

**City of Steamboat Springs
 Technical Specifications
 Table of Contents**

REVISED 04/17

Division	Description
02050	Removals
02100	Site Preparation
02125	Tree Protection
02200	Earthwork
02221	Excavating, Backfilling, and Compacting
02232	Aggregate Base Course
02236	Crusher Fines Paving
02238	Pavement Removal and Replacement
02242	Geotextiles
02260	Fine Grading
02261	Rip Rap
02513	Asphalt Pavement
02515	Concrete Roadway Paving – REV 04/17
02516	Concrete Paving for Sidewalks, Trails, Curbs, Gutter and Bands Surfaces – REV 04/17
02521	Concrete Unit Pavers
02601	Manholes
02623	Culvert and Storm Pipe Installation
02720	Catch Basin Inlets
02925	Topsoil
02933	Revegetation

SECTION 2050

REMOVALS

PART 1 GENERAL

- 1.01 RELATED DOCUMENTS: The General Contract Conditions, Drawings and other Division-1 Specification sections apply to Work of this Section.
- 1.02 DESCRIPTION: The work of this section consists of demolition and removal of items as shown in the drawings. The work also includes removal, salvage and resetting of items shown on the drawings. The work also includes filling and grading, and disposal of unsalvageable materials.
- 1.03 RELATED SECTIONS:
- A. Construction Facilities and Temporary Controls – Section 01500
 - B. Tree Protection and Retention - Section 02125
 - C. Earthwork - Section 02200
- 1.04 QUALITY ASSURANCE: Comply with safety requirements for demolition, ANSI A10.6-83. Erect suitable barriers around open excavations. Blasting will not be permitted without prior approval of Project Engineer. No burning will be permitted.
- 1.05 PROJECT CONDITIONS:
- A. Any and all materials removed, unless designated to be salvaged or reused, shall become the property of the Contractor and disposed of offsite in a legal manner.
 - B. Materials to be reused shall be protected from defacing or damage, and shall be reused in conformance with the applicable specification sections and in the configuration shown on the construction plans.
 - C. Materials to be salvaged shall be protected from defacing and damage, and shall be stockpiled in a location designated by the Project Engineer.
 - D. Keep dust to a minimum at removal areas. Use sprinklers or water trucks as necessary.
 - E. Ensure safety of persons in demolition area. Provide temporary barricades as required per Section 01500.

PART 2 PRODUCTS

- 2.01 FILL MATERIALS: Satisfactory soil material for backfilling hole and pits created by removals shall be in conformance with the provisions of Section 02200.

PART 3 EXECUTION

3.01 PREPARATION:

- A. Protect structures, pavement, utilities, and vegetation to remain.
- B. Set up all barriers, including those for tree protection, per Sections 02125.

3.02 REMOVALS:

- A. The contractor shall remove all items and materials as designated on the construction plans, or otherwise directed by the Owner, without disturbing existing adjacent improvements. Where adjacent improvements are damaged by the Contractor's operations they shall be repaired and/or replaced to the satisfaction of the Project Engineer and at the Contractor's expense.
- B. Where concrete, pavers, asphalt walks, or roadways are to be removed; sawcutting or other approved methods shall be performed at the location of the extent of demolition. Sawcutting shall be to the full thickness of the material and shall be straight and true.
- C. Underground utilities shall be removed or abandoned as indicated on the construction plans. Underground utilities not specified to be removed or abandoned in the construction plans shall remain unless their location conflicts with the proposed improvements. Contractor shall be responsible for notifying Project Engineer of location of utility abandonments prior to backfill of trench and all underground abandonments shall be clearly delineated on the project record drawings. Contractor shall fill and/or plug abandonments as indicated on the construction plans and as directed by the Project Engineer.
- D. Underground utility materials shall be removed to the nearest joint beyond the limits of removal. Contractor shall coordinate all isolation, disconnection and shut-off of utility systems with Project Engineer and utility provider a minimum of seven days prior to affecting service of any utility. Excavation, backfill and compaction associated with underground demolition and relocation shall be performed in accordance with the requirements of Section 02200.
- E. Miscellaneous street items including valves, control points, benchmarks, property corners, monuments, shall be salvaged, removed, and reset as required by Drawings. Contractor shall be responsible for maintenance of these points and any surveying required to re-establish control or monumentation prior to final acceptance.
- F. In areas where existing materials are specified to remain, the Contractor shall coordinate all removals with Project Engineer to ensure appropriate connections and transitions of pavement material. Contractor shall be responsible for replacement of all materials designated to remain damaged by construction operations. In addition, the Contractor shall be responsible for reinstalling existing snowmelt systems impacted or disrupted by construction at no additional cost to the Owner.
- G. Where existing electrical services, light poles, and fixtures are designated for removal, contractor shall remove poles and fixtures in a manner to not disrupt electrical services and operation of light poles and fixtures to remain. Contractor shall be responsible for rewiring and connection existing light poles and fixtures at no additional expense to Owner.

- H. All materials designated to be removed or demolished and not designated to be reused or salvaged shall be hauled off the Project site and legally disposed of at the Contractor's expense.

3.03 RESTORATION:

A. Backfilling:

1. Holes and pits created by removing existing structures and materials shall be backfilled and compacted with satisfactory soil material. This material shall be placed in lifts, moisture treated and compacted in accordance with the requirements of Section 02200. The backfill shall be graded to within plus or minus 0.1 foot of the elevations indicated on the final drawings.
2. Ensure that areas to be filled are free of standing water, frost, frozen material, and debris.

