CONSTRUCTION DETAILS
SECTION 200
EARTHWORK

SECTION 201
CLEARING AND GRUBBING

DESCRIPTION

201.01 This work consists of clearing, grubbing, removing, and disposing of vegetation and debris within the limits of the right of way, easement areas, borrow pits, and other areas shown in the Contract or required by the work. Vegetation and objects designated to remain shall be preserved free from injury or defacement.

CONSTRUCTION REQUIREMENTS

201.02 The Engineer will designate all trees, shrubs, plants, and other objects to remain. Every object that is designated to remain and is damaged shall be repaired or replaced as directed, at the Contractor's expense.

Clearing and grubbing shall extend to the toe of fill or the top of cut slopes, unless otherwise designated.

All surface objects, trees, stumps, roots, and other protruding obstructions not designated to remain shall be cleared and grubbed, including mowing, as required. Undisturbed stumps, roots, and nonperishable solid objects located 2 feet or more below subgrade or embankment slope may remain in place. In areas to be rounded at the tops of backslopes, stumps shall be removed to at least 2 feet below the surface of the final slope line.

Except in areas to be excavated, all holes resulting from the removal of obstructions shall be backfilled with suitable material and compacted in accordance with subsection 203.06.

Burning of perishable material will not be permitted without the written approval of the Engineer. If permitted, perishable material shall be burned under the constant care of the Contractor, at times and in a manner that will not endanger the surrounding vegetation, adjacent property, or objects designated to remain. Burning shall be done in accordance with applicable laws and ordinances.

No material or debris shall be disposed of within the project limits without the written permission of the Engineer. Material or debris that is disposed of within the project limits shall be buried to a depth of at least 2 feet and the surface shall be reshaped to match the adjacent ground line. The Contractor shall make all arrangements to obtain written permission from property owners for disposal locations outside the limits and view of the project. Copies of this written agreement shall be furnished to the Engineer before the disposal area is used.

All cleared merchantable timber shall be removed from the project and shall become the property of the Contractor.

Branches on trees or shrubs shall be removed as directed. Branches of trees extending over the roadbed shall be trimmed to give a clear height of 20 feet above the roadbed surface. All trimming shall be done in accordance with good tree surgery practices.

The Contractor shall scalp the areas within the excavation or embankment grading limits. Mowed sod need not be removed where the embankment to be constructed is 4 feet or more in height. Scalping shall include the removal from the ground surface of brush, roots, sod, grass, residue of agricultural crops, sawdust, and other vegetable matter. See subsection 208.04(d) for disturbed area limits.

METHOD OF MEASUREMENT

201.03 Measurement will be by one of the following methods:

(a) *Area Basis.* The work to be paid for will be the number of acres acceptably cleared and grubbed, including scalping, within the limits shown on the plans or staked by the Engineer.

(b) *Lump Sum Basis.* When the Contract contains a clearing and grubbing lump sum item, no measurement will be made.

BASIS OF PAYMENT

201.04 The accepted quantities of clearing and grubbing will be paid for at the contract unit prices as follows:

(a) *Area Basis.* The quantities will be paid for at the contract unit price bid per acre for each pay item that appears in the bid schedule.

(b) *Lump Sum Basis.* When the bid schedule contains a lump sum item, the lump sum price so bid will be paid and shall be full compensation for clearing and grubbing the entire project.

Clearing and grubbing beyond the limits designated under this item will be paid for as Extra Work in accordance with subsection 104.03.

Payment will be made under:

Pay Item	Pay Unit
Clearing	Acre, Lump Sum
Grubbing	Acre, Lump Sum
Clearing and Grubbing	Acre, Lump Sum

(c) Exclusions. When the bid schedule does not contain an estimated quantity or a lump sum item for clearing and grubbing, the work will not be paid for separately but shall be included in the work.

SECTION 202
REMOVAL OF STRUCTURES AND OBSTRUCTIONS

DESCRIPTION

202.01 This work consists of the removal and disposal of trees, slope and ditch protection, abandoned utility services, curb, gutter, pipes, sidewalk, structures, bridges or parts of bridges, railroad appurtenances, traffic control devices, impact attenuators, guardrail, fences, foundations, detours, pavements, pavement markings, and all other obstructions that are not designated or permitted to remain. It shall also include salvaging, stockpiling and loading salvable materials, sandblasting, plugging structures, cleaning culverts, and sawing and cutting to facilitate controlled breaking and removal of concrete and asphalt to a neat line. Except in areas to be excavated, the resulting trenches, holes, and pits shall be backfilled. This work also consists of plugging and abandoning water wells as designated in the Contract.

Materials removed and not designated in the Contract to be salvaged or incorporated into the work shall become the property of the Contractor.

CONSTRUCTION REQUIREMENTS

202.02 General. The Contractor shall raze, remove, and dispose of all structures and obstructions which are identified on the project, except utilities, structures and obstructions removed under other contractual agreements, and salvable material designated to remain the property of the Department.

Basements and other cavities left by structure removal shall be filled to the level of the surrounding ground with suitable material and, if within the construction limits, shall be compacted in accordance with subsection 203.06.

Bridges, culverts, and other drainage structures shall not be removed until satisfactory arrangements have been made to accommodate traffic and drainage.

Blasting or other operations used to remove existing structures or obstructions, which may damage new construction, shall be completed prior to placing the new work.

Where portions of structures are to be removed, the portions designated to remain shall be prepared to fit the new construction, and shall be protected from damage. All damage to structures designated to remain in place shall be repaired at the Contractor's expense. Method of repair shall be approved by the Engineer.

Sawing of concrete shall be done to a true line, with a vertical face, unless otherwise specified. The minimum depth of a saw cut in concrete shall be 2 inches or to the depth of the reinforcing steel, whichever occurs first.

Removed concrete and asphalt material may be used to construct embankments in accordance with subsection 203.06.

Where culverts or sewers are to be left in place and plugged, the ends of concrete or masonry culverts shall be filled with suitable material. The ends of corrugated metal pipe culverts shall be crushed. Culvert and sewer ends are to be sufficiently filled or crushed to prevent future settlement of embankments. Plugging of culverts shall include removal of headwalls and other appurtenances where necessary to accommodate the work.

Procedures for abandoning water wells shall conform to the Revised and Amended Rules and Regulations of the State of Colorado, Division of Water Resources, Board of Examiners of Water Well Construction and Pump Installation Contractors, (Board). The State Engineer who acts for the Board is located at 818 Centennial Bldg., 1313 Sherman St., Denver, CO 80203 (Phone 303-866-3587).

The Contractor shall properly plug and abandon the designated wells and file an abandonment report for each. An abandonment report shall be prepared using Form GWS-9 obtained from the Board at the above address. The report shall describe the well location and how it was plugged. This report shall be submitted to the Board, with a copy given to the Project Engineer, within 60 days after performing the work.

Existing guardrail shall not be removed unless the need for the guardrail has been eliminated or the hazard has been protected or delineated. The duration and manner of protection or delineation shall be submitted in writing for approval by the Engineer.

202.03 Salvable Material. All salvable material designated in the Contract to remain the property of the Department shall be removed without damage, in sections or pieces which may be readily transported, and shall be stockpiled by the Contractor at specified locations within the project limits. The Contractor shall safeguard salvable materials and shall be responsible for the expense of repairing or replacing damaged or missing material until it is incorporated into the work, or is loaded onto Department equipment by the Contractor.

202.04 Signs and Traffic Signals. Removal of signs shall include removal of posts, footings, pedestals, sign panels, and brackets. Concrete adhering to salvable sign posts shall be removed.

Removal of sign panel shall include removal of the panel and its attachment hardware from the existing installation and adjusting the spacing of the remaining panels.

The removal of traffic signal items shall include poles, mast arms, signal heads, span wires, footings, all attachment hardware, and other incidental materials. Removal of signal pole or pedestal pole shall include pole, span wire, cable, signal heads, overhead sign support wire, footings, and pedestrian push buttons. Removal of traffic signal controller and cabinet shall include removal of the footing and all auxiliary equipment contained within the cabinet.

202.05 Pavement Markings. Pavement markings shall be removed from the pavement to the maximum extent possible, by methods that do not materially alter or damage the surface or texture of the pavement, to the satisfaction of the Engineer. The proposed method of pavement marking removal shall be designated by the Contractor at the preconstruction conference, and approved by the Engineer. Operations that do not produce the desired result, damage the pavement, or may constitute a hazard to the traveling public will not be permitted. Materials deposited on the pavement as a result of removal of pavement markings shall be promptly removed so as not to interfere with traffic or roadway drainage.

Pavement markings, designated to be removed, shall be removed before any change is made in traffic patterns. Temporary marking tape sections longer than one foot shall be removed before placement of the final pavement course. All tape shall be removed on sections where tape conflicts with revised traffic lanes prior to opening of new lanes to traffic.

The pavement surface area to be covered with pavement marking material shall be sandblasted, or blast cleaned by another approved method, prior to the application of pavement primer or prior to the placing of pavement marking material when used without a pavement primer. A dustless-abrasive shot blasting, power washing, or other approved cleaning method may be used to do the sandblasting work. The sandblast shall be applied to remove all dirt, laitance, and curing compound residue. After sandblasting, all loose dust and dirt shall be removed before application of pavement primer or pavement marking material.

202.06 Detours. The Contractor shall completely remove the detour and dispose of the materials in accordance with the Contract.

202.07 Pavements, Sidewalks, Curbs. All concrete pavement, sidewalks, structures, curbs, gutters, etc., designated for removal, shall be disposed of in accordance with subsection 201.02. Concrete pavement to be broken and left in place shall be broken so the largest fragment does not exceed 1 square yard in surface.

202.08 Portions of structures. Unless otherwise directed, the substructures of existing structures shall be removed down to the natural stream bottom and those parts outside of the stream shall be removed down 1 foot below natural ground surface. Where such portions of existing structures lie wholly or in part within the limits of a new structure, they shall be removed as necessary to accommodate the construction of the proposed structure.

Reinforcing steel projecting from the structure, designated to remain, shall be cleaned and aligned to the new construction. Required dowels shall be securely grouted with approved grout. When concrete is removed, all exposed reinforcing steel designated to remain in place shall be cleaned by sandblasting to sound steel free of oil, dirt, concrete fragments or laitance, loose rust scale, and other coatings that would destroy or inhibit the bond with the new concrete.

Adequate measures shall be taken by the Contractor to protect the steel from contamination or corrosion. Reinforcing steel, contaminated as a result of the Contractor's failure to provide adequate protection, shall be resandblasted at the Contractor's expense with no allowance for contract time extension.

A protective device shall be placed between the sandblasting operations and the traveling public.

202.09 Removal of Asphalt Mat (Planing). The Contractor shall not commence planing operations until the hot mix asphalt (HMA) Mix Design (CDOT Form 43) has been approved and signed.

Prior to beginning planing operations, the Contractor shall submit a planing plan for approval by the Engineer. This plan shall include as a minimum:

(1) The number and types of planers to be used.
(2) The width and location of each planing pass.
(3) The number and types of brooms to be used, and their locations with respect to the planers. The Contractor shall have at least one back-up broom on the project at all times in case one of the operating brooms breaks down.

Each planer shall conform to the following:

The planer shall have sufficient power, traction, and stability to maintain an accurate depth of cut. The propulsion and guidance system of the planer shall be maintained in such condition that the planer may be operated to straight and true lines.

Operation with broken or missing teeth will not be allowed. Worn teeth shall be replaced if the planer does not produce a uniform surface.

The planer shall be capable of picking up the removed asphalt in a single operation. A self loading conveyer shall be an integral part of the planer. Windrows will not be allowed.

All planed areas shall be broomed with a pick up broom, unless otherwise specified, before being opened to traffic. A sufficient number of brooms shall be used immediately after planing to remove all planed material remaining on the roadway.

If the Contractor fails to adequately clean the roadway, work shall cease until the Engineer has approved the Contractor's revised written proposal to adequately clean the roadway.

At the completion of each days work, vertical edges caused by planing that are greater than 1 inch in height shall be: Longitudinal - tapered to not less than a 3:1 slope, Transverse - tapered to not less than a 50:1 slope.

The roadway shall be left in a safe and usable condition at the end of each work day. All required pavement markings, removed by the planing, shall be restored before the roadway is opened to traffic.

All planing shall be completed parallel to the travel lanes unless otherwise directed by the Engineer.

All planing shall be completed full width before resurfacing commences.

The longitudinal surface smoothness of the roadway prior to and after planing shall be tested in accordance with subsection 105.07(c).

202.10 Clean Culvert. Culverts designated in the Contract to be cleaned shall be cleaned by removing all sedimentation and debris from within the culvert and all appurtenant structures.

METHOD OF MEASUREMENT

202.11 When the Contract provides payment for removal of obstructions on a lump sum basis, this payment will include all stipulated structures and obstructions encountered within the right of way in accordance with this section. When the Contract provides payment for the removal of specific items on a unit basis, measurement will be by the unit.

Removal of pavement marking will be measured in square feet, completed and accepted. Sandblasting of pavement that is to be covered with pavement marking material will be measured as the same area as measured for the pavement marking for which the sandblasting is required.

Removal of temporary pavement markings will not be measured and paid for separately but shall be included in the work.

Removal of asphalt mat (planing) will be measured by the area in square yards, completed to the required depth, and accepted.

Sandblasting reinforcing steel will be measured by the square yard of deck surface. Multiple layers of reinforcing steel within a common area of the deck exposed and requiring sandblasting will not be measured separately.

Clean culvert will be measured by the number of culverts acceptably cleaned as designated on the plans, irrespective of the kind or size involved.

Abandon well will be measured by the actual number plugged, abandoned, and the abandonment report submitted.

BASIS OF PAYMENT

202.12 The accepted quantities will be paid for at the contract unit price for each of the pay items listed below that appear in the bid schedule. Payment shall be full compensation for sawing, removing, disposal, excavation and subsequent backfill, and salvage of materials removed, their custody, preservation, storage, and disposal as provided herein.

Payment will be made under:

Pay Item	**Pay Unit**
Removal of Structures and Obstructions	Lump Sum
Removal of	Each, Linear Foot, Square Yard Cubic Yard
Removal of Asphalt Mat (Planing)	Square Yard
Plug	Each
Clean Culvert	Each
Abandon Well	Each
Sandblasting	Square Foot
Sandblasting Reinforcing Steel	Square Yard

When the Contract does not include pay items for removal of structures and obstructions, the removal will not be paid for separately but shall be included in the work.

Payment for abandon well will be full compensation for all labor and materials required to complete the work, including preparing and submitting the abandonment report.

SECTION 203
EXCAVATION AND EMBANKMENT

DESCRIPTION

203.01 General. This work consists of excavation, hauling, disposal, placement, and compaction of all material encountered within the limits of the work, including construction of dikes and the excavation for ditches and channels, necessary for the construction of the roadway in accordance with the Contract. All excavation will be classified, "unclassified excavation", "stripping", "muck excavation", "rock excavation", "borrow", or "potholing" as hereafter described. All embankment will be classified "embankment material" or "rock fill" as hereafter described.

203.02 Excavation.

(a) *Unclassified Excavation.* Unclassified excavation shall consist of the excavation of all materials of whatever character required for the work, obtained within the right of way, including surface boulders and excavation for ditches and channels that is not removed under some other item.

Overhanging rock or other rock considered dangerous shall be removed when ordered, and will be classified "Unclassified Excavation".

(b) *Stripping.* Stripping shall consist of removing overburden or other specified material from material pits, and the replacement of overburden or other specified material over the disturbed area of the site or pit after the underlying material has been removed.

(c) *Muck Excavation.* Muck excavation shall consist of the removal and disposal of mixtures of soils and organic matter not suitable for foundation or embankment material.

(d) *Rock Excavation.* Rock excavation shall consist of igneous, metamorphic, and sedimentary rock which cannot be excavated without blasting or the use of rippers, including all boulders or other detached stones having a volume of ½ cubic yard or more, as determined by physical or visual measurement.

(e) *Borrow.* Borrow shall consist of approved material obtained from outside the right of way, required for the construction of the project.

(f) *Potholing.* Potholing consists of exposing and verifying the location of existing utilities at locations as directed.

203.03 Embankment.

(a) *Embankment Material.* Embankment material shall consist of approved material acquired from excavations, hauled and placed in embankments. Approval of the embankment material will be contingent on the material having a resistance value when tested by the Hveem Stabilometer, or equivalent resilient modulus value, of

at least that specified in the Contract, and a maximum dry density of not less than 90 pounds per cubic foot. The material must be stable when tested in accordance with Colorado Procedure L-3102.

1. *Soil Embankment.* Soil embankment shall consist predominantly of materials smaller than 4.75 mm (No. 4) sieve in diameter. Soil embankment shall be constructed with moisture density control in accordance with the requirements of subsection 203.07.

2. *Rock Embankment.* Rock embankment shall consist of materials with 50 percent or more by weight, at field moisture content, of particles with least dimension diameters larger than 4.75 mm (No. 4) sieve and smaller than 6 inches. Rock embankments shall be constructed without moisture density control in accordance with the requirements of subsection 203.08.

(b) *Rock Fill.* Rock fill shall consist of sound, durable stones, boulders, or broken rock not less than 6 inches in least dimension. At least 50 percent of the rock used shall have a volume of 2 cubic feet or more, as determined by physical or visual measurement.

Claystone or soil-like nondurable shale, as defined by Colorado Procedure 26, shall not be treated as sound rock and shall be pulverized, placed, and compacted as soil embankment. Claystone or soil-like non-durable shale particles greater than 12 inches in diameter shall not be placed in the embankment.

CONSTRUCTION REQUIREMENTS

203.04 General. The excavations and embankments shall be finished to smooth and uniform surfaces conforming to the typical sections specified. Variation from the subgrade plan elevations specified shall not be more than 0.08 foot. Where bituminous or concrete surfacing materials are to be placed directly on the subgrade, the subgrade plane shall not vary more than 0.04 foot. Materials shall not be wasted without written permission of the Engineer. Excavation operations shall be conducted so material outside of the slope limits will not be disturbed. Prior to beginning grading operations, all necessary clearing and grubbing in that area shall have been performed in accordance with Section 201.

The Contractor shall notify the Engineer not less than five working days prior to beginning excavation so the necessary cross sections may be taken. The Contractor shall not excavate beyond the dimensions and elevations established.

Archaeological and paleontological materials encountered during the work shall be dealt with in accordance with subsection 107.23.

203.05 Excavation.

(a) *Rock.* Unless otherwise specified, rock shall be excavated to a minimum depth of 0.5 foot and a maximum depth of 1 foot below subgrade, within the limits of the roadbed. Rock removed in excess of 1 foot below subgrade will not be paid

for. Backfilling of the depth in excess of 1 foot below subgrade shall be at the Contractor's expense. Approved embankment material shall be used to bring the rock-excavated areas to subgrade elevations within the tolerances specified in subsection 203.04.

Undrained pockets shall not be left in the rock surface and depressions shall be drained at the Contractor's expense.

Any change to cut slopes by the Department will be made prior to the next drilling operations.

(b) *Unclassified.* Excess or unsuitable excavated material, including rock and boulders, that cannot be used in embankments may be placed on the side slopes of the nearest fill as approved.

Wherever specified by the Engineer, intercepting ditches shall be made above the top of cut slopes and carried to outlets near the ends of the cuts. In order to blend the intersection of cut slopes with the slope of the adjacent natural ground surfaces in a uniform manner, the tops of all cut slopes, except those in solid rock, shall be flattened and rounded in accordance with typical sections and details specified. Earth overburden lying above solid rock cuts shall be treated in the same manner as earth cuts.

The Department reserves the right to change cut slopes during the progress of excavation.

(c) *Muck.* Unsuitable materials encountered in the subgrade shall be removed to the depth directed by the Engineer. The excavated area shall be backfilled to the finished graded section with approved material.

The Engineer will designate as unsuitable those soils that are detrimental to the roadway and they shall be removed to the depth as determined by the Engineer. All unsuitable material shall be disposed of as directed.

(d) *Borrow.* If the Contractor places more borrow than is specified or approved and causes a waste of roadway excavation, the quantity of waste will be deducted from the borrow volume. All borrow areas shall be bladed and shaped to permit accurate measurements after excavation is completed. The finished borrow areas shall be graded to a smooth and uniform surface and shall be finished so water will not collect or stand therein, unless otherwise specified.

(e) *Stripping.* Overburden shall be removed to the depth required for the production of acceptable material, and at least 5 feet beyond the working limits of the area being excavated.

(f) *Potholing.* All necessary potholing as determined by the Contractor and agreed to by the Engineer shall be completed under this item with appropriate equipment as approved.

The Contractor shall acquire necessary permits, locate utilities, excavate all materials of whatever character required to expose the utilities, survey the location of the utilities, and backfill the excavation to existing grade lines with the excavated or other approved materials. Backfilling shall be accomplished in accordance with subsection 206.03.

The Contractor shall use extreme caution during this work. All damage to existing utility lines or adjacent facilities shall be repaired promptly at the Contractor's expense.

203.06 Embankment. Embankment construction shall include preparation of the areas upon which embankments are to be placed, construction of dikes, placing and compacting of approved material within roadway areas including holes, pits, and other depressions within the roadway area. Only approved materials shall be used in the construction of embankments and fills.

Free running water shall be drained from the material before the material is placed on the roadway.

The type of relative compaction required shall be as provided in the Contract.

Broken concrete, broken asphalt, or other solid materials more than 6 inches in greatest dimension shall not be placed within embankment areas supporting the roadway shoulders and pavement structure. These embankment areas are defined as the cross-sectional areas of an embankment situated beneath the shoulders and pavement structure and inside the lines projected downward and outward on a 1:1 slope from the outside edges of the roadway shoulders to their intersection with the base of the embankment. Broken concrete, broken asphalt, or other solid materials more than 6 inches in greatest dimension removed on the project may be disposed of in embankment side slope areas not supporting the roadway shoulders and pavement structure, as defined above. These materials shall be placed in layers; the thickness of each layer shall be less than 1½ times the following maximum allowable dimensions. Rocks and concrete shall not have any single dimension greater than 2 feet and asphalt shall not have any single dimension greater than 12 inches. Each layer shall be separated by a minimum of 6 inches of compacted and approved embankment material. No layer shall be within the top 2 feet of the subgrade or final finished side slope surface. These materials shall be placed as the embankment is being constructed. Excavation of in-place embankment to accommodate disposal of materials shall not be permitted.

When embankment is placed on a slope that is steeper than 4:1, as measured in the steepest direction, the embankment shall be continuously benched as the work is brought up in layers. Benching shall be well keyed and, where practical, a minimum of

8 feet wide. Each horizontal cut shall begin at the intersection of the original ground and the vertical sides of the previous bench. Excavation from benching shall be compacted along with the new embankment material at the Contractor's expense.

Where embankment is to be placed and compacted and end dumping is permitted, the slopes of the original ground or embankment shall be deeply plowed or cut into before starting end dumping.

Where the base of embankment is within 4 feet of the subgrade, all sod, and vegetable and other organic matter shall be removed from the surface upon which the embankment is to be placed. The cleared surface shall be completely broken up by plowing or scarifying to a minimum depth of 6 inches, and compacted to the specified embankment density. Sod not requiring removal shall be thoroughly disked prior to embankment construction.

If embankment can be placed on only one side of structures such as retaining walls, abutments, wing walls, piers, or culvert headwalls, compaction shall be accomplished without overturning of or placing excessive pressure against the structure. When noted on the plans, the fill adjacent to the abutment of a bridge shall not be placed higher than the bottom of the backwall until the superstructure is in place. When embankment is placed on both sides of a concrete wall or box type structure, the embankment shall be brought up equally on both sides of the structure.

