DESIGN & IMPROVEMENT STANDARDS TECHNICAL SPECIFICATIONS STANDARD DETAILS

MARCH 2018

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SECTION 01300

SUBMITTALS

PART I- GENERAL

1.01 REQUIREMENTS INCLUDED

The **CONTRACTOR** shall submit to the **ENGINEER** for approval all submittals required by the General Conditions and these Specification sections.

1.02 **INSURANCE CERTIFICATES**

Refer to General Conditions for submittal requirements. Submit updated certificates as necessary to verify current coverage.

1.03 **SCHEDULE OF VALUES**

Refer to General Conditions for requirements. On bid items to be paid as lump sum that may extend beyond a single pay estimate, a schedule of values shall be submitted to **OWNER** a minimum of 10 days prior to work on that item. Adequate detail shall be given to allow a value to be placed on work completed during any given pay estimate. Where payment is to be based on unit bid prices, correlate schedule of values with Divisions and Sections of Specifications unless otherwise approved by the **ENGINEER.** If separate payment is to be requested for materials suitably stored but not installed, segregate delivered costs from installation costs, including overhead and profit.

1.04 **CONSTRUCTION SCHEDULE**

(See Section 01310 for Construction Schedule Submittal details).

1.05 **SHOP DRAWINGS**

(See Section 01340 for Shop Drawing Submittal details).

1.06 **PROJECT RECORD DOCUMENTS**

(See Section 01700, Contract Closeout, for project record document details).

END OF SECTION

SECTION 01310

CONSTRUCTION SCHEDULES

PART I

1.01 GENERAL

A. Within ten (10) days after EFFECTIVE DATE OF AGREEMENT or by the pre-construction conference, the **CONTRACTOR** shall prepare and submit to the **ENGINEER** estimated construction progress schedules for the Work, with subschedules of related activities which are essential to the progress of the Work.

B. Submit revised progress schedules as follows:

1. Weekly: Submit a two week schedule depicting items of work and general locations for the two weeks succeeding the date of submittal. Needs from **Owner** (submittal reviews, construction staking, etc) shall be included. This may be in the form of a spreadsheet and shall contain adequate detail to provide clear vision to all of the intended work. The Resident Project Representative shall be notified of variations from this schedule as soon as known and no later than the morning of the effected change.

2. Monthly: With each progress payment request, submit an updated progress schedule as detailed herein. Failure to submit this updated progress schedule or providing a progress schedule that does not represent the true status of the project as determined by the **Owner,** shall be grounds for a determination that no further progress payments are to be made until **Contractor** is in full compliance with this section.

C. **OWNER** may require **CONTRACTOR** to add to his plant, equipment or construction forces, as well as increase the working hours, if operations fall behind schedule at any time during the construction period.

D. Related Requirements Specified Elsewhere.

1. General Conditions.
2. Supplemental General Conditions.
3. Standard Specifications.

E. Additional Requirements Specified Elsewhere.

1. Measurement and Payment: Section 01000.
2. Summary of Work: Section 01010.
3. Shop Drawings: Section 01340.

1.02 FORM OF SCHEDULES

A. Prepare schedules in the form of a horizontal bar chart.

1. Provide separate horizontal bar for each trade or operation.
2. Horizontal time scale: Identify the first work day of each week.
3. Scale and spacing: To allow space for notations and future revisions.

4. Maximum sheet size: 24" x 36".

B. Computer generated schedule.

Network analysis system may be utilized in lieu of bar chart.

C. Format of Listings.

The chronological order of the start of each item of work.

1.03 CONTENT OF SCHEDULES

A. Construction Progress Schedules to include:

1. The complete sequence of construction by activity.

2. The dates for the beginning, and completion of, each major element in each major area of construction, including but not limited to:

a. Shop Drawing submittal
b. Pipeline installation, per size & station.
c. Bores/open cuts
d. Tank fabrication, shipping
e. Access road installation.
f. Tank site preparation.
g. Foundation
h. Tank installation
i. Tank preparation & painting
j. Telemetry installation

3. Projected percentage of completion for each item, as of the date on which each scheduled Application for Payment is due.

4. Complete projected progress payment schedule.

B. Schedule of Submittals for Shop Drawings and Product Data to include:

1. The dates for **CONTRACTOR's** submittals.
2. The dates approved submittals will be required from the **ENGINEER.** Extensions of time for delays in submittal review and distribution will only be allowed as provided for in Section 01340.

C. Products Delivery Schedule.

Show delivery dates for all major items of material and equipment.

D. Methods Statement.

A Methods Statement shall be included for all work items that fall on the critical path of the construction schedule. This Methods Statement shall be a detailed narrative describing each feature and all work necessary to complete the feature. The Methods Statement shall be submitted with the Construction Schedule. The following

format is required.

1. *Feature:* name of the feature.
2. *Responsibility:* Contractor, subcontractor, supplier, utility, etc. responsible of the feature.
3. *Procedures:* procedures to be used to complete the work. The procedure to be used shall include general information regarding methods such as forming, excavation, placing, heating, curing, backfill and embankment, trenching, protecting the work, etc. When separate or different procedures are to be employed by the **Contractor** due to seasonal or project phasing requirements, such differing procedures shall be described in the procedure statement.
4. *Production* Rates: the planned quantity of work per day for each feature.
5. *Labor Force:* the labor force planned to do the work.
6. *Equipment:* the number, types, and capacities of equipment planned to do the work.
7. *Work Times:* the planned time for the work to include:
   A. Number of work days per week.
   B. Number of shifts per day.
   C. Number of hours per shift.

At the **Owner's** request, the **Contractor** shall update the Methods Statement, or any part thereof, and submit it with the next monthly schedule update.

1.04 PROGRESS REVISIONS

A. Indicate progress of each activity to date of submission.

B. Show changes occurring since previous submission of schedule.

1. Major changes in scope.
2. Activities modified since previous submission.
3. Revised projections of progress and completion.
4. Revisions to projected progress payment schedule.
5. Other identifiable changes.

C. Provide a narrative report as needed to define:

1. Problem areas, anticipated delays, and the impact on the schedule.
2. Corrective action recommended and its effect.

1.05 SUBMISSIONS

A. Submit initial schedules within ten (10) days after effective date of Agreement.

1. **ENGINEER** will review Schedules and return review copy within ten (10) days after receipt.

2. If required, resubmit within seven (7) days after return of review copy.

B. Submit revised progress schedules with each Application for Payment.

C. Number of copies required at each submission:

1. The number of opaque reproductions required by the **CONTRACTOR** plus four (4) copies which will be retained or distributed by the **ENGINEER.**
2. Do not submit fewer than five (5) copies.

1.06 DISTRIBUTION

A. After review, **ENGINEER** will distribute copies of schedules to:

1. Two (2) copies to **OWNER.**
2. One (1) copy to Resident Project Representative.
3. One (1) copy to be retained in **ENGINEER's** file.
4. One (1) copy to **CONTRACTOR** to be kept on file at **CONTRACTOR's** field office.
5. Remainder to **CONTRACTOR** for his distribution following modifications if required.

B. Schedule recipients will report promptly to **ENGINEER** and **CONTRACTOR,** in writing, any problems anticipated by the projections shown on the schedules.

END OF SECTION

SECTION 01320

PRODUCT DELIVERY, STORAGE AND HANDLING

PART I - GENERAL

1.01 RELATED REQUIREMENTS

A. General and Supplementary Conditions

1.02 PRODUCTS

A. Products include material, equipment and systems.

B. Comply with Specifications and referenced standards as minimum requirements.

1.03 TRANSPORTATION AND HANDLING

A. Transport products by methods to avoid product damage; deliver in undamaged condition in manufacturer's unopened containers or packaging, dry.

B. Provide equipment and personnel to handle products by methods to prevent soiling or damage.

C. Promptly inspect shipments to assure that products comply with requirements, quantities are correct, and products are undamaged.

1.04 STORAGE AND PROTECTION

A. Store products in accordance with manufacturer's instructions, with seals and labels intact and legible. Store sensitive products in weathertight enclosures; maintain within temperature and humidity ranges required by manufacturer's instructions.

B. For exterior storage of fabricated products, place on sloped supports above ground. Cover products subject to deterioration with impervious sheet covering; provide ventilation to avoid condensation.

C. Store loose granular materials on solid surfaces in a well-drained area; prevent mixing with foreign matter.

D. Arrange storage to provide access for inspection. Periodically inspect to assure products are undamaged, and are maintained under required conditions.

END OF SECTION

SECTION 01340

SHOP DRAWINGS

PART I - GENERAL

1.01 REQUIREMENTS INCLUDED

A. The **CONTRACTOR** shall submit to the **ENGINEER** for approval all shop drawings required by the specification sections.

1.02 SHOP DRAWINGS

A. Shop drawings shall be prepared by a qualified detailer for **CONTRACTOR,** subcontractor, supplier, or manufacturer, and shall illustrate some portion of the work, showing fabrication, layout, setting, or erection details.

B. Identify details by reference to sheet and detail numbers shown on Contract Drawings. Use same symbols used on Contract Drawings to identify shop drawing details wherever practicable.

1.03 PRODUCT DATA

A. Submit manufacturer's standard schematic drawings:

1. Modify drawings to delete information that is not applicable to the project.

2. Supplement standard information to provide additional information applicable to project.

B. Submit manufacturer's catalog sheets, brochures, diagrams, schedules, performance charts, illustrations, and other standard descriptive data.

1. Clearly mark each copy to identify pertinent materials, products or models.

2. Show dimensions and clearances required, performance characteristics and capabilities, wiring diagrams and controls, and any other pertinent data applicable to the project.

C. Submit manufacturer's certificate of compliance certifying to compliance with specification requirements, applicable reference standards and test data requirements. Include reference to the specification section and paragraph with which the product or materials is intended to comply.

1.04 CONTRACTOR RESPONSIBILITIES

A. **CONTRACTOR** shall submit five (5) copies of each shop drawing required.

B. Submittals shall be made by **CONTRACTOR** to the **ENGINEER** with a transmittal form or letter and not by subcontractors, suppliers or manufacturers. **CONTRACTOR** shall review, stamp with his approval, and submit in orderly sequence all submittals required by the specifications. By approving and submitting items, **CONTRACTOR** represents that he has verified all field measurements, field construction criteria, materials, catalog numbers, and similar data, and has coordinated each shop drawing with requirements of the project.