3.04 DISPOSAL:

- A. Remove trash, debris and waste materials, and legally dispose of it off the property.
- B. All materials to be stockpiled, whether temporarily for reuse or for disposition by the Owner, shall be protected from contamination, defacement, degradation, adverse weather condition, and vandalism in accordance with the contract documents.

END OF SECTION

SECTION 02100

SITE PREPARATION

PART 1 GENERAL

1.01 RELATED DOCUMENTS: The General Contract Conditions, Drawings, and other Division-1 Specifications apply to Work of this Section.

1.02 DESCRIPTION: The work of this section consists of removing and disposing of vegetation and debris.

1.03 RELATED SECTIONS:

- A. Tree Retention and Protection - Section 02125
- B. Dust Control – Section 01560
- C. Erosion Control - Section 01565
- D. Traffic and Pedestrian Control – Section 01570

1.04 DEFINITIONS:

- A. TOPSOIL: Natural or cultivated surface soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches in diameter, and free of weeds, roots, and other deleterious materials.
- B. CLEARING: The scalping and removal of on-grade or above-ground vegetative growth such as live and dead trees, logs, stump, downed branches, brush, weeds, grass, sod, decayed vegetative matter and other organic material, trash, rubbish, and any improvement or obstructions not removed by site or building demolition work.
- C. GRUBBING: The removal of trunks, stumps, buried logs, roots, and other objectionable materials below the surface of the ground.

1.05 GENERAL:

- A. Protect benchmarks, stakes, and similar items from damage.
- B. Protect and maintain existing utilities and underground work which is to remain.
- C. Protect improvements on adjoining properties.
- D. Protect existing trees and other vegetation.
- E. Provide dust control as required for alleviation or prevention of dust nuisance on or about the site or borrow area.

1.06 SUBMITTALS:

- A. Contractor shall submit list of all items to be salvaged.

- B. Photographs or videotape, sufficiently detailed, or existing conditions of buildings, trees and planting adjoining construction, and site improvements that might be misconstrued as damage caused by construction.
- C. Record drawings identifying and accurately locating all capped utilities and others subsurface structural, electrical, and mechanical conditions.

1.07 PRODUCTS

- A. BACKFILL MATERIAL: As specified in Section 02200.

PART 2 EXECUTION

2.01 PROTECTION OF TREES AND VEGETATION TO REMAIN: Locate and suitably identify trees and improvements indicated to remain. See Section 02125.

2.02 CLEARING: Remove brush and vegetation from areas designated to be cleared. As directed by the Owner, trim low hanging, unsound, or unsightly branches on trees and shrubs designated to remain. Make cuts flush with trunk or branch.

2.03 GRUBBING: Remove all stumps, roots, and debris a minimum of 18 inches below original ground in all areas as required. Use hand methods for grubbing inside drip line of trees to remain. Fill stump and root holes as specified in Section 02200.

2.04 TOPSOIL STRIPPING

- A. Remove sod and grass before stripping topsoil.
- B. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials. Strip surface soil of unsuitable topsoil, including trash, debris, weeds, roots, and other waste materials.
- C. Stockpile topsoil materials away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Do not stockpile topsoil within drip line of remaining trees.
- D. Place topsoil in accordance with Section 02925 Topsoil and as directed by Project Engineer.
- E. Dispose of excess topsoil as specified for waste material disposal.

2.05 PROTECTION OF BENCHMARKS, STAKES AND SIMILAR ITEMS: Protect all existing benchmarks, stake, and control points within the limits of construction to the extent possible. All survey control points disturbed during construction shall be reset and documented with the appropriate agency at the Contractor's expense

2.06 PROTECTION OF EXISTING UTILITIES, UNDERGROUND WORK AND ADJOINING PROPERTY IMPROVEMENTS

- A. Protect all existing utilities and underground feature to remain within the limits of construction. Contractor shall coordinate construction near existing features with the appropriate agency requirements and the Project Engineer.
- B. Protect all adjacent property improvements during construction. Contractor shall repair all damage incurred at their own expense.

- C. Comply with all applicable noise abatement ordinances or regulations.

2.07DISPOSAL

- A. All materials removed, unless otherwise noted, shall become property of Contactor and shall be removed off-site and legally disposed of.
- B. Burning of waste materials on site is prohibited.