Embankment shall be placed in horizontal layers not to exceed 8 inches loose measurement and shall be compacted as specified before the next layer is placed. Spreading equipment shall be used to obtain uniform thickness prior to compaction. As the compaction progresses, continuous mixing, leveling, and manipulating shall be done to assure uniform moisture and density. Bridging across streams, ponds, and swampy ground may be placed in layers greater than 8 inches as directed.

When embankments are constructed using claystone or soil-like non-durable shale as identified in the plans or by the Engineer, the material shall be pulverized to a maximum dimension of 12 inches in diameter, placed in a maximum layer thickness of 12 inches and watered to promote slaking and breakdown of the nondurable material in conformance with subsection 203.07.

Excavated material containing particles greater than 6 inches in greatest dimension shall not be used as embankment material unless designated in the Contract or approved by the Engineer. When the excavated material consists predominately of rock too large to be placed in 8 inch layers, the Engineer may permit the material to be placed in thicknesses up to the average rock dimension, not to exceed 3 feet. Placing of occasional boulders of sizes larger than the maximum layer thickness may be authorized by the Engineer. Each layer shall be leveled and smoothed by distribution of finer material or approved embankment material. If the use of leveling equipment is not practicable the Engineer may permit rock fill material to be cast or end dumped. In such cases sufficient hand or machine work will be required to

construct a compact, stable fill and to finish the slopes to a neat and smooth appearance. Each layer shall be compacted as specified in subsection 203.08.

Rock fill, or claystone or soil-like non-durable shale, or both shall not be constructed above an elevation 2 feet below the finished subgrade. The top 2 feet of the embankment shall be placed in layers not to exceed 8 inches loose thickness and compacted in accordance with subsections 203.07 and 203.08 as applicable.

When a rock fill is placed over any structure, the structure shall be covered with a minimum of 2 feet of compacted embankment material or other approved material before the rock is placed.

Cross hauling may be used to insure that the best available material is placed in the top 2 feet of all embankments. When directed by the Engineer, cross haul will be paid for in accordance with subsection 109.04.

Frozen materials shall not be used in construction of embankments.

During the construction of the roadway, the roadbed shall be maintained so that it is well drained at all times.

203.07 Construction of Embankment and Treatment of Cut Areas with Moisture and Density Control. Soil embankments shall be constructed with moisture and density control, and the soil upon which the embankments are to be constructed shall be scarified to a depth of 6 inches and compacted with moisture and density control. The moisture content of the soil at the time of compaction shall be as specified or directed.

The material shall be removed from the full width of roadbed in all cut sections to the designated depth. The soil below the designated depth shall be thoroughly scarified to a depth of 6 inches and the moisture content increased or reduced, as necessary, to obtain the moisture content specified. This scarified layer shall then be compacted to the relative compaction specified.

All embankment material shall also be compacted to the specified relative compaction.

Maximum dry density of all soil types encountered or used will be determined in accordance with AASHTO T 99, AASHTO T 180, or a modification thereof.

The amount of water to be used in compacting A-2-6, A-2-7, A-4, and A-6 through A-7 soils shall not deviate from optimum on the dry side by more than two percentage points as determined by AASHTO T 99, T 180, or a modification thereof, as designated in the Contract. A-4 soils which are unstable at the above moisture content shall be compacted at a lower moisture content to the specified density. The amount of water used in compacting all other soils shall be as required to obtain the percent relative compaction required.

Additional work involved in drying embankment material to the required moisture content shall be included in the contract price paid for excavating or furnishing the material with no additional compensation.

Density requirements will not apply to materials which cannot be tested in accordance with any of the above procedures for determining maximum dry density. Compaction for materials which cannot be tested shall be in accordance with subsection 203.08.

The percent of relative compaction specified shall be equal to or greater than minimum values as shown in the following table for the various classes of soil and type of compaction.

Claystone or soil-like non-durable shale shall be pulverized and compacted to the specified moisture and percent of relative compaction and shall be compacted with a heavy tamping foot roller, weighing at least 30 tons. Each tamping foot shall protrude from the drum a minimum of 4 inches. Each embankment layer shall receive a minimum of three or more coverages with the tamping foot roller to obtain density. One coverage consists of one pass over the entire surface designated. One pass consists of the passing of an acceptable tamping foot roller over a given spot. The roller shall be operated at a uniform speed not exceeding 3 miles per hour. No additional compensation will be made for additional roller coverages to achieve specified density requirements

Soil Classification (AASHTO M 145)	**AASHTO T 99 Minimum Relative Compaction (Percent)**	**AASHTO T 180 Minimum Relative Compaction (Percent)**
A-1	100	95
A-3	100	95
A-2-4	100	95
A-2-5	100	95
All Others	95	90

203.08 Construction of Embankments without Moisture and Density Control. Rock embankment material shall be placed in layers in accordance with the requirements of subsection 203.06.

Each layer of rock embankment material shall be compacted by routing construction equipment, compactors, or both, uniformly over the entire surface of each layer before the next layer is placed. At least one compactor shall be in simultaneous operation with each separate rock embankment placement operation. Specific types of compactors shall be furnished and used when required by the Contract.

Each layer of rock embankment shall not be covered by another layer until the Engineer is satisfied that adequate compaction has been obtained. If the Engineer determines that the compactive effort is unsatisfactory, the Engineer may order the Contractor to compact the unsatisfactory area by two additional passes using approved compaction equipment.

203.09 Proof Rolling. Proof rolling with pneumatic tire equipment shall be performed using a minimum axle load of 18 kips per axle. A weigh ticket from an approved scale shall be furnished by the Contractor to substantiate this weight.

The subgrade shall be proof rolled after the required compaction has been obtained and the subgrade has been shaped to the required cross section.

The proof roller shall be operated in a systematic manner so that a record may be readily kept of the area tested and the working time required for the testing. Areas that are observed to have soft spots in the subgrade, where deflection is not uniform or is excessive as determined by the Engineer, shall be ripped, scarified, dried or wetted as necessary and recompacted to the requirements for density and moisture at the Contractor's expense. After recompaction, these areas shall be proof rolled again and all failures again corrected at the Contractor's expense.

Upon approval of the proof rolling, the sub base, base course, or initial pavement course shall be placed within 48 hours. If the Contractor fails to place the sub base, base course, or initial pavement course within 48 hours or the condition of the subgrade changes due to weather or other conditions, proof rolling and correction shall be performed again at the Contractor's expense.

203.10 Presplitting. When presplitting is designated in the Contract, the top of the rock slope will be established by the Engineer. The Contractor shall drill the bore holes along the slope line, maintain the drill holes at the angle designated in the Contract, and ensure that all drill holes are in the same plane. The diameter, spacing, and loading of presplit holes shall result in a neat break. The presplitting holes shall be drilled for the full depth of the ledge.

The initial presplitting of each geological formation shall be accomplished utilizing a 100 foot test section. After drilling, loading, and shooting this test section, the material shall be removed so the Engineer can determine if the diameter, spacing, and loading of the presplit holes are adequate to give an acceptable backslope. If the results are determined acceptable by the Engineer, the presplitting may continue throughout the geological formation using those methods and procedures. If the presplitting is determined unsatisfactory, the Contractor shall make adjustments in the spacing, diameter, loading, or a combination thereof of the presplit holes utilizing another test section.

Presplitting holes shall be loaded with explosives in accordance with the manufacturer's recommendations. The cost of presplitting shall be included in the contract unit price for rock excavation.

203.11 Blading. Blading shall consist of furnishing motor graders of the specified horsepower rating, with operators, for shaping roadway, shoulders, or other areas as designated by the Engineer.

When scarifying is specified the motor grader shall be equipped with an independently operated "V"type scarifier and attachments.

203.12 Dozing. Dozing shall consist of furnishing crawler-type tractors of the specified horsepower rating, complete with operators and bulldozer blades. Rippers, if specified, will not be measured and paid for separately, but shall be included in the work.

METHOD OF MEASUREMENT

203.13 Items paid for by volume will not be remeasured but will be the quantities designated in the Contract. Exceptions will be made when field changes are ordered or when it is determined that there are discrepancies on the plans in an amount of at least plus or minus two percent of the plan quantity.

(a) *Excavation.* When payment is specified on a volume basis, all accepted excavation and borrow will be measured in its original position by cross-sectioning the area excavated. These measurements will include authorized excavation of rock, shale, muck, or other unsuitable material. All accepted stripping will be measured in stockpiled locations by cross-sectioning.

When the excavation conforms to the staked lines and grades, the original cross-sections and the staked sections shall be used for the determination of volumes excavated. Volumes will be computed from the cross-sections by the average end area or other acceptable method.

When topsoil or wetland topsoil is included as a pay item and is specified, the measured volume of excavation will be reduced by the volume of topsoil or wetland topsoil removed from the area shown as excavation on the plans.

Measurements will include over-breakage in rock excavation from the backslopes to an amount not to exceed, in any half station of 50 feet, 10 percent of the actual quantity required for that half station.

(b) *Embankment.* If provided in the Contract, embankment material will be measured in its final compacted position in the roadway. Measurement will be made upward from the original ground line without any allowance for subsidence due to compaction of the base under the embankment. The original cross-sections will be used for determination of volumes of embankment material placed, unless changes have been directed.

The measured volume of embankment material will be increased by the volume of topsoil or wetland topsoil removed from the area below the original ground line and under the embankment, only when the topsoil or wetland topsoil is designated to be removed within the roadway prism. When the topsoil source is not designated in the Contract, embankment will be measured from the original ground line.

(c) *Rock Fill.* Rock fill will be measured as the volume in cubic yards in its final position, unless otherwise specified, and shall be limited to the elevations specified.

(d) *Blading and Dozing.* The quantity measured under blading and dozing will be the number of hours that each motor grader or bulldozer is actually used as ordered. A minimum of four hours for any half shift or part thereof will be paid for unless the equipment is inoperative due to breakdown or other causes determined to be the Contractor's responsibility. Time involved in moving onto or off the project will not be measured and paid for.

Time will be paid for moving motor graders or bulldozers from one location on the project to another, if directed; but time will not be allowed for moves which are made for the convenience of the Contractor.

Payment for a minimum of four hours will not be allowed in cases where the motor grader, bulldozer, or operator is assigned to work on other pay items connected with the project.

(e) *Potholing.* Potholing will be measured by the total number of hours that excavation and backfilling equipment is actually used as directed. All other related work, including removal of existing pavement, backfilling, shoring, and labor will not be measured and paid for separately, but shall be included in the work.

(f) *Proof Rolling.* Proof rolling will be measured by the actual number of hours that the pneumatic equipment is used as a proof roller.

The time to be measured under this item will be the number of hours that each piece of equipment is actually used as ordered.

Proof rolling will be measured and paid for only once. Additional proof rolling shall be at the Contractor's expense.

BASIS OF PAYMENT

203.14 The accepted quantities will be paid for at the contract unit price for each of the pay items listed below that appear in the bid schedule.

Payment will be made under:

Pay Item	Pay Unit
Rock Excavation	Cubic Yard
Rock Fill	Cubic Yard
Unclassified Excavation	Cubic Yard
Unclassified Excavation (Complete in Place)	Cubic Yard

Pay Item (cont.)	Pay Unit (cont.)
Muck Excavation	Cubic Yard
Borrow	Cubic Yard
Borrow (Complete in Place)	Cubic Yard
Embankment Material (Complete in Place)	Cubic Yard
Stripping	Cubic Yard
Blading	Hour
Dozing	Hour
Potholing	Hour
Proof Rolling	Hour

Water will not be measured and paid for separately but shall be included in the work.

Compaction will not be measured and paid for separately, but shall be included in the work.

Excavated materials which, when specified, require more than one handling prior to final placement will be paid for at the contract unit price for unclassified excavation, rock excavation, stripping, muck excavation, or borrow as appropriate, for the first approved handling. Payment for the second approved handling will be made at the same unit price as the first handling, except that material used in conjunction with another pay item will be paid for in that pay item.

Payment for Unclassified Excavation (Complete in Place), Embankment Material (Complete in Place), and Borrow (Complete in Place) shall be full compensation for all work necessary to complete the item including construction of embankments, unclassified excavation, borrow, compaction, compaction of bases of cuts and fills, all work in available materials pits, and disposal of excess excavated material.

All costs associated with reducing the size of the claystone particles, removing the oversized particles, and disposal of the oversized particles will not be paid for separately but shall be included in the work.

Pavement replacement if required due to potholing, shall be accomplished, measured, and paid for in accordance with appropriate sections of the specifications.

Pneumatic tire equipment and load required to achieve the desired weight of proof rolling equipment will not be measured and paid for separately, but shall be included in the work.

SECTION 206
EXCAVATION AND BACKFILL FOR STRUCTURES

DESCRIPTION

206.01 This work consists of the excavation, and backfill or disposal of all material required for the construction of structures. The excavation and disposal of excavated material for ditches and channels shall be accomplished in accordance with Section 203.

All excavation and backfill for structures below the designed slope or subgrade line provided in the Contract shall be included under this item.

Unless otherwise specified, structure excavation shall include all pumping, bailing, draining, sheeting, bracing, and incidentals required for proper execution of the work.

MATERIALS

206.02 General. All structure backfill, bed course material, and filter material will be accepted in place.

(a) *Structure Backfill.* Class 1 and Class 2 structure backfill shall be composed of non-organic mineral aggregates and soil from excavations, borrow pits, or other sources. Material shall conform to the requirements of subsection 703.08. Class of material shall be as specified in the Contract or as designated.

Structure backfill (flow-fill) meeting the following requirements shall be used to backfill bridge abutments. The Contractor may substitute structure backfill (flow-fill) for structure backfill (class 1) or structure backfill (class 2) to backfill culverts and sewer pipes.

Ingredients	**Lbs./Cu.Yd.**
Cement	50
Coarse Aggregate (AASHTO No. 57 or 67)	1700
Fine Aggregate (AASHTO M 6)	1845
Water	325 (or as needed)

The amount of water shall be such that the structure backfill (flow-fill) flows into place properly without excessive segregation. Approximately 39 gallons of water per cubic yard of structure backfill (flow-fill) is normally needed.

The Contractor may use aggregate which does not meet the above specifications if the cement is increased to 100 pounds per cubic yard and the aggregate conforms to the following gradation:

Sieve Size	Percent Passing
25.0 mm (1 inch)	100
75 μm (No. 200)	0-10

The Contractor may substitute 30 pounds per cubic yard of cement and 30 pounds per cubic yard of fly ash for 50 pounds per cubic yard of cement or may substitute 60 pounds per cubic yard of cement and 60 pounds per cubic yard of fly ash for 100 pounds per cubic yard of cement.

Recycled broken glass (glass cullet) is acceptable as part or all of the aggregate. Aggregate including glass must conform to the required gradations. All containers used to produce the cullet shall be empty prior to processing. Chemical, pharmaceutical, insecticide, pesticide, or other glass containers containing or having contained toxic or hazardous substances shall not be allowed and shall be grounds for rejecting the glass cullet. The maximum debris level in the cullet shall be 10 percent. Debris is defined as any deleterious material which impacts the performance of the flowfill including all non-glass constituents.

(b) *Bed Course Material.* Material shall conform to the requirements of subsection 703.07. Upon approval, aggregate base course conforming to the requirements of subsection 703.03 may be used in lieu of bed course material.

(c) *Filter Material.* Class A, Class B, and Class C filter material shall conform to the requirements of subsection 703.09. Class of material shall be as specified or designated.

CONSTRUCTION REQUIREMENTS

206.03 Structure Excavation and Structure Backfill. Unsuitable foundation material shall be removed and wasted in a manner acceptable to the Engineer, and the excavated material will be paid for as structure excavation. Excavation and backfill for areas in excess of 3 feet below designed elevation will be paid for as provided in subsections 104.03 and 109.04. Unsuitable foundation material which is suitable for embankments, and suitable surplus excavated material shall be used in the construction of embankments. Unsuitable material removed below designed elevation shall be replaced with approved material.

Rock, hardpan, or other unyielding material encountered in trenches for culvert pipe or conduit shall be removed below the designed grade for a minimum depth of 12 inches. This extra depth excavation shall be backfilled with loose structure backfill (Class 1) or other approved material. The base of structure backfill shall be scarified to a depth of 6 inches and compacted with moisture and density control prior to placement of any structural element or structure backfill. The type of compaction shall be the same as that required for structure backfill (Class 2), as specified below. Backfill shall consist of approved materials uniformly distributed in layers brought up equally on all sides of the structure. Each layer of backfill shall not exceed 6 inches before compacting to the required density and before successive layers are placed.

206.03

Structure backfill (Class 1) shall be compacted to a density of not less than 95 percent of maximum density determined in accordance with AASHTO T 180.

Required density for structure backfill (Class 2) shall conform to subsection 203.07. The type of compaction shall be as specified in the contract for embankment construction. When there is no embankment in the Contract or the type of compaction for structure backfill (Class 2) is not designated, the type of compaction shall be AASHTO T 180.

Pipes, culverts, sewers, and other miscellaneous structures outside the roadway prism and not subjected to traffic loads shall be backfilled in layers as described above but shall be compacted to the density of the surrounding earth.

The excessive use of water during backfilling operations will not be permitted.

Compaction equipment or methods that produce horizontal or vertical earth pressures, which may cause excessive displacement or overturning, or may damage structures, shall not be used.

Backfill material shall not be deposited against newly constructed masonry or concrete structures until the concrete has developed a compressive strength of $0.8f'_c$.

Backfill at the inside of bridge wingwalls and abutments shall be placed before curbs or sidewalks are constructed over the backfill and before railings on the wingwalls are constructed.

Unless otherwise indicated in the Contract or directed, all sheeting and bracing used in making structure excavation shall be removed by the Contractor prior to backfilling.

Structure backfill placed at bridge piers in waterways and water channels, that does not support embankments, pavements, or slope protection, will not require compaction.

Compaction of structure backfill (flow-fill) will not be required.

The maximum layer thickness for structure backfill (flow-fill) shall be 3 feet. Additional layers shall not be placed until the structure backfill (flow-fill) has lost sufficient moisture to be walked on without indenting more than 2 inches. Damage resulting from placing structure backfill (flow-fill) in layers that are too thick or from not allowing sufficient time between placement of layers shall be repaired at the Contractor's expense.

When the Contractor substitutes Structure Backfill (Flow-Fill) for Structure Backfill (Class 1) or (Class 2), the trench width may be reduced to provide a minimum 6 inch clearance between the outside diameter of the culvert and the trench wall.

206.04 Bed Course Material. Construction requirements for bed course material for sidewalks and curbing shall conform to the applicable requirements of Sections 608 and 609.

206.05 Filter Material. Construction requirements for filter material for subsurface drains shall conform to the applicable requirements of Section 605.

Filter material shall be placed behind bridge abutments, wingwalls, and retaining walls as provided in the Contract and in accordance with the following requirements:

When provided in the Contract, wall drain outlets shall be backed with sacked filter material conforming to the gradation requirements for coarse aggregate No. 3 or No. 4 set forth in Table 703-2.

Filter material shall be placed in horizontal layers along with and by the same methods specified for structure backfill.

METHOD OF MEASUREMENT

206.06 Structure excavation, structure backfill, and bed course material will not be measured but will be the quantities designated in the Contract. When field changes are ordered or when there are errors on the plans, quantities will be measured as follows:

(a) For bridges and irregular shaped structures, quantities will be computed to neat lines 18 inches outside and parallel to the outline of the revised foundation plan or as shown on the plans.

(b) For pipes, a profile will be made along the bottom of the center line extending 18 inches beyond the end of the structure, including end sections. Material excavated between this profile and a profile 1 foot above the top of the pipe will not be measured for payment, but shall be included in the bid price for the pipe. In excavation sections the area above the profile 1 foot above the top of the pipe and below the limits of roadway excavation will be multiplied by the width shown on the plans to obtain the volume of structure excavation measured for payment. In embankment sections the area above the profile 1 foot above the top of the pipe and below the natural ground will be multiplied by the width shown on the plans to obtain the volume of structure excavation measured for payment.

(c) Backfill and filter material will be the calculated volume of material lying within the prism shown on the plans, from which shall be deducted the volume occupied by the structure.

(d) Bed course material will be the calculated volume of material lying within the prism shown on the plans.

BASIS OF PAYMENT

206.07 The accepted quantities will be paid for at the contract unit price for each of the pay items listed below that appear in the bid schedule.

Payment will be made under:

Pay Item	Pay Unit
Structure Excavation	Cubic Yard
Structure Backfill (Class____)	Cubic Yard
Structure Backfill (Flow-fill)	Cubic Yard
Bed Course Material	Cubic Yard
Filter Material (Class____)	Cubic Yard

Compaction, water, and all other work necessary to complete the above items will not be measured and paid for separately but shall be included in the work.

Structure backfill, including bed course material, for pipes and end sections will not be measured and paid for separately, but shall be included in the work. Where only end section work is required the structure excavation quantity and the structure backfill quantity will not be measured and paid for separately, but shall be included in the work.

When the Contractor substitutes Structure Backfill (Flow-Fill) for Structure Backfill (Class 1) or (Class 2), there will be no adjustment in the price or the quantity paid for structure excavation or structure backfill as a result of reducing the trench width.

SECTION 207
TOPSOIL

DESCRIPTION

207.01 This work consists of salvaging and stockpiling topsoil, and excavating suitable topsoil from stockpiles, contractor sources, available sources, or from the approved natural ground cover to place on designated areas. It shall include the placing of topsoil upon constructed cut and fill slopes after grading operations are completed.

MATERIALS

207.02 Topsoil shall consist of loose friable soil from the zone of major root development free of subsoil, refuse, stumps, woody roots, rocks, brush, noxious weed seed and reproductive plant parts from current state and county weed lists, heavy clay, hard clods, toxic substances, or other material which would be detrimental to its use on the project.

Wetland topsoil material shall consist of the moist, organic soil, including any existing wetland vegetation and seeds, to be excavated from areas as shown on the plans or as directed.

CONSTRUCTION REQUIREMENTS

207.03 Wetland topsoil material shall be excavated from the designated area to a maximum depth of 12inches, or as otherwise designated, and placed within 24 hours in the specified area. The Contractor shall prepare the relocation site to elevations specified and approved by the Engineer prior to excavating the wetlands. If the Engineer determines that this is not possible, then the Contractor shall stockpile the material in an approved area, to remain undisturbed until the relocation site has been prepared. Storage time within the stockpile shall be as short as possible. Wetland topsoil material shall be placed over the prepared relocation areas to a depth of 12 inches, or as otherwise designated.

Topsoil within the limits of the roadway shall be salvaged prior to beginning hauling, excavating, or fill operations by excavating and stockpiling the material at designated locations in a manner that will facilitate measurement, minimize sediment damage, and not obstruct natural drainage. Topsoil shall be placed directly upon completed cut and fill slopes whenever conditions and the progress of construction will permit.

Topsoil shall be placed at locations and to the thickness provided in the Contract and shall be keyed and tracked to the underlying material without creating a compacted surface by the use of harrows, bulldozers, rollers, or other equipment suitable for the purpose.

Salvaged topsoil exceeding the quantity required under the Contract shall be disposed of at locations acceptable to the Engineer.

METHOD OF MEASUREMENT

207.04 Topsoil salvaged from the roadway and placed in stockpiles shall be measured in the stockpile in cubic yards by the method of average end areas and paid for as Stockpile Topsoil.