C. The **CONTRACTOR** shall not begin work that requires submittals until the **ENGINEER** reviews and approves submittals. The **ENGINEER** will return an approved copy of the submittal to the **CONTRACTOR.**

D. **CONTRACTOR's** responsibility for errors and omissions in submittals, or for deviations in submittals from requirements of the Contract Documents, shall not be relieved by review of submittals unless **ENGINEER** gives written acceptance of specific deviations. The **CONTRACTOR** shall notify **ENGINEER** in writing at time of submission of deviations in submittals from requirements of the Contract Documents.

END OF SECTION

SECTION 01570

DETOURING/TRAFFIC CONTROL

1.0 GENERAL

1.01 Scope. This work shall consist of furnishing, installing, moving, maintaining and removing temporary traffic signs, advance warning signs, barricades, channelizing devices, delineators, and flagmen as required by the latest revision of the "Manual on Uniform Traffic Control Devices for Streets and Highways" and the latest revisions of the Colorado Supplement thereto, in accordance with the Drawings and these Specifications.

1.02 Related Work Specified Elsewhere.

All Sections.

1.03 Reference Standards.

A. Colorado Department of Transportation, Standard Specifications for Road and Bridge Construction 1999; Subsection 107.10 and Section 630.
B. Colorado Department of Transportation, Standard Plans Oct 2000; S Standards.
C. Federal Highway Administration; Manual on Uniform Traffic Control Devices.

1.04 Submittals.

A. Methods of Handling Traffic (MHT). The Contractor shall control traffic in accordance with the Traffic Control Plan (TCP), as shown in the contract. To implement the TCP, the Contractor shall develop and submit a method for handling traffic (MHT) for each different phase of construction which shows the Contractor's proposed construction phasing and proposed traffic control devices consistent with the TCP. If at any time the Contractor desires to change the MHT, it shall be considered a different phase requiring a new MHT.

Each proposed MHT shall be approved in writing by the Engineer before the corresponding phase of construction will be allowed to begin. The initial MHT shall be submitted a minimum of 10 days prior to the start of work on the project. All successive MHT's shall be submitted to allow reasonable time for review. MHT's for work in COOT rights-of-ways shall be submitted a minimum of twenty (20) days prior to commencement of related work.

The proposed MHT shall include detailed information as contained in Section 630.09 of the COOT Standard Specifications.
Submit a schedule of traffic control devices to be used at preconstruction conference.

Approval of the proposed method of handling traffic shall constitute authorization to furnish the devices on the schedule. If, at any time, it is determined that unnecessary units are on the schedule or that additional units are required, the Engineer will request the Contractor to revise the MHT and the devices shall be added or removed as approved. Any change in the plan or the

methods of handling traffic shall be approved by the Engineer. Approval of the proposed methods of handling traffic in no way shall relieve the Contractor of liability specifically provided for in the Contract.

2.00 MATERIALS

2.01 General. All materials shall conform to the applicable portions of the Reference Standards.

2.02 Barricades. Minimum 8' wide on movable skids.

3.00 METHODS AND PROCEDURES

3.01 Detours. None as anticipated.

3.02 Road Restrictions. As stated on Drawings.

3.03 Flagmen. Provide as needed, as directed by Engineer or as stated on Drawings to control traffic encroaching in construction zone.

3.04 Barricades, Channelizing Devises, Flashing Warning Lights. Provide for all work areas, open trenches, lane closures, equipment and material storage, etc., and as called for on the Drawings and located within limits of construction. Protection to be in place 24 hours per day and device inspection shall be seven days per week.

3.05 Traffic Control Management. Provided by a certified traffic control supervisor on a 24-hours-per-day basis. An after-hours contact shall be provided for every calendar day from the first placement of traffic control devices until all devices are removed. Any changes to this contact shall be submitted to the Engineer and to Dispatch Services.

4.00 Measurement and Payment.

Work under this item shall be paid for as lump sum. Work shall include contractor development of methods of handling traffic in accordance with the traffic control plan; placement and maintenance of traffic control devices; other devices as needed to protect and secure the work area; flagmen; traffic control management and inspection; and other items not specifically stated that are essential to the safe movement of vehicular and pedestrian traffic through and around the work area.

End of Section

SECTION 01700

PROJECT ACCEPTANCE

1.0 GENERAL

1.01 Scope. Work to be performed under this section shall include all labor, equipment, materials and miscellaneous items necessary to provide all documents, information and items as specified herein.

1.02 Related Work Specified Elsewhere.

All specification sections.

1.03 Project Record Documents.

A. Job site documents: Maintain at the job site one record copy of the following:

1. Drawings
2. Specifications
3. Addenda
4. Reviewed Shop Drawings
5. Change Orders
6. Other Modifications to Contract
7. Field Test Records

Do not use record documents for construction purposes. Maintain documents in clean, dry legible condition, apart from documents used for construction.

B. Record Information: Label each document "Record Document". Mark all information with contrasting color using ink. Keep each record current. Do not permanently conceal any work until required information is recorded.

Record following information on Drawings:

1. Depth of foundation elements.

2. Horizontal and vertical location of underground utilities.

3. Location of internal utilities and appurtenances concealed in construction.

4. Field changes of dimension and detail.

5. Changes by Change Order or field order.

6. Details not on original Contract Drawings.

Record following information on Specifications:

1. Manufacturer, trade name, catalog number and supplier of each

product and item of equipment actually installed.

2. Changes by change order or field order.

3. Other matters not originally specified.

Maintain Shop Drawings as record documents recording changes made after review as specified for Drawings above.

Submittal: At completion of project, deliver record documents to Engineer with transmittal letter containing date, project title and number, contractor's name and address, title and number of each record document, and certification that each document is complete and accurate. Submittal shall be signed by Contractor or his authorized representative.

1.04 Closeout Procedures. The following project closeout procedure defines the responsibilities of the Contractor, Owner and Engineer in closing the project:

Step 1: Contractor advises Engineer in writing that he has reached "Substantial Completion" and provides a list of items to be completed or corrected. Closeout may be conducted by areas or portions of the work if requested by Owner.

Step 2: Engineer inspects the work to determine if it is substantially complete, and issues a Certification of Substantial Completion plus a "punch list" of items to be completed or corrected.

Step 3: Contractor completes and/or corrects all punch list items and notifies in writing that his work is ready for final inspection. At this time, a final application for payment is submitted to the Engineer.

Step 4: Engineer makes final inspection. When the Work is found to be acceptable under the Contract Documents, and the contract fully performed, Engineer will issue a final Certificate of Payment.

1.05 Re-Inspection Fees. Should the Contractor fail to complete and/or correct all punch list items such that additional inspections are required by the Engineer, the Contractor will be billed at the Engineer's current rate for additional services. If the Contractor has any question with regard to any items on the punch list, he is to request clarification before final inspection.

1.06 Final Paperwork. Prior to release of final payment, the General Contractor shall deliver the following items to the Engineer:

Inspection Certificates, as applicable.
Materials Certificates of Compliance.
Equipment and material guarantees.
General Contractor's two-year guarantee of materials and workmanship.
Maintenance Manuals and Parts Lists, as specified.
All other guarantees, warranties and submittals, as specified.
Receipts for extra materials delivered to the Owner.
Miscellaneous keys, switches, etc.

Final application for payment.
Consent of surety to final payment.
Contractor's affidavit of release of liens (AIA Form G-706A).
Project record drawings.
Contractor acknowledgement of Date of Substantial Completion.
All documentation as required for federally funded projects or as contained herein.

The above items are described in following articles or applicable sections of the Specifications.

1.07 Inspection Certificates. Each subcontractor shall, upon completion of the Work, secure in triplicate from any state or local governing bodies having jurisdiction in dictating that the Work is in strict accordance with the applicable codes and deliver same to the General Contractor for transmittal to the Owner.

1.08 Certificates of Compliance. Provide certificates of compliance for materials and products incorporated into the project. Each certificate shall include:

1. The Engineer's project number
2. A complete description of the material.
3. The manufacturer's name.
4. The name of the product or assembly.
5. The model, catalog, of stock number if applicable.
6. A lot, heat, or batch number that identifies the material delivered.
7. A statement that the product or assembly to be incorporated into the project was fabricated in accordance with and meets the applicable specifications.

1.09 Warranties. The General Contractor and each subcontractor shall remedy any defects due to faulty materials or workmanship and pay for any damage to other Work resulting therefrom, which shall appear in his Work within a period of two-year from the date of Notice of Acceptance and in accordance with the terms of any special warranties provided in the Contract. The Owner shall give notice of observed defects with reasonable promptness. A complete warranty inspection will be scheduled at approximately one (1) year, eleven (11) months.

Upon completion of his Work, the General Contractor shall deliver to the Engineer in duplicate, a written warranty based on the provision of the Article properly signed and notarized. Warranty shall be address to the Owner. Provide separate written warranties from mechanical and electrical contractors.

1.10 Miscellaneous Keys and Wrenches. At the completion of the project, all adjustment wrenches and keys of electric switches, electrical panels, etc., shall be accounted for and turned over to the General Contractor for transmittal to the Owner.

End of Section

SECTION 02101

REMOVAL OF STRUCTURES AND OBSTRUCTIONS

1.00 GENERAL

1.01 Scope. This Work shall consist of furnishing all labor, equipment, materials and miscellaneous items for the removal and satisfactory disposal or abandonment in place of all fences, signs, structures, old pavements, roads, sidewalks, retaining walls and any other obstructions. It shall also include salvaging of designated materials and backfilling the resulting trenches, holes, and pits.

This Work shall include sawing concrete and asphalt in reasonably close conformity with the dimensions of these Specifications to create lines of weakness in order to facilitate controlled breaking for removal.

1.02 Submittals. Copies of written agreements for disposal areas will be given to the Engineer before work begins.

2.00 MATERIALS. Not applicable.

3.00 METHODS AND PROCEDURES

3.01 General. Contractor shall meet with Owner to determine which items are to be removed and which are to be salvaged. The Contractor shall remove and dispose of all signs, structures, fences, old pavements, abandoned pipelines, and other obstructions. All salvageable materials noted shall be removed, without unnecessary damage, in sections or pieces which may be easily transported and stored.

3.02 Disposal. Unusable material may be disposed of outside the limits of view from the project with written permission of the property owner on whose property the material is placed. Copies of all agreements with property owners are to be furnished to the Engineer.

Where portions of structures are to be removed, the remaining portions shall be prepared to fit new construction. The work shall be done in accordance with Drawings, and in such manner that materials to be left in place shall be protected from damage; all damage to portions of structures to remain in place shall be repaired by the Contractor at his expense. Reinforcing steel projecting from the remaining structure shall be cleaned and aligned to provide bond with new extension.