END OF SECTION

**SECTION 02125
TREE PROTECTION AND RETENTION**

PART 1: GENERAL

- 1.01 RELATED DOCUMENTS: The General Contract Conditions, Drawings, and Division - 1 Specification sections, apply to Work of this section.
- 1.02 DESCRIPTION: The work of this section consists of retaining and protection of trees and landscape material during the construction of the project.
- 1.03 GENERAL REQUIREMENTS
- A. Contractor shall flag trees to be removed as well as trees to remain, prior to construction as directed by the Project Engineer. Trees located in the City Right of Way that are proposed for removal but are not shown to be removed on the Drawings shall be approved for removal by the City Engineer. Marking flags for each designation shall be distinctly different colored, as approved by the Project Engineer.
 - B. There should be daily supervision of field crews by the Project Engineer or Project Consulting Arborist during the critical phases of the project: for example, demolition of existing concrete; root pruning; construction of retaining walls and construction of new curb or sidewalk in tree protection areas. Owner shall be responsible for retaining Project Consulting Arborist for applicable phases of the project.
 - C. If it appears that the completion of the construction may cause damage to the branches of any tree, the Contractor shall contact the Project Engineer. The Project Engineer will make a determination as to whether such damage is eminent.
 - D. To prevent or minimize soil compaction, designated routes for equipment and foot traffic by work crews shall be determined prior to commencing construction activities, and shall be indicated in the tree protection plan to be submitted by Contractor. These routes shall be marked at the site, prior to commencement of construction, with tree protection fencing and signage as specified in this section.
 - E. Motorized equipment and trailers, including tractors, bobcats, bulldozers, trackhoes, trucks, cars, and carts shall not be allowed access within tree protection areas. Should access be necessary within designated tree protection areas, the existing grade shall be covered with six (6) to eight (8) inches of wood mulch to help distribute the weight of equipment and to minimize soil compaction and rutting. Plywood and/or mulch is not acceptable bridging material for driving over exposed tree roots. Exposed tree roots shall not be driven over. The Project Engineer or Project Consulting Arborist shall be notified and shall approve of the access and driving surface prior to its use.
 - F. Materials and supplies shall not be stockpiled or stored within the tree protection area. Should temporary storage be necessary within designated tree protection areas, the existing grade shall be covered with double, overlapping sheets of ¾ inch thick plywood, or six (6) to eight (8) inches of wood mulch to help distribute the weight of materials or supplies and to minimize soil compaction.
 - G. Under no circumstances shall any objects or materials be leaned against or supported by a tree's trunk, branches, or exposed roots. The attachment or installation to trees of any sign, cable, wire, nail, swing, or any other material that is not needed to help support the natural

structure of the tree is prohibited. Standard arboricultural techniques such as bracing or cabling that are performed by professional arborists are acceptable upon approval by the Project Engineer or Project Consulting Arborist.

1.04 DEFINITIONS

- A. **TREE PROTECTION AREA:** Generally, a tree protection area should consist of the ground encompassing from 1.5 (minimum) to 2.0 times the distance between the trunk and dripline, or one linear foot away from the trunk base for every inch diameter of the trunk, whichever is greater, unless otherwise directed by Project Engineer. (See section below). Areas of ground covered by pavement, buildings, or other permanent structures where the presence of roots is minimal or negligible, are excluded. The area under or within the tree's dripline is also referred to as the "Critical Root Zone" (see below).
 - 1. With groups of trees or where an array effect is present, there may be discontinuous (non-overlapping) perimeters of tree protection areas which result in difficult to maintain or ineffective tree protection fencing. In these cases, even though tree protection areas do not overlap, they should be treated as though they do if the distance between the perimeters of such areas is less than thirty (30) feet. In effect, this will artificially enlarge the area of tree protection, but will result in a more clearly defined, manageable area.
- B. **DRIPLINE:** The outermost edge of the tree's canopy or branch spread. The area within a tree's dripline is all the ground under the total branch spread.
- C. **CRITICAL ROOT ZONE:** Generally, all of the ground area included in the dripline.
- D. **DIAMETER (CALIPER):** The size (in inches) of a tree's trunk is measured at:
 - 1. six (6) inches above grade for trunk diameters up to and including four (4) inches;
 - 2. twelve (12) inches above grade for trunk diameters from four (4) inches up to and including eight (8) inches; and
 - 3. four and a half (4½) feet above grade for trunk diameters greater than eight (8) inches; in accordance with guidelines established in the "Guide for Plant Appraisal". All measurements should be rounded to the nearest inch.
- E. **HIGH-VALUE SHRUB:** Any specimen shrub with an appraised value of \$100.00 or more.
- F. **PROJECT CONSULTING ARBORIST:** An independent consultant with a degree in a field related to arboriculture, and at least five years field experience in tree preservation or on-site monitoring of public works or construction projects involving tree retention and protection. The Consultant should be an active member in the American Society of Consulting Arborists and International Society of Arboriculture.

1.05 REFERENCE STANDARDS AND GUIDELINES:

- A. Contractor shall comply with applicable requirements and recommendations of the most current versions of the following standards and guidelines. Where these conflict with other specified requirements, the more restrictive requirements shall govern.
 - 1. ANSI Z133.1-1988 - American National Standard for Tree Care Operations
 - 2. ANSI A300-1994 - Standard Practices for Trees, Shrubs and Other Woody Plant Maintenance

3. NATIONAL ARBORIST ASSOCIATION STANDARDS - Pruning, Cabling and Bracing, Fertilization
4. GUIDE FOR PLANT APPRAISAL-8TH EDITION, Authored by the Council of Tree and Landscape Appraisers; published by the International Society of Arboriculture.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

- 3.01 CONSTRUCTION REQUIREMENTS: This section provides standards and guidelines for the retention and protection of trees and high-value shrubs for any proposed public works or construction project.
- 3.02 DEMOLITION OF EXISTING CONCRETE
 - A. Caution should be used during removal of existing street, curb, gutter, sidewalk, drain inlets, and other concrete and asphalt demolition, to minimize injury to tree root systems. The following procedures should be used when removing existing concrete.
 1. Breaking of the existing concrete and asphalt for removal should be done in a manner that will minimize ground disturbance and vibration.
 2. Curbs and sidewalks within designated tree protection areas and critical root zones shall be removed by hand. When removing existing sidewalks and curbs, care should be taken to avoid injury to roots located under, over, or adjacent to paved surfaces.
 3. Roots and root-trunk flares growing over curbs should not be injured during breaking of curbs and removal of debris. Wood and bark tissues shall not be injured by striking tissues with equipment.
 4. During the removal of concrete, all root systems and soil areas exposed shall not be disturbed.
 5. Motorized equipment and trailers, including tractors, Bobcats, bulldozers, trackhoes, trucks, cars, and carts are to be limited to access on the existing paved street only. Access is not allowed behind the curb within tree protection areas.
 6. Should access be necessary within designated tree protection areas, the existing grade shall be covered with double, overlapping sheets of ¾ inch thick plywood, or six (6) to eight (8) inches of wood mulch to help distribute the weight of equipment and to minimize soil compaction and rutting. Plywood and/or mulch is not acceptable bridging material for driving over exposed tree roots. Exposed tree roots shall not be driven over. The Project Engineer or Project Consulting Arborist shall be notified and shall approve of the access and driving surface prior to its use.
- 3.03 CONSTRUCTION OF SIDEWALKS, CURBS, CONCRETE, ASPHALT PAVING AND DRAINAGE INLETS
 - A. The following procedures shall be used when constructing sidewalks, curbs, concrete, asphalt paving, and drainage inlets.
 1. Keep all materials and equipment within the street bounded by existing curbs.
 2. Protect exposed roots from contamination by stabilization materials and concrete.