Topsoil salvaged from the roadway, taken from stockpiles or from approved pits, hauled and placed directly upon completed cut and fill slopes shall be measured at its source in cubic yards, as described in subsection 203.13, and paid for as Topsoil.

Topsoil generated from the roadway and placed in windrows will be measured at its source in cubic yards, as described in subsection 203.13, and paid for as Stockpile Topsoil. When it is subsequently placed upon the completed cut and fill slopes, the same quantity will be paid for as Topsoil, except that adjustment in quantity shall be made if the total windrowed quantity is not utilized.

Wetland topsoil material excavated from areas within the right-of-way and placed in stockpiles will be measured in the stockpile by the method of average end areas and paid for as Stockpile Wetland Topsoil.

Wetland topsoil material excavated from areas within the right-of-way or from stockpiles, hauled and placed directly on a relocated site will be measured at its source in cubic yards, as described in subsection 203.13, and paid for as Wetland Topsoil.

Topsoil secured from the Contractor's source will be measured in place by measuring random depths of topsoil, and computing the volume by multiplying the area times the average depth

BASIS OF PAYMENT

207.05 The accepted quantities measured as provided above will be paid for at the contract unit price per cubic yard for each of the pay items listed below that appear in the bid schedule.

Payment will be made under:

Pay Item	Pay Unit
Stockpile Topsoil	Cubic Yard
Topsoil	Cubic Yard
Stockpile Wetland Topsoil	Cubic Yard
Wetland Topsoil	Cubic Yard

SECTION 208
EROSION CONTROL

DESCRIPTION

208.01 This work consists of constructing, installing, maintaining, and removing when required, erosion control measures during the life of the Contract to prevent or minimize erosion, sedimentation, and pollution of any state waters as defined in subsection 107.25, including wetlands. This work includes constructing a stabilized construction entrance, as shown on the plans, or as directed by the Engineer.

The Contractor shall coordinate the construction of temporary erosion control measures with the construction of permanent erosion control measures to assure economical, effective, and continuous erosion control throughout the construction period.

MATERIALS

208.02 The material for erosion control measures shall conform to the following:

(a) *Erosion Bales:* Material for erosion bales shall consist of Certified Weed Free hay or straw. The hay or straw shall be certified under the Colorado Department of Agriculture Weed Free Forage Certification Program and inspected as regulated by the Weed Free Forage Act, Title 35, Article 27.5., CRS. Each certified weed free erosion bale shall be identified by one of the following:

(1) One of the ties binding the bales shall consist of blue and orange twine, or
(2) One of the ties binding the bale shall consist of specially produced shiny galvanized wire, or
(3) The bale shall have a regional Forage Certification Program tag indicating the Regional Forage Certification Program Number.

Erosion bales shall be inspected for and Regionally Certified as weed free based on the Regionally Designated Noxious Weed and Undesirable Plant List for Colorado, Wyoming, Montana, Nebraska, Utah, Idaho, Kansas, and South Dakota.

The Contractor shall not unload certified weed free erosion bales or remove their identifying twine, wire or tags until the Engineer has inspected and accepted them.

The Contractor shall provide a certificate of compliance showing the transit certificate number or a copy of the transit certificate as supplied from the forage producer.

The Contractor may obtain a current list of Colorado Weed Free Forage Crop Producers who have completed certification by contacting the Colorado Department of Agriculture, Weed Free Forage Program, 700 Kipling Street, Suite 4000, Lakewood, CO 80215, (303) 239-4177.

Bales shall be approximately 5 cubic feet of material and weigh not less than 35 pounds.

(b) *Silt Fence.* Silt fence posts shall be metal or wood with a minimum length of 42 inches. Metal posts shall be "studded tee" or "U" type with minimum weight of 1.33 pounds per linear foot. Wood posts shall have a minimum diameter or cross section dimension of 2 inches. Silt fence geotextile shall conform to subsection 712.08(b). Geotextile shall be attached to posts with three or more staples per post.

(c) *Temporary Berms.* Temporary berms, shall be constructed of compacted soil.

(d) *Temporary Slope Drains.* Temporary slope drains shall consist of fiber mats, plastic sheets, stone, concrete or asphalt gutters, half round pipe, metal or plastic pipe, wood flume, flexible rubber or other materials suitable to carry accumulated water down the slopes.

(e) *Brush Barrier.* Brush barriers shall consist of brush, limbs, root mat, vines, soil, rock, or unmerchantable timber. The erosion control geotextile that covers the barrier shall conform to subsection 712.08(b).

(f) *Check Dam.* Check dams shall be constructed of stone, logs, or wooden timbers. Stone shall meet the requirements of Section 506.

(g) *Outlet Protection.* Outlet protection riprap shall conform to section 506. Erosion control geotextile shall conform to subsection 712.08(b).

(h) *Sediment Trap and Basin*. In constructing an excavated Sediment Trap or Basin, excavated soil may be used to construct the dam embankment, provided the soil meets the requirements of Section 203.

(i) *Erosion Logs*. Erosion logs shall be curled aspen wood excelsior with a consistent width of fibers evenly distributed throughout the log. The casing shall be seamless, photodegradable tube netting and shall have minimum dimensions as shown in Table 208-1, based on the diameter of the log called for in the plans. The curled aspen wood excelsior shall be fungus free, resin free and shall be free of growth or germination inhibiting substances.

Table 208-1
NOMINAL DIMENSIONS OF EROSION LOGS

Diameter	Length	Weight (minimum)	Stake Dimensions
8 inch	7-10 feet	1.6 pounds/foot	1.5 by 1.5 by 20 inches
12 inch	7-10 feet	2.5 pounds/foot	1.5 by 1.5 by 24 inches
18 inch	7-10 feet	4 pounds/foot	1.5 by 1.5 by 30 inches

Stakes to secure erosion logs shall consist of pinewood or hardwood.

(j) *Silt Dikes*. Silt dikes shall be pre-manufactured triangular shaped urethane foam covered with a woven geotextile fabric. The fabric aprons shall extend a minimum of two feet beyond each side of the triangle.

Each silt dike shall have the following dimensions:

Center height	8 to 10 inches
Base	16 to 21 inches
Section length	3 to 7 feet
Section width including fabric extensions	5.6 feet

(k) *Concrete Washout Structure.* The Contractor shall design and construct a concrete washout structure that will contain washout from concrete placement and construction equipment cleaning operations. Embankment required for the concrete washout structure may be excavated material, provided that this material meets the requirements of Section 203 for embankment.

(l) *Stabilized Construction Entrance*. Unless otherwise directed by the Engineer, aggregate for the construction entrance shall be coarse material that meets the following gradation requirements:

Sieve size	**Percent by weight Passing Square Mesh Sieves**
75 mm (3 inch)	100
50 mm (2 inch)	95-100
19.0 mm (¾ inch)	0-15

Geotextile shall conform to the requirements of subsection 420.02.

CONSTRUCTION REQUIREMENTS

208.03 Project Review, Schedule, and Erosion Control Supervisor.

(a) *Project Review.* The Contractor may submit modifications to the Contract's erosion control measures in a written proposal to the Engineer. Such proposed modifications shall be submitted at least ten working days prior to the beginning of any construction work. The written proposal shall include the following minimum information:

(1) Reasons for changing the erosion control measures.
(2) Diagrams showing details and locations of all proposed changes.
(3) List of appropriate pay items indicating new and revised quantities.
(4) Schedules for accomplishing all erosion and sediment control work.
(5) Effects on permits or certifications caused by the proposed changes.

The Engineer will approve or reject the written proposal in writing within two weeks after the submittal. The Engineer may order additional control measures prior to approving the proposed modifications. The Contractor shall obtain amendments to permits or certifications required as a result of the approved changes. Modifications to the erosion control measures shall not be reason for extension of contract time.

(b) *Schedules.* At least 10 working days prior to the beginning of any construction work, the Contractor shall submit for approval a schedule for accomplishment of temporary and permanent erosion control work. This schedule shall specifically indicate the sequence of clearing and grubbing, earthwork operations, and construction of temporary and permanent erosion control features. The schedule shall include erosion and sediment control work for all areas within the project boundaries, including but not limited to, haul roads, borrow pits, and storage and plant sites. Work shall not be started until the erosion and sediment control schedule has been approved in writing by the Engineer.

Once the work has started, and during the active construction period, the Contractor shall update the schedule for all erosion and sediment control work on a weekly basis, and submit the updated schedule to the Engineer. If during construction the Contractor proposes changes which would affect the Contract's erosion and sediment control measures, the Contractor shall propose revised erosion and sediment control measures to the Engineer for approval in writing. Revisions shall not be implemented until the proposed measures have been approved in writing by the Engineer.

(c) *Erosion Control Supervisor.* When included in the Contract, the Contractor shall assign to the project an employee to serve in the capacity of the Erosion Control Supervisor (ECS). The ECS shall be a person other than the Superintendent, unless otherwise approved by the Engineer. The ECS shall be experienced in all aspects of construction and have satisfactorily completed an ECS training program authorized by the Department. Proof that this requirement has been met shall be submitted to the Engineer at least ten working days prior to the beginning of any construction work. A list of authorized ECS training programs will be provided by the Engineer upon request by the Contractor.

The ECS's responsibilities shall be as follows:

(1) Ensure compliance with all water quality permits or certifications in effect during the construction work.
(2) Directly supervise the installation, construction, and maintenance of all erosion control measures specified in the Contract and coordinate the construction of erosion control measures with all other construction operations.
(3) Direct the implementation of suitable temporary erosion and sediment control features as necessary to correct unforeseen conditions or emergency

situations. Direct the dismantling of those features when their purpose has been fulfilled unless the Engineer directs that the features be left in place.

(4) Inspect, with the Engineer or designated representative, all erosion control features implemented for the project. The inspections shall take place at least once every 14 calendar days and after each storm event that causes surface runoff. A report shall be submitted to the Engineer after every inspection and shall become part of the Department's project records. The appropriate form for this report will be supplied by the Engineer. The inspections shall be made during the progress of the work, during work suspensions, and until final acceptance of the work. During project suspensions, inspections shall take place at least once every 30 calendar days, or as directed.

(5) Attend the Preconstruction Conference, all project scheduling meetings, and reviews by the Erosion Control Advisory Team (ECAT) and Regional Erosion Control Advisory Team (RECAT) as requested by the Engineer.

(6) Upon the Engineer's request, implement necessary actions to reduce anticipated or presently existing water quality or erosion problems resulting from construction activities. The criteria by which the Engineer initiates this action may be based on water quality data derived from monitoring operations or by any anticipated conditions (e.g., predicted storms) which the Engineer believes could lead to unsuitable water quality situations.

(7) Make available, upon the Engineer's request, all labor, material, and equipment judged appropriate by the Engineer to install and maintain suitable erosion and sediment control features.

208.04 Erosion Control.

(a) *Unforeseen Conditions.* The Contractor shall design and implement erosion and sediment control measures for correcting conditions unforeseen during the design of the project, or for emergency situations, that develop during construction. The Department's "Erosion Control and Stormwater Quality Guide" shall be used as a reference document for the purpose of designing erosion and sediment control measures. Measures and methods proposed by the Contractor shall be reviewed and approved in writing by the Engineer prior to installation.

(b) *Work Outside the Right of Way.* In areas outside the right-of-way that are used by the Contractor and which include, but are not limited to, borrow pits, haul roads, storage and disposal areas, maintenance, batching areas, etc., erosion and sediment control work shall be performed by the Contractor at the Contractor's expense.

(c) *Construction Implementation.* The Contractor shall incorporate into the project all erosion and sediment control features as outlined in the accepted schedule.

(d) *Stabilization.* Permanent stabilization is defined as the covering of disturbed areas with final seed and mulch as indicated on the plans. When required by the plans, an erosion control blanket shall be used in combination with the final seed

and mulch. Temporary stabilization is defined as the covering of disturbed areas with seed, mulch, mulch with a tackifier, or a combination thereof. Other permanent or temporary soil stabilization techniques may be proposed, in writing, by the Contractor and used upon approval, in writing, by the Engineer.

The surface area of erodible earth material exposed at one time by clearing and grubbing, and earthwork operations shall not exceed 34 acres: 17 acres for clearing and grubbing plus 17 acres for earthwork operations. The Contractor shall permanently stabilize each 17 acre increment of the project immediately upon completion of the grading of that section. Once earthwork has begun on a section, it shall be pursued until completion. If approved by the Engineer, slopes from the edge of pavement to the point of slope selection may be left unseeded until paving has been completed.

The duration of the exposure of uncompleted construction to the elements shall be as short as practicable. Completed areas shall be permanently stabilized within seven calendar days after completion. Disturbed areas where work is temporarily halted shall be temporarily stabilized within seven days after the activity ceased unless work is to be resumed within 30 calendar days after the activity ceased. Payment for temporary stabilization will be made at the contract unit price if the work was interrupted due to no fault or negligence of the Contractor. Payment will not be made for temporary stabilization required by Contractor's negligence, by the lack of proper Contractor scheduling or for the convenience of the Contractor.

Clearing and grubbing operations shall be scheduled and performed so that grading operations and permanent stabilization measures can follow immediately thereafter if the project conditions permit. Otherwise temporary stabilization measures may be required between successive construction stages. No payment will be made for additional work required because the Contractor has failed to properly coordinate the entire erosion control schedule, thus causing previously seeded areas to be disturbed by operations that could have been performed prior to the seeding. Upon failure of the Contractor to coordinate the permanent stabilization measures with the grading operations in a manner to effectively control erosion and prevent water pollution, the Engineer will suspend the Contractor's grading operations and withhold monies due to the Contractor on current estimates until such time that all aspects of the work are coordinated in an acceptable manner.

(e) *Maintenance.* The Contractor shall continuously maintain all erosion and sediment control features so that they function properly during construction and work suspensions until the project is accepted.

From the time seeding and mulching work begins until the date the project is declared complete, the Contractor shall keep all seeded areas in good condition at all times. Any damage to seeded areas or to mulch materials shall be promptly repaired as directed.

If the Contractor fails to maintain the erosion and sediment control features in accordance with the Contract, or as directed, the Engineer may at the expiration of a period of 48 hours, after having given the Contractor written notice, proceed to maintain the features as deemed necessary. The cost thereof will be deducted from any compensation due, or which may become due to the Contractor under this contract.

Temporary erosion and sediment control measures shall remain upon completion of the project unless otherwise directed by the Engineer. If removed, the area in which these features were constructed shall be returned to a condition similar to that which existed prior to its disturbance. At the completion of the Contract, removed salvageable temporary erosion control items shall become the property of the Contractor.

(f) *Disposal of Sediment.* Sediment removed during maintenance of erosion control features shall be used in or on embankment provided it meets conditions of Section 203, or it shall be wasted in accordance with subsection 107.25.

208.05 Construction of Erosion Control Measures. Erosion control measures shall be constructed in accordance with the following.

(a) *Seeding, Mulching, Sodding, Soil Retention Blanket.* Seeding, mulching, sodding, and soil retention blanket shall be performed in accordance with Sections 212, 213, and 216.

(b) *Erosion Bales.* The bales shall be placed embedded into the soil and shall be anchored securely to the ground with wood stakes. Stakes shall have a minimum diameter or cross section dimension of 2 inches. Re-bars shall not be used. Gaps between bales shall be filled with Certified Weed Free mulch to obtain tight joints.

(c) *Silt Fence.* Silt fence shall be installed in locations specified in the Contract prior to any grubbing or grading activity. Sediment shall be removed from behind the silt fence when it accumulates to one half the exposed geotextile height and shall be disposed of in accordance with subsection 208.04(f).

(d) *Temporary Berms.* Berms shall be constructed to the dimensions shown in the Contract, graded to drain to a designated outlet, and compacted with a minimum of two passes of a rubber tire vehicle, preferably a grader wheel.

(e) *Temporary Diversion.* Unless otherwise specified in the Contract or directed, the diversion's ridge and channel shall be stabilized within 14 calendar days of its installation. The diversion shall be installed prior to any up slope land disturbance.

(f) *Temporary Slope* Drains. Temporary slope drains shall be installed prior to installation of permanent facilities or growth of adequate ground cover on the

slopes. All temporary slope drains shall be securely anchored to the slope. The inlets and outlets of temporary slope drains shall be protected to prevent erosion.

(g) *Brush Barrier*. The barrier shall be constructed at the time of clearing and shall be covered by an erosion control geotextile.

(h) *Check Dam.* Logs shall be obtained, if possible, from clearing operations on the project. Sediment shall be removed from behind the check dam when it has accumulated to one half of the original height of the dam and shall be disposed of in accordance with subsection 208.04(f).

(i) *Outlet Protection.* Geotextile used shall be protected from cutting or tearing. Overlaps between two pieces of geotextile shall be 1 foot minimum.

(j) *Storm Drain Inlet Protection.* Storm drain inlet protection measures shall be constructed in locations and with materials and techniques specified in the Contract. Construction shall be in a manner that will facilitate maintenance, and minimize interference with construction activities.

At excavated drop inlet sediment traps, sediment shall be removed when it has accumulated to one-half the design dept of the trap and shall be disposed of in accordance with subsection 208.04(f).

(k) *Sediment Trap and Basin.* Sediment traps or basins shall be installed before any land disturbance takes place in the drainage area.

Area under the embankment shall be cleared, grubbed, and stripped of all vegetation and root mat. Embankment construction shall conform to Section 203.

Sediment shall be removed from the trap or basin when it has accumulated to one half of the wet storage depth of the trap or basin and shall be disposed of in accordance with subsection 208.04(f).

(l) *Erosion Logs.* The Contractor shall maintain the erosion logs during construction to prevent sediment from passing over or under the logs or from sediment accumulation greater than two thirds of the original exposed height of each erosion log.

Stakes shall be embedded to a minimum depth of 12 inches. At the discretion of the Engineer, a shallower depth may be permitted if rock is encountered.

(m) *Silt Dikes*. Prior to installation of silt dikes, the Contractor shall prepare the surface of the areas in which the dikes are to be installed such that they are free of materials greater than two inches in diameter and are suitably smooth for the installation of the silt dikes, as approved by the Engineer.

Dikes shall be secured with "U" staples, 8 inches in length and 11-gauge minimum, placed in two rows per apron along edges one foot on center. The staple pattern shall be as shown on the plans.

(n) *Concrete Washout Structure Design.* The concrete washout structure shall be designed to meet or exceed the dimensions shown on the plans. At least ten days prior to start of paving operations, the Contractor shall submit in writing a *method* statement outlining the design, site location and installation of a concrete structure that will contain washout from concrete placement operations. Work on this structure shall not begin until written acceptance is provided by the Engineer.

The structure shall meet the following requirements:

(1) Structure shall contain all washout water.
(2) Stormwater shall not carry wastes from washout and disposal locations.
(3) The site shall be located a minimum of 50 horizontal feet from state waters and shall meet all requirements for containment and disposal as defined in subsection 107.25.
(4) The site shall be signed as "Concrete Washout".
(5) Each concrete truck driver and pumper operator shall be aware of site locations.
(6) The site shall be accessible to appropriate vehicles.
(7) The bottom of excavation shall be a minimum of five feet vertical above groundwater or, alternatively, excavation must be lined with an impermeable synthetic liner that is designed to control seepage to a maximum rate of 10^{-6} centimeters per second.
(8) Freeboard capacity shall be included into structure design to reasonably ensure the structure will not overtop during or because of a precipitation event.
(9) The Contractor shall prevent tracking of washout material onto the roadway surface.
(10) Solvents, flocculents, and acid shall not be added to wash water.

The structure shall be fenced with orange plastic construction fencing or equivalent fencing material to provide a barrier to construction equipment and to aid in identification of the concrete washout area.

The concrete washout structure shall be completed and ready for use prior to concrete placement operations.

Waste material from concrete washout operations shall be removed and disposed of in accordance with subsection 208.04 (f) when it has accumulated to two-thirds of the wet storage capacity of the structure.

(o) *Stabilized construction entrance.* Stabilized construction entrances shall be constructed to the minmum dimensions shown on the plans, unless otherwise directed by the Engineer. Construction of approved stabilized construction entrances shall be completed before any excavation or work is started between such entrances, as shown on the plans.

The Contractor shall maintain the stabilized construction entrance during the entire time that it is in use in the project. The stabilized construction entrance shall be removed at the completion of this project unless otherwise directed by the Engineer.

208.06 Failure to Perform Erosion Control. The Contractor will be subject to liquidated damages for incidents of failure to perform erosion control as required by the Contract. Incidents to which these liquidated damages may be applied include the following:

(1) Failure to submit an initial schedule or failure to submit a weekly schedule update as specified in subsection 208.03(b).
(2) Failure of the Erosion Control Supervisor to perform the inspections required by subsection 208.03(c)4.
(3) Failure of the Erosion Control Supervisor to implement necessary actions requested by the Engineer as required by subsection 208.03(c)6.
(4) Failure to design and implement erosion and sediment control measures for unforseen conditions as required by subsection 208.04(a).
(5) Failure to construct or implement erosion control or spill containment measures required by the Contract, or failure to construct or implement them in accordance with the Contractor's approved schedule as required by subsection 208.04(c).
(6) Failure to limit the exposed surface area of erodible earth to 34 or fewer acres as required by subsection 208.04(d).
(7) Failure to temporarily stabilize areas where work is temporarily halted within seven days as required by subsection 208.04(d).
(8) Failure to perform maintenance of an erosion control feature within 48 hours after notice from the Engineer to perform maintenance as required by subsection 208.04(e).
(9) Failure to remove and dispose of sediment from erosion control features as required by subsection 208.04(f) and subsections 208.05(c), (h), (j), and (k).
(10) Failure to install and properly utilize a concrete washout structure for containing washout from concrete placement operations

The Engineer will notify the Contractor in writing of each incident of failure to perform erosion control, items (1) through (10) above. The Contractor will be allowed seven calendar days from the date of notification to correct the failure. The Contractor will be charged liquidated damages in the amount of $500 for each calendar day after the seventh day that one or more of the incidents of failure, items (1) through (10) above, remains uncorrected. This deduction will not be considered a penalty, but will be considered liquidated damages based on estimated additional

construction engineering costs. The liquidated damages will accumulate, for each cumulative day that one or more of the incidents remains uncorrected. The number of days to which liquidated damages are assessed will be cumulative for the duration of the project; that is: the damages for a particular day will be added to the total number of days for which liquidated damages are accumulated on the project. The liquidated damages will be deducted from any monies due the Contractor.

METHOD OF MEASUREMENT

208.07 Erosion bales and check dams will be measured by the unit.

Silt fence, erosion logs, silt dikes, temporary berms, temporary diversions, temporary drains, and brush barriers will be measured by the actual number of linear feet that are installed and accepted. Stakes, anchors, connections and tie downs used for temporary slope drains will not be measured and paid for separately, but shall be included in the work.

Concrete washout structure will be measured by the actual number of structures that are installed and accepted, and will include excavation, embankment, concrete, liner, erosion bales, fencing, and containment and disposal of concrete washout and all other associated waste material.

Storm drain inlet protection will be measured by the unit as specified in the Contract.

Sediment trap and sediment basin quantities will be measured by the unit which shall include all excavation and embankment required to construct the item. Other materials used to provide for outlet and overflow will be measured and paid for separately.

The Erosion Control Supervisor will not be measured, but will be paid for on a lump sum basis. The lump sum price bid will be full compensation for all work required to complete the item.

Excavation required for removal of accumulated sediment from traps, basins, areas adjacent to silt fences and erosion bales, and other clean out excavation of accumulated sediment, and the disposal of such sediment, will be paid for on a lump sum basis.