3.03 Salvage. Salvage all items shown on the Drawings. During demolition, Owner or his representatives may designate additional materials to be salvaged rather than disposed. All salvage materials shall be removed from the job site by the Contractor and stored at a site to be designated by the Owner.

3.04 Pipe to be left in place. All metal pipe and metal culverts directed to be left in place shall have the ends crushed and crimped back where possible. The ends of all masonry and plastic pipe products shall be completely back-filled with concrete or grout a minimum of 18" or one pipe diameter, whichever is greater. All headwalls and appurtenances shall be removed. Where shown on the Drawings, pipe shall be backfilled their full length.

3.05 Sawing of Concrete. The sawing of concrete shall be done carefully, and all damage to concrete remaining in place, due to Contractor's operations, shall be repaired by the Contractor at his expense and as directed by Project Engineer. An effective dust control method must be utilized throughout concrete sawing operations. The minimum depth of saw cut in concrete shall be two (2) inches or to the depth of the reinforced steel, whichever occurs first, unless otherwise designated.

3.06 Safety. Operations that may damage or constitute a hazard to the traveling public will not be permitted. Contract shall abide by OSHA standards.

3.07 Removal of Culverts and Other Drainage Structures. Culverts and other drainage structures in areas under traffic use shall not be removed until satisfactory arrangements have been made to accommodate traffic.

Where 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.

3.08 Removal of Pipe. Pipes indicated on the Drawings to be removed for salvage and reuse shall be carefully removed, cleaned and every precaution taken to avoid damage to the pipe. Removal of pipe shall include all appurtenances. Pipe to be salvaged shall be taken to the Owner's designated storage yard; pipe to be re-laid shall be stored by the Contractor so that no damage to pipe will occur. The Contractor shall replace, at his expense, all pipe lost or damaged due to negligence, improper storage or improper construction techniques.

3.09 Removal of Pavement, Sidewalks, Curbs, etc. All concrete pavement, sidewalks, curbs, gutters, etc., designated for removal, shall be broken into pieces, the size of which shall not exceed approximately 400 pounds or 3 square yards of surface area, and shall be disposed of off-site by Contractor or otherwise directed by Project Engineer.

Where old concrete construction abuts new concrete construction, edges of pavement sidewalks, curbs, etc., to be left in place shall be sawn to a true line with a vertical face (see Sawing of Concrete).

Asphalt and bituminous pavements shall be cut the full depth of the pavement with a vertical face in a straight line parallel to the limit of excavation. Cuts shall be made with flat bladed air hammer or saw, or as approved in writing by Engineer, so as to provide a straight, true cut. Concrete pavements, including curbs, gutters and sidewalks, shall be saw cut the full depth of the pavement with a vertical face in a straight line parallel to the limit of excavation. An effective method of dust control shall be utilized throughout concrete sawing operations.

Feathering of new asphalt pavements onto old pavements will not be permitted under this Contract.

3.10 Abandonment of Manholes, Catch Basins, Inlets, etc. Remove all portions of structure to 12 inches below finish grade. Fill all voids with concrete or Class 1 Structure Backfill (95% Standard Proctor density). Backfill to surface with concrete, Class 6 aggregate and/or bituminous asphalt or topsoil to match final surface treatment.

4.00 MEASUREMENT AND BASIS OF PAYMENT

Removals included on the bid schedule will be paid for by the unit given. Removals that are essential to the project but for which there are no specific pay items, will not be measured and paid for separately but shall be included in the project.

End of Section

SECTION 02200

EXCAVATION AND EMBANKMENT

1.00 GENERAL

1.01 Scope. Work to be performed under this section shall include all labor, equipment, materials and miscellaneous items necessary to perform all clearing and grubbing, excavation, backfilling, compacting, testing and related work not specified elsewhere, as shown on the Drawings and required by the Specifications.

All work within the rights-of-way of the Federal Government, the Colorado Division of Highways, County Governments or Municipal Governments shall be completed in compliance with requirements issued by those agencies. All such requirements shall take precedence over these Specifications. It shall be the Contractor's responsibility to secure all required permits and pay all costs thereof to complete work in accordance with Town of Silt.

1.02 Related Work Specified Elsewhere.

Section 02201 - Excavation and Backfill for Structures
Section 02222 - Embedment and Base Course Aggregate

1.03 Reference Standards.

A. State Department of Highways, Division of Highways, State of Colorado, "Standard Specifications for Road and Bridge Construction," latest edition.

1.04 Field Conditions.

A. Existing Utilities. Underground utilities, except service lines, known to the Engineer have been shown on the Drawings. Locations are approximate only and may prove to be inaccurate. The Contractor is responsible for verification of the existence, location and protection of all utilities within the construction limits.

Before commencing with work, the Contractor shall notify all public and private companies who may have utilities within the project limits. The Contractor shall coordinate with these entities all excavation performed. The Contractor shall obtain all permits required by utility owners.

In the event of damage to any existing utility, the Contractor shall be solely responsible for the repair and payment for repair of all such damage.

The Contractor shall make arrangements for relocation of utilities requiring relocation as indicated on the Drawings. Should utility obstructions, not shown on the Drawings, be encountered and require relocation, the Contractor shall notify the Owner and the Engineer and shall make arrangements necessary for such relocation.

B. Existing Improvements. The Contractor shall restore or protect from damage all existing improvements encountered in performance of the work. Improvements

damaged as a result of this work shall be restored to the pre-construction condition or better, as determined by the Engineer.

Adjacent property shall be protected by the Contractor from any damage. The Contractor shall be held solely liable for any damage to adjacent property and shall be responsible for all costs resulting from repair of such damage.

C. Soil Conditions. It shall be the responsibility of the Contractor to examine soil conditions and characteristics, including the presence of groundwater, that will be encountered within the limits of construction.

1.05 Protection of Work.

A. Safety. All excavations shall be protected by barricades, lights, signs, etc. as required by governing federal, state and local safety codes and regulations.

B. Sheeting, shoring and bracing. Except where banks are cut back on a stable slope, provide and maintain sheeting, shoring and bracing systems necessary to protect adjoining grades and structures from caving, sliding, erosion or other damage, and suitable forms of protection against bodily injury, all in accordance with applicable codes and governing authorities.

Remove sheeting and shoring systems as excavations are backfilled in a manner to protect the construction or other structures, utilities or property and to assure complete removal of system components unless otherwise provided for in the construction drawings.

Sheeting and shoring systems shall be structurally designed and sufficiently braced to provide necessary restraining of retained backfill. Prior to installation of such systems, methods of installation and materials proposed shall be discussed with and approved by the Engineer. All systems shall be in strict compliance with local, state and federal safety regulations. Contractor is solely liable for the installation and performance of their systems and for non-compliance with appropriate safety regulations.

C. Site Drainage. Excavation to be protected from surface water drainage at all times. At no time shall excavated area be allowed to fill with storm water runoff. Contractor shall provide proper, temporary drainage structures at their cost to detour runoff from excavated areas.

1.06 Blasting. No blasting shall be permitted without written consent of the Engineer. Blasting shall be done only after Engineer receives permission from the appropriate governmental authority(ies). Blasting shall be performed only by properly licensed, experienced individuals and in a manner such that no damage to any property or persons will occur due to either the blast or debris.

Contractor shall provide proof of insurance as required by these Specifications, the governing authority or as required by Engineer prior to any blasting. All damage as the result of blasting shall be repaired, at the Contractor's expense, to the satisfaction of the Engineer. All earth or rock loosened by blasting shall be removed from excavations prior to proposed construction.

1.07 Construction in Streets. When construction operations are located within streets or

pedestrian ways, make provisions for free passage of vehicles and pedestrians. Do not block streets or walks without prior approval. Pedestrian routing plans shall be shown on Traffic Control Plans.

2.00 MATERIALS

All materials for construction fills and backfills shall meet specified requirements for gradation and other factors defining suitability for the intended use. All classes of suitable material shall be free from perishable matter, debris, frozen material and stones and/or cemented pieces larger than permitted by the specified gradation. Classification of materials shall be as follows:

2.01 Excavation. 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 and not being removed under some other item.

2.02 Materials for Embankment. Embankment material shall consist of approved material acquired from excavations, hauled and placed in embankments in reasonably close conformity with the line, grades, thicknesses and typical cross sections shown on the plans or as designated.

When source of embankment material is not designated on the plans, approval of the source will be contingent on the material having a resistance value of at least that shown on the plans, when tested by the Hveem Stabilometer, and a maximum dry density of not less than 90 pounds per cubic foot.

2.03 Topsoil. Topsoil shall consist of selectively excavated, loose, friable loam reasonably free of admixtures of sub-soil, refuse, stumps, roots, rocks, brush, weeds or other material which would be detrimental to the proper development of vegetative growth; topsoil to be free of any stone or rock greater than 3" in size.

3.0 METHODS AND PROCEDURES

3.01 Clearing and Grubbing.

A. Preservation of Existing Conditions.

The contract documents will indicate locations of right-of-way, applicable easements, and construction limits. The Owner shall field mark all trees, shrubs, plants and other things to remain. The Contractor shall preserve all things designated to remain. Paint required for cut or scarred surfaces of trees or shrubs selected for retention shall be an approved asphaltum base paint prepared especially for tree surgery.

B. Clearing and Grubbing.

As needed to allow for the contracted work, clear and/or grub all surface objects and all trees, stumps, roots and other protruding obstructions, not designated to remain, including mowing, as required, except undisturbed stumps and roots and non-perishable solid objects which will be a minimum of two feet below subgrade or slope embankment. Outside cut or fill limits, but within construction limits, stumps may be left at finish grade if allowed by Engineer.

Except in areas to be excavated, backfill stump holes and other holes from which obstructions are removed, with embankment material and compacted in accordance with Section 3.05.

C. Disposal.

Contractor may request from the Town of Silt and the Fire District the option of burning organic materials, but the Town and the District, in their sole discretions, determine the ability of any Owner or Contractor to burn organic material. If allowed, Contractor may burn organic material under the constant care of competent watchmen at such times and in such a manner that the surrounding vegetation, the other adjacent property, or anything designated to remain, will not be jeopardized. Contractor shall burn in accordance with applicable laws and ordinances.

When permitted, materials and debris which cannot be burned and perishable materials may be removed from the property and right-of-way and disposed of at locations off the project outside the limits of view from the project with the written permission of the property owner on whose property the materials and debris are placed. The Contractor shall make all necessary arrangements with property owners for obtaining suitable disposal locations and the cost involved shall be included in the unit price bid.

All merchantable timber in the clearing area which has not been removed from the right-of-way and property prior to the beginning of construction, shall become the property of the Contractor, unless otherwise specified.