3. Locate concrete washout areas away from roots and tree protection areas.
4. When excavating for the construction of inlets, excavated soil shall be deposited in trucks and hauled off or deposited temporarily on ¾ inch thick plywood outside the critical root zone. Excavated and fill soil shall not be deposited, even temporarily, on unprotected natural grade.
5. After proper pruning, as needed, cover exposed roots within thirty (30) minutes to minimize desiccation. Roots may be covered with soil, mulch, or moistened burlap (7 ounce or equivalent), and shall be kept moist during the period until the final grade is established.
6. Where possible, sidewalks should be raised or relocated to prevent cutting and removing major roots (e.g. roots greater than three inches in diameter).
7. Place a sheet of six (6) mil or thicker plastic over the grade within affected portions of tree protection areas prior to pouring concrete sidewalks, curbs, inlets, ramps, and driveway approaches. The plastic will assist in providing a non-leaching barrier between the concrete, soil and roots.
8. Limit grading to a maximum of two (2) inches of fill over natural grade within critical root zones. Fill should consist of sandy loam topsoil. Clay soils shall not be used as fill. When using fill soil, the existing surface to receive fill should be scarified prior to filling. Any filling operation should not occur during water saturated soil conditions.
9. Existing soil may be used as a form for back of curb and gutter, with or without the use of a thin masonite-type form, although a masonite form is preferred. This will minimize excavation in the critical root zone and prevent undue injury to the roots. This method is unnecessary in areas outside the critical root zone. Place a layer of Typar BioBarrier between the curb and tree roots to help inhibit root growth that may exploit small cracks in the curb. Where appropriate, use curbs with discontinuous footings to maintain natural grade near the base of trees adjacent to the curbing, and to minimize injury to roots and root flares.
10. Provide for easy concrete removal and replacement where an obvious raised root may cause sidewalk cracking in the future. This can be accomplished by installing an expansion joint on either side of the root or by etching the concrete on either side of the root to allow that particular section to be broken out and replaced. Compaction rating for the replacement walkway should not exceed 80% Proctor density. Tree roots will continue to slowly add girth every year; therefore, the base material needs to be malleable (e.g. suitable subgrade aggregates, crushed granite, or compacted sand) to prevent a fulcrum or pressure point which can crack or heave the walkway.
11. Where appropriate, and under the direction of the Project Engineer or Project Consulting Arborist, root restricting barriers can be installed with a minimal amount of disturbance. There are several promising landscape related materials used as barriers to root growth, especially away from sidewalks, curbs and streets. Three such materials are:
 - a. A stiff nylon woven fabric (Q899 nylon fabric with extra firm finish from Jason Mills, Westwood, NJ);
 - a) 14-mesh or smaller copper wire screen;
 - b) Typar BioBarrier (REEMAY, Inc., Old Hickory, TN). The nylon fabric has holes approximately 1/26th-inch square separated by strands approximately 1/26th-inch thick, with strands fused together. Copper screen has been shown to be effective in controlling

seedling root growth. Typar BioBarrier is a commercial product developed specifically to control roots of trees, and consists of a felt-like spun-bounded polypropylene fabric to which polyethylene pellets are attached at one and a half (1½) by one and a half (1½) inch spacing. The pellets are impregnated with the herbicide Trifluralin and release it slowly over time (many years). After a two (2) foot deep, narrow trench is dug adjacent to the curb, sidewalk, or other structure involved, and after any affected roots are properly pruned, the material of choice should be placed against the side of the wall closest to the roots that were severed (side of the wall farthest from the structure being protected). Note: This procedure should not be used if large, existing roots (four (4) inches or larger in diameter) will be severed. The nylon fabric and copper screen will constrict roots to the size of the openings in the material; beyond the constrictions, roots will be greatly stunted except for knobs that form against the barriers. The barrier should be installed at least eighteen (18) to twenty-four (24) inches deep (in a vertical plane).

12. In areas where roots have to be removed for construction of drain inlets, roots shall be severed prior to excavation to eliminate unnecessary tearing of roots by equipment. a. Excavate soil by hand at the construction cut limit to a depth of thirty (30) inches or to the depth of the required root cut, whichever is less.

a) Prune roots as specified in Part 3, 3.1, D of this section.

b) Protect exposed roots as specified in Part 3, 3.1, B.5 of this section.

13. Concrete or chemicals spilled within tree protection areas should be completely removed. Contamination soil shall be completely removed at the time of the spill and removed by hand without disturbance to root systems. Appropriate soil should be added as necessary to restore the grade.