Stabilized construction entrance will be measured by the actual number constructed and accepted.

BASIS OF PAYMENT

208.08 Work to furnish, install, maintain, remove, and dispose of erosion and sediment control features specified in the Contract will be paid for at the contract unit price.

208.08

Payment will be made under:

Pay Item	Pay Unit
Erosion Bales (Weed Free)	Each
Silt Fence	Linear Foot
Temporary Berms	Linear Foot
Temporary Diversion	Linear Foot
Temporary Slope Drains	Linear Foot
Brush Barrier	Linear Foot
Check Dam	Each
Storm Drain Inlet Protection	Each
Sediment Trap	Each
Sediment Basin	Each
Sediment Removal and Disposal	Lump Sum
Erosion Control Supervisor	Lump Sum
Erosion Log (____ Inch)	Linear Foot
Silt Dike	Linear Foot
Concrete Washout Structure	Each
Stabilized Construction Entrance	Each

Payment for stabilized construction entrance will be full compensation for all work, materials and equipment required to construct, maintain, and remove the entrance upon completion of the work. Aggregate and geotextile will not be measured and paid for separately, but shall be included in the work.

Temporary erosion and pollution control measures required due to the Contractor's negligence, carelessness, or failure to install permanent controls as a part of the work as scheduled or ordered by the Engineer or for the Contractor's convenience, shall be performed at the Contractor's expense.

In the case of repeated failures on the part of the Contractor in controlling erosion, sedimentation, or water pollution, the Engineer reserves the right to employ outside assistance or to use Department forces to provide the necessary corrective measures. Such incurred direct costs, plus project engineering costs, will be charged to the Contractor, and appropriate deduction will be made from the Contractor's monthly progress estimate.

Accepted work performed to install measures for the control of erosion and sedimentation, and water pollution, not originally included in the Contract will be paid for as extra work in accordance with subsection 104.03.

Seeding, sod, mulching, soil retention blanket, and riprap will be measured and paid for in accordance with Sections 212, 213, 216, and 506.

SECTION 209
WATERING AND DUST PALLIATIVES

DESCRIPTION

209.01 This work consists of applying water to soils or aggregates for moisture and density control, landscaping, prewetting an excavation area, and dust palliatives. It shall also include applying magnesium chloride dust palliative for the control of dust and the stabilization of soil and aggregate surfaced roads.

MATERIALS

209.02 Water applied for moisture and density control, as dust palliative, and for prewetting shall be free from injurious matter. Water for landscaping shall be free from oil, acids, alkalis, salts, or any substance injurious to plant life.

When the water source proposed for use by the Contractor is not of known quality and chemical content, samples of the water shall be submitted for approval prior to use.

Magnesium chloride dust palliative shall consist of a magnesium chloride base agent, water, and other enhancing or nondetrimental ions. The chemical analysis shall conform to the following:

Chemical Constituents	Percent by Weight
Magnesium Chloride ($MgCl_2$)	28 to 35
Enhancing or Nondetrimental Ions	0 to 5
Water	65 to 72

CONSTRUCTION REQUIREMENTS

209.03 Moisture and Density Control. Sprinkling equipment shall deliver uniform and controlled distribution of water without ponding or washing. Water for finishing operations shall be uniformly applied by spraying across the full width of the course.

209.04 Prewetting. Prewetting material in excavation areas prior to its removal for placement in embankments will be allowed when approved. The Contractor shall furnish a prewetting layout for each area to be prewetted including nozzle size, spacing, number of lines, and other equipment to be used. The Contractor shall obtain the approval of the Engineer for each prewetting layout prior to each prewetting operation.

209.05 Dust Palliative. The Contractor shall furnish and apply a dust palliative on portions of the roadway and on haul roads at the locations and in the amounts as provided in the Contract.

Dust palliative shall consist of water. Application of water shall be done with acceptable sprinkling equipment at an appropriate rate as approved by the Engineer.

Magnesium Chloride dust palliative shall be applied as follows: Scarify the top 2 inches of the existing road surface and wet with water to approximately four percent moisture content, or as directed. Apply the magnesium chloride dust palliative in two applications of 0.25 gallon per square yard in each application. Allow to soak for 30 minutes after each application. Roll the surface with a pneumatic tire roller, as specified in the Contract. Do not permit traffic on the treated surface until approved.

209.06 Landscaping. The Contractor shall furnish water for seeding, mulching, planting, transplanting, sodding, herbicide treatment, and any other landscaping work when called for on the plans or when designated.

METHOD OF MEASUREMENT

209.07 Water will be measured by the number of thousand gallons (M Gallon) used and accepted. Measurement of water may be made in the vehicle at point of delivery or by meter. When water is to be metered for measurement, the Contractor shall provide and use an approved metering device.

Magnesium Chloride dust palliative will be measured by the number of gallons applied and accepted.

BASIS OF PAYMENT

209.08 The accepted quantities of water measured as provided above will be paid for at the contract unit price per M Gallon. The accepted quantities of Magnesium Chloride dust palliative measured as provided above will be paid for at the contract unit price per Gallon.

Payment will be made under:

Pay Item	Pay Unit
Water	(M Gallon)
Water (Landscaping)	(M Gallon)
Dust Palliative (Magnesium Chloride)	Gallon

Water required for all items of work will not be measured and paid for separately, but shall be included in the work, except that water for dust palliative, and water ordered for the benefit or safety of the public will be measured and paid for separately in accordance with the Contract.

If the area for landscape work is irrigated by a Department-owned system, the Contractor may use the water from this source. Water used from a Department source will not be measured and paid for.

SECTION 210
RESET STRUCTURES

DESCRIPTION

210.01 This work consists of removing, relaying, resetting, or adjusting structures and related materials. All designated items shall be carefully removed, and stored, reinstalled, or adjusted, in a manner that will avoid loss or damage.

CONSTRUCTION REQUIREMENTS

210.02 General. Relaid pipe and conduit, and reset structures shall be cleaned of foreign material prior to reinstallation.

Except in areas to be excavated, all holes resulting from the removal of structures shall be neatly backfilled. Methods shall conform to those required in the specifications for the various types of construction involved.

Materials in good condition from removed structures may be re-used. Salvable material, as designated in the Contract, that is not re-used shall remain the property of the Department, and the Contractor shall be held responsible for safekeeping of all materials until receipted by the Department. Materials damaged, stolen, or lost prior to receipt by the Department shall be repaired or replaced, as determined by the Engineer, at no cost to the Department.

Unserviceable material, as determined by the Engineer, shall be replaced with new material of similar dimensions, and the material costs will be paid for in accordance with subsection 109.04(b), except as otherwise provided in this section. All new materials and replacement parts shall conform to the requirements of the Contract for the appropriate items.

210.03 Light Standard. Light standards shall be reset on new concrete foundation pads complete with conduit and wiring in accordance with the Department's Standard Plans at locations indicated in the Contract.

210.04 Fences and Gates. Where fences (except snow fence) are reset the Contractor shall supply and install any new materials required to restore the fence to acceptable condition except for new posts. The Contractor shall supply new posts as needed for the reset fence in accordance with Section 607. Wire in the old fence shall be salvaged and used in the reset fence.

Where snowfences are reset, panels shall be removed from their existing location and reset at the new location.

Gates designated to be reset shall be removed and restored for service at the new locations.

Right of way fence shall be reset approximately 6 inches inside the boundary of the highway right of way shown on the plans. Anchorages, footings, or fence appurtenances shall not extend beyond the limits of the highway right of way without the written consent of the abutting property owner.

210.05 Guardrail. Where guardrail is reset the Contractor shall supply and install any new materials needed to restore the guardrail to acceptable condition. New materials shall include additional posts, blocks, and hardware needed to complete the intermediate post installations as shown on the Department's Standard Plans. Posts with similar tops shall be installed in groups as directed. Installation of fiat-top posts alternately with other top shapes will not be permitted. Posts may be cut, rotated, or turned upside down to eliminate unacceptable tops. If the posts are cut, the Contractor shall treat the exposed surface with two coats of an approved preservative.

Adjust guardrail shall be the work necessary to adjust the height to the standard 27 inches in accordance with Standard Plan M-606-1, and filling the resulting voids under the posts with a lean concrete mixture consisting of one part cement and ten parts sand.

210.06 Mailbox. Mailboxes complete with supporting structures are to be removed and temporarily reset at points near their original location to be accessible for mail delivery service. Upon completion of surfacing operations, the boxes shall again be reset at the locations designated. A supporting structure may contain one or more mailboxes. New permanent mailbox support posts and mounting brackets shall be furnished and installed in accordance with the Department's Standard Plans.

210.07 Ground Sign. Signs and posts designated to be reset shall be removed, cleaned, and reset at designated locations, including all work necessary to provide the existing posts with break-away devices, where required.

210.08 Sign Structure. Sign structures shall be sandblasted and repainted prior to reinstallation.

210.09 Traffic Signal. Traffic signals designated to be reset shall be removed along with existing poles and electrical equipment. New concrete footings shall be installed along with any new electrical equipment necessary to restore the structure to service at the new location. Equipment and materials shall be cleaned prior to being reset.

210.10 Adjust Structure. Adjusting structures shall apply, but not be limited to, manhole rings and covers, inlet gratings and frames, water valve boxes, water meters, gate posts, and other structures and facilities. Construction operations shall consist of raising, lowering, moving, or removing masonry or concrete; adding brick-work, masonry, or concrete; and resetting grates, frames, or rings and covers to fit the new construction. Structures in the traveled roadway shall be adjusted to a tolerance of ¼ to ½ inch below the surface of the roadway. Work on water services shall be subject to inspection and testing by the owners. Damage to any fire hydrant or any part of the water system by the Contractor shall be repaired at the Contractor's expense.

210.11 Flashing Beacon. Reset Flashing Beacon shall consist of providing a new concrete foundation or footing, adjustments of post and breakaway device as required, and providing all electrical equipment and materials necessary to restore the installation to service at the new location. The Contractor shall provide necessary connections from the nearest power source or from the source designated on the plans to the new location.

METHOD OF MEASUREMENT

210.12 The quantity to be measured where items are reset or adjusted on an "each" basis shall be the actual number of those items restored for service at new location, completed and accepted.

Concrete foundation pads will be measured and paid for as "Concrete Foundation Pad" in accordance with Section 613.

Concrete footings for ground signs and overhead sign structures, if required, will be measured and paid for in accordance with Section 614.

Steel post extensions, if required, will be measured and paid for as "Steel Sign Post" in accordance with Section 614, of the type shown on the plans.

The quantity to be measured where items are reset or adjusted on a "linear foot" basis shall be the actual number of linear feet of the items completed and accepted, measured end to end, except guardrail and snow fence. Guardrail will be measured as the actual number of linear feet completed and accepted, as shown on the Department's Standard Plans. Snow fence shall be measured end to end of the anchor posts.

The quantity to be measured for "Relay Pipe" shall be the number of linear feet of relaid pipe including end sections, measured end to end, in place, completed and accepted.

The quantity to be measured for "Reset Mailbox Structure" shall be the number of supporting structures, complete with mailboxes, restored at new locations and accepted. Moving the mailbox structures for temporary mail service during construction, and installing new support post, base, mounting brackets, and hardware will not be measured or paid for separately but shall be included in the work.

Resetting of structures, fences, and related materials shall include all work necessary to remove the items from their existing location to the new location, and shall include all mounting hardware, footings, and all other work necessary to complete the reset item, except for new fence posts. Fence posts required and approved will be measured and paid for in accordance with Section 607.

Resetting of traffic signals, poles, controllers, cabinets, preemption units, coordination and interconnection equipment, and related equipment and materials shall include all work necessary to remove the items from their existing location and reset them at the new location, and shall include all mounting hardware, footings,

other electrical equipment and service, and all other materials and work necessary to complete the reset item in service at the new location.

BASIS OF PAYMENT

210.13 The accepted quantities, measured as provided above, will be paid for at the contract price for each of the pay items listed below that appear in the bid schedule.

Payment will be made under:

Pay Item	**Pay Unit**
Reset	Each, Linear Foot, Square Yard, Lump Sum
Relay Pipe (___)	Linear Foot
Adjust	Each, Linear Foot
Modify	Each
Reset Mailbox Structure (Type___)	Each
Adjust Guardrail	Linear Foot

Structure excavation and structure backfill required for "Relay Pipe" will be measured and paid for in accordance with Section 206. Any void in the structure excavation prism created by the removal of pipe will be excluded from measurement and payment of structure excavation.

Except as otherwise provided in the Contract, collars and connecting devices will not be measured and paid for separately but shall be included in the work.

SECTION 212
SEEDING, FERTILIZER, SOIL CONDITIONER, AND SODDING

DESCRIPTION

212.01 This work consists of soil preparation, application of fertilizer, soil conditioners, or both, and furnishing and placing seed and sod. The work shall be in accordance with the Contract and accepted horticultural practices.

MATERIALS

212.02 Seed, Soil Conditioners, Fertilizers, and Sod.

(a) *Seed.* All seed shall be furnished in bags or containers clearly labeled to show the name and address of the supplier, the seed name, the lot number, net weight, origin, the percent of weed seed content, the guaranteed percentage of purity and germination, pounds of pure live seed (PLS) of each seed species, and the total pounds of PLS in the container. All seeds shall be free from noxious weed seeds in accordance with current state and local lists and as indicated in Section 213. The Contractor shall furnish to the Engineer a signed statement certifying that the seed is from a lot that has been tested by a recognized laboratory for seed testing within six months prior to the date of seeding. Seed which has become wet, moldy, or damaged in transit or in storage will not be accepted.

Seed types and amount of PLS required per acre shall be provided in accordance with the Contract.

Seed and seed labels shall conform to all current State and Federal regulations and will be subject to the testing provisions of the Association of Official Seed Analysis. Computations for quantity of seed required on the project shall include the percent of purity and percent of germination.

The formula used for determining the quantity of PLS shall be:

Bulk Pounds of Seed Species • (%Purity • %Germination) = Pounds of PLS

(b) *Soil Conditioners and Fertilizer* .

1. Fertilizer: Fertilizer (plant nutrients) shall conform to the applicable State fertilizer laws. It shall be uniform in composition, dry, and free flowing, and shall be delivered to the site in the original, unopened containers, each bearing the manufacturer's guaranteed analysis. Fertilizer which becomes caked or damaged will not be accepted.

2. Soil conditioner: Soil conditioner shall consist of an organic amendment, biological nutrient, biological culture or humic acid based material.
   .
   Humic acid based material (Humate) shall include the following:

(1) pH 3 to 5
(2) Maximum 20 percent inert ingredient
(3) Minimum 80 percent organic matter with 40 percent minimum humic acid.

Organic amendment shall be an organic product containing a mixture of composted cow or sheep manure and plant residue produced by aerobic (biological) decomposition. It shall be processed at a consistent temperature of 140 °F or greater to accomplish the following:

(1) Compost the windrows of composted organic amendment (cow or sheep manure) for 90 to 120 days. Certification must be provided to prove the product has gone through this process.

(2) Eradicate harmful pathogens including coliform bacteria.

(3) Create a carbon to nitrogen ratio of 15:1 to 25:1.

(4) Contain no solid particle greater than ½ inch diameter.

(5) Have a non-offensive smell similar to fresh turned soil.

(6) Contain no significant level of dirt, soil, or chemical preservatives and contain a maximum of 30 percent composted plant residue.

(7) Have a pH after composting between 6 and 8 with an organic matter content of at least 20 percent.

(8) Contain soluble salts not greater than 5mmhos/cm.

The Contractor shall submit a two pound sample of the soil conditioner product four weeks before its use on the project site for the Engineer's approval. A certificate of Compliance shall be provided to the Engineer to verify the organic matter content, pH, and carbon matter to nitrogen ratio, and salt levels (by electrical conductivity mmhos/cm).

(c) *Sod.* Sod shall be nursery grown and 99 percent weed free. Species shall be as shown on the plans. Other sod types may be used only if approved in writing by the Engineer. The one percent allowable weeds shall not include any undesirable perennial or annual grasses or plants defined as noxious by current State statute. Soil thickness of sod cuts shall not be less than ¾ inch nor more than 1 inch. Sod shall be cut in uniform strips with minimum dimensions of 18 inches in width and 48 inches in length. The Contractor shall submit a sample of the sod proposed for use, which shall serve as a standard. Any sod furnished, whether in place or not, that is not up to the standard of the sample may be rejected. Sod that was cut more than 24 hours prior to installation shall not be used.

Each load of sod shall be accompanied by a certificate from the grower stating the type of sod and the date and time of cutting.

CONSTRUCTION REQUIREMENTS

212.03 Seeding Seasons. Seeding in areas that are not irrigated shall be restricted according to the following time table and specifications.

Zone	Spring Seeding	Fall Seeding
Areas OtherThan Western Slope		
Below6000'	Spring thaw toJune 1	September 1 until consistent ground freeze
6000'to 7000'	Spring thaw toJune 1	September 15 until consistent ground freeze
7000'to 8000'	Spring thaw toJuly 15	August 1 until consistent ground freeze
Above8000'	Spring thaw to consistent ground freeze	
Western Slope		
Below6000'	Spring thaw to May 1	August 1 until consistent ground freeze
6000'to 7000'	Spring thaw to June 1	September 1 until consistent ground freeze
Above7000'	Spring thaw to consistent ground freeze	

(1) "Spring thaw" shall be defined as the earliest date in a new calendar year in which seed can be buried ½ inch into the surface soil (topsoil) thru normal drill seeding methods.

(2) "Consistent ground freeze" shall be defined as that time during the fall months in which the surface soil (topsoil), due to freeze conditions, prevents burying the seed ½ inch thru normal drill seeding operations. Seed shall not be sown, drilled, or planted when the surface soil or topsoil is in a frozen or crusted state.

Seeding accomplished outside the time periods listed above will be allowed only when ordered by the Engineer or when the Contractor's request is approved in writing. When requested by the Contractor, the Contractor must agree to perform the following work at no cost to the Department: reseed, remulch, and repair areas which fail to produce species indicated in the Contract.

When seeding is ordered by the Engineer outside the time periods listed above, the cost of additional material will be paid for by the Department. The Contractor will not be responsible for failure of the seeded area to produce species indicated in the Contract due to reasons beyond the control of the Contractor.

The seeding, the soil conditioning, and the fertilizing application rate shall be as specified. The Engineer may establish test sections for adjusting the seeding and the

fertilizing equipment to assure the specified rate. The Engineer may order equipment readjustment at any time.

Seed , soil conditioner and fertilizer shall not be applied during inclement weather including rain and high winds, or when soil is frozen or soil moisture is too high to evenly incorporate seed, soil conditioner or fertilizer.

212.04 Lawn Grass Seeding. Lawn grass seeding shall be accomplished in the seeding seasons described in subsection 212.03.

(a) *Soil Preparation.* Preparatory to seeding lawn grass, irregularities in the ground surface, except the saucers for trees and shrubs, shall be removed. Measures shall be taken to prevent the formation of low places and pockets where water will stand.

Immediately prior to seeding, the ground surface shall be tilled or hand worked into an even and loose seedbed to a depth of 4 inches, free of clods, sticks, stones, debris, concrete, and asphalt in excess of 2 inches in any dimension, and brought to the desired line and grade.

(b) *Fertilizing and Soil Conditioning.* The first application of fertilizer, soil conditioner, or both shall be incorporated into the soil prior to seeding, and shall consist of a soil conditioner, commercial fertilizer, or both as designated in the Contract. Fertilizer called for on the plans shall be worked into the top 4 inches of soil at the rate specified in the contract. Biological nutrient, culture or humic acid based material called for on the plans shall be applied in a uniform application onto the soil service. Organic amendments shall be applied uniformly over the soil surface and incorporated into the top 6 inches of soil.

The second application of fertilizer shall consist of a fertilizer having an available nutrient analysis of 20-10-5 applied at the rate of 100 lbs. per acre. It shall be uniformly broadcast over the seeded area three weeks after germination or emergence. The area shall then be thoroughly soaked with water to a depth of 1 inch.

Fertilizer shall not be applied when the application will damage the new lawn.

(c) *Seeding.* After the surface is raked and rolled, the seed shall be drilled or broadcast and raked into the top ¼ inch of soil. Seeding shall be accomplished by mechanical landscape type drills. Broadcast type seeders or hydraulic seeding will be permitted only on small areas not accessible to drills. Seed shall not be drilled or broadcast during windy weather or when the ground is frozen or untillable. All loose exposed rock larger than 2 inches shall be removed from slopes that are to be seeded by drilling.

Hydraulic seeding equipment shall include a pump capable of being operated at 100 gallons per minute and at 100 pounds per square inch pressure, unless

otherwise directed. The equipment shall have a nozzle adaptable to hydraulic seeding requirements. Storage tanks shall have a means of estimating the volume used or remaining in the tank.

212.05 Sodding.

(a) *Soil Preparation.* Preparatory to sodding, the ground shall be tilled or hand worked into an even and loose sod bed to a depth of 4 inches, and irregularities in the ground surface shall be removed. Sticks, stones, debris, clods, asphalt, concrete, and other material more than 2 inches in any dimension shall be removed. Any depressions or variances from a smooth grade shall be corrected. Areas to be sodded shall be smooth before any sodding is done.

(b) *Sodding.* The sod shall be laid by staggering joints with all edges touching. On slopes, the sod shall run approximately parallel to the slope contours. Where the sod abuts a drop inlet, the subgrade shall be adjusted so that the sod shall be 1 ½ inch below the top of the inlet.

Within one hour after the sod is laid and fertilized it shall be watered. After watering the sod shall be permitted to dry to the point where it is still wet enough for effective rolling. It shall then be rolled in two directions with a lawn roller weighing at least 150 pounds.

(c) *Fertilizing and Soil Conditioning.* Prior to laying sod, the 4 inches of subsoil underlying the sod shall be treated by tilling in fertilizer, soil conditioner, or both. The rate of application shall be as designated in the Contract. Fertilizer called for on the plans shall be worked into the top 4 inches of soil at the rate specified in the contract. Biological nutrient, culture or humic acid based material called for on the plans shall be applied in a uniform application onto the soil service. Organic amendments shall be applied uniformly over the soil surface and incorporated into the top 6 inches of soil.

After laying, the sod shall be fertilized with a fertilizer having an available nutrient analysis of 20-10-5 at the rate of 200 pounds per acre. Fertilizer shall not be applied when the application will damage the sod.

212.06 Native Seeding. Areas that are unirrigated shall be seeded in accordance with subsection 212.03.

(a) *Soil Preparation.* Slopes flatter than 2:1, shall be tilled into an even and loose seed bed 4 inches deep. Slopes 2:1 or steeper shall be left in a roughened condition. Slopes shall be free of clods, sticks, stones, debris, concrete, and asphalt in excess of 4 inches in any dimension, and brought to the desired line and grade.

(b) *Fertilizing and Soil Conditioning.* Prior to seeding, fertilizer, soil conditioner, or both shall be applied. The fertilizer and soil conditioner type and rate of application shall be as designated in the Contract. Fertilizer called for on the

plans shall be worked into the top 4 inches of soil at the rate specified in the contract. Biological nutrient, culture or humic acid based material called for on the plans shall be applied in a uniform application onto the soil service. Organic amendments shall be applied uniformly over the soil surface and incorporated into the top 6 inches of soil.