D. Scalping.

Scalp areas where excavation or embankment is to be made. Scalping shall include the removal of material such as brush, roots, sod, grass, residue or agricultural crops, sawdust, and other vegetable matter from the surface of the ground.

E. Hedges.

Hedges shall be pulled or grubbed in such a manner as to assure complete and permanent removal. Scattered hedge or shrubs not classified as hedge shall be removed as specified for hedge.

F. Topsoil.

Strip topsoil from all areas to be disturbed by construction. Topsoil to be stockpiled separately from excavated materials.

3.02 Construction Requirements. The excavation and embankments required shall be finished to smooth and uniform surfaces. Materials shall not be wasted without permission of the Engineer. The Engineer reserves the right to change grade lines, cut slopes or fill lines during the progress of the Work.

3.03 Excavation. Material outside of the limits of excavation shall not be disturbed. Prior to

beginning excavation operations in any area, all necessary clearing and grubbing in that area shall have been performed in accordance with these Specifications. The Contractor shall not excavate beyond the dimensions and elevations established. Common excavation shall include all materials of whatever nature encountered in the work for construction of excavations to the lines and grades called for on the Drawings. Structure excavation shall include all earthwork required for the construction of structures to the lines and grades called for on the Drawings. If any areas are inadvertently over-excavated, fill such over-excavation with embankment material and compact in accordance with Section 3.05.

A. Tolerances. In those areas upon which a subbase material is required, upon which finished landscaping improvements, including sodding or lawn seeding, or upon which a structure is to be constructed directly, deviation of not more than 1 inch shall be permitted when tested with a 16-foot straight edge. Deviation from grade shall not exceed 1 inch at any point.

In those areas upon which a base course material is required, deviation of not more than 0.04 foot shall be permitted when tested with a 16-foot straight edge. Deviation from grade shall not exceed 0.04 foot at any point.

In those areas where no additional construction, other than topsoil addition and native seeding will occur, the finished surface shall be smooth and shall not deviate from grade by more than 0.5 foot at any point.

B. Groundwater Control. Contractor is to maintain facilities on site to remove all groundwater from excavated area and keep water below the bottom of the excavation to a point such that a firm base for equipment or concrete installation exists. Facilities shall be maintained until all backfilling is in place at least 24 inches above anticipated water levels before water removal. All water removal shall be subject to approval by the Engineer.

Removal of water by bucketing, sump or trench diversions, intermittent pumping, or sump or submersible pumps is considered incidental to excavation work. Inclusion of a bid item for dewatering indicates dewatering by continuous pumping, well- point type systems is expected. If such dewatering system is required, in the opinion of the Engineer, this work to be paid for as indicated in the Bid Schedule, unless otherwise noted on plans or in specifications. If not included in the Bid Schedule, to be considered extra work paid for at a price negotiated between Contractor and Owner prior to the start of dewatering.

C. Stockpile Excavated Material. Excavated material to be stockpiled so as not to endanger the work or public safety. Maintain existing vehicular and pedestrian traffic with minimum disruption. Do not place materials such that site distances are reduced. Maintain emergency access and access to existing fire hydrants and water valves. Maintain natural drainage courses and street gutters. Stockpile locations are subject to approval by Owner.

Backfill material to be segregated from stock piled topsoil and unusable backfill materials.

D. Over-excavation. Whenever the site is over-excavated more than 0.1' to eliminate point bearing by rocks or stones beneath proposed structures, unsuitable materials

or when grade tolerances are exceeded, the Contractor is to re-establish grade using Class 1 Backfill (CDOT Section 703.08 - Class 1). Compaction shall be to 95% standard Proctor. All work to re-establish grade shall be at the Contractor's expense.

E. Unstable Materials. Materials which are not capable of supporting superimposed loadings are defined as unstable materials. Should unstable materials be encountered during excavation, immediately notify Engineer. If, in the opinion of the Engineer, unstable soil excavation is required and the Contractor could not have reasonably been expected to discover the existence of such materials during his site investigation, than a contract price for Unstable Soil Excavation shall be negotiated between Owner & Contractor. No payment shall be made for materials excavated prior to notification of the Engineer and negotiation of payment for extra work.

Inclusion of a bid item for Unstable Soil Excavation indicates such excavation is anticipated. The Contractor is to notify the Engineer prior to any unstable soil excavation; no payment shall be made for excavation prior to authorization of Engineer.

F. Rock Excavation. Rock excavation shall be defined as removal of boulders in excess of three (3) cubic yards or solid or fractured rock, which requires techniques, such as blasting or jacking for removal, other than those which are being employed by the Contractor or are normally used in excavation, such as use of backhoes, trenchers, draglines, etc. Should unanticipated rock conditions be encountered, immediately notify the Engineer. If in the opinion of the Engineer, rock excavation is required and the Contractor had in fact made a diligent and determined effort to remove the material using normal excavation procedures as stated above and the Contractor could not have reasonably been expected to determine the existence of such material during his site investigation, then a contract price for Rock Excavation shall be negotiated between the Contractor and the Owner. No payment shall be made for excavation performed prior to determination of a negotiated price.

Rock shall be removed to a 4" depth below grade. In addition, all rock loosened during jacking, blasting, etc. shall be removed from the site. For payment purposes, maximum depth to be paid for shall be 12" below required grade. All over-excavation shall be replaced as specified in Subsection 3.03, D.

Inclusion of a bid item for Rock Excavation indicates such excavation is anticipated. Contractor to notify Engineer prior to any rock excavation; no payment shall be made for excavation prior to notification.

G. Disposal of Excess Excavation. Contractor to dispose of excess excavation off-site. The Owner shall have the right to elect to have the excess excavation disposed of at a designated site within the Work limits. Excavation may be wasted on site only if approved by the Engineer and shall be done at the direction of the Engineer. Disposal in any case shall be the sole responsibility of the Contractor.

3.04 Pavement Materials. Prior to placing pavement materials, fabric or any embankment, the entire subgrade shall be scarified to a depth of 8 eight inches (8") adjusted to a moisture content near optimum and compacted to at least 95% of the maximum standard Proctor Density. The final subgrade shall be proof-rolled with a heavy loaded pneumatic-tire vehicle. Areas which deform excessively under wheel loading are not stable and should be

improved prior to placing pavement or embankment materials.

If unstable and wet subgrade areas are encountered, the contractor shall notify the Engineer prior to commencing with subsequent work items. The Engineer will determine the method to be used to stabilize the area. Any materials placed on the unstable subgrade prior to an investigation and determination by the Engineer are subject to removal.

3.05 Embankment and Backfilling. Do not begin embankments until construction below grade has been approved, underground utility systems have been inspected, tested and approved and trash and debris have been cleaned from the excavation.

Place approved excavated material in successive uniform maximum loose layers not exceeding 8 inches for the full width of the cross-section in all accessible areas. Place material in successive uniform loose layers not exceeding 4 inches in areas not accessible or permitted for the use of self-propelled rollers or vibrators. Do not place fill on muddy or frozen subgrade, or until subgrade is approved by the Engineer.

Plow, step, or bench sloped surfaces steeper than 4 to 1 on which fill or backfill is to be placed in such a manner that fill material will adequately bond with existing surfaces. Scarify all surfaces to receive backfill to a depth of 6" before filling.

Construct fills and embankments to the lines and grades indicated on the Drawings within tolerances stated in Section 3.03, A above.

Use suitable materials removed from the excavation prior to obtaining material from borrow areas.

Where otherwise suitable material is too wet, aerate, dry or blend to provide the moisture content specified for compaction.

3.06 Compaction. During placing and/or compacting operations of earth or earth-and-rock mixtures, the moisture content of materials in the layers being compacted shall be near optimum and uniform throughout the layer. In general, maintain the moisture content of the material being placed and compacted within 2% of optimum condition as determined as ASTM Standard D698.

A. Compaction Equipment. Perform all compaction with approved equipment well suited to location and material being compacted. Use heavy vibratory rollers or sheepsfoot rollers where heavy equipment is authorized. Do not operate heavy equipment closer to structures than a horizontal distance equal to height of backfill above bottom of structure foundation. Compact remaining area with hand tampers suitable for material being compacted. Place and compact backfill around pipes with care to avoid damage.

Compact fill materials to following densities at optimum moisture content based on ASTM D698 or AASHTO T99:

1. Structure fill under or within 5' horizontally of all concrete structures: 95%.

2. Backfill beneath or within 5' horizontally or within the area defined by a line extended at an angle of 1:1 of existing or proposed pavements, roadways, sidewalks, curbs, utility lines, retaining wall bases, or other improvements: 95%

3. Backfill within public or designated rights-of-way: 90% or as shown on the Drawings.

4. Backfill within undeveloped, green or undesignated area: 90%.

5. Backfill for any fill for overcut grading in areas of lot/home construction: 95%

B. Jetting. Jetting and water inundation are generally not permitted methods of compaction. The Engineer may allow jetting under certain field conditions. If jetting is allowed; techniques including depth of lifts, amount of water to be used, penetration of hose jet, etc., shall be submitted to the Engineer for approval. The contractor remains solely responsible for the results gained when using this method. Any areas of compaction that do not meet the requirements of the Contract will be removed and re-compacted at the Contractor's expense. No jetting will be allowed on materials with a 200-minus gradation of greater than 15%. Contractor shall pay cost of all water used, soil classification testing and compaction testing and any retesting or re-compaction required. No jetting shall be done prior to written approval and direction of the Engineer.

C. Maintenance. Contractor to maintain all embankment in satisfactory condition during the extent of the contract and warranty period. All surface deterioration determined to be the responsibility of the Contractor and all settlement shall be repaired at once by the Contractor upon notice by the Owner. All costs for repair and all liability as a result of surface deterioration or settlement shall be the responsibility of the Contractor.

3.07 Proof Rolling. Proof rolling with a heavy rubber-tired vehicle will be required. Proof rolling shall be done after specified compaction has been obtained. Areas found to be weak and those areas which failed shall be ripped, scarified, wetted or dried if necessary and re-compacted to the requirements for density and moisture at the Contractor's expense. Equipment to be used for proof rolling may be a fully loaded, tandem axle dump truck or water truck or rubber-tired roller with equivalent loading characteristics.

3.08 Surface Restoration. All existing surface improvements and site conditions disturbed or damaged during construction to be restored to a condition equal to pre-construction condition. All restoration costs are considered incidental to excavation and backfill.

A. Improvements. Replace, repair or reconstruct all improvements as required. Work will not be accepted until restoration is accepted by Engineer and all affected property owners.