3.04 IRRIGATION OR UTILITY INSTALLATION

A. Protection of Trees and High Value Shrubs:

1. Contractor shall protect all trees and high-value shrubs from injury due to irrigation related work. All injuries to trees and high-value shrubs shall be mitigated to the satisfaction of the Owner, and, if appropriate in accordance with guidelines established in the "Guide for Plant Appraisal". All costs of such mitigating shall be charged to and paid by the Contractor.

2. All irrigation lines shall be indicated on construction plans and pre-approved by the Project Engineer or Project Consulting Arborist. Unless absolutely necessary, no irrigation lines shall be located within 10 feet of any existing tree trunk. (See item 2 below).

B. Existing Trees:

1. The Project Engineer or Project Consulting Arborist shall be notified prior to any trenching or excavation known or suspected to involve cutting of more than: a. two roots, three inches or more in diameter; and/or four roots between two (2) and three (3) inches in diameter. The Project Engineer or Project Consulting Arborist shall be notified immediately in the event that roots in excess of that described above are cut, torn, ripped, or otherwise injured.

2. All trenching or other work under the dripline of any tree shall be done by hand or by other methods which will prevent breakage or other injury to branches and roots.

3. Where it is necessary to excavate within the critical root zone of existing trees, contractor shall use all possible care to avoid injury to trees and tree roots. Excavation, in areas where two (2) inch diameter and larger roots occur, shall be done by hand with approved hand tools. Where possible, tree roots two (2) inches or larger in diameter shall be tunneled or bored under and shall be covered with moistened burlap to prevent excessive drying.
4. Wherever a trenching machine exposes roots smaller than two (2) inches in diameter, such roots extending through the trench wall shall be hand pruned (see Part 3, 3.1, D of this section. All trenches within critical root zones shall be closed within twelve (12) hours-if this is not possible, the trench walls shall be covered with burlap and kept moistened. Prior to backfilling, Contractor shall contact the Project Engineer or Project Consulting Arborist to inspect the condition and treatment of roots larger than two (2) inches in diameter injured by trenching.
5. Horizontal directional boring (auger tunneling), rather than open trenching, should be used for irrigation line or other utility installation within one half (½) foot linear distance from the trunk base for every inch of trunk diameter, if root disruption or utility installation occurs on no more than one side of the tree. If trenching or utility installation will occur on two or more sides of a tree trunk (e.g. N,S,E, or W), then horizontal directional boring should be used if line installation is within one (1) foot linear distance from the trunk base for every inch of trunk diameter.

C. Root Pruning:

1. Tree roots shall not be pruned or cut unless their removal is unavoidable or absolutely necessary. The Project Engineer or Project Consulting Arborist shall be notified prior to any operation known or suspected to involve cutting of more than: a. two roots, three (3) inches or more in diameter; and/or b. four (4) roots between two (2) and three (3) inches in diameter. The Project Engineer or Project Consulting Arborist shall be notified immediately in the event that roots in excess of that described above are cut, torn, ripped, or otherwise injured.
2. Upon approval by the 's Project Engineer, prior to any excavation, removal of sidewalk, or other activity that will result in removal of soil and tree roots, all tree roots within a designated area will be pruned to a depth of fourteen (14) inches. Pruning shall occur with a Dosko Root Pruner, or equivalent, in accessible areas, and by hand in areas inaccessible to the root pruning machine. All other root pruning shall be done by hand with approved tools.
3. Removal of roots greater than one (1) inch diameter or parts of roots that are injured or diseased should be performed as follows: a.
 - a) Preserve the root bark ridge (similar in structure and function to a branch bark ridge). Directional root pruning is the recommendation technique and should be used during hand excavation around tree roots. Roots are similar to branches in their response to pruning practices. With directional root pruning, objectionable and severely injured roots are properly cut to a lateral root, if possible, that is growing downward or in a favorable direction.
 - b) All roots needing to be pruned or removed shall be cut cleanly with sharp hand tools, with oversight by the Project Engineer or Project Consulting Arborist. No wound dressings shall be used.
 - c) Recommended root pruning tools:

- Scissor-type lopper.
- 2.) Scissor-type pruner.
- 3.) Large and small hand saws.
- 4.) Wound scribe.
- 5.) Trowel or small shovel.
- 6.) Garden Fork.
- 7.) Hand broom.

4. Root Pruning Near Sidewalks: a.

- a) Root pruning should be done carefully, by hand, to achieve the objective of reducing future sidewalk problems as well as preserving the trees. Removing anchoring roots or causing injuries in anchoring roots and root flares can cause future decay and windthrow hazards. Indiscriminate cutting of vigorous roots results in their resprouting so that several more new roots may grow from the cut end, back under the sidewalk, thereby reducing the time between sidewalk repairs. Roots can be managed in the ground without significant harm to trees, if care is taken to avoid injuries that lead to root and trunk decay.
- b) Directional root pruning is recommended because it considers the tree's response to root pruning and decay. With directional root pruning, roots are cut to a large lateral, if possible, that is growing downward or in a more favorable direction. The pruned root ends will be less likely to resprout, since a large lateral can assume the new terminal role of the root.
- c) Proper removal of selected roots or parts of roots can direct roots away from sidewalks in the future. Procedures for root pruning directly next to sidewalks are as follows:
- d) Hand dig a trench six (6) to eight (8) inches in depth at the edge of the planting strip and sidewalk.
- e) Remove all roots less than two (2) inches diameter in this trench back to a desirable lateral root, preserving the root bark ridge. If careful excavation does not reveal a desirable lateral root within twelve (12) inches of the exposed root in question, then the exposed root shall be pruned properly so that a minimal amount of root is removed.
- f) Small root bundles, the source of future sidewalk problems, should also be removed at this time.
- g) All roots between two (2) and four (4) inches in diameter should be examined by the Project Engineer or Project Consulting Arborist in terms of their role in anchoring the tree. a. All roots that contribute significantly to anchorage should be preserved. Remove all other roots in this size range to sound, downward growing lateral roots that are at least one half (½) the size of the root being removed.
- h) All roots larger than four (4) inches in diameter are to be preserved unless their removal is absolutely necessary. Preservation of large roots may require: 1.) reducing the sidewalk width near the root flare; and/or 2.) ramping or bridging the sidewalk over the roots to allow for root growth.