(c) *Seeding.* Seeding shall be accomplished within 24 hours of tilling or scarifying to make special seed bed preparation unnecessary. The seeding application rate shall be as designated in the Contract. All slopes flatter than 2:1 shall be seeded by mechanical power drawn drills followed by packer wheels or drag chains. Mechanical power drawn drills shall have depth bands set to maintain a planting depth of at least ¼ inch and shall be set to space the rows not more than 7 inches apart. Seed that is extremely small shall be sowed from a separate hopper adjusted to the proper rate of application.

If strips greater than 7 inches between the rows have been left unplanted or other areas skipped, the Engineer will require additional seeding at the Contractor's expense.

When requested by the Contractor and approved by the Engineer, seeding may be accomplished by broadcast or hydraulic type seeders at twice the rate specified in the Contract at no additional cost to the project.

All seed sown by broadcast-type seeders shall be "raked in" or covered with soil to a depth of at least ¼ inch. Broadcasting seed will be permitted only on small areas not accessible to machine methods.

Hydraulic seeding equipment and accessories shall conform to the equipment and accessories described in subsection 212.04(c).

Seeded areas damaged due to circumstances beyond the Contractor's control shall be repaired and reseeded as ordered. Payment for this corrective work, when ordered, shall be at the contract prices.

Multiple seeding operations shall be anticipated as portions of job are completed to take advantage of growing conditions and to comply with Section 208 and subsection 212.03.

METHOD OF MEASUREMENT

212.07 The quantities of lawn seeding and native seeding will not be measured but shall be the quantities designated in the Contract, except that measurements will be made for revisions requested by the Engineer, or for discrepancies of plus or minus five percent of the total quantity designated in the Contract. The quantity of lawn seeding shall include soil preparation, water, fertilizer, and seed, completed and accepted. The quantity of native seeding shall include soil preparation, fertilizer, soil conditioner, and seed applied, completed, and accepted.

The quantity of sod to be measured will be the actual number of square feet, including soil preparation, water, fertilizer, and sod, completed and accepted.

The Contractor shall furnish the Engineer with seed certifications and analysis, fertilizer analysis, and bag weight tickets prior to placing any seed or fertilizer. Any seed or fertilizer placed by the Contractor without the Engineer's approval will not be paid for.

Measurement for acres will be by slope distances.

BASIS OF PAYMENT

212.08 The accepted quantities of lawn seeding, native seeding, soil conditioning, and sod will be paid for at the contract unit price for each of the pay items listed below that appear in the bid schedule.

Payment will be made under:

Pay Item	Pay Unit
Seeding (Lawn)	Acre
Seeding (Native)	Acre
Sod	Square Foot
Soil Conditioning	Acre

Soil preparation, water, seed, fertilizer, and soil conditioner, incorporated into the seeding sodding or soil conditioning will not be paid for separately but shall be included in the work.

Adjusting or readjusting seeding or fertilizing equipment will not be paid for separately but shall be included in the work.

SECTION 213
MULCHING

DESCRIPTION

213.01 This work consists of mulching the seeded areas, furnishing and placing wood chip mulch in the planting beds and plant saucers, furnishing and applying hydromulch with tackifier on roadway ditches and slopes, furnishing and placing tackifier on mulch or soil on roadway ditches or slopes, and furnishing and installing metal landscape border for the separation of planting beds, in accordance with the Contract or as directed. Mulching may be accomplished by the crimping method using straw or hay, by the hydraulic method using wood cellulose fiber mulch, or by other approved methods with approved materials. When a specific mulching method is required, it will be designated in the Contract.

MATERIALS

213.02 Materials for mulching shall consist of Certified Weed Free field or marsh hay or straw of oats, barley, wheat, rye or triticale certified under the Colorado Department of Agriculture Weed Free Forage Certification Program and inspected as regulated by the Weed Free Forage Act, Title 35, Article 27.5, CRS. Each certified weed free mulch bale shall be identified by one of the following:

(1) One of the ties binding the bale shall consist of blue and orange twine, or
(2) One of the ties binding the bale shall consist of specially produced galvanized shiny wire, or
(3) The bale shall have a regional Forage Certification Program tag indicating the Regional Forage Certification Program Number.

Mulch shall be inspected for and Regionally Certified as weed free based on the Regionally Designated Noxious Weed and Undesirable Plant List for Colorado, Wyoming, Montana, Nebraska, Utah, Idaho, Kansas and South Dakota.

The Contractor shall not unload certified weed free mulch bales or remove their identifying twine, wire, or tags until the Engineer has inspected and accepted them.

The Contractor shall provide a transit certificate that has been filled out and signed by the grower and by the Department of Agriculture inspector.

The Contractor may obtain a current list of Colorado Weed Free Forage Crop Producers who have completed certification by contacting the Colorado Department of Agriculture, Division of Plant Industry.

Straw or hay in a stage of decomposition (discolored, brittle, rotten, or moldy) or old, dry mulch which breaks in the crimping process will not be accepted.

The type and application rate of mulch material shall be as designated in the Contract.

The hydromulch material for hydraulic mulching shall consist of virgin wood fibers manufactured expressly from clean whole wood chips. The chips shall be processed in such a manner as to contain no growth or germination inhibiting factors. Fiber shall not be produced from recycled materials such as sawdust, paper, cardboard, or residue from pulp and paper plants. The wood cellulose fiber mulch shall be dyed green to aid in visual metering during application. The dye shall be biodegradable and not inhibit plant growth. The wood cellulose fibers of the mulch must maintain uniform suspension in water under agitation. Upon application, the mulch material shall form a blotter-like mat covering the ground. This mat shall have the characteristics of moisture absorption and percolation and shall cover and hold seed in contact with the soil. The Contractor shall obtain certifications from suppliers that laboratory and field testing of their product has been accomplished, and that it meets all of the foregoing requirements pertaining to wood cellulose fiber mulch.

The wood cellulose fiber mulch shall conform to the following specifications:

(1)	Percent moisture content	10.0% ± 3.0%
(2)	Percent Organic Matter* (Wood Cellulose Fiber)	99.3% ± 0.2%
(3)	Percent Ash Content*	0.7% ± 0.2%
(4)	pH	4.9 ± 0.5
(5)	Water Holding Capacity*	**1200-1600 grams

*Oven-Dried Basis
**Per 100 grams of fiber

The wood cellulose fiber mulch shall be packaged in units containing current labels, with the manufacturer's name, the net weight, and certification that the material meets the foregoing requirements for wood cellulose fiber mulch.

Material for mulch tackifier shall consist of a free-flowing, noncorrosive powder produced from the natural plant gum of Plantago insularis (Desert Indianwheat), applied in a slurry with water and wood fiber. The powder shall possess the following properties:

(1)	Protein content	1.6% ± 0.2%
(2)	Ash content	2.7% ± 0.2%
(3)	Fiber	4.0% ± 0.4%
(4)	pH 1% solution	6.5 - 8.0

The material used for mulch tackifier shall not contain any mineral filler, recycled cellulose fiber, clays, or other substances which may inhibit germination or growth of plants. Water shall conform to subsection 209.02.

Wood chip mulch shall consist of fresh, moist pole peelings material having approximate dimensions;

Width: ¼ to ½ inch; Length: 3 to 4 inches

The Contractor shall submit a sample to the Engineer for approval at least 30 days prior to placing on the project.

The metal landscape border shall consist of a strip of metal such as steel conforming to ASTM A 1011 or approved equal.

CONSTRUCTION REQUIREMENTS

213.03

(a) *Hay or Straw Mulching.* After seeding has been completed or when required for erosion control, hay or straw shall be uniformly applied, with no bare soil showing, at the rate designated in the Contract or as directed. It shall be crimped in with a crimper or other approved equipment. The Engineer may order hand-crimping on areas where mechanical methods cannot be used.

The seeded area shall be mulched and crimped within four hours after seeding. Areas not mulched and crimped within four hours after seeding or prior to precipitation or damaging winds on site shall be reseeded with the specified seed mix at the Contractor's expense, prior to mulching and crimping.

When tackifier is required in the Contract it shall be applied in the following order: (1)hydraulic mulching, (2)mulch tackifier.

(b) *Hydraulic Mulching.* Cellulose fiber mulch and tackifier shall be added to water to form a homogeneous slurry. The operator shall spray apply the slurry mixture uniformly over the designated seeded area.

Hydraulic mulching shall not be done in the presence of free surface water.

1. Mixing procedure for the hydraulic mulch and tackifier mixture shall be as follows:

   (1) Fill tank with water approximately ¼ full.
   (2) Continue filling while agitating with engine at full rpm.
   (3) Pour tackifier, at a moderate rate, directly into area of greatest turbulence.
   (4) With the recommended amount of tackifier in solution, add wood cellulose fiber mulch. Do not add fertilizer.

   Apply the hydromulch and tackifier mixture at the following rate:

Wood Cellulose Fiber Mulch	Tackifier
2000 lbs./Acre	100 lbs./Acre

2. Mixing procedure for Mulch Tackifier shall be as follows:
   (1) Fill tank with desired amount of water and run engine at full R.P.M.

(2) Add wood fiber. Agitate until a homogenous, non-lumpy slurry is formed. Do not add fertilizer
(3) Slowly sift powdered tackifier into slurry and continue to agitate for at least five minutes.
(4) Spray onto mulch or soil using a nozzle that will disperse the spray into a mist that will uniformly cover the mulch.

Application Rate: Apply this as an overspray at the following rate or as approved by the Engineer.

Powder	Fiber	Water
200 lbs./Acre	300 lbs./Acre	1000 gal./Acre

(c) *General.* Mulch shall be tacked simultaneously or immediately upon completion of mulching and crimping to avoid non-uniform coverage. Areas not properly mulched, or areas damaged due to the Contractor's negligence, shall be repaired and remulched as described above, at the Contractor's expense.

Mulch removed by circumstances beyond the Contractor's control shall be repaired and remulched as ordered. Payment for this ordered corrective work shall be at the contract prices.

The Engineer may order test sections be established for adjusting the mulching equipment to assure conformance with the specified application rate. The Engineer may order equipment readjustment at any time.

(d) *Wood Chip Mulch.* A 4-inch layer, unless otherwise shown in the plans, of wood chip mulch shall be uniformly applied to all planting beds as shown on the plans or as directed. Wood chip mulch shall be placed in all tree and shrub saucers in seeded areas. Wood chip mulch shall be capable of matting together to resist scattering by the wind.

(e) *Metal Landscape Border.* Metal Landscape border shall be installed along the lines and at the grades shown on the plans by an approved method that will not damage the border. Ends of metal landscape border shall overlap the next adjacent section a minimum of 6 inches. Metal landscape border shall be anchored with wire tiedowns at intervals of approximately 2 feet. Wire tiedowns shall be 9 gage wire at least 14 inches long. Metal landscape border shall be inserted into the ground by driving against the wire tiedowns; ground may be moistened to ease entrance into the ground. Driving on edge of metal landscape border will not be permitted except when the edge is properly shielded. Metal landscape border may be bent for sharp angles, and overlapped at closure of perimeter.

METHOD OF MEASUREMENT

213.04 The quantity of hay and straw mulch, wood chip mulch, wood cellulose fiber hydromulch, and tackifier will not be measured but shall be the quantity designated in

the Contract, except that measurements will be made for revisions requested by the Engineer, or for discrepancies of plus or minus five percent of the total quantity designated in the Contract. Measurement for acres will be by slope distances.

The quantity of mulch tackifier to be measured will be the actual number of pounds of dry tackifier powder used.

Metal landscape border will be measured by the linear foot of completed and accepted metal border. Measured length of metal landscape border will not include required overlap splices.

BASIS OF PAYMENT

213.05 The accepted quantities will be paid for at the contract unit price for each of the pay items listed below that appear in the bid schedule.

Payment will be made under:

Pay Item	**Pay Unit**
Mulching (___)	Acre
Mulching (Weed Free Hay)	Acre
Mulching (Weed Free Straw)	Acre
Mulching (Wood Chip)	Cubic Foot
Mulch Tackifier	Pound
Metal Landscape Border __x__ Inch	Linear Foot

Water, wood fiber, mixing and application for mulch tackifier will not be measured and paid for separately but shall be included in the work.

Adjusting or readjusting mulching equipment will not be paid for separately but shall be included in the work.

SECTION 214
PLANTING

DESCRIPTION

214.01 This work consists of furnishing and planting trees, shrubs, wetland perennials, and other plant material, hereinafter referred to as "plants" and obtaining live brush layer cuttings from on-site willow species designated by the Engineer near the project site and planting them in moist areas as shown on the plans or as directed.

MATERIALS

214.02 General. Plants shall be of the species or variety designated in the Contract, in healthy condition with normal well developed branch and root systems, and shall conform to the requirements of the current "American Standard for Nursery Stock." The Contractor shall obtain certificates of inspection of plant materials that are required by Federal, State, or local laws, and submit the certificates to the Engineer.

All plants shall be free from plant diseases and insect pests. All shipments of plants shall comply with all nursery inspection and plant quarantine regulations of the State of origin and destination, and the Federal regulations governing Interstate movement of nursery stock.

The minimum acceptable sizes of all plants, with branches in normal position, shall conform to the measurements specified in the Contract.

Plants hardy in hardiness zones 2, 3, 4, and 5 only will be accepted. Hardiness zones are defined in U.S. Department of Agriculture publications.

All container grown plants shall be those plants that have been growing in a nursery for at least one growing season, or plants that have established themselves in accordance with definitions set forth in the Colorado Nursery Act, Title 35, Article 26, CRS.

Trees and shrubs shall have been root-pruned during their growing period in the nursery in accordance with standard nursery practice.

If plants of acceptable quality and specified variety or size are not available locally, the Contractor may:

(1) Substitute acceptable plants that are larger than specified at no change in contract price.
(2) On written approval, substitute smaller plants than those specified in the Contract at the adjusted price stated in the written approval.
(3) On written approval, substitute plants of a different genus, species, or variety at the adjusted price stated in the written approval.

Before any substitution of plants will be considered, the Contractor shall furnish to the Engineer written statements from three sources verifying that the plants designated on the plans are not available.

At the landscape pre-construction conference, the Contractor shall name the nursery stock supplier for all items. The Contractor shall tag all nursery stock for inspection by the Engineer. The Engineer will reject any nursery stock not meeting the Contract at any of the three following times and locations:

(1) At the named supplier's location. The Engineer will notify the Contractor when nursery stock will be inspected at the supplier's location.
(2) On the project site at the time of delivery, prior to planting.
(3) At the time of installation. Final acceptance of all plant material will be made at the time of installation on the project site.

Deciduous plants, broadleaf evergreens, and conifers shall be balled and burlapped, or in containers used in standard nursery practice. Balling and burlapping shall conform to the recommended specifications in the "American Standard for Nursery Stock". The ball of the plant shall be natural, not made, and the plant shall be handled by the ball at all times. No balled and burlapped plant shall be accepted if the ball is broken or the trunk is loose in the ball.

Each species shall be identified by means of grower's label affixed to the plant. The grower's label shall include the data necessary to indicate conformance to specifications.

Plants for fall planting shall be furnished balled and burlapped or container-grown unless otherwise designated in the Contract or approved.

(a) *Brush Layer Cuttings*. Brush layer cuttings taken from designated plants shall be at least 0.5 inch in diameter or larger. Brush layer cuttings shall be 24 to 36 inches long with the bottom end cut off at an angle and the top end with a straight cut. Cuttings shall be taken and installed while dormant in early spring. Cuttings shall not be planted when the ground is frozen. Brush layer cuttings shall be stored no longer than one week. The cuttings shall be stored by submerging them at least $^{2}/_{3}$ of their length in containers of water, free from any harmful oil, chemical, sprays, or other materials. The containers shall be kept in the shade.

(b) Wetland Perennial Plants. Perennial wetland plants shall be supplied in containers as designated in the Contract; no bare root material will be allowed. The original plant stock for the plants shall be from Colorado. Perennial plants shall have been growing at least one growing season in the nursery. Perennials shall not be shipped while in a dormant condition. Perennials shall be a minimum of 6 inches in height when applicable to the species. Water shall be applied to wetland perennial plants until soil is saturated. Wetland perennial plants shall be watered thoroughly every day for a period of one month.

(c) *Stakes.* Wood stakes shall be 2 inches x 2 inches square, or 2 ½ inch diameter and 6 feet long free from bends. Metal stakes shall be 6 feet long standard T-bar steel fence post or #4 or larger rebar. Wood stakes shall be made of untreated wood guaranteed to last in the ground at least two growing seasons. The bottom of wood stakes shall be pointed.

(d) *Soil Conditioners and Fertilizer.* Soil conditioner shall consist of composted plant material, 90 percent ¼ inch or less with a carbon to nitrogen ratio of 15:1 to 25:1. A sample of the soil conditioner and certificate of compliance shall be provided to the Engineer to verify the organic matter content, and carbon matter to nitrogen ratio shall be submitted one month prior to planting for a approval.

Fertilizer for planting shall be used as specified in the Contract.

CONSTRUCTION REQUIREMENTS

214.03 General. All plants shall be protected from drying out or other injury. Broken and damaged roots shall be pruned before planting.

(a) *Planting Seasons.* Plants shall be planted in accordance with the Contract.

Areas to be planted shall be brought to the lines and grades designated or approved. The location of plants shown in the Contract is approximate to the degree that unsuitable planting locations shall be avoided. Trees shall be planted at least 30 feet from the edge of the traveled way, except when guardrail or vertical curb exists, this distance may be reduced to 20 feet. Locations and layouts shall be approved before preparatory work for planting is started. Shrubs shall not be planted closer than 6 feet from the edge of pavement.

All layout staking for planting shall be done by the Contractor and shall be approved by the Engineer before planting holes are prepared.

The Contractor shall place all plant material according to the approved planting plans, or as directed.

(b) *Excavation.* Planting pits shall be circular in outline with vertical or sloped sides. Pits for trees and shrubsshrubs shall be at least two times greater in diameter than the earth ball.

(c) *Planting.* Planting shall be done in accordance with good horticultural practices. Plants of upright growth shall be set plumb and plants of prostrate type shall be set normal to the ground surface. Plants with dry, broken, or crumbling roots will not be accepted for planting.

Planting pits shall be dug 2 to 4 inches shallower than the height of the rootball for trees, and 2 inches shallower for shrubs. In non-irrigated areas, planting pits shall be dug so that the top of the rootball is level with the final grade. The

tree rootball shall be set in the center of the planting pit on undisturbed soil. Trees shall be stabilized and then the wire basket, any twine or wire, and burlap shall be removed before the pit is backfilled. Shrubs shall be planted in the center of the pit. Plastic, metal, fabric, or peat containers shall be removed. Shallow scores ¼ to ½ inch deep shall be made along the edges of the rootball.

Areas to be planted with ground cover shall be prepared by placing topsoil and a ½ inch layer of soil conditioner on the ground surface, and roto-tilling to a depth of 6 inches. Ground cover shall be planted by excavating to a depth sufficient to accommodate the root structure of plant materials without crimping or bending roots. After planting, backfill shall be placed around the ground cover and compacted firmly around the roots. The planted areas shall be brought to a smooth and uniform grade, and then top dressed with a 2 inch mulch cover of the type specified on the plans.

(d) *Backfilling.* When soil conditioner is specified, composted plant material shall be added and thoroughly mixed into the backfill material at the rate of 0.5 cubic foot per tree and 0.1 cubic foot per shrub.

Backfill shall be thoroughly worked and watered-in to eliminate air pockets. Watering shall be done immediately after the plant is placed. Backfilling of the planting pit shall be resumed after this water is absorbed. Roots and crown shall be covered with soil at this time. After the soil has settled, plants must be in the proper position and at the proper depth. Saucers shall be prepared around each plant to the dimensions shown on the planting details. When saucers are required they shall be covered with a 4 inch thick layer of fresh moist wood chip mulch conforming to Section 213. After completion of all planting and before acceptance of the work, the Contractor shall water plants installed under this Contract, as needed to maintain a moist root zone optimum for plant growth. Plants damaged by the Contractor's operations shall be replaced at the Contractor's expense.

Surplus soil remaining after backfilling is completed shall be used for constructing water retention berms, or, if not needed for berms, shall be thinly distributed (wasted) in the vicinity, subject to approval of the Engineer.

(e) *Pruning.* All deciduous trees and shrubs shall be pruned in accordance with standard horticultural practice, preserving the natural character of the plant. Guidelines for pruning are indicated in the planting details. Pruning cuts shall be made with sharp clean tools.

All clippings shall become the property of the Contractor and be removed from the site..

(f) *Staking.* All deciduous trees 2 inch caliper and greater shall be staked with two stakes. Stakes shall conform to subsection 214.02(c). Stakes shall be driven 2

feet into the ground with one stake on the side of the prevailing wind (generally the west side) and the other stake on the opposite side. Stakes shall be driven at least 1 foot outside each edge of the planting pit. Trees shall be guyed with 1 to 2 inch wide strips of nylon webbing with metal grommets.

Coniferous trees 4 feet or taller shall be staked as designated in the Contract or directed.

Stakes shall be spaced equally around the tree.

Trees specified to be guyed with wire shall be secured with No. 12 gage annealed galvanized steel wire free of bends and kinks.

(g) *Wrapping Materials.* Wrapping material shall be horticulturally approved waterproof wrapping paper. Wrapping shall be applied from the base of the tree upward to the second scaffold branch and secured with arbor tape. *Populus sp.* are exempt from tree wrap. The Contractor shall submit the manufacturer's certification for the wrapping material requirements. Wrapping shall be done in the fall months prior to freeze, and removed in the spring. Wrapping shall not remain on any trees throughout the summer months. Wrapping shall be removed by the Contractor.

All plant tags shall be removed from plants and all packing or other material used by the Contractor shall be removed from the site.

(h) *Brush Layer Cuttings.* Using a rock bar or other tool, holes at least 20 inches deep shall be made in the streambank or other areas. A cutting shall be placed in each hole. If in riprap, the hole shall be backfilled with soil to within 3 inches of the riprap surface. The top 3 inches of the void shall be filled with gravel from the streambank or streambed and compacted slightly. The remaining exposed length shall be cut off 2 to 3 inches above the ground line. The placement of these cuttings shall be in areas shown on the plans that remain damp or are seasonally inundated, as directed. Brush layer cuttings shall be planted at a density of one cutting per square yard on streambank or other designated areas that have been regraded, riprapped, or disturbed. The strip that is most successful for brush layer cutting establishment is only several yards wide and approximately, plus or minus, 2 feet from the ordinary high water line.

Water shall be applied to the brush layer cuttings planted areas until the soil mass is saturated. Brush layer cuttings shall be watered thoroughly every day for a period of one month.

(i) *Irrigation*. Plantings that are to be irrigated shall be planted so that the irrigation system is operating and supplying the designated amount of water as planting is occurring. Plants shall be watered within 15 minutes of planting.

214.04 Landscape Establishment. From the time of installation, during construction, and throughout the Landscape Establishment period the Contractor shall maintain all plant material and seeded areas in a healthy and vigorous growing condition, and ensure the successful establishment of vegetation. This includes performing establishment, replacement work, and landscape maintenance work as described below.

(a) *Establishment and Replacement.* After all planting on the project is complete, a plant inspection shall be held including the Contractor, Engineer and CDOT Landscape Architect to determine acceptability of plant material. During the inspection, an inventory of rejected material will be made, and corrective and necessary cleanup measures will be determined.

Dead, dying, or rejected material shall be replaced each month during the Landscape Establishment period as directed. Plant replacement stock shall be planted in accordance with the Contract and be subject to all requirements specified for the original material. Plant replacement shall be at the Contractor's expense.