B. Final Grading. The Contractor is to re-establish existing final grade or finish to final grades as modified and shown on the Drawings. The Contractor is to backfill to proper subgrade elevation with backfill material to allow placement of surface improvements or materials.

C. Roadways. Materials and methods to conform to Section 02222 - Embedment and Base Course Aggregate; Section 02612 - Hot Bituminous Pavement; and Section 02614 - Portland Cement Concrete Paving. All roadways to be restored to pre-construction condition with material types removed. Replacement materials shall match adjacent pavement structures in type and thickness with the following minimum requirements.

1. Minimum base course material on gravel roadways or minimum depth gravel beneath hard surface roadways to be 8".

2. Minimum asphalt pavement surfacing to be 4".

3. Minimum concrete pavement surfacing to be 6".

D. Green Areas. Place excavated topsoil from the roadway or from pits directly upon constructed cut and fill slopes without the use of stockpiles whenever conditions and the progress of construction will permit.

Do not place topsoil until the areas to be covered have been properly prepared and grading operations in the area have been completed.

Place and spread 6" of topsoil at locations and to the thickness shown on the plans. Key to the underlying material by the use of harrows, rollers or other equipment suitable for the purpose.

Apply water to the topsoil at the locations and in the amounts designated. Apply in a fine spray by nozzles or spray bars in such manner that it will not wash or erode the topsoil areas.

All loose exposed rock larger than three inches shall be removed from slopes that are to receive topsoil.

See Section 02821, Revegetation - Seeding, Sodding, Hydroseeding.

4.00 QUALITY CONTROL - FIELD

4.01 Inspection and Testing. Inspection and testing to be performed at the direction of the Engineer. Contractor to cooperate fully with all persons engaged in testing. Contractor to excavate as required to allow testing; Contractor to backfill all test excavations in accordance with these Specifications.

4.02 Density Testing and Control.

A. Reference Standards. Density/moisture relationships to be developed for all soil types encountered according to ASTM D698 or AASHTO T99.

B. Field Testing. Testing for density during compaction operations to be done in accordance with ASTM D2922 using nuclear density methods.

C. Frequency of Testing. Frequency of testing to be done at the direction of the Engineer.

D. Retesting. In the event of failure to meet compaction criteria, Contractor shall re-excavate and re-backfill at direction of Engineer. All retesting to be paid for by Contractor and to be performed by soils testing firm approved by the Engineer.

4.03 Payment for Testing. Owner responsible for all costs of initial testing of backfill. Contractor to pay all costs of any retesting required.

5.00 MEASUREMENT AND PAYMENT.

Where items are specifically included on the bid schedule, they will be paid for by the unit given. All other items in this section that are essential to the project but for which there are no specific pay items, will not be measured and paid for separately but shall be included in the project.

End of Section

SECTION 02201

EXCAVATION AND BACKFILL FOR STRUCTURES

1.00 GENERAL

1.01 Scope. Work to be performed under this section shall include all labor, equipment, materials and miscellaneous items necessary to perform all clearing and grubbing, excavation, backfilling, compacting, testing and related work not specified elsewhere, as shown on the Drawings and required by the Specifications.

All work within the rights-of-way of the Federal Government, the Colorado Division of Highways, County Governments or Municipal Governments shall be done in compliance with requirements issued by those agencies. All such requirements shall take precedence over these Specifications. It shall be the Contractor's responsibility to secure all required excavation permits and pay all costs thereof.

1.02 Related Work Specified Elsewhere.

Section 02230 - Embedment and Base Course Aggregate
Section 03300 - Cast-In-Place Concrete

1.03 Reference Standards.

A. State Department of Highways, Division of Highways, State of Colorado, "Standard Specifications for Road and Bridge Construction," latest edition.

1.04 Field Conditions.

A. Existing Utilities. Underground utilities, except service lines, known to the Engineer have been shown on the Drawings. Locations are approximate only and may prove to be inaccurate. The Contractor is responsible for verification of the existence, location and protection of all utilities within the construction limits.

Before commencing with work, the Contractor shall notify all public and private companies who may have utilities within the project limits. The Contractor shall coordinate with these entities all excavation performed. The Contractor shall obtain all permits required by utility owners.

In the event of damage to any existing utility, the Contractor shall be solely responsible for the repair and payment for repair of all such damage.

The Contractor shall make arrangements for relocation of utilities requiring relocation as indicated on the Drawings. Should utility obstructions, not shown on the Drawings, be encountered and require relocation, the Contractor shall notify the Owner and the Engineer and shall make arrangements necessary for such relocation.

B. Existing Improvements. The Contractor shall restore or protect from damage all

existing improvements encountered in performance of the work. Improvements damaged as a result of this work shall be restored to pre-construction condition or better, as determined by the Engineer.

Adjacent property shall be protected by the Contractor from any damage. The Contractor shall be held solely liable for any damage to adjacent property and shall be responsible for all costs resulting from repair of such damage.

C. Soil Conditions. It shall be the responsibility of the Contractor to examine soil conditions and characteristics, including the presence of groundwater that will be encountered within the limits of construction.

1.05 Protection of Work.

A. Safety. All excavations shall be protected by barricades, lights, signs, etc. as required by governing federal, state and local safety codes and regulations.

B. Sheeting, shoring and bracing. Except where banks are cut back on a stable slope, provide and maintain sheeting, shoring and bracing systems necessary to protect adjoining grades and structures from caving, sliding, erosion or other damage, and suitable forms of protection against bodily injury, all in accordance with applicable codes and governing authorities.

Remove sheeting and shoring systems as excavations are backfilled in a manner to protect the construction or other structures, utilities or property and to assure complete removal of system components unless otherwise provided for in the construction drawings.

Sheeting and shoring systems shall be structurally designed and sufficiently braced to provide necessary restraining of retained backfill. Prior to installation of such systems, methods of installation and materials proposed shall be discussed with and approved by the Engineer. All systems shall be in strict compliance with local, state and federal safety regulations. Contractor is solely liable for the installation and performance of their systems and for non-compliance with appropriate safety regulations.

C. Site Drainage. Excavation to be protected from surface water drainage at all times.

1.06 Blasting. No blasting shall be permitted without written consent of the Engineer. Blasting shall be done only after Engineer receives permission from the appropriate governmental authority(ies). Blasting shall be performed only by properly licensed, experienced individuals and in a manner such that no damage to any property or persons will occur due to either the blast or debris.

Contractor shall provide proof of insurance as required by these Specifications, the governing authority or as required by Engineer prior to any blasting. All damage as the result of blasting shall be repaired, at the Contractor's expense, to the satisfaction of the Engineer. All earth or rock loosened by blasting shall be removed from excavations prior to proposed construction.

1.07 Construction in Streets. When construction operations are located within streets or pedestrian ways, make provisions for free passage of vehicles and pedestrians. Do not block streets or walks without prior approval. Pedestrian routing plans shall be shown on Traffic Control Plans.

2.00 MATERIALS

All materials for construction fills and backfills shall meet specified requirements for gradation and other factors defining suitability for the intended use. All classes of suitable material shall be free from perishable matter, debris, frozen material and stones and/or cemented pieces larger than permitted by the specified gradation. Classification of materials shall be as follows:

2.01 Materials for Structure Backfill. Structure backfill shall be composed of materials designated as Class 2 or Class 6.

A. Class 2 Structure Backfill (CDOH Section 703.08 - Class 2). Class 2 structure backfill shall be composed of suitable materials developed from excavation, borrow areas, or other sources. If the material contains rock fragments which, in the opinion of the Engineer, will be injurious to the structure, the material will not be used for backfilling. In addition, no rock larger than 4″ shall be placed within the structure backfill zones shown in CDOT M-Standards M-206-1 and M-206-2.

B. Class 6 Backfill (CDOT Section 703.03 – Class 6). Class 6 backfill shall consist of crushed stone, crushed slag, crushed gravel, or natural gravel conforming to the following requirements when tested with laboratory sieves.

Sieve Designation	% by Weight Passing
1 inch	100
¾ inch	95
No. 4	30-65
No. 8	25-55
No. 200	5-12

In addition, this material shall have a liquid limit not exceeding 30 and a plasticity index of not over 6 when determined in conformity with AASHTO T89 and T90.

C. Flow-fill (CDOT Section 206.02). The Contractor may substitute flow-fill for structure backfill Class 2 or structure backfill Class 6 to backfill culverts, sewer pipes and shallow utilities when approved by the utility provider.

2.02 Topsoil. Topsoil shall consist of selectively excavated, loose, friable loam reasonably free of admixtures of sub-soil, refuse, stumps, roots, rocks, brush, weeds or other material which would be detrimental to the proper development of vegetative growth.

3.00 METHODS AND PROCEDURES

3.01 Site Preparation.

A. Clearing. Remove all vegetation, stumps, roots, organic matter, debris and other miscellaneous structures and materials from work site. Dispose of off-site.

B. Topsoil Removal. Strip existing topsoil from all areas to be distributed by construction. Topsoil to be stockpiled separately from excavated materials.

C. Pavement Removal. See Section 02101 - Removal of Structures and Obstructions.

D. Preservation of Trees. The Owner shall field mark all trees, shrubs, plants, and other things to remain. Do no remove trees outside of excavated or filled areas, unless their removal is authorized by the Engineer. Protect trees left standing from permanent damage by construction operations.

3.02 Construction Requirements. The excavation and embankments required shall be finished to smooth and uniform surfaces. Materials shall not be wasted without permission of the Engineer. The Engineer reserves the right to change grade lines, cut slopes or fill lines during the progress of the work.

3.03 Structure Excavation. Material outside of the limits of excavation will not be disturbed. Prior to beginning excavation operations in any area, all necessary clearing and grubbing in that area shall have been performed in accordance with these Specifications. The Contractor shall not excavate beyond the dimensions and elevations established.

Structure excavation shall include all earthwork required for the construction of structures to the lines and grades called for on the Drawings.

If any areas are inadvertently over-excavated, fill such over-excavation with Class 1 or Class 3 backfill.

A. Tolerances. In those areas upon which a subbase or base course material is required, or upon which a structure is to be constructed directly, deviation of not more than 1 inch shall be permitted when tested with a 16-foot straight edge. Deviation from grade shall not exceed 1 inch at any point.

In those areas where no additional construction, other than topsoil addition, will occur, the finished surface shall be smooth and shall not deviate from grade by more than 0.5 foot at any point.

B. Groundwater Control. Contractor to maintain facilities on site to remove all groundwater from excavated area and keep water below the bottom of the excavation to a point such that a firm base for equipment or concrete installation exists. Facilities shall be maintained until all backfilling is in place at least 24 inches above anticipated water levels before water removal. All water removal shall be subject to approval by the Engineer.