5. Tree guying subsequent to root pruning: Upon review of on-site root pruning and constructing grading limits, the Project Engineer or Project Consulting Arborist shall determine if existing trees subject to root pruning should be guyed or otherwise stabilized. Contractor shall retain a qualified tree service company to complete tree guying and

stabilization in accordance with National Arborist Association standards as referenced in Section 5.00. Tree service company shall be certified by the International Society of Consulting Arborists, ISCA.

3.05 TREE PROTECTION FENCING

- A. Tree protection fencing should be installed two as designated on construction documents and at all locations within or adjacent to the project limits where existing trees and landscape material shall remain. Tree protection areas shall be designated on construction documents, and fencing locations should be staked for approval by the Project Engineer or Project Consulting Arborist.
- B. Tree protection fences should be:
 - 1. Galvanized chain-link - six (6) feet in height, or approved equal. Posts should be installed on ten (10) foot centers (maximum), at a depth of three (3) feet minimum. Installation of post shall not result in injury to surface roots or root flares of trees.
 - 2. Fencing should be installed to completely surround the limits of tree protection areas, and should extend at least ten (10) feet beyond the designated construction limits.
 - 3. Tree protection fencing shall be installed prior to any site activity and shall remain until its removal is authorized by the Project Engineer or Project Consulting Arborist.
- C. Tree Protection Signage: 1. A sign shall be mounted on tree protection fencing at fifty (50) foot intervals warning constructing personnel and the public to keep out of the tree protection areas.

3.06 PROJECT SITE MONITORING: As determined by the Project Engineer for projects of sufficient size to warrant such, a Project Consulting Arborist should be retained to enforce and monitor the Tree Retention and Protection objectives. The project site should be monitored a minimum of two (2) times weekly-more frequently at the start of the project until all procedures and specifications are understood and properly executed by all parties. Specific monitoring schedules should be developed at preconstruction meetings and modified as deemed necessary by the appropriate parties.

3.07 INJURIES TO EXISTING PLANTS - DAMAGE PENALTIES

- A. Tree and High Value Shrub Appraisal:
 - 1. All trees and high-value shrubs will be evaluated and appraised by the Project Engineer or Project Consulting Arborist, and a list of all tree values for the project will be on file in the Construction Manager's office. Any tree or other plant requiring retention or protection that is not on the list shall be appraised by the Project Engineer or Project Consulting Arborist as necessary to comply with this damage penalty.
 - a) Documentation for appraisals will consist of: a. measurement of plant size;
 - b) identification by common and botanical names;
 - c) current condition (overall health, injuries, overt hazard status, etc.) and
 - d) location factors as described in the "Guide for Plant Appraisal". Photographs may be taken of certain trees and shrubs to document debilitating condition factors.

2. The threshold level for plants to be appraised shall be \$100.00; only those trees and shrubs estimated to have a monetary value greater than \$100.00 shall be appraised.
3. Trees and other plants designated as requiring retention or protection shall be identified and located on construction plans. Loss of, or partial injury to, any of these plants due to Contractor neglect or improper construction activities will result in liquidated damages for the assessed value of the tree as determined by the Project Engineer or Project Consulting Arborist.
4. Trees determined as requiring "general protection" or "special protection" in the construction areas and in other key locations should be clearly identified by the Project Engineer or Project Consulting Arborist. Loss or partial injury to any of these trees due to Contractor neglect or improper construction activities will result in liquidated damages for the assessed value of the trees as determined by the Project Engineer or Project Consulting Arborist. Injury to a portion of these trees will be assessed by the Project Engineer or Project Consulting Arborist and a corresponding portion of the liquidated damages will be assessed to the Contractor.
5. A fine of one-thousand dollars (\$1,000.00) will be levied against the Contractor for each incident of construction damage (including construction traffic) within designated tree protection areas. Any fine shall be independent of any applicable liquidated damages for the assessed value of the tree or tree part.
6. Trees or roots visibly and unnecessarily injured will cause the Owner to withhold from the Contractor an assessed amount conforming to the requirements stipulated above, for a period of one full year. After that period the impact of the injury to any tree will be assessed by the Project Engineer or the Project Consulting Arborist.
7. If any trees or shrubs designated to be retained or protected are injured and replacement is justified, a number and equivalent diameter inches of trees or shrubs of same or similar species shall be furnished and planted by the Contractor. The total inch diameter of the replacement plant(s) shall equal the diameter of the plant(s) to be replaced, in accordance with the "Guide for Plant Appraisal".