(b) *Landscape Maintenance.* During the Landscape Establishment period the Contractor shall perform landscape maintenance as described herein. The Contractor shall maintain all landscaped areas in the condition they were in when first installed and accepted.

Prior to the Notice of Substantial Landscape Completion, the Contractor shall submit a detailed maintenance plan which includes a schedule showing the number of hours or days personnel will be present, the type of work to be performed, supervision, equipment and supplies to be used, emergency program and responsible person to contact for emergency work, and inspection schedule. The detailed maintenance plan is subject to review and approval by the Engineer. The Engineer will not issue the Notice of Substantial Completion until the Engineer has received and approved the maintenance plan.

The proposed types, brand names, material safety data sheets, and rates of application of herbicides, pesticides, and fertilizers to be used shall be submitted for approval with the detailed maintenance plan. Herbicides, pesticides, and fertilizers shall meet all local, state, and federal regulations and shall be applied by a licensed applicator.

The Contractor shall perform start-up, watering, programming, operation, and fall winterization of the irrigation system. The Contractor shall do a spring start-up of the irrigation system prior to Final Acceptance and perform all irrigation system warranty work as specified in Section 623.

The Contractor shall keep a project diary documenting all landscape and irrigation maintenance activities including work locations and time spent. The Contractor shall provide copies of the diary to the Engineer upon request.

The Contractor shall restore and reseed eroded areas and areas of poor establishment in accordance with Sections 212 and 213. The Contractor shall maintain staking and guying until the end of the Landscape Establishment period. The Contractor shall remove all guying wire, straps, and stakes at the end of the Landscape Establishment period.

1. *Watering in Irrigated Areas.* Trees planted at all locations on the project shall be watered once per month at the rate of 30 gallons per tree for the months November through April until the Landscape Establishment period ends.

   Shrubs planted at all locations on the project shall be watered once per month at the rate of 10 gallons per shrub for the months November through April until the Landscape Establishment period ends.

2. *Watering in Non-irrigated Areas.* Trees planted shall be watered twice per month by the Contractor at the rate of 30 gallons per tree per watering for the months May through October, and once per month at the rate of 30 gallons per tree for the months November through April of the 12 month period following planting.

   Shrubs planted in upland areas shall be watered twice per month by the Contractor at the rate of 10 gallons per shrub per watering for the months May through October, and shall be watered once per month at the rate of 10 gallons per shrub for the months November through April of the 12 month period following planting.

The contract performance bond, required by subsection 103.03, shall guarantee replacement work during the plant establishment period.

If all other work is completed on a project, no contract time will be charged during the plant establishment period.

METHOD OF MEASUREMENT

214.05 The quantity of planting to be measured will be the number of plants, of the types and sizes designated in the Contract, that are actually planted and accepted.

The quantity of brush layer cuttings will be measured by the actual number planted, complete in place and accepted.

Landscape Maintenance will not be measured, but will be paid for on a lump sum basis.

BASIS OF PAYMENT

214.06 The accepted quantities of planting, and brush layer cuttings will be paid for at the contract unit price for each of the various items listed below that appear in the bid schedule.

Payment for the total cost of the item will be made at the completion of planting.

Cost of the performance bond shall be included in the cost of the plant items.

Payment will be made under:

Pay Item	**Pay Unit**
_____ Tree ____Inch Caliper	Each
_____ Tree ____Foot	Each
_____ Shrub (____Gallon Container)	Each
Perennials (____Quart Container)	Each
Perennials (____Gallon Container)	Each
Brush Layer Cuttings	Each
Landscape Maintenance	Lump Sum

Water required for all items of work will not be measured and paid for separately, but shall be included in the work.

Payment shall be full compensation for all work necessary to complete the item.

For each month that landscape maintenance is performed and accepted during the Landscape Maintenance period as specified in subsection 214.04, payment for Landscape maintenance will be made in installments as follows:

(1) 10 percent of the lump sum amount will be paid for each of the eight growing season months, March through October.
(2) 5 percent of the lump sum amount will be paid for each of the winter months, November through February.

Landscape maintenance performed during construction will not be measured and paid for separately, but shall be included in the work.

Landscape Establishment, except for landscape maintenance, will not be paid for separately, but shall be included in the work.

SECTION 215
TRANSPLANTING

DESCRIPTION

215.01 This work consists of transplanting trees, shrubs, plugs of wetland material including root mats from existing wetlands, and other plant material, hereinafter referred to as "plants," of the designated species in accordance with this specification and accepted standard horticultural practice at the designated locations. Transplanting season is that period when plants are in a dormant condition and can be moved. Dormant means that deciduous material is without leaves and coniferous material is without new candle growth. Transplanting done in periods not considered dormant transplanting season shall require advance approval.

MATERIALS

215.02 Plants to be transplanted shall be those which are flagged on the project site within the right of way, or as directed.

Plugs shall be dug from areas noted in the Contract or as directed by the Engineer. Removal shall be dispersed throughout the areas so as not to impact the existing wetland. Plugs shall be taken in early spring, when plants are emerging. Plugs shall be a minimum of 4 inches in diameter and 6 inches to 8 inches deep with the root mat to remain intact. Plugs shall not be stockpiled but shall be transplanted directly to wetland mitigation sites as directed. Transplanting shall be accomplished the day they are dug. Plugs shall be kept moist and shall not be placed in holding beds

CONSTRUCTION REQUIREMENTS

215.03 Plants shall be dug, properly pruned, and prepared for transplanting in accordance with standard practice. The root system shall be kept moist and plants shall be protected from adverse conditions due to climate and transporting from the time they are dug to the actual planting.

Prior to removal for transplanting, all coniferous trees shall be sprayed with an approved anti-desiccant.

The following table represents the minimum diameter of root balls for collected plants.

Type 6 - Collected Pinon Pine

Caliper	**Min. Ball Dia.**
1 to 1½ inch	15 inch
1½ to 2 inch	17 inch
2 to 2½ inch	20 inch
2½ to 3 inch	24 inch
3 to 3½ inch	26 inch
3½ to 4 inch	28 inch
4 to 4½ inch	30 inch
4½ to 5 inch	32 inch

Type 7 - All Collected Plants Other than Pinon Pine

Caliper	**Min. Ball Dia.**
1 to 1½ inch	14 inch
1½ to 2 inch	16 inch
2 to 2½ inch	20 inch
2½ to 3 inch	24 inch
3 to 3½ inch	28 inch
3½ to 4 inch	32 inch
4 to 4½ inch	36 inch
4½ to 5 inch	40 inch

For caliper sizes larger than those given under Type 7, the ratio of ball diameter to caliper shall be 8:1.

Planting pits for balled and burlapped trees shall be circular in outline with vertical sides. Pits shall be at least two times greater in diameter than the earth ball. Before a tree is placed in a plant pit, the pit shall be filled half full of water. Backfill shall be thoroughly worked and watered to eliminate air pockets. Unsuitable backfill soils shall be replaced.

Trees shall be machine transplanted with tree spades. The following table represents the minimum size of spade machine equipment to be used for transplanting plants based upon caliper size. The table also represents the minimum diameter of root-balls for machine transplanted plants.

Caliper	**Min. Spade Machine Size (Based upon root ball width)**
1 to 3 inch	44 inch
3 to 6 inch	65 inch
6 to 9 inch	80 inch
9 to 12 inch	90 + inch

Each tree shall be transported to the new site using the same spade with which it was dug, or several trees may be spade-dug and transported in a pod trailer manufactured specifically for this purpose. Trees shall not be removed from spade or transported in a haul truck. The Contractor shall give the Engineer one week notice prior to transplanting trees. At the time of transplanting the Engineer will designate a Department landscape architect to be on the site to oversee all tree planting.

Planting pits for machine-dug trees shall have the same dimension as the machine ball being placed. Before a tree is placed in a planting pit, the pit shall be filled half full of water and allowed to drain. Once the tree is placed, voids in the pit shall be filled with clean suitable backfill and tamped. If unsuitable soil is encountered in the planting pits, the Contractor shall dispose of said material and backfill with suitable material as determined by the Engineer.

After the tree is planted (collected or machine transplanted), a basin shall be built to hold at least 30 gallons of water. For each inch of trunk diameter greater than 3 inches, the basin capacity shall be increased by 10 gallons. The depth of saucer shall not be below the top of the root system of the tree. The basin shall be filled with water three times and allowed to stand each time until empty before refilling. Saucers shall be covered with a 4 inch thick layer of fresh moist wood chip mulch as shown on the plans. The size of mulch shall be approximately ¼ to ½ inch wide and 3 to 4 inches long. A sample shall be submitted in advance to the Engineer for approval.

Transplanting shall be accomplished within one day. Trees shall not be placed in holding beds.

All transplanted trees shall be subject to a 180-day maintenance period during one or more growing seasons and shall be watered every seven calendar days. Each watering shall be 100 gallons per tree.

All transplanted trees shall be guyed in accordance with Standard Plan M-214-1. Guying material shall be removed at the end of the 180 day maintenance period. All trees damaged by the Contractor's operations shall be replaced and replanted at the Contractor's expense as approved. At the end of the 180 day maintenance period all dead trees shall be replaced and replanted with trees at the Contractor's expense. Further maintenance will not be required.

The Contractor shall not damage existing landscaped areas, including but not limited to turf, irrigation equipment, and other plants, during the transplanting operation. The Contractor may use suitable platform material over existing turf to prevent damage from heavy machinery.

Wetland plugs shall be a minimum of 4 inches in diameter and 6 to 8 inches in depth. Holes left in the existing wetlands from plug removal shall be filled with topsoil and tamped lightly. After tamping, the filled hole shall be at the same elevation as the existing surrounding wetlands.

Transplant plugs shall be placed in containers (one plug per container) after harvesting to facilitate handling and placing of material.

Plugs shall be spaced as directed in the Contract. Plugs shall be planted to match surrounding grade.

Water shall be applied to plugs until soil is saturated. Plugs shall be watered thoroughly every day for a period of one month.

METHOD OF MEASUREMENT

215.04 The quantity of transplanting to be measured will be the actual number of plants of the various types transplanted and accepted.

The quantity of transplanted trees to be measured will be the actual number of trees of the various caliper and types transplanted and accepted in their final location.

Caliper measurement shall conform to the USA Standard for Nursery Stock, sponsored by the American Association of Nurserymen, Inc.

Only living plants in healthy condition at the end of the maintenance period will be accepted. If all other work is completed on the project, contract time will not be charged during the maintenance period.

The quantity of transplanted plugs to be measured will be the actual number of plugs transplanted and accepted in their final locations.

BASIS OF PAYMENT

215.05 The accepted quantities of transplanting measured as provided above will be paid for at the contract unit price each.

Payment will be made under:

Pay Item	**Pay Unit**
Transplant Tree __Inch	Each
Transplant Shrub	Each
Transplant Plug	Each

Water required will not be measured and paid for separately, but shall be included in the work.

Hauling plants to their new location, removing unsuitable backfill, and providing clean suitable backfill for planting pit voids will not be measured and paid for separately but shall be included in the work.

SECTION 216
SOIL RETENTION COVERING

DESCRIPTION

216.01 This work consists of furnishing, preparing, applying, placing, and securing soil retention covering for erosion control on roadway ditches or slopes as designated in the Contract or as directed.

MATERIALS

216.02

(a) *Covering.* Covering shall consist of blankets with close weave mesh and nettings with open weave mesh made of various materials as specified herein.

Blankets and nettings shall be photodegradeable or biodegradable, non-toxic to vegetation or germination of seed, and shall not be toxic or injurious to humans.

1. *Excelsior.* Excelsior soil retention covering shall be either photodegradable or biodegradable as follows.

   A. The blanket shall consist of a machine produced mat of curled wood excelsior of 80 percent, 6 inch or longer fiber length with a consistent thickness of fibers evenly distributed over the entire area of the blanket. The top side of the blanket shall be covered with a photodegradable extruded plastic mesh and stitched on 2 inch centers the entire width of the blanket.

Dimensions:	48" by 180' or 96" by 90'
Roll Weight:	0.9 to 1.1 pounds per sq. yd.

   B. The blanket shall consist of a machine produced mat of curled wood excelsior of 80 percent, 6 inch or longer fiber length with a consistent thickness of fibers evenly distributed over the entire area of the blanket. The top side of the blanket shall be covered with a biodegradable netting, manufactured from a jute or other biodegradable material and stitched on 2 inch centers the entire width of the blanket.

Dimensions:	48" by 180' or 96" by 90'
Roll Weight:	0.9 to 1.1 pounds per sq. yd.

2. *Soil Retention Blanket (Coconut).* Soil Retention Blanket (Coconut) shall be a machine produced mat consisting of 100 percent coconut fiber. The blanket shall be of consistent thickness with the coconut fiber evenly distributed over the entire area of the mat. The blanket shall be covered on the top and bottom side with polypropylene netting having ultraviolet additives to reduce breakdown and an approximate $^{5}/_{8}$ inch x $^{5}/_{8}$ inch mesh

size. The blanket shall be sewn together with polyester, biodegradable or photodegradable thread.

Material requirements:

Coconut Fiber Content:	100%, 0.50 to 0.60 lb. per sq. yd.
Netting:	Both sides, heavyweight nondegradable 3 lbs. per 1000 sq. ft.
Thread:	Polyester, biodegradable or photodegradable
Roll Width:	6.5 to 7.5 feet
Roll Length:	83.5 to 90 feet
Area Covered by One Roll:	60 to 75 sq. yds.

A sample of the soil retention blanket (coconut) shall be submitted at least 2 weeks in advance of its use on the project for approval by the Engineer.

3. *Soil Retention Blanket (Straw).* Soil Retention Blanket (Straw) shall be a machine produced mat consisting of 100 percent agricultural straw. The blanket shall be of consistent thickness with the straw evenly distributed over the entire area of the mat. The blanket shall be covered on the top side with polypropylene netting having an approximate $^{5}/_{8}$ inch x $^{5}/_{8}$ inch to ½ inch x ½ inch mesh and on the bottom with polypropylene netting with an approximate ¼ inch x ¼ inch to ½ inch x ½ inch mesh. The blanket shall be sewn together with biodegradable or photodegradable thread.

Material requirements:

Straw Content:	100%, 0.50 lb. per sq. yd.
Netting:	Bottom side lightweight polypropylene photodegradable, 1 to 1.65 lbs. per 1000 sq. ft. Top side heavyweight or lightweight polypropylene photodegradable, 1.65 to 3 lbs. per 1000 sq. ft.
Thread:	Biodegradable or photodegradable
Roll Width:	6.5 to 7.5 feet
Roll Length:	83.5 to 90 feet
Area Covered by One Roll:	60 to 75 sq. yds

A sample of the soil retention blanket (straw) shall be submitted at least 2 weeks in advance of its use on the project for approval by the Engineer.

4. *Soil Retention Blanket (Straw and Coconut).* Soil Retention Blanket (Straw/Coconut) shall be a machine produced mat consisting of 70 percent agricultural straw and 30 percent coconut fiber. The blanket shall be of consistent thickness with the straw and coconut fiber evenly distributed

over the entire area of the mat. The blanket shall be covered on the top side with polypropylene netting having an approximate $^{5}/_{8}$ inch x $^{5}/_{8}$ inch mesh and on the bottom with polypropylene netting with an approximate ¼ inch x ¼ inch to ½ inch x ½ inch mesh. The blanket shall be sewn together with cotton, biodegradable or photodegradable thread.

Material requirements:

Straw Content:	70% 0.35 lb. per sq. yd.
Coconut Fiber Content	30% 0.15 lb. per sq. yd.
Netting:	Bottom side lightweight polypropylene photodegradable, 1 to 1.65 lbs. per 1000 sq. ft. Top side heavyweight or lightweight polypropylene photodegradable, 1.65 to 3 lbs. per 1000 sq. ft.
Thread:	Cotton, biodegradable or photodegradable
Roll Width:	6.5 to 7.5 feet
Roll Length:	83.5 to 90 feet
Area Covered by One Roll:	60 to 75 sq. yds

A sample of the soil retention blanket (straw and coconut) shall be submitted at least 2 weeks in advance of its use on the project for approval by the Engineer.

(b) *Pins and Staples.* Pins and staples shall be made of wire 0.162 inch or larger in diameter. "U" shaped staples shall have legs 8 inches long and a 1 inch crown. "T" shaped pins shall not be used.

CONSTRUCTION REQUIREMENTS

216.03

(a) *Excelsior.* The area to be covered shall be prepared, fertilized, and seeded in accordance with Section 212, before the blanket is placed. When the blanket is unrolled, the netting shall be on top and the fibers shall be in contact with the soil. In ditches, blankets shall be unrolled in the direction of the flow of water. The end of the upstream blanket shall overlap the buried end of the downstream blanket a maximum of 8 inches and a minimum of 4 inches, forming a junction slot. This junction slot shall be stapled across at 8 inch intervals. Adjoining blankets (side by side) shall be offset 8 inches from center of ditch and overlapped a minimum of 4 inches. Six staples shall be used across the start of each roll, at 4 foot intervals, alternating the center row so that the staples form an "X" pattern. A common row of staples shall be used on adjoining blankets.

(b) *Soil Retention Blanket (Coconut), (Straw), and (Straw and Coconut).* The area to be covered with Soil Retention Blanket (Coconut), (Straw), and (Straw and Coconut) shall be properly prepared, fertilized, and seeded before the blanket is placed. When the blanket is unrolled, the heavyweight polypropylene netting shall be on top and the lightweight polypropylene netting shall be in contact with

the soil. In ditches and on slopes, blankets shall be unrolled in the direction of the flow of water. Installation shall be in accordance with manufacturer's recommendations. A representative of the manufacturer shall be present to give instruction during the installation of the soil retention blanket.

The blanket shall be placed smoothly but loosely on the soil surface without stretching. The upslope end shall be buried in a trench 6 inches wide by 6 inches deep beyond the crest of the slope to avoid undercutting. For slope applications, there shall be a 6 inch overlap wherever one roll of blanket ends and another begins with the uphill blanket placed of top on the blanket on the downhill side. There shall be a 4 inch overlap wherever two widths of blanket are applied side by side. Insert staples in a pattern according to the manufacturer's recommendation at approximately two staples per square yard.

At terminal ends, and every 35 feet, Soil Retention Blanket (Coconut), (Straw), and (Straw/Coconut) placed in ditches shall be buried in a trench approximately 6 inches deep by 6 inches wide. Before backfilling, staples shall be placed across the width of the trench spaced at 6 inches on center in a zigzag pattern. The trench shall then be backfilled to grade and compacted by foot tamping.

(c) *Maintenance.* The Contractor shall maintain the blanket, fabric, or netting areas until all work on the Contract has been completed and accepted. Maintenance shall consist of the repair of areas where damage is due to the Contractor's operations. Maintenance shall be performed at the Contractor's expense. Repair of those areas damaged by wind, fire, or other causes not attributable to the Contractor's operations shall be repaired by the Contractor and will be paid for at the contract unit price. Areas shall be repaired to reestablish the condition and grade of the soil prior to application of the covering and shall be refertilized, reseeded, and remulched as directed.

METHOD OF MEASUREMENT

216.04 Soil retention covering, including staples, complete in place and accepted, will be measured by the square yard of finished surface. No allowance will be made for overlap.

BASIS OF PAYMENT

216.05 The accepted quantities of soil retention covering will be paid for at the contract unit price per square yard.

Payment will be made under:

Pay Item	**Pay Unit**
Soil Retention Blanket (____)	Square Yard

Preparation of seedbed, fertilizing, and seeding will be measured and paid for in accordance with Section 212.

Mulching will be measured and paid for in accordance with Section 213.

SECTION 217
HERBICIDE TREATMENT

DESCRIPTION

217.01 This work consists of furnishing and applying herbicides to prevent or control plant growth in areas shown on the plans or designated.

MATERIALS

217.02 Herbicides shall be designated in the contract.

All herbicide labels shall be currently registered with the Colorado Department of Agriculture and the U.S. Environmental Protection Agency. All herbicides shall be supplied to the project in labeled containers. The labels shall show the product name, chemical composition, expiration date, and directions for use.

CONSTRUCTION REQUIREMENTS

217.03 All herbicides shall be applied by commercial pesticide applicators licensed by the Colorado Department of Agriculture as qualified applicators. The Contractor shall furnish documentation of such licensing prior to herbicide application. Herbicide mixing and application shall be done in accordance with instructions on the registered product label. The Engineer shall be furnished such label information prior to mixing and application.

The Contractor shall notify the Engineer at least 24 hours prior to each herbicide application and shall indicate the time and location application will begin. Application will not be allowed on Saturdays, Sundays, or holidays unless otherwise approved by the Engineer.

Herbicides shall not be applied when weather conditions, including wind conditions, are unsuitable for such work. Herbicides shall not be applied when soil is extremely dry.

Herbicide application method shall be such that plant growth outside the designated treatment areas will not be damaged. All damage caused by improper herbicide application shall be repaired at the Contractor's expense.

Herbicides shall not be used on areas that are to be topsoil sources unless otherwise approved by the Engineer.

METHOD OF MEASUREMENT

217.04 The quantity of herbicide treatment to be measured will be the actual number of square yards treated in accordance with the foregoing requirements or the actual number of hours the Contractor spends applying the herbicide and accepted by the Engineer. Areas designated to receive herbicide treatment will be measured once for each designated application. Reapplication of herbicide required due to inappropriate timing of the original application will not be measured or paid for.

BASIS OF PAYMENT

217.05 The accepted quantities of herbicide treatment will be paid for at the contract unit price per square yard or per hour.

Payment will be made under:

Pay Item	Pay Unit
Herbicide Treatment	Square Yard
Herbicide Treatment	Hour

Water will not be measured and paid for separately but shall be included in the work.

SECTION 250
ENVIRONMENTAL, HEALTH AND SAFETY MANAGEMENT

DESCRIPTION

250.01 This work consists of protection of the environment, persons, and property from contaminants that may be encountered on the Project. This includes monitoring the work for encounters with contaminants, and the management of solid, special and hazardous waste when encountered on the Project.

MATERIALS AND EQUIPMENT

250.02 The Contractor shall furnish all personnel, materials, equipment, laboratory services and traffic control necessary to perform the contamination monitoring, testing, and site remediation when required. Traffic control shall be in accordance with the requirements of Section 630.

Monitoring equipment used to detect flammable gas, oxygen level, and toxic gas shall be capable of detection to meet the following standards:

Instrument Detection

Constituent	Threshold Limit	Increments
Flammable Gas	1% LEL	1%
Oxygen	19%	0.1%
Toxic Gas	1 PPM	1 PPM

LEL = lower explosive limit
PPM = parts per million

CONSTRUCTION REQUIREMENTS

250.03 General. Prospective bidders, including subcontractors, are required to review the environmental documents available for this project. These documents are listed in subsection 102.05 as revised for this project.

This project may be in the vicinity of property associated with petroleum products, heavy metal based paint, landfill, industrial area or other sites which can yield hazardous substances or produce dangerous gases. These hazardous substances or gases can migrate within or into the construction area and could create hazardous conditions. The Contractor shall use appropriate methods to reduce and control known landfill or industrial gases and hazardous substances which exist or migrate into the construction area.

Encountering suspected contaminated material, including groundwater, is possible at some point during the construction of this project. When suspected contaminated material, including groundwater, is encountered or brought to the surface, the procedures under subsection 250.03(d)4. shall be followed.