Removal of water by bucketing, sump or trench diversions, intermittent pumping, or sump or submersible pumps is considered incidental to excavation work. Inclusion of a bid item for dewatering indicates dewatering by continuous pumping, well-point type systems is expected. If such dewatering system is required, in the opinion of the Engineer, this work to be paid for as indicated in the bid schedule, or if not included in the bid schedule to be considered extra work paid for at a price negotiated between Contractor and Owner prior to the start of dewatering.

C. Stockpile Excavated Material. Excavated material to be stockpiled so as not to endanger the work or public safety. Maintain existing vehicular and pedestrian traffic with minimum disruption. Maintain emergency access and access to existing fire hydrants and water valves. Maintain natural drainage courses and street gutters.

Backfill material to be segregated from stockpiled topsoil and unusable backfill materials.

D. Over-excavation. Whenever the site is over-excavated more than 0.1' to eliminate point bearing by rocks or stones beneath proposed structures or when grade tolerances are exceeded, the Contractor is to re-establish grade using Class 1 backfill. Compaction shall be to 95% maximum density. All work to re-establish grade shall be at the Contractor's expense.

E. Unstable Materials. Materials which are not capable of supporting superimposed loadings are defined as unstable materials. Should unstable materials be encountered during excavation, immediately notify Engineer. If, in the opinion of the Engineer, unstable soil excavation is required and the Contractor could not have reasonably been expected to discover the existence of such materials during his site investigation, than a contract price for Unstable Soil Excavation shall be negotiated between Owner & Contractor. No payment shall be made for materials excavated prior to notification of the Engineer and negotiation of payment for extra work.

Inclusion of a bid item for Unstable Soil Excavation indicates such excavation is anticipated. The Contractor is to notify the Engineer prior to any unstable soil excavation; no payment shall be made for excavation prior to authorization of Engineer.

F. Rock Excavation. Rock excavation shall be defined as removal of boulders in excess of three (3) cubic yards or solid or fractured rock, which requires techniques, such as blasting or jacking for removal, other than those which are

being employed by the Contractor or are normally used in excavation, such as use of backhoes, trenchers, draglines, etc. Should unanticipated rock conditions be encountered, immediately notify the Engineer. If in the opinion of the Engineer, rock excavation is required and the Contractor had in fact made a diligent and determined effort to remove the material using normal excavation procedures as stated above and the Contractor could not have reasonably been expected to determine the existence of such material during his site investigation, then a contract price for Rock Excavation shall be negotiated between the Contractor and the Owner. No payment shall be made for excavation performed prior to determination of a negotiated price.

Rock shall be removed to a 4" depth below grade. In addition, all rock loosened during jacking, blasting, etc. shall be removed from the site. For payment purposes, maximum depth to be paid for shall be 12" below required grade. All over-excavation shall be replaced as specified in Subsection 3.03, D.

Inclusion of a bid item for Rock Excavation indicates such excavation is anticipated. Contractor to notify Engineer prior to any rock excavation; no payment shall be made for excavation prior to notification.

G. Disposal of Excess Excavation. Contractor to dispose of excess excavation off-site. The Owner shall have the right to elect to have the excess excavation disposed of at a designated site within the project limits. Excavation may be wasted on site only if approved by the Engineer and shall be done at the direction of the Engineer. Disposal in any case shall be the sole responsibility of the Contractor.

3.04 Backfilling. Do not begin backfilling until construction below grade has been approved, underground utility systems have been inspected, tested and approved and trash and debris have been cleaned from the excavation.

Place approved excavated material in successive uniform maximum loose layers not exceeding 8 inches for the full width of the cross-section in all accessible areas. Place material in successive uniform loose layers not exceeding 4 inches in areas not accessible or permitted for the use of self-propelled rollers or vibrators. Do not place fill on muddy or frozen subgrade, or until subgrade is approved by the Engineer.

Construct fills to the lines and grades indicated on the Drawings within tolerances stated in Section 3.03, A above. Use suitable materials removed from the excavation prior to obtaining material from borrow areas. Where otherwise suitable material is too wet, aerate, dry or blend to provide the moisture content specified for compaction.

3.05 Compaction. During placing and/or compacting operations with earth or earth-and-rock mixtures, the moisture content of materials in the layers being compacted shall be near optimum and uniform throughout the layer. In general, maintain the moisture content of the material being placed and compacted within 2% of optimum condition as determined as ASTM Standard D698.

A. Compaction Equipment. Perform all compaction with approved equipment well suited to location and material being compacted. Use heavy vibratory rollers or sheepsfoot rollers where heavy equipment is authorized by Engineer. Do not

operate heavy equipment closer to structures than a horizontal distance equal to height of backfill above bottom of structure foundation. Compact remaining area with hand tampers suitable for material being compacted. Place and compact backfill around pipes with care to avoid damage.

Compact fill materials to following densities at optimum moisture content based on ASTM D698 or AASHTO T99 as shown on the Drawings or as follows:

1. Structure fill under or within 5' horizontally of all concrete structures: 95%.

2. Backfill beneath or within 5' horizontally of existing or proposed pavements, roadways, sidewalks, curbs, utility lines or other improvements: 95%

3. Backfill within public or designated rights-of-way: 95% or as shown on the Drawings.

4. Backfill within undeveloped, green or undesignated area: 90%.

B. Jetting. Jetting and water inundation are generally not permitted methods of compaction. The Engineer may allow jetting under certain field conditions. If jetting is allowed: techniques including depth of lifts, amount of water to be used, penetration of hose jet, etc., shall be submitted to the Engineer for approval. The contractor remains solely responsible for the results gained when using this method. Any areas of compaction that do not meet the requirements of the Contract will be removed and recompacted at the Contractor's expense. No jetting will be allowed on materials with a 200-minus gradation of greater than 15%. Contractor shall pay cost of all water used, soil classification testing and compaction testing and any retesting or recompaction required. No jetting shall be done prior to written approval and direction of the Engineer.

C. Maintenance. Contractor to maintain all backfill in satisfactory condition during the extent of the contract and warranty period. All surface deterioration determined to be the responsibility of the Contractor and all settlement shall be repaired at once by the Contractor upon notice by the Owner. All costs for repair and all liability as a result of surface deterioration or settlement shall be the responsibility of the Contractor.

3.06 Surface Restoration. All existing surface improvements and site conditions disturbed or damaged during construction are to be restored to a condition equal to pre-construction condition. All restoration costs are considered incidental to excavation and backfill.

A. Improvements. Replace, repair or reconstruct all improvements as required. Work will not be accepted until restoration is accepted by Engineer and all affected property owners.

B. Final Grading. The Contractor is to re-establish existing final grade or finish to final grades as modified and shown on the Drawings. The Contractor is to backfill to proper subgrade elevation with backfill material to allow placement of surface improvements or materials.

C. Roadways. Materials and methods to conform to Section 02222 - Embedment and

Base Course Aggregate; Section 02612 - Hot Bituminous Pavement; and Section 02614 - Portland Cement Concrete Paving. All roadways to be restored to pre-construction condition with material types removed. Replacement materials shall match adjacent pavement structures in type and thickness with the following minimum requirements.

1. Minimum base course material on gravel roadways or minimum depth gravel beneath hard surface roadways is to be 8" or as specified on the PLANS.

2. Minimum asphalt pavement surfacing to be 4" or as specified on the PLANS.

3. Minimum concrete pavement surfacing to be 6" or as specified on the PLANS.

D. Green Areas. Restore all green areas as specified in Section 02700- Trees, Plants and Ground Cover.

4.00 QUALITY CONTROL - FIELD

4.01 Inspection and Testing. Inspection and testing to be performed at the direction of the Engineer. Contractor to cooperate fully with all persons engaged in testing. Contractor to excavate as required to allow testing; Contractor to backfill all test excavations in accordance with these Specifications.

4.02 Density Testing and Control.

A. Reference Standards. Density/moisture relationships to be developed for all soil types encountered according to ASTM D698 or MSHTO T99.

B. Field Testing. Testing for density during compaction operations to be done in accordance with ASTM D2922 using nuclear density methods.

C. Frequency of Testing. Frequency of testing to be done at the direction of the Engineer.

D. Retesting. In the event of failure to meet compaction criteria, Contractor shall re-excavate and re-backfill at direction of Engineer. All retesting to be paid for by Contractor and to be performed by soils testing firm approved by the Engineer.

4.03 Payment for Testing. Owner is responsible for all costs of initial testing of backfill. Contractor to pay all costs of any retesting required.

5.00 MEASUREMENT AND PAYMENT

Where items are specifically included on the bid schedule, they will be paid for by the unit given. All other items in this section that are essential to the project but for which there are no specific pay items, will not be measured and paid for separately but shall be included in the project.

End of Section

SECTION 02221

TRENCHING, BACKFILLING AND COMPACTION

1.00 GENERAL

1.01 Scope. Work to be performed under this section shall include all labor, equipment, materials and miscellaneous items necessary to perform all excavation, backfilling and compaction of underground pipelines, conduits, cables and appurtenances shown on the Drawings and specified herein.

All work within the rights-of-way of the Federal Government, Colorado Department of Transportation, County Governments or Municipal Governments shall be done in compliance with requirements issued by those agencies. All such requirements shall take precedence over these Specifications. It shall be the Contractor's responsibility to secure all required excavation and street cut permits and pay all costs thereof to complete the Work.

1.02 Related Work Specified Elsewhere.

Section 02222 - Embedment and Base Course Aggregate
Section 02555 - Water Transmission and Distribution Lines
Section 02520 - Storm Drainage Utilities
Section 02530 - Sanitary Sewerage

1.03 Field Conditions.

A. Existing Utilities. Underground utilities, except service lines, known to the Engineer have been shown on the Drawings. Locations are approximate only and may prove to be inaccurate. The Contractor is responsible for verification of the existence, location and protection of all utilities within the construction area.

Before commencing with work, the Contractor shall notify all public and private companies who may have utilities within the project limits. The Contractor shall coordinate with these entities all excavation performed. The Contractor shall obtain all permits required by utility owners.

In the event of damage to any existing utility, the Contractor shall be solely responsible for the repair and payment for repair of all such damage.

The Contractor shall make arrangements for relocation of utilities requiring relocation as indicated on the Drawings. Should utility obstructions, not shown on the Drawings, be encountered and require relocation, the Contractor shall notify the Owner and the Engineer and shall make arrangements necessary for such relocation.