3.08 SUBMITTALS

- A. Proposed methods and schedule for effectuating tree and other plant protection shall be submitted for approval. Contractor shall submit construction schedule which includes a time frame for work near existing plants. Approval of such shall be obtained from the Project Engineer prior to commencement of construction near tree protection areas.
- B. Proposed methods, materials, and schedule for root pruning, branch pruning, and other tree maintenance shall be submitted for approval. The Project Engineer or Project Consulting Arborist shall mark the location of root pruning lines in the field prior to the operation. If possible, root pruning should occur between autumnal leaf fall and spring foliage. Root pruning during the growing season shall require approval of the Project Engineer or Project Consulting Arborist.

3.09 TREE AND OTHER PLANT MAINTENANCE DURING AND AFTER COMPLETION OF CONSTRUCTION.

- A. Proper maintenance should include, but without limitation to: structural and remedial pruning; watering; mulching; remediating soil compaction; fertilization; insect and disease control; soil and tissue analysis; aeration; and wound treatment. Contractor shall maintain existing trees during and after completion of construction as directed by the Project Engineer.

- B. The timing duration and frequency of necessary maintenance practices should be determined by the Project Engineer or Project Consulting Arborist, based on factors associated with the site and affected plants.

END OF SECTION

SECTION 02200
EARTHWORK

PART 1 GENERAL

1.01 RELATED DOCUMENTS: The General Contract Conditions, Drawings and other Division - 1 Specification sections apply to Work of this section.

1.02 WORK INCLUDED

A. Furnish and Install:

1. Excavation, including haul
2. Fill
3. Removal and replacement of subgrade material

1.03 RELATED WORK

- A. Section 02221: Excavating, Backfilling and Compacting
- B. Special Provisions: Geotechnical Investigation

1.04 QUALITY ASSURANCE

- A. Testing Agency: All soils testing during construction will be conducted by an approved testing laboratory.
- B. All materials and operations under this section of the Specifications shall be executed under the supervision of a Testing Engineer or Project Engineer who will place qualified personnel on the site during earthwork operations, as necessary. Provide free access to work sites and facilities at all times and provide the equipment and manpower necessary for the Project Engineer and Testing Engineer to perform his work at no additional cost to the Owner.
- C. Regulatory Requirements: Applicable codes, ordinances and regulations of authorities having jurisdiction.

1.05 REFERENCES

- A. Reference Standards: Comply with: Compaction standard: Standard Proctor Density, ASTM D-698-78, or as specified by the Geotechnical Report or Geotechnical Engineer.

1.06 SUBMITTALS: Test reports of soils testing during construction will be distributed by the testing laboratory and/or Testing Engineer.

1.07 PROJECT CONDITIONS

- A. General: Visit, inspect, and become familiar with the site and the work required under this Section.
- B. Test Holes:

1. Contractor Investigation: Test borings and other exploratory work may be made by the Contractor, at no cost to the Owner, after obtaining approval to proceed from the Owner. The Contractor will not be entitled to extra compensation for any additional work required thereby.

C. Existing Utilities:

1. Locate all existing underground utilities and pipes in the areas of work. If the utilities and pipes are to remain in place, provide adequate means of protection during earthwork operations. Properly repair damage to utilities to the satisfaction of the utility company at no expense to the Owner.
2. Should pipes or utilities be encountered during excavation which had not been located or were incorrectly located, consult the utility company immediately and provide assistance and cooperation in repairing and restoring the utility service.
3. Do not interrupt any existing utility service, except after obtaining written permission from both the utility company and the Owner. Provide acceptable temporary utility services during these interruptions.

1.08 WARRANTY

- A. Fill and Backfill: Settlement in backfill, fill, or in structures and paving built over backfill or fill, which may occur within the one year warranty period shall be corrected at no cost to the Owner. Restore any structures damaged by settlement to their original condition at no cost to the Owner.

PART 2 PRODUCTS

2.01 FILL

- A. General: Fill material shall be approved as to type by the Testing Engineer and/or Project Engineer before placement.
- B. Fill Material: On-site excavated material free of debris, ice, foreign solids, and/or organic material and approved by the Testing Engineer and/or Project Engineer, meeting moisture placement limitations.

- 2.02 HAUL: The transportation of unusable excavated material from the work site to a disposal area or the haul of fill into the site as may be required. Haul will not be paid separately, and costs should be included in the earthwork quantities.

PART 3 EXECUTION

- 3.01 INSPECTION Visit and inspect the site and take into consideration known or reasonably inferable conditions affecting the work. Failure to visit the site will not relieve the Contractor of furnishing materials or performing the work required.

3.02 PREPARATION:

- A. Field Engineering: See the drawings for benchmarks, monuments, reference points and layout of the work.
- B. Explosives: The use of explosives is not allowed.
- C. Protection:

1. Barricade open excavations occurring as part of this work and post warning lights. Provide barricades and warning lights as recommended by authorities having jurisdiction.
2. Adequately protect all structures, utilities, sidewalks, pavements, and other facilities existing prior to this work from damage caused by settlement, lateral movement, undermining, washout and other hazards created by earthwork.
3. Restore any structure or facility existing prior to this work which is damaged during completion of this work to a condition as good as or better than existed before the work commenced, regardless if the damage was caused accidentally or through carelessness. Restoration shall be approved by the Owner or other parties having jurisdiction over the facilities and shall be at no additional cost to the Owner.