Transportation of waste materials on public highways, streets and roadways shall be done in accordance with Title 49, Code of Federal Regulations (CFR). All labeling, manifesting, transportation, etc. of waste materials generated on this project shall be coordinated with the Engineer. All hazardous waste manifests for waste materials generated on this project shall list the Colorado Department of Transportation as the generator of the waste materials except as otherwise noted. If the Contractor contaminates the site, the Contractor shall be listed as the generator on the hazardous waste manifests, permits, and other documents for such material. If the project is not on a State Highway or frontage road, then the appropriate local governmental entity having jurisdiction over the transportation system facility shall be listed as the hazardous waste generator.

If waste materials must be handled in a permitted treatment, storage and disposal (TSD) facility, the facility shall be designated in writing by the Engineer. If the waste materials are the result of the Contractor's actions, the Contractor shall designate the facility.

The hazardous waste transportation phase of the work involves insurance required by law and regulations. If the waste materials are determined to be hazardous, the Contractor must submit proof that the transportation company is covered by the appropriate type and amount of insurance required by laws and regulations governing the transportation of hazardous waste.

The Contractor alone bears the responsibility for determining that the work is accomplished in strict accordance with all applicable federal, state and local laws, regulations, standards, and codes governing special waste, petroleum and hazardous substance encounters and releases.

The Contract will list known or suspected areas of contamination. Health and Safety Officer, Monitoring Technician, and Health and Safety Plan shall be required when so stated in the Contract.

(a) *Health and Safety Officer (HSO).* The Contractor shall designate a HSO, not the project superintendent, who shall have at least two years field experience in chemical related health and safety. The HSO shall be either a certified industrial hygienist (CIH), certified hazardous materials manager (CHMM), professional engineer (PE) licensed in the State of Colorado, certified safety professional (CSP), or registered environmental manager (REM) meeting the criteria set forth in 29 CFR 1926. The HSO shall meet the minimum training and medical surveillance requirements established by the Occupational Safety and Health Administration (OSHA) and the Environmental Protection Agency (EPA) for a supervisory Site Safety Official per 29 CFR 1962.65. The Contractor shall furnish documentation to the Engineer, at the preconstruction conference, that the above requirements have been met.

The HSO shall be equipped with the following:

(1) Communication equipment as required in subsection 250.03(d)2.A. and a vehicle.
(2) Monitoring and detection equipment for flammable gas, oxygen sufficiency, toxic gas, radiological screening and other hazards. This includes, as required, a combustible gas indicator, flame ionization or photo ionization detector, oxygen meter, radiation monitor with Geiger Mueller detector and other foreseeable equipment.
(3) Depth gauging equipment, sampling equipment and sampling containers.
(4) Personal protective equipment (levels C and D) when required.

The HSO shall recommend and supervise those actions which will minimize the risk of hazardous substance related injury to the workers, Department personnel, the general public, property and the environment. Hazardous substance is defined in 29 CFR 1926.32. The HSO shall prepare written procedures for the monitoring of confined space entry and working in or near excavations, including but not limited to trenches and drill holes associated with this project. The HSO shall conduct or supervise all hazardous substance and solid waste related testing, sampling, monitoring and handling for this project to ensure compliance with applicable statutes and regulations, and other applicable environmental requirements under subsections 107.01 and 107.02.

The HSO shall be available for consultation and assistance with contaminated materials related testing, sampling, and field monitoring as required by the Engineer.

The HSO shall prepare and submit a bound and indexed final site report to the Engineer at the end of the project. This site report shall include a detailed summary of all contaminated materials and contaminated water that were encountered and their final disposition.

During each week the HSO is utilized, the HSO shall prepare a daily diary which shall be submitted to the Contractor and the Engineer. This diary shall be submitted at the end of the week and shall become a part of the Department's records. The diary shall contain a chronological log of activities on the project including: dates and times on site, equipment used and calibrations, field monitoring results, visual observations, conversations, directives both given and received, and disposition of suspected hazardous substances. The Engineer will review this submittal and approve the actual number of hours to be paid.

(b) *Monitoring Technician (MT).* The Contractor shall designate a monitoring technician to be responsible for monitoring of hazardous substances during work on the project. The MT shall have a minimum of two years of actual field experience in assessment and remediation of hazardous substances that may be encountered during highway construction projects. The MT shall be experienced in the operation of monitoring devices, identifying substances based upon experience and observation, and field sampling (for testing) of all media that may be found on the site. Completion of the 40 hour hazardous waste and 8 hour

supervisory training required by OSHA and U.S. EPA rules and regulations which complies with the accreditation criteria under the provisions of the proposed 29 CFR 1910.121 is required prior to beginning work. The Contractor shall furnish documentation at the Preconstruction Conference that demonstrates these requirements have been met.

The MT shall be equipped with the following:

(1) Communication equipment as required in subsection 250.03(d)2.A. and a vehicle.
(2) Monitoring and detection equipment for flammable gas, oxygen sufficiency, toxic gas, radiological screening and other hazards. This includes, as required, a combustible gas indicator, flame ionization or photo ionization detector, oxygen meter, radiation monitor with Geiger Mueller detector and other foreseeable equipment.
(3) Personal protective equipment (levels C and D) when required.

The MT shall be present on site and perform monitoring as required by 250.03(d) when work is being performed in areas of suspected contamination and on a predetermined basis throughout other work on the project.

The MT shall monitor for compliance with regulations, the project Health and Safety Plan and the Materials Management Plan (if they exist for the project), the Contract, and the environmental documents for the project. The MT shall immediately notify the Contractor, the Engineer and the HSO of any hazardous condition.

During each week the MT is utilized, the MT shall prepare a daily monitoring diary which shall be submitted to the Contractor, HSO and the Engineer. This diary shall be submitted at the end of the week and shall become a part of the Department's records. The diary shall contain a chronological log of activities on the project including: dates and times on site, equipment used and calibrations, field monitoring results, visual observations, conversations, directives both given and received, and disposition of suspected hazardous substances. The Engineer will review this submittal and approve the actual number of hours to be paid.

(c) *Health and Safety Plan (HASP).* The HSO shall prepare a written HASP for the project, formatted as shown in Appendix B, *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities*, DHHS (NIOSH) Publication Number 85-115, available from the Superintendent of Documents, U.S. Government Printing Office. The Contractor and the HSO shall review the environmental documents listed prior to preparation of the HASP.

Four signed copies of the HASP shall be furnished to the Engineer for acceptance. The Engineer shall have seven calendar days to review and accept or reject the proposed HASP. Within five calendar days after acceptance, the HSO

shall distribute signed and stamped (or sealed) copies of the accepted HASP to each emergency response agency servicing the project area, the HASP designated emergency hospital, and five copies to the Engineer. Earth or demolition work shall not occur until after the HASP is accepted and the HASP has been distributed. The HASP shall also be available to the Contractor's employees, their representatives, and officials of OSHA, EPA, Colorado Department of Public Health and Environment (CDPHE), local government health department, Federal Highway Administration, and other appropriate agencies and officials as may be designated by the Engineer. The Engineer will distribute the accepted HASP to appropriate Department personnel. The HASP shall be kept current and shall be revised by the HSO as warranted by changes in the field conditions.

All on-site workers (Contractor's, Department's, Utilities', and others) shall be briefed by the HSO on the contents of the HASP and any revisions thereof. The HSO shall conduct briefings (group or individual) to inform new employees, subcontractors, utility companies and other on-site workers of the HASP contents prior to their entry on site. A signature log of all briefing attendees shall be kept and furnished to the Engineer.

The Contractor shall provide, as required, eye wash equipment and stations, emergency showers, hand and face washing facilities and first aid equipment.

The Contractor shall provide, as required, decontamination facilities for personnel and equipment employed in the work. The exact procedure for decontamination and frequency shall be included in the accepted HASP. Decontamination facilities shall meet the criteria set forth in the Code of Federal Regulations (29 CFR and 40 CFR).

(d) *Precautions and Procedures.* The following minimum precautions and procedures shall be followed during the construction of the project:

1. General construction precautions:

   A. All monitoring and piezometer wells and test borings shall be established or abandoned by the Contractor as regulated by the State Engineer's Office. Copies of all required permits, notification, and abandonment documents shall be submitted to the Engineer prior to payment approval.

   B. Hazardous substance related activities shall have a work plan for each work phase which shall be coordinated with the Engineer at least three working days prior to commencement of each phase of the work.

   C. The Contractor shall properly handle all investigation derived waste generated by this project. Documentation shall be submitted to the Engineer of all tests performed for Treatment, Storage and Disposal (TSD) determination; classification of waste; hauling records; TSD

acceptance; manifest (if required); etc. in accordance with applicable laws and regulations.

D. When the work may involve air emissions, the Contractor shall contact the Colorado Department of Public Health and Environment(CDPHE), Air Pollution Control Division to ascertain if an air pollution emission notice (APEN) or permit is required for this operation. The Contractor shall be responsible for filing the APEN and obtaining said permit, if required. The processing of air pollution permits, if required, in non-attainment areas or where public hearings are required, likely will take more than 90 days.

2. For construction on a known or potentially contaminated site, the following conditions shall apply, in addition to those listed in subsection 250.03(d)1.:

A. The HSO shall be on site or readily available by radio, telephone or pager at all times during the work. When on site, the HSO shall have an operational portable or mobile cellular telephone available for immediate use in areas where such service is available. When on site in cellular telephone non-service areas, the HSO shall have available, for immediate use, radio access to a site with telephone service. The HSO shall be notified at least 24 hours prior to the start of confined space entry, storage tank removal, drilling, excavation, trenching, or dewatering operations.

B. The HSO shall designate the on site monitoring equipment for flammable gases, oxygen deficient or enriched atmosphere, and toxic gases, such as but not limited to, a flame ionization detector, photoionization detector, combustible gas indicator, and oxygen meter. This designated equipment shall be on site during all construction operations and be utilized during trenching, drilling, excavating, confined space entry, underground storage tank removal, and other appropriate construction operations. The exact equipment to fulfill this requirement shall be specified in the accepted HASP. The HSO shall conduct or supervise the monitoring. The monitoring equipment shall be calibrated as recommended by the manufacturer.

C. When drilling, trenching, or excavating in the presence of detectable concentrations of explosive gases, the soil shall be wetted and the operating equipment shall be provided with spark proof exhausts.

D. The Contractor, through the HSO, is responsible for ensuring that 29 CFR 1926 is fully complied with during the construction of the project.

E. Affected excavation operations shall be discontinued and personnel shall be removed from the affected excavation sites where any of the following levels are detected:

(1) 20.0 percent or more LEL flammable gas, or 10.0 percent in an underground or confined space,
(2) Permissible Exposure Limit (PEL) of any toxic gas,
(3) 19.5 percent or less oxygen,
(4) 25.0 percent or more oxygen,
(5) Greater than 2 mrem/hr. (Beta particle & photon radioactivity),
(6) Greater than 15 pCi/L (Gross alpha particle activity), or
(7) Other action levels as determined by the HSO.

F. Personnel shall be issued and utilize appropriate Health and Safety equipment as determined by the HSO, who shall provide the Engineer with a written explanation of what personal protective equipment (PPE) shall be worn, when, and by which personnel. Except in emergency cases, the Engineer shall be advised by the HSO of changes in the degree of PPE prior to implementation.

G. Personnel shall avoid the area immediately downwind of any excavation unless the excavation is monitored and declared safe.

H. The operators of excavating, trenching, or drilling equipment shall wear appropriate PPE as required in the HASP.

I. Exhaust blowers shall be present at the location where required in the accepted HASP.

J. The Contractor shall accomplish the work with employees who have been trained and equipped as required by the HASP and applicable provisions of 29 CFR 1910 and 29 CFR 1926.

K. Fire extinguishers, electrical equipment and wiring shall conform to the applicable requirements of 29 CFR 1926 and 49 CFR.

L. Smoking shall not be permitted within 50 feet of any excavation.

3. For construction within 1000 feet of a known or potentially contaminated site, the following conditions, in addition to those listed in subsection 250.03(d) 1. shall apply:

A. The areas under construction shall be checked with a combustible gas indicator before excavation begins to determine if flammable or combustible gas is in the area.

B. Excavations, trenches and drill holes shall be monitored by the HSO for flammable gas, toxic gas and oxygen deficiency or enrichment. This shall be carried out continuously unless the presence of flammable, combustible or toxic gas, or oxygen deficiency or enrichment in the area can be ruled out by the HSO. The

recommendation to discontinue monitoring must be agreed to by the Engineer and the Contractor. Prior to implementation, this agreement shall be written, and shall contain specific conditions that will require re-evaluation of the area.

C. When flammable or toxic gas is found in the area, those precautions and procedures in subsection 250.03(d)2. shall apply.

4. The following procedures shall be followed if the level of contamination as documented in the environmental documents referenced in subsection 102.05 as revised for this project is exceeded, or if previously unidentified contaminated air, soil or water, is encountered during the construction of the project:

A. Work in the immediate area of the release or discovery of contamination shall cease. The Engineer shall be immediately notified.

B. If no HSO is required by the Contract, the Contractor shall designate an HSO as directed, in accordance with subsection 250.03(a).

C. The Engineer may direct the HSO to evaluate the material for potential hazardous substance or other contamination or unsafe conditions. This evaluation may include, but is not limited to, on site field monitoring, on site testing, and on or off site laboratory analysis. Removal of storage tanks and surrounding contaminated soils shall be in accordance with applicable laws, regulations and established procedures. If the contaminated material cannot be placed in the embankment or remediated on site, it must be removed to an appropriate TSD facility, as designated in writing by the Engineer. The HSO shall supervise the necessary testing required to make appropriate TSD determinations. Disposal of the unsuitable material shall be considered as remediation work as described in subsection 250.03(d)4.D. and 250.03(d)4.E.

D. If this site is determined to be contaminated with petroleum products, hazardous substances or other solid waste in excess of that indicated in the above listed site investigation documents, a thorough Site Investigation and Waste Management Plan may be accomplished under the supervision of the HSO, if proposed by the HSO and approved by the Engineer. This investigation and study shall determine the extent of contamination and study the feasibility of at least three types of remedial action for the contaminated area as required by applicable statutes and regulations. The HSO shall be available to assist the Engineer in explaining this study to the regulatory agencies. The Contractor shall prepare the Remediation Plan as directed. The time required for the Engineer's review of the Remediation Plan,

including all necessary drawings, calculations, specifications, and other documentation will not exceed four weeks after a complete submittal is received. This work shall not be done unless authorized in writing by the Engineer.

E. If the site is determined to be contaminated with petroleum products; hazardous chemicals, materials, or wastes; or other solid wastes, and is required to be remediated, the HSO or other qualified individuals will supervise the Remediation Plan implementation as concurred to by the regulatory agencies, as directed. Hazardous Waste generated by remedial activities shall list the Colorado Department of Transportation as the hazardous waste generator on the required paperwork for projects on State Highways and their associated frontage roads. If this project is not on a State Highway or frontage road, then the appropriate local governmental entity having jurisdiction over the transportation system facility shall be listed as the hazardous waste generator. If the waste produced was caused by Contractor action, the Contractor shall be listed as the hazardous waste generator. Remediation work shall be done only when authorized by the Engineer in writing.

250.04 Heavy Metal Based Paint Management. When the work includes the removal of paint or items covered with paint which may contain lead, chromium or other heavy metals, the requirements of this subsection shall apply in addition to the requirements of subsection 250.03.

The requirements of the HASP shall be in accordance with OSHA Publication Number 3142, *Working with Lead in the Construction Industry.*

Paint Removal and Waste Disposal work shall be performed in accordance with 29 CFR 1926.62, State and local air quality regulations, the Steel Structures Painting Council (SSPC) Guide for Containing Debris Generated During Paint Removal Operations, the "Industrial Lead Paint Removal Handbook" (SSPC 91-18), and the references contained therein.

The following minimum precautions and procedures shall be followed unless modified in the approved HASP or its updates:

(a) The Contractor shall contact the CDPHE, Air Pollution Control Division to ascertain if an air pollution permit is required for the cleaning or demolition work. If an air pollution permit is required, the Contractor shall obtain the permit. The Contractor shall furnish the Engineer with a copy of the permit application and the permit issued prior to starting cleaning or demolition activities. A copy of the Air Pollution Emission Notice [APEN] shall be provided to the Engineer, if such notice is required under the Colorado Air Quality Control Commission's regulations. The processing of air pollution

permits in non-attainment areas, or where public hearings are required, likely will take more than 90 days.

(b) The Contractor shall contain paint chips, corrosion residues, and spent abrasives, herein referred to as waste materials, resulting from the cleaning or demolition operations. The Contractor shall not deposit or release waste material into the water, air or onto the ground below or adjacent to the structure. The Contractor shall conduct cleaning operations to minimize the waste materials produced. Prior to beginning the work, the Contractor shall submit to the Engineer for acceptance, a detailed methods statement for capturing, testing, and disposing of the removed materials. The Engineer will have seven calendar days to review, and accept or reject this methods statement.

(c) Abrasives utilized for blast cleaning shall be low-dusting and low waste. Unless approved otherwise, vacuum blasting or wheel blasting shall be used.

(d) The HSO shall sample and test the waste material for lead, chromium, and other paint associated heavy metals using the Toxicity Characteristic Leaching Procedure (TCLP) Test, Method 1311 of the EPA publication, Test Methods for Evaluating Solid Waste 846. Sample collection methodology and frequency shall be recommended by the HSO and accepted by the Engineer with an adequate number of samples taken to be representative of all waste material collected. If the waste material does not pass the TCLP test, it shall be disposed of in a permitted TSD facility as designated in writing by the Engineer. The waste materials handling decision shall be documented by a report (five copies) submitted to the Engineer. This documentation shall include a description of sample collection methodology, testing performed, test results and comparison of test results with hazardous waste requirements. The waste material shall not be held at an unpermitted TSD facility site in excess of Resource Conservation and Recovery Act (RCRA) temporary storage time limits.

(e) When an item coated with paint is removed, all loose paint shall be removed and collected from the item within 24 hours of the time it is removed or placed onto the ground. All loose paint shall be removed and collected from a painted item before it is removed from the site. The Contractor shall contain loose paint until it is removed and collected. Loose paint is defined as that which can be removed by manual scraping methods. Over waterways, the Contractor shall capture all paint debris by the method specified in the methods statement. The paint debris shall be collected on a daily basis and shall be stored in a properly labeled, tightly sealed container and placed in a secured location at the end of each working day.

(f) All painted steel components which are not designated to be salvaged shall be recycled. Contractor possession of the steel for future use shall be considered a form of recycling. Prior to transport of the components off-site, the Contractor shall obtain a letter from the recipients of the painted steel components stating that they have been fully informed of the contents of the paint and are capable of

handling the paint. If the Contractor is to maintain future possession of the steel, the Contractor shall supply this letter. If there will be more than one recipient of the painted material, one letter shall be obtained from each recipient. The Contractor shall provide a copy of each letter to the Engineer. If the painted steel components will be recycled by melting, this letter is not required. The Contractor shall submit a letter stating the destination of the painted steel components and that they will be melted.

(g) When the work consists of the removal of a bridge or components of a bridge coated with paint which has been assumed to contain lead, chromium, other heavy metals, or a combination thereof the Contractor shall capture paint debris which is dislodged during removal operations. The Contractor may choose any method for dismantling the bridge, subject to the following required construction sequence limitations:

(1) The concrete deck shall be removed prior to removal of the steel superstructure.

(2) If the methods statement indicates that girders will be dropped to the ground during dismantling, all debris from the concrete deck removal operation shall be removed from the area below the bridge before any girders are dropped into this area.

(3) Girders may be cut and dropped only if the span is located entirely over land.

250.05 Material Handling. This work consists of the additional handling of soils to be excavated for construction of the project which are suspected or known to be contaminated. This work also includes stockpiling or containerization, analytical sampling and testing, and final disposition of soils specially handled.

The Contractor shall maintain vertical trench walls for the work in the specified areas of known or potential contamination, as shown on the plans. Shoring may be necessary to meet this requirement. The Contractor shall confine the removal of contaminated soils in the specified areas to the vertical and horizontal limits of structure excavation specified in the Contract. The Contractor shall be responsible for any contaminated materials generated beyond the limits of excavation. This shall include any sampling, analysis, and disposal required, and the costs thereof. The Contractor shall be listed as the generator of any such material. The limits of excavation shall be determined as 18 inches outside of structures, including sewers, water lines, inlets, manholes, and other underground structures to be constructed, or as directed.

Specific areas of known or potential contamination have been identified in the project plans. There is the potential of encountering contaminated soil, which has

not been summarized in the plans or specifications, at unknown locations on the site. Suspected contaminated soil will be handled by one of three methods as follows:

(a) *Materials Handling (Stockpile).* When recommended by the HSO and authorized by the Engineer, material will be stockpiled for analysis and characterization for proper handling and, disposal, or both. Sampling and testing of materials shall be as described in the Contract. If analysis indicates that soil samples are designated as uncontaminated, as determined by the criteria shown in the Contract or as determined by the CDPHE, the associated soils will not require any special handling and will become the property of the Contractor and may be used on site, subject to other requirements of the Contract. Health and safety monitoring and strict fugitive dust control shall be conducted during the placement of these soils.

Stockpiled materials shall be secured in compliance with the following provisions until they are determined to be uncontaminated:

1. The Contractor shall not store the material for more than 90 days.

2. The Contractor shall prevent any runoff from infiltrating the ground or running out of the containment area.

3. Soils containing different contaminants shall be placed in separate stockpiles.

4. The Contractor shall prevent the dispersion of materials or the dilution or mixing of stockpiles.

5. The ground surface on which the contaminated soils will be placed shall be covered with plastic sheeting which will withstand the placement and removal of stockpiled materials without breaching.

6. The ground surface shall be graded to drain toward the edge of the soil piles and the berm or trench around them shall be covered by plastic sheeting.

7. Proper security shall be provided in accordance with 40 CFR.

(b) *Solid Waste Disposal.* Soils determined to be contaminated, but not hazardous, as established by criteria in the Contract or as determined by CDPHE or other regulatory agencies having jurisdiction, shall be handled and,disposed of, or both as recommended by the HSO and approved by the Engineer. The Contractor shall haul this material to a solid waste disposal facility.

(c) *Hazardous Waste Disposal.* Soils that are designated or suspected to be hazardous shall be containerized immediately upon excavation or upon discovery. Hazardous material shall be labeled and transported to a hazardous waste disposal facility designated by the Engineer.

(d) *Additional Requirements*. Stockpiled or containerized material characterized as uncontaminated, contaminated or hazardous shall be stored and disposed of in a manner consistent with current established federal, state, and local regulations for waste materials.
Materials with contaminants not specifically regulated shall be disposed of by the Contractor as directed, in consultation with CDPHE. All areas where wastes are generated shall be reviewed by the HSO to identify potential contaminant sources that may result in a contaminated waste stream.

Contaminated soils, which have been identified as solid waste or hazardous waste, requiring disposal according to federal, state, and local regulations, shall be transported in accordance with 49 CFR by the Contractor to an appropriately permitted landfill, incinerator or asphalt plant or other facility approved to accept the waste. CDPHE and the landfill or other treatment or disposal facility shall be notified by the HSO of the material to be disposed of and the corresponding analytical test results prior to shipment.

Potentially contaminated water collected from the lined trench of a stockpile shall be treated as required by Colorado Wastewater Discharge Permit System (CDPS) permits, 29 CFR and 40 CFR and reimbursed separately in accordance with Contract requirements.

250.06 Sample delivery. This work consists of the collection, containerization and delivery of material samples for analysis to the testing facility designated in the Contract.