B. Existing Improvements. The Contractor shall restore or protect from damage all existing improvements encountered in performance of the work. Improvements damaged as a result of this work shall be restored to original condition or better, as determined by the Engineer.

Adjacent property shall be protected by the Contractor from any damage. The Contractor shall be held solely liable for any damage to adjacent property and shall be responsible for all costs resulting from repair of such damage.

C. Soil Conditions. It shall be the responsibility of the Contractor to examine soil conditions and characteristics, including the presence of groundwater that will be encountered within the limits of construction.

1.04 Protection of Work.

A. Safety. All excavation shall be protected by barricades, lights, signs, etc., as required by governing federal, state and local safety codes and regulations.

B. Sheeting, Shoring and Bracing. Where trench walls are not excavated at a stable slope, the Contractor shall provide and maintain support sufficient to prevent caving, sliding or failure and property or bodily damage. Any damage due to inadequate support shall be repaired at the sole expense of the Contractor.

Under normal construction conditions, support shall be removed/repositioned as work progresses. A method to allow safe working conditions, protection of new and existing construction and improvements, and to assure for the complete removal of the supporting system shall be used.

Use of a movable trench shield or coffin box will not be allowed where pipe strength is insufficient to support backfill as defined by the trench width after the trench shield is removed.

The Contractor is solely responsible for the installation and performance of their support systems and for any violation of applicable safety standards. Particular attention is called to minimum requirements of OSHA and COSH (Colorado Occupational Safety and Health).

C. Site Drainage. Excavation to be protected from surface water at all times. At no time shall excavated area be allowed to fill with storm water runoff. Contractor shall provide proper, temporary drainage structures at their cost to detour runoff from excavated areas.

1.05 Blasting. No blasting shall be permitted without written consent of the Engineer. Blasting shall be done only after Engineer receives permission from the appropriate governmental authority(ies). Blasting shall be performed only by properly licensed, experienced individuals and in a manner such that no damage to any property or persons will occur due to either the blast or debris. Contractor shall provide proof of insurance as required by these Specifications, the governing authority or as required by Engineer prior to any blasting. All damage as the result of blasting shall be repaired, at the Contractor's expense, to the satisfaction of the Engineer. All earth or rock loosened by blasting shall be removed from excavations prior to proposed construction.

1.06 Construction in Streets. When construction operations are located within streets or pedestrian ways, make provisions for free passage of vehicles and pedestrians. Do not block streets or walks without prior approval. Pedestrian routing plans shall be shown on Traffic Control Plans.

1.07 Submittals.

A. Bedding Material
   1. Submit sieve analysis

B. Select Fill
   1. Submit sieve analysis

2.0 MATERIALS

2.01 Embedment Material. Pipe line embedment material shall comply with the appropriate classes as listed below and as illustrated in the Construction Drawings:

A. Class A - Use where improper trenching or unexpected trench conditions require its use as determined by the Engineer.

   1. Characteristics - Concrete cradle foundation with densely compacted Class 6 aggregate base backfill to 12" above top of pipe, or densely compacted Class 6 aggregate granular foundation with concrete arch cover to 6" above top of pipe.

B. Class B - Use for all PVC, DIP, CMP, CPP and concrete pipe under normal construction conditions.

   1. Characteristics - Densely compacted Class 6 aggregate granular foundation of depth shown on Typical Details with densely compacted Class 6 aggregate 12" above top of pipe. If squeegee sand is approved, it shall be wrapped with an approved filter fabric. 3/4" screened rock shall not be used.

2.02 Select Material. Subject to approval by the Engineer, select material shall be allowed in place of the aggregate backfill for Class B when excavation and soil conditions allow, but only if approved by Engineer. Contractors shall bid project based upon Class B. If Class A or select material is used, price adjustments shall be made.

A. Characteristics - Soil materials free from rocks, clods, and organic material.

2.03 Flow-Fill for Embedment. Flow-fill may be used if approved by the Engineer and shall conform to CDOT Section 206.02.

2.04 Backfill Material.

A. Characteristics - Native materials free from debris, organic matter and frozen material which is uniformly graded and sufficient to allow proper compaction.

B. Gradation - No rocks greater than 3 inch diameter.

Rocks no greater than 6-inch diameter may be allowed at discretion of Engineer provided rocks can be uniformly dispersed and will not interfere in the compactive effort.

3.00 METHODS AND PROCEDURES

3.01 Site Preparation.

A. Clearing. Remove all vegetation, stumps, roots, organic matter, debris and other miscellaneous structures and materials from project site. Dispose of off site.

B. Topsoil Removal. Strip existing topsoil from all areas to be disturbed by construction. Topsoil to be stockpiled separately from excavated materials.

C. Pavement Removal. See Section 02101 - Removal of Structures and Obstructions.

3.02 Trench Excavation.

A. Limits of Excavation. Trenches to be excavated along lines and grades shown on the Drawings, or as modified in the field by the Engineer. Trench widths for pipe loading to be measured 12 inches above top of pipe.

Minimum trench width to be the outside diameter of the pipe or conduit plus 18 inches.

Maximum trench width to be the outside diameter of the pipe or conduit plus 24 inches for all pipes or conduits with outside diameter of 24 inches or less, and plus 30 inches for all pipes or conduits with outside diameters greater than 24 inches.

If maximum trench width is exceeded, Contractor will provide at his expense, higher strength pipe or special bedding including concrete at the direction of the Engineer.

Trench excavation not to be completed more than 100 feet in advance of pipe installation. Backfill to be completed within 100 feet of pipe installation.

B. Groundwater Control. Contractor to maintain facilities on-site to remove all groundwater from trench and keep water at least 12 inches below the trench bottom to a point such that a firm base for pipe or conduit installation exists. Facilities shall be maintained until all concrete is cured and backfilling is in place at least 24 inches above anticipated water levels before water removal is discontinued; all water removal shall be subject to approval by the Engineer.

C. Stockpile Excavated Material. Excavated material to be stockpiled so as not to endanger the work or public safety. Maintain existing vehicular and pedestrian traffic with minimum disruption. Do not place materials such that site distances are reduced. Maintain emergency access and access to existing fire hydrants and water valves. Maintain natural drainage courses and street gutters. Stockpile locations are subject to approval by Owner.

Backfill material to be segregated from stockpiled topsoil and unusable backfill

materials.

D. Excavation for Appurtenances. Excavation to be done in accordance with these Specifications and as shown on the Drawings. Adequate working clearances to be maintained around appurtenances. Provisions for base and bottom preparations shall apply to all appurtenances.

Precautions to be taken to maintain trench widths in the vicinity of adjacent pipelines and conduits.

3.03 Bottom Preparation.

A. Undisturbed Foundation. Where soils are suitable and have adequate strength, bottom is to be graded and hand-shaped such that pipe barrel rests uniformly on undisturbed soil. All rocks or stones which may result in a point bearing on the pipe shall be removed.

Undisturbed grades shall be within 0.1 feet of tolerance. Soils for final pipe grade placed within these limits shall be fine granular (100% passing No. 4 sieve) or may be native materials, hand compacted to 95% maximum density.

B. Bell Holes. Material to be removed to allow installation of all fitting and joint projections without affecting placement of pipe.

C. Over-excavation. Whenever trench is over-excavated to eliminate point bearing by rocks or stones or when undisturbed grade tolerances of 0.1' are exceeded, the Contractor is to re-establish grade using Class 6 aggregate bedding material. Compaction shall be 95% maximum density. All work to re-establish grade shall be at the Contractor's expense.

D. Unstable Materials. Materials which are not capable of supporting superimposed loadings are defined as unstable materials. Should unstable materials be encountered during excavation, immediately notify Engineer. If, in the opinion of the Engineer, unstable soil excavation is required and the Contractor could not have reasonably been expected to discover the existence of such materials during his site investigation, then a contract price for Unstable Soil Excavation shall be negotiated between Owner and Contractor. No payment shall be made for materials excavated prior to notification of the Engineer and negotiation of payment for extra work.

Inclusion of a bid item for Unstable Soil Excavation indicates such excavation is anticipated. The Contractor is to notify the Engineer prior to any unstable soil excavation; no payment shall be made for excavation prior to authorization of Engineer.

E. Rock Excavation. Rock excavation shall be defined as removal of boulders in excess of three (3) cubic yards of solid or fractured rock, which makes hand shaping of the bottom impossible and which requires techniques, such as blasting or jacking for removal, other than those which are being employed by the Contractor or are normally used in trench excavation, such as use of backhoes,

trenchers, draglines, etc. Should unanticipated rock conditions be encountered, immediately notify the Engineer. If in the opinion of the Engineer, rock excavation is required and the Contractor has in fact made a diligent and determined effort to remove the material using normal excavation procedures as stated above, and the Contractor could not have reasonably been expected to determine the existence of such material during his site investigation, then a contract price for rock excavation shall be negotiated between the Contractor and the Owner. No payment shall be made for excavation performed prior to determination of a negotiated price.

Rock shall be removed to a 4" depth below grade. Additionally, all rock loosened during jacking, blasting, etc., shall be removed from the trench. For payment purposes, maximum trench width to be paid for shall be as defined in Subsection 3.02, A. Maximum depth to be paid for shall be 12" below required grade. All over-excavation shall be replaced as specified in Subsection 3.03, C.

Inclusion of a bid item for rock excavation indicates such excavation is anticipated. Contractor to notify Engineer prior to any rock excavating; no payment shall be made for excavation prior to notification.

3.04 Backfilling.

A. Tamping Equipment. Except immediately next to the pipe, mechanical or air operated tamping equipment to be used. Hand equipment such as T-bar to be used to pipe if necessary. Care to be taken when compacting under, along-side and immediately above pipe to prevent crushing, fracturing or shifting of the pipe. The Contractor is to note densities required for materials being backfilled and shall use appropriate approved equipment to obtain those densities.

Wheel rolling is not considered to be an adequate compaction technique to meet these Specifications and will not be allowed. Where 85% compaction is required, wheel rolling may be considered. Before acceptance, the Contractor shall backfill a portion of the trench and pay for density testing to verify adequacy of the proposed backfill techniques.

A hydro hammer may be allowed to obtain the specified density up to 4' in depth. The Contractor will be required to re-excavate those areas that have been tamped so that density tests can be taken to insure that the specified density is being obtained full depth.

B. Moisture Control. Generally maintain moisture of backfill material with ±. 2% of optimum moisture content as determined by ASTM 0698. Maintain closer tolerances as needed to obtain densities required.

