater than the outside diameter of the post.

Fill the hole in the solid rock with grout consisting of 1 part hydraulic cement and 3 parts clean, well-graded sand after the posts are set and plumbed. If desired, other grouting materials may be used only if approved. Thoroughly work the grout into the hole, leaving no voids. Construct concrete footings from the solid rock to the top of the ground.

70.2.3. **Gate Posts.** Align the tops of all gate frames with the fencing top tension wire or top rail. Provide vehicular gates that are greater in overall height than the adjacent fencing by the height necessary to extend to within 2 in. of the pavement between the curbs if curbs are shown on the plans.

70.2.4. **Concrete Footings.** Center posts in their footings. Place concrete and compact by tamping or other approved methods. Machine mix all batches of concrete over 1/2 cu. yd. Hand mixing concrete is allowed on batches under 1/2 cu. yd.

Use forms for footings where the ground cannot be satisfactorily excavated to neat lines. Crown the concrete or grout (for solid rock) to carry water from the post. Keep the forms in place for at least 24 hr. Backfill the footing with moistened material as soon as each form is removed, and thoroughly tamp. Cover concrete with at least 4 in. of loose moist material, free of clods and gravel, immediately after placing concrete. No other curing is required.

Spread all excess excavated and loose material used for curing neatly and uniformly. Remove excess concrete and other construction debris from the site.

70.3. **Erection of Fabric.** Place the fabric with the cables drawn taut with the turnbuckles after all posts have been permanently positioned and anchorages firmly set. Secure one end and apply enough tension to the other end to remove all slack before making attachments. Cut the fabric and independently attach each span at all corner posts and pull posts unless otherwise shown on the plans.

Follow the finished contour of the site with the bottom edge of fabric located approximately 2 in. above the grade.

Grade uneven areas so the maximum distance between the bottom of fabric and ground is 6 in. or less.

Fasten fabric at 12 in. intervals to the top and bottom tension wires between posts. Fasten the fabric in the same manner when top rail is shown on the plans. Fasten the fabric on gate frames to the top and bottom of the frame at 12 in. intervals. Use steel wire fabric ties of 9 gauge steel or larger. Fasten fabric to terminal posts by steel stretcher bars and stretcher bar bands fitted with carriage bolts and nuts of the size and spacing shown on the plans. Use stretcher bars to fasten end posts, pull posts, corner posts, and gateposts with stretcher bar bands at intervals of no more than 15 in. Attach stretcher bars to terminal posts with 1 × 1/8 in. flat steel bands with 3/8-in. carriage bolts at intervals up to 15 in.

- 70.4. **Electrical Grounds.** Provide at least one electrical ground for each 1,000 ft. of fence, located near the center of the run. Provide additional grounds directly under the point where power lines pass over the fence.

Vertically drive or drill in the grounding rod until the top of the rod is approximately 6 in. below the top of the ground. Connect a No. 6 solid copper conductor to the rod and to the fence by a UL-listed method so that each element of the fence is grounded.

- 70.5. **Repair of Coatings.** Repair damaged zinc coating in accordance with Section 445.3.5., "Repairs."

71. MEASUREMENT

Chain link fence will be measured by the foot of fence installed, repaired, replaced, or removed, measured at the bottom of the fabric along the centerline of the fence from center to center of posts, excluding gates.

Gates will be measured as each gate installed, repaired, replaced, or removed.

72. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Chain Link Fence (Install)" or "Chain Link Fence (Repair)" of the height specified or "Chain Link Fence (Remove)" and "Gate (Install)" or "Gate (Repair)" of the type, height, and width of opening specified or "Gate (Remove)." Clearing and grading for fencing and gates will not be paid for directly but is subsidiary to this Item.

- 72.1. **Chain Link Fence (Install).** This price is full compensation for furnishing and installing fencing, except gates; cleaning, grading, and backfilling; removing and disposing of surplus material; and equipment, labor, tools, and incidentals.
- 72.2. **Chain Link Fence (Repair).** This price is full compensation for furnishing materials; repairing or replacing fencing, except gates; cleaning, grading, and backfilling; removing and disposing of surplus or damaged material; and equipment, labor, tools, and incidentals.
- 72.3. **Chain Link Fence (Remove).** This price is full compensation for removing all fencing, except gates; cleaning, grading, and backfilling; removing and disposing of surplus material; and equipment, labor, tools, and incidentals.
- 72.4. **Gate (Install).** This price is full compensation for installing gate and for providing materials, center anchorages, equipment, labor, tools, and incidentals.
- 72.5. **Gate (Repair).** This price is full compensation for repairing or replacing gate and for furnishing materials; removing and disposing of damaged materials; and equipment, labor, tools, and incidentals.

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72.6.

Gate (Remove). This price is full compensation for removing gate and for materials, equipment, labor, tools, and incidentals.