Environmental Protection Agency (EPA) protocol and standards shall be followed in the collection, containerization and transport of samples to be analyzed, including the documentation of the proper chain of custody of all samples. The Contractor shall collect sufficient sample material to perform the required analysis and is responsible for ensuring that appropriate climate control has been provided for sample transport. Sample delivery shall be made within the maximum allowable holding time for each sample type, not to exceed 24 hours, excluding weekends. The time period required for sample collection and delivery to the testing facility will not be considered an excusable delay. The analysis to be completed and turnaround time shall be approved by the Engineer.

The Contractor shall provide the Engineer with a copy of documentation indicating that proper chain of custody requirements have been followed for all samples.

Quality control samples shall be provided by the Contractor in accordance with the quality control requirements of the testing facility designated in the Contract (quality control requirements are available from the Engineer). The Contractor shall prepare, label and transport these samples to the testing facility in conjunction with the

delivery of other samples authorized for analysis by the Engineer, at no additional cost.

The Engineer may request splits of samples, in advance of collection, which shall be provided at no additional cost by the Contractor.

250.07 Asbestos-Containing Material Management. If known or suspected asbestos-containing material is encountered, the requirements of subsection 250.03(d)4. shall be followed. Management of asbestos-containing materials shall be by an Asbestos Inspector and Manager.

METHOD OF MEASUREMENT

250.08 Environmental Health and Safety Management will not be measured, but will be paid for on a lump sum basis. This will include all work, materials, and hourly time charges by the HSO and other personnel required to accomplish the following:

Preparation and briefing of the initial HASP;
Procedures and equipment specified in subsections 250.03 - 250.07;
PPE (levels C and D) for Contractor's personnel for any contamination identified in the preconstruction investigations;
Preparation and submittal of the final site report.

The quantity to be measured for Health and Safety Officer will be the total number of hours that the Health and Safety Officer is actually used, as authorized, for the following work:

Field monitoring necessary to ensure the safety of workers on the site;
Hours in excess of the items listed under Environmental Health and Safety Management;
Hours that are necessary due to unforeseen site conditions; and
Hours of additional consultation or field work that is requested by the Engineer.

Equipment specified in subsection 250.03(a), preparation and submittal of the daily HSO diary, travel to and from the project site, and PPE (Levels C and D) required for use by the HSO will not be measured and paid for separately, but shall be included in the hourly cost of the HSO.

The quantity to be measured for Monitoring Technician will be the total number of hours that Monitoring Technician is actually used as authorized. Equipment specified in subsection 250.03(b), supervision of the MT, preparation and submittal of the daily monitoring diary, travel to and from the project site, and PPE required for use by the MT (Levels C & D) will not be measured and paid for separately, but shall be included in the hourly cost of the MT.

Materials stockpiled under the requirements of this specification will be measured by the cubic yard computed from cross sections by the average end area or other acceptable

method. Disposal of solid waste and hazardous waste materials will be measured by the cubic yard in the disposal container.

Materials Sampling and Delivery will be measured by the actual number of samples collected, containerized and transported to the testing facility indicated in the Contract.

Additional environmental health and safety management work required and authorized by the Engineer, but not included in the items listed above, will be considered extra work to be paid for in accordance with subsection 109.04, unless such work is caused by the Contractor's action.

BASIS OF PAYMENT

250.09 Partial payment for Environmental Health and Safety Management, as determined by the Engineer, will be made as the work progresses. The Contractor shall submit a schedule of environmental related Health and Safety Management work before the first partial payment is made. The schedule shall indicate the environmental related Health and Safety Management time for each work item that requires Contractor environmental related Health and Safety Management effort and the total time for the project.

The accepted quantity for Health and Safety Officer will be the number of hours actually used and approved for payment by the Engineer and will be paid for at the contract unit bid price.

The accepted quantity for Monitoring Technician will be the number of hours of on site monitoring as approved by the Engineer and will be paid at the Contract unit price.

Environmental Health and Safety Management, Health and Safety Officer and Monitoring Technician bid items shall include vehicles, phone charges, supplies, printing, postage, office support, and all other miscellaneous costs associated with the work.

Payment for Materials Handling (Stockpile) will be made at the contract unit price for all excavated material required to be stockpiled for analysis. The contract unit price will be full compensation for furnishing all materials, labor, equipment and incidentals necessary to complete this work, and all handling of the material prior to disposal. This includes haul, stockpile, water collection, and security. Payment for this work will be in addition to any payment made under other bid items for excavation, embankment or backfill on the project, or waste disposal of this material.

Payment for Solid Waste Disposal and Hazardous Waste Disposal will be made at the appropriate contract unit price for the disposal of material determined to be either solid waste or hazardous waste. The contract unit prices will be full compensation for furnishing all materials, labor, equipment, tools, storage containers for transport, containerization of material for up to 60 days, and incidentals necessary to complete this work. This includes all handling of the material, loading for disposal, unloading for disposal, and borrow material required for replacement of excavated material disposed of off site. It does not include stockpiling required for analysis which is included in the item Materials Handling (Stockpile) paid for as described above.

250.09

Payment for waste disposal fees and transport of hazardous waste will be made as shown below. Payment for this work will be in addition to any payment made under other bid items for excavation, embankment, backfill or material handling (stockpile) on the project.

(1) *Solid Waste Disposal.* Transport costs to the disposal facility and disposal fees will be included in the contract unit price for this work.

(2) *Hazardous Waste Disposal.* Transport costs to the disposal facility and disposal fees will be paid for in accordance with subsection 109.04

The cost of shoring required to limit the removal of contaminated materials to the specified limits shall be included in the bid unit prices for any excavation to be performed. Such shoring ordered by the Engineer in areas other than the specified areas of known or potential contamination, as shown in the plans, will be paid for in accordance with subsection 109.04.

Payment for Materials Sampling and Delivery will be made at the contract unit price for each material sample collected, containerized and transported to the laboratory testing facility as designated in the Contract. The Contract unit price will be full compensation for furnishing all materials, labor, equipment, tools and incidentals necessary to complete this work including required sampling kits, containers, sample splits and quality control samples.

The Contractor shall be responsible for damage caused by construction operations to the environment, persons, or property. Expenditures associated with actions of the Contractor shall be borne by the Contractor at no cost to the project.

The accepted quantities will be paid for at the contract unit price for each of the pay items listed below that appear in the bid schedule.

Payment will be made under:

Pay Item	**Pay Unit**
Environmental Health and Safety Management	Lump Sum
Health and Safety Officer	Hour
Monitoring Technician	Hour
Materials Sampling and Delivery	Each
Materials Handling (Stockpile)	Cubic Yard
Solid Waste Disposal	Cubic Yard
Hazardous Waste Disposal	Cubic Yard

SECTION 300
BASES

SECTION 304
AGGREGATE BASE COURSE

DESCRIPTION

304.01 This work consists of furnishing and placing one or more courses of aggregate and additives, if required, on a prepared subgrade.

MATERIALS

304.02 Aggregate. The aggregates shall meet the requirements of subsection 703.03.

Acceptance will be based on random samples taken from each lift.

304.03 Commercial Mineral Fillers. Portland cement shall conform to subsection 701.01. Hydrated lime shall conform to subsection 712.03.

CONSTRUCTION REQUIREMENTS

304.04 Placing. If the required compacted depth of the aggregate base course exceeds 6 inches, it shall be constructed in two or more layers of approximately equal thickness. The maximum compacted thickness of any one layer shall not exceed 6 inches. When vibratory or other approved types of special compacting equipment are used, the compacted depth of a single layer may be increased to 8 inches upon request, provided that specified density is achieved and written approval is given.

304.05 Mixing. The Contractor shall mix the aggregate by methods that insure a thorough and homogenous mixture.

304.06 Shaping and Compaction. Compaction of each layer shall continue until a density of not less than 95 percent of the maximum density determined in accordance with AASHTO T 180 has been achieved. The surface of each layer shall be maintained during the compaction operations so that a uniform texture is produced and the aggregates are firmly keyed. Water shall be uniformly applied during compaction in the quantity necessary for proper consolidation.

The surface of the base course will be tested with a 10 foot straightedge, or other approved device. The surface shall be tested prior to the application of any primer or pavement. The variation of the surface from the testing edge of the straightedge between any two contacts with the surface shall not exceed ¼ inch. All irregularities exceeding the specified tolerance shall be corrected to the satisfaction of the Engineer at no additional cost to the Department.

The above compaction and straightedge requirements shall not apply to shoulder gravel. Compaction of shoulder gravel shall be accomplished by wheel rolling, as directed.

METHOD OF MEASUREMENT

304.07 Aggregate base course will be measured by the ton, or by the cubic yard compacted in place.

BASIS OF PAYMENT

304.08 The accepted quantities of aggregate base course, of the class specified, will be paid for at the contract price bid per ton or per cubic yard, as shown in the bid schedule.

Payment will be made under:

Pay Item	Pay Unit
Aggregate Base Course (Class___)	Ton, Cubic Yard

Water will not be measured and paid for separately but shall be included in the work.

Commercial mineral fillers, when used, will be measured and paid for in accordance with Section 307 or as provided in the Contract.

SECTION 306
RECONDITIONING

DESCRIPTION

306.01 This work consists of blading, shaping, wetting, and compacting the existing subgrade with moisture and density control.

CONSTRUCTION REQUIREMENTS

306.02 The top 6 inches of the existing subgrade shall be reconditioned by blading and rolling. Sufficient water shall be added to meet the density requirements as specified in the Contract. The reconditioned surface shall not vary above or below the lines and grades as staked by more than 0.08 foot. The surface shall be tested for smoothness and density prior to the application of any base course material. Where bituminous surfacing materials are to be placed directly on the subgrade, the subgrade plane shall not vary more than 0.04 foot. All irregularities exceeding the specified tolerance shall be corrected to the satisfaction of the Engineer at no additional cost to the Department. The surface shall be satisfactorily maintained until base course has been placed.

METHOD OF MEASUREMENT

306.03 Reconditioning will be measured by the square yard of subgrade, including auxiliary lanes, and shall include blading, shaping, scarifying, compacting the subgrade, finishing, and maintenance of the finished surface.

BASIS OF PAYMENT

306.04 The accepted quantities of reconditioning will be paid for at the contract unit price for reconditioning.

Payment will be made under:

Pay Item	Pay Unit
Reconditioning	Square Yard

Water will not be measured and paid for separately but shall be included in the work.

SECTION 307
LIME TREATED SUBGRADE

DESCRIPTION

307.01 This work consists of treating the earth subgrade by combining lime and water with the pulverized soil subgrade material to the specified depth and compaction requirements as shown on the plans.

MATERIALS

307.02 Lime. Lime for lime treated subgrade shall be applied in slurry form. Dry application of lime will not be allowed unless otherwise approved by the Engineer. Commercial lime slurry shall be a pumpable suspension of solids in water. Lime for lime treated subgrade shall conform to the requirements of ASTM C 977 and rate of slaking test for moderate reactivity per ASTM C 110 and shall be the product of a high-calcium limestone as defined by ASTM C 51.

307.03 Water. Water used for mixing or curing shall be shall be in accordance with subsection 712.01, with the additional requirement that the sulfate content shall be less than 500 ppm.

CONSTRUCTION REQUIREMENTS

307.04 General. The Contractor shall construct one or more compacted courses of treated material, to the depth specified in the Contract. The treated material shall be a uniform blend of soil, lime, and water, free from loose or segregated areas. It shall have uniform density and moisture content and be void of all vegetation and other organic or man-made material. The subgrade shall be well bound for its full depth and width with a smooth surface suitable for placing subsequent courses. The Contractor shall regulate the sequence of the work to accurately apply and uniformly blend the lime at the designated rate and rework the courses as necessary to meet the above requirements.

The Contractor shall submit a mix design to the Engineer for approval, prior to constructing the test section.

The Contractor shall mix hydrated or quicklime with water to produce lime slurry at the job site with equipment specifically manufactured for this purpose.

Excessive aeration of lime slurry will not be permitted

The lime-treated subgrade shall not be mixed when it is raining, or when the subgrade material is frozen. The lime-treated subgrade shall not be mixed or compacted if the temperature of the lime or soil is below 35 °F.

307.05 Preparation of Subgrade. Prior to beginning any lime treatment the subgrade shall be constructed and finished to smooth and uniform surfaces conforming to the grades and typical sections specified. Variation from the subgrade

plane elevations specified shall not be more than ± 0.1 foot. The subgrade shall also be proof rolled in accordance with subsection 307.07. Soft or otherwise unsuitable subgrade disclosed by proof rolling shall be over-excavated, and replaced to a compacted stable state. The in-place density shall be at least 95 percent of AASHTO T 99 density within 0-3 percent of optimum moisture content.

307.06 Test Section. Prior to full-scale production, the Contractor shall construct a test section to demonstrate, to the satisfaction of the Engineer, subgrade stabilization using the materials, equipment, and methods to be used in full-scale production. The test section shall be at least 100 feet long, two spreading and mixing lanes wide, and the same depth as the course represented in the plans. The test section shall be constructed at a location approved by the Engineer.

The test section shall be tested in accordance with the same test requirements for the lime and soil design mix, and as determined by the Contractor.

If the test section is unsatisfactory, the Contractor shall adjust the materials, equipment, and methods or combinations thereof as necessary to conform to the specifications. Additional test sections shall be constructed as required to produce a satisfactory test section prior to full-scale production. Unsatisfactory test sections shall be removed and replaced at the Contractor's expense. Full production shall not begin until a satisfactory test section is completed and approved by the Engineer.

Prior to start of work, the Contractor shall determine the lime application rate, and the maximum dry density and optimum moisture content of the material after it has been treated with lime. All tests shall be performed in the presence of the Engineer. These test results will be used to determine the Contract requirements for lime application.

307.07 Proof Rolling. Both prior to and after the lime treatment, the Contractor shall perform proof rolling in accordance with subsection 203.09, except that final proof rolling will take place a minimum of seven days after lime treatment, unless otherwise approved by the Engineer.

307.08 Processing Materials. After the subgrade has been finished and approved as specified, the subgrade shall then be cut and pulverized by a cutting and pulverizing machine to the depth and width shown on the plans. Precautions shall be taken to avoid forming furrows of loosened material below the depth specified for the lime-stabilized soil mixture. The machine shall uniformly cut and pulverize the loosened material to a depth not greater than 10 percent over the thickness of the lime-treated layer as specified in the Contract and shall have cutters that plane the base of the cut and pulverize zone to a smooth surface over the entire width of the cut. The machine must give visible indication at all times that it is cutting to the proper depth.

(a) *Lime Application.* Lime shall be applied in the form of a slurry, on that area where the initial mixing operations can be completed during the same working day, and at the specified percentage of hydrated lime, by equipment capable of

pumping and re-circulating the mixture while in transit. The slurry shall be applied through spray bars to assure a uniform flow and distribution.

(b) *Initial Mixing.* Initial mixing shall take place immediately after lime application. The lime, soil, and water shall be thoroughly mixed and blended by a self propelled rotary type mixing machine, until a uniform mixture throughout the required depth and width is obtained and all clods and lumps are reduced to a maximum 2 inch diameter size. There shall be a minimum 6 inch overlap between passes to assure consistent mixing and breakdown.

The mixing machine shall make at least of two passes to uniformly mix the lime, water, and soil to the full depth of the pulverized layer. Non-uniformity of color reaction, when the treated material is tested with the standard phenolphthalein alcohol indicator, will be considered evidence of inadequate mixing. Streaks and pockets of lime will also be considered evidence of inadequate mixing, and shall require additional mixing to correct.

The moisture content of the mixture immediately following the blending of water, lime, and soil shall not be less than optimum as determined by AASHTO T 99, plus necessary hydration moisture. Hydration moisture will be considered as one percentage point for each percent of lime being added. When proper mixing has been accomplished, the mixture shall be cured for at least 48 hours. Light rolling to seal the surface of the mixture shall be required. The mixture shall be maintained in a moist condition throughout the entire curing period.

(c) *Final Mixing.* After the required curing period, the mixture shall be uniformly mixed by a self-propelled rotary type mixing machine and maintained at approximate optimum moisture content as determined herein. If the lime stabilized soil mixture contains clods, they shall be reduced by approved pulverization so that the remainder of the material shall meet the gradation requirements of Table 307-1 when tested dry by laboratory sieves. If it is determined that additional lime needs to be added to the previously mixed subgrade, the total depth of the subgrade shall be mixed.

307.09 Compaction

(a) Compaction of the lime and soil mixture shall begin immediately after final mixing. The material shall be aerated or sprinkled as necessary to maintain the mixture within the specified moisture content limits during and following compaction. The field density for the compacted mixture shall be at least 95 percent of the maximum density of laboratory specimens prepared from samples taken from the lime soil material in place after curing and prior to compacting. The specimens will be compacted and tested in accordance with AASHTO T 99, and the in-place field density will be determined in accordance with Colorado Procedure (CP) 80. Any mixture that has not been compacted shall not be left undisturbed for more than 30 minutes. The moisture content of the mixture at the start of compaction shall be at 2 ± 1 percent above the optimum moisture

content. The optimum moisture content will be determined in accordance with AASHTO T 99.

(b) The finished surface shall be smooth and uniform conforming to the typical sections specified. All irregularities, depressions, or weak spots, which develop, shall be corrected immediately by scarifying the areas affected, adding or removing material as required, and reshaping and re-compacting by sprinkling and rolling. The surface of the course shall be maintained in a smooth condition, free from undulations and ruts, until other work is placed thereon or the work is accepted.

(c) In addition to the requirements specified for density, the full depth of the materials shown on the plans shall be compacted to the extent necessary to remain firm and stable under construction equipment. After each section is completed, the Engineer will conduct tests. If the material fails to meet the density and strength requirements in accordance with the lime and soil design mix, it shall be reworked to meet these requirements at the Contractor's expense. Throughout this entire operation, the shape of the course shall be maintained by blading, and the surface upon completion shall be smooth and shall conform with the typical section shown on the plans and to the established lines and grades. Variation from the subgrade plan elevations specified shall not exceed 0.04 foot. Should the material, due to any reason or cause, lose the required stability, density, or finish, before the next course is placed or the work is accepted, it shall be recompacted and refinished at the Contractor's expense.

307.10 Finishing and Curing . When initial compaction of the top layer of the lime-stabilized soil mixture is nearing completion, the surface shall be shaped to the required lines, grades, and cross section, and compaction continued until uniform and adequate compaction is obtained. The treated material shall be maintained at a moisture content satisfactory for proper curing by one of the following:

(1) Sprinkling for a period of seven days.

(2) Sprinkling for a period less than seven days until emulsified asphalt prime coat (diluted 1 to 1) is applied in accordance with subsection 307.10, item (3) below.

(3) Applying a protective film of emulsified asphalt prime coat (diluted 1 to 1 with water) immediately after the lime-treated subgrade has been finished. One application shall be made consisting of 0.20 gallon diluted mixture per square yard.

The completed section shall be cured for a minimum of seven days before further courses are added or any traffic is permitted, unless otherwise directed by the engineer. Acceptable compressive strength test results shall be in a range from a minimum of 160 pounds per square inch to 500 pounds per square inch.

307.11 Construction Joints. Construction joints are not required after each day's work unless there is a time lapse of seven days or more between the processing of adjacent sections. If construction joints are required, they shall be formed by cutting back into the completed work to form a vertical face. Damage to completed work shall be avoided.

307.12 Thickness Acceptance. Lime treated subgrade will be accepted for minimum thickness on a lot basis. A lot will consist of 1,500 square yards. One core shall be taken at random by the Contractor's Quality Control Inspector in each lot. When the measurement of the core from a lot is not deficient by more than 0.5 inch from the minimum plan thickness, full payment will be made. When such measurement is deficient by more than 0.5 inch and not more than 1.0 inch from the plan thickness, two additional cores shall be taken at random and used in determining the average thickness for that lot. The thickness of the core shall be determined by average caliper measurement of cores tested in accordance with ASTM C 174. When the average measurement of the three cores is not deficient by more than 0.5 inch from the plan thickness, full payment will be made. If the average measurement of the three cores is deficient by more than 0.5 inch but less than 1.0 inch from the plan thickness, the entire lot may be left in place and a 10 percent price reduction to the contract unit price will be made. If the average measurement of the three cores is deficient more than 1.0 inch but less than 2.0 inches from the plan thickness, the entire lot may be left in place and a of 50 percent price reduction to the contract unit price will be made. When the average thickness is deficient by more than 2.0 inches, the entire lot shall be replaced at the Contractor's expense.

Table 307-1
SCHEDULE FOR MINIMUM SAMPLING AND TESTING

Element and Procedure	Process Control	Acceptance	Remarks
pH ASTM C 977 (App) (Design) *ASTM G 51 (Field)*	1/5,000 sq. yds. or fraction thereof	1/10,000 sq. yds. or fraction thereof	pH will be determined after % lime has been established based on unconfined compressive strength
Atterburg Limits AASHTO T 89, T 90	1/5,000 sq. yds. or fraction thereof	1/10,000 sq. yds. or fraction thereof	Reduce by ½ original PI
Swell Potential ASTM D 4546	1/5,000 sq. yds. or fraction thereof	1/10,000 sq. yds. or fraction thereof	½ % or less with 200 psf surcharge pressureModified as per local practices
Unconfined Compressive Strength ASTM D 5102(Procedure B)	1/5,000 sq. yds. or fraction thereof 1/soil type	1/10,000 sq. yds. or fraction thereof 1/soil type.	Determined by design plan criteria. Do not immerse in water after moist-cure period. The tests shall be conducted on samples cured in a moist environment for 5 days @ 100 °F
Thickness Acceptance ASTM C 174	A lot is defined as 1 core per 1,500 sq. yds. or fraction thereof	1/3,000 sq. yds. or fraction thereof	When measurement is <0.5", 2 additional cores shall be taken in that lot and the average of 3 cores will determine the thickness of that lot
Gradation CP 31	1/5,000 sq. yds. or fraction thereof	1/10,000 sq. yds. or fraction thereof	1" – 100% passing; #4 – 60% passing, dry sieving after final mixing
Determining Percent Relative Compaction Soil-Aggregate by Nuclear Method CP 80	1/5,000 sq. yds. or fraction thereof	1/10,000 sq. yds. or fraction thereof	Minimum 95% of maximum dry density as per AASHTO T 99. Moisture content of mixture at the start of compaction shall be at 2 ± 1% above optimum moisture content
Moisture Density CurveAASHTO T 99	1/soil type	1/soil type	
Sulfate AASHTO T 290	1/soil type	1/soil type	Sulfate content shall be less than 0.2% by weight in a 10:1 water to soil solution.

METHOD OF MEASUREMENT

307.13 Hydrated lime will be measured by the ton. If quicklime is used the pay quantity will be determined using the certified lime purity for each truckload as follows:

Pure quicklime (CaO) • 1.32 = Hydrated Lime ($Ca(OH)_2$)
Quicklime delivered • % purity • 1.32 = A
Quicklime delivered • % inert material = B
A + B = total hydrated lime produced = pay quantity

Processing lime-treated subgrade will be measured by the square yard for the area completed and accepted. Overlap mixing will not be measured and paid for separately but shall be included in the work.

BASIS OF PAYMENT

307.14 The accepted quantities will be paid for at the contract unit price for each of the pay items listed below that appear in the bid schedule. Payment shall include all processing materials, lime application and mixing, compaction, and materials used in curing.

Payment will be made under:

Pay Item	**Pay Unit**
Hydrated Lime	Ton
Processing Lime Treated Subgrade (____Inch)	Square Yard

Test sections and coring will not be measured and paid for separately, but shall be included in the work.

All proof rolling will be measured and paid for in accordance with Section 203.