C. Compaction. Maximum density (100%) based on ASTM 0698 or AASHTO T99.

1. Bedding Material, including material used for over-excavation of any kind: 95%

2. Select Material: 95%

3. Backfill beneath existing or proposed pavement, roadways, sidewalks, curbs, utility lines and other improvements or within 5' horizontally of such improvements: 95%

4. Backfill within public or designated right-of-way: 95% or as shown on the Drawings.

5. Backfill within undeveloped, green or undesignated area: 90%

D. Placing Backfill. The maximum loose lifts of backfill material to be as follows: use smaller lifts where necessary to obtain required densities:

1. Bedding and select material: 6" (or see Section 3.03A).

2. Backfill Material: 12" where 95% compaction required. 24" where less than 95% compaction required.

E. Backfilling Appurtenances. Backfilling is to be done generally at the same time as adjacent pipelines. Backfilling procedures are to conform to this Section. Use special techniques or materials as shown on drawings.

F. Disposal of Excess Excavation. Contractor to dispose of excess excavation off-site. The Owner shall have the right to elect to have the excess excavation disposed of at a designated site within the project limits. Excavation may be wasted on-site only if approved by the Engineer. Disposal in any case shall be the sole responsibility of the Contractor.

G. Jetting. Jetting and water inundation are generally not permitted methods of compaction. The Engineer may allow jetting under certain field conditions. If jetting is allowed; techniques including depth of lifts, amount of water to be used, penetration of hose jet, etc., shall be submitted to the Engineer for approval. The Contractor remains solely responsible for the results gained when using this method. Any areas of compaction that do not meet the requirements of the Contract will be removed and re-compacted at the Contractor's expense. No jetting will be allowed on materials with a 200-minus gradation of greater than 15%. Contractor shall pay cost of all water used, soil classification testing and compaction testing and any retesting or re-compaction required. No jetting shall be done prior to written approval and direction of the Engineer.

H. Maintenance of Backfill. Contractor to maintain all backfill in a satisfactory condition during the extent of the contract and warranty period. All surface deterioration determined to be the responsibility of the Contractor and all settlement shall be repaired at once by the Contractor upon notice by the Owner. All costs for repair and all liability as a result of surface deterioration or settlement shall be the responsibility of the Contractor.

I. Clay Barrier Water Stops. Because of the presence of ground water, a clay barrier may be required to be installed full depth in trench in place of all bedding material and backfill. This barrier shall be full depth and two feet thick and installed every 500 lineal feet of trench. Clay barrier installation shall be considered incidental to the pipe installation and not paid for separately.

3.05 Surface Restoration. All existing surface improvements and site conditions disturbed or damaged during construction to be restored to a condition equal to pre-construction condition. All restoration costs are considered incidental to excavation and backfill.

A. Improvements. Replace, repair or reconstruct all improvements as required. Work will not be accepted until restoration is accepted by Engineer and all affected property owners. Improvements include, by example, other utilities, culverts, structures, curb and gutter, mail boxes, signs, sprinkler systems, etc.

B. Final Grading. The Contractor is to re-establish existing final grade or finish final grades as modified and shown on the Drawings. The Contractor is to backfill to proper subgrade elevation with backfill material to allow placement of surface improvements or materials.

C. Roadways. Materials and methods to conform to Section 02222 - Embedment and Base Course Aggregate; Section 02612 - Hot Bituminous Pavement; and Section 02614 - Portland Cement Concrete Paving. All roadways to be restored to pre-construction condition with material types removed. Replacement materials shall match adjacent pavement structures in type and thickness with the following minimum requirements.

1. Minimum base course material on gravel roadways or minimum depth gravel on hard surface roadways to be 8".

2. Minimum bituminous surfacing to be 4".

3. Minimum concrete paving to be 6".

D. Green Areas. Restore all green areas as specified in Section 02821 - Revegetation - Seeding, Sodding, Hydro-seeding.

4.00 QUALITY CONTROL - FIELD

4.01 Compaction. It should be fully understood that it will be the sole responsibility of the Contractor to achieve the specified densities for all embedment and backfill material placed. Contractor will be responsible for ensuring that correct methods are being used for the placement and compaction of said materials. Correct backfill methods include, but are not limited to:

1. Use of proper equipment for existing soil condition encountered.

2. Moisture content of existing soils; determination if water should be added or if soil should be air dried to reduce moisture content.

3. Thickness of backfill lift.

Contractor may, at his own expense, have an approved geotechnical engineer monitor the methods of backfill and compaction used to ensure that the desired densities are being obtained.

Inspection and testing will be performed as directed by the Engineer. Testing will be conducted as a quality control check to verify the Contractor's compliance with the standards indicated in the Specifications.

4.02 Inspection and Testing. Inspection and testing to be performed at the direction of the Engineer. Contractor is to cooperate fully with all persons engaged in testing. Contractor to excavate as required to allow testing. Contractor to backfill all test excavations in accordance with these Specifications. Any areas which require a specified density, including fill, backfill, trenches, embankments, road base, hot bituminous pavement, backfill for structures, shall be tested.

4.03 Density Testing and Control.

A. Reference Standards. Density/moisture relationships to be developed for all soil types encountered according to ASTM D698 or AASHTO T99.

B. Field Testing. Testing for density during compaction operations to be done in accordance with ASTM D2922 using nuclear density methods.

C. Frequency of Testing. Minimum of one (1) test every 100' trench per lift or as directed by Engineer. Contractor to excavate to depths required by Engineer for testing and backfill test holes to density specified. Testing to be paid for by Owner.

D. Re-testing. In the event of failure to meet compaction criteria, Contractor shall re-excavate and re-backfill at direction of Engineer. All retesting to be paid for by Contractor and to be performed by soils testing firm approved by the Engineer.

4.04 Payment for Testing. Owner responsible for all costs of initial testing of backfill. Contractor to pay all costs of any retesting required.

5.00 MEASUREMENT AND PAYMENT

Where items are specifically included on the bid schedule, they will be paid for by the unit given. All other items in this section that are essential to the project but for which there are no specific pay items, will not be measured and paid for separately but shall be included in the project.

End of Section

SECTION 02222

EMBEDMENT AND BASE COURSE AGGREGATE

1.00 GENERAL

1.01 Scope. This work shall consist of furnishing and placing one or more courses of aggregate on the prepared surface in accordance with these Specifications in reasonably close conformity with the lines, grades and typical cross sections shown on the drawings or established by the Engineer in the field.

1.02 Related Work Specified Elsewhere.

Section 02201 - Excavation and Backfill for Structures
Section 02221 - Trenching, Backfilling and Compaction
Section 02555 - Water Transmission and Distribution Lines
Section 02520 - Storm Drainage Utilities
Section 02530 - Sanitary Sewerage
Section 02612 - Hot Bituminous Pavement

1.03 Submittals.

Aggregates. Contractor shall submit certified statement from independent testing laboratory, acceptable to Engineer, of material compliance.

2.00 MATERIALS

Aggregate used for pipeline bedding, base course and subbase course and specified by Class in other sections of this Specification shall conform to the gradation schedule shown below.

CLASSIFICATION TABLE FOR AGGREGATE BASE COURSE*

Percentage by Weight Passing Square Mesh Sieves

Sieve	LL not greater than 35			LL not greater than 30			
Designation	Class I	Class 2	Class 3	Class 4	Class 5	Class 6	Class 7
6 inch			100				
4 inch		100					
3 inch		95-100					
2.5 inch	100						
2 inch	95-100			100			
2 inch				90-100	100		
1 inch					95-100	100	100
3/4 inch				50-90		95	
No. 4	30-65			30-50	30-70	30-65	
No. 8						25-65	20-85
No. 200	3-15	3-15	20 max.	3-12	3-15	3-12	5-15

*Reproduced from Colorado Department of Highways Standard Specifications for Road and Bridge Construction.

3.00 METHODS AND PROCEDURES

3.01 Placing. The base course material shall be placed on the previously prepared subgrade at the locations and in the proper quantities to conform to the typical cross sections as shown on the Drawings and as directed by the Engineer. Placing and spreading shall be done by means of spreader machine, moving vehicle, motor grader or other approved equipment methods. The material shall be placed without segregation. Any segregated areas shall be removed and replaced with uniformly graded material at the Contractor's expense.

The base material may be placed in lifts of up to 6 inches, providing that after compaction, uniform density is obtained throughout the entire depth of the lift. If the required depth exceeds 6 inches, it shall be placed in two or more lifts of approximately equal thicknesses. If uniform density cannot be obtained by 6 inch lifts, the maximum lift shall not exceed 4 inches in final thickness.

3.02 Compacting. Rolling will be continuous until the base material has been compacted to not less than 95% of maximum density as determined by ASTM D698 or AASHTO T99. Water shall be uniformly applied as necessary during compaction to obtain optimum moisture content and to aid in consolidation. The surface of each layer shall be maintained during the compaction operations in such a manner that a uniform texture is produced and the aggregates are firmly keyed.

The finished base course surface shall be smooth and free of ruts and irregularities and true to grade and crown as shown on the plans or as directed by the Engineer. The final surface shall be finished with a surface smoothness tolerance of 3 inch, measured as vertical ordinate from the face to a ten-foot straight edge. The base course shall be maintained in this condition by watering, drying, rolling or blading as necessary, or as the Engineer may direct, until the surface material is placed.

4.00 QUALITY CONTROL - FIELD

4.01 Inspection and Testing. Inspection and testing to be performed at the direction of the Engineer. Contractor to cooperate fully with all persons engaged in testing. Contractor to excavate as required to allow testing; Contractor to backfill all test excavations in accordance to these Specifications.

4.02 Density Testing and Control.

A. Reference Standards. Density/moisture relationships to be developed for all soil types encountered according to ASTM D698 or ASSHTO T99.

B. Field Testing. Testing for density during compaction operations to be done in accordance with ASTM D2922 using nuclear density methods.

C. Frequency of Testing. Conduct a minimum of one test for each layer of specified depth of fill or backfill as follows:

Trenches within Roadways: For each 100 lineal feet or less of trench.

Trenches outside Roadways: For each 200 lineal feet or less of trench.

Foundations/Slabs on Grade: For each 1,000 square feet or less of building area.

Pavement and Walks: For each 1,000 square feet or less.

All Other Areas: For each 2,000 square feet or less.

4.03 Payment for Testing. Owner is responsible for all costs of initial testing of backfill. Contractor to pay for all costs of any retesting required.

5.00 MEASUREMENT AND PAYMENT

Where items are specifically included on the bid schedule, they will be paid for by the unit given. All other items in this section that are essential to the project but for which there are no specific pay items, will not be measured and paid for separately but shall be included in the project.

End of Section