3.03 EXCAVATION

- A. General: Excavate existing materials to the lines and grades indicated. Remove materials in such a manner as to provide as much readily usable a material as possible. Excavation to be hauled off as part of infrastructure, utility trench, water, sewer, and storm sewer systems construction is required but will not be paid as part of Earthwork Pay Item. Actual quantities will vary due to excess material excavated for the structures, utility trench system, storm sewer trench riprap placement, etc. No additional payment will be made for this earthwork and shall be paid as part of the work required for the related construction item.
- B. Unclassified Excavation: All excavation is considered as unclassified and is defined as removal of all material encountered, regardless of soil type. Unclassified excavation is considered normal excavation and no extra payments will be allowed.
- C. Methods of Excavation: It is anticipated that excavation can be performed by conventional equipment.

3.04 STABILIZATION MATERIAL

- A. Observation: When excavation has reached the designed lines and grades, notify the Project Engineer who will observe the conditions in the excavation.
- B. Remedial Work: If material exposed in the excavations is deemed unsuitable for construction, remove and replace the unsuitable material with angular rock ranging in size from 3-inch spalls to Type VL (as defined by CDOT), as directed by the Testing Engineer and/or Project Engineer. Use of Stabilization Material below design lines and grades shall only be completed upon prior approval by the Project Engineer.

3.05 PREPARATION OF NATURAL GROUND

- A. General: Remove frozen or muddy ground in fill areas.
- B. Structure Subgrade Preparation: Prior to placing any new fill, fill areas should be stripped of all the existing fill, vegetation and organic soil. These materials require stripping to reduce the potential for excessive and/or differential settlement under load and potential for excessive seepage resulting from their high permeability. To properly prepare the structure subgrade areas may require lowering of the groundwater level. This may be accomplished by installation of an interceptor drain, trench or dewatering wells authorized and operated under appropriate permits. The ground surface beneath the

embankment prism should be scarified to a depth of 15 inches and re-compacted to 95% of the maximum standard Proctor density prior to the beginning of fill placement.

3.06 FILLING

- A. General: Fill and compact to levels required to complete the work indicated. Filling may require soil material in excess of quantity of suitable material available from required grading and excavations. Some material may require adjustment of moisture and rehandling before placement.
- B. Placing Fill: Distribute material to avoid formation of lenses or layers of material differing substantially from surrounding material. Deliver material at uniform rate to permit satisfactory procedure to result in well and uniformly compacted fill. Avoid unnecessary concentration of travel causing ruts and uneven compaction. Regrade and compact ruts and hollows more than 6 inches deep before compacting. Spread fill material in horizontal layers not greater than 8 inches thickness of loose material to within optimum moisture limits described below.
- C. Environmental Conditions:
 - 1. Under no condition shall fill be placed on frozen soil nor shall frozen fill or fill containing snow or ice be placed. Fill shall be material having a temperature of 32o Fahrenheit or more.
 - 2. Fill placement during inclement weather shall be as directed by the Testing Engineer. Develop fill placement techniques which will prevent frozen fill conditions from developing. Removal and replacement of frozen fill shall be at the Contractor's expense.
- D. Fill Moisture Content: Distribute uniformly and consistently as possible throughout the fill material. The moisture content of the fill shall be as specified below and the fill shall be at the specified moisture content prior to placement. Moisten fill material by the addition of water, if fill moisture contents are below the moisture contents specified. Aerate and dry the fill material if fill moisture contents are above those specified. The addition of water or additional drying of fill material may be allowed after placement, prior to compaction, so long as such procedures provide a uniform and consistent fill moisture content as designated by the Testing Engineer and/or Project Engineer. Reference Section 02221 for optimum moisture and additional fill requirements.

3.07 DAMAGED OR UNUSABLE MATERIAL

- A. Earth that has been rendered unfit to receive planting due to concrete water, mortar or lime water dumped on it shall be removed from the site and replaced with clean earth.

3.08 FINISH GRADING

- A. General: Grade smooth all planting areas after weeding, soil preparation, and soil conditioning have been completed and soil has been thoroughly watered and settled prior to seeding or planting.
- B. Provide all grades for natural runoff of water without low spots or pockets. Accurately set flow line grades at 2% minimum unless otherwise noted in Drawings. Finish grades shall pitch away from structures. In no case shall drainage from the project site be so altered or controlled as to result in damage from erosion or flooding, or the potential for damage to adjacent property or to any portion of the work executed under this Contract.
- C. . Finish grades shall be smooth, even, and on a uniform plane with no abrupt changes of surface. Slope uniformly between given spot elevations.

- D. Grades not otherwise indicated shall be uniform levels or slopes between points where elevations are given, or between points established by walks, paving, curbs or catch basins.
- E. Tops and toes of all slopes shall be rounded to produce a gradual natural-appearing transition between relatively level areas and slopes.
- F. Prior to acceptance of grades, hand rake to smooth, even surface, free of debris, clods, rocks, and vegetable matter greater than .5 inch.
- G. Tolerances:
 - 1. Cut and fill areas as indicated or required to permit finishing to the finish grades indicated.
 - 2. Subgrade under Sidewalk, Curb, Gutter and Slabs-on-Grade: Finish grade to bearing surface as required. Tolerance (+/-) 0.05 foot.
 - 3. Subgrade Under Paving: Finish grade to bottom elevation of aggregate base course or other material to be placed. Tolerance: (+/-) 0.05 foot.
 - 4. Subgrade Under Landscaped Areas: Finish grade to elevations indicated. Tolerance (+/-) 0.1 foot.

3.09 FIELD QUALITY CONTROL

- A. Placement Method: Obtain the Testing Engineer and/or Project Engineer approval of the method of placing and compacting before starting compacted fill or backfill placement.
- B. Compaction: Comply with Section 02221, Trenching, Backfilling, And Compacting.
- C. Quality Control Testing: Comply with Section 01400 Quality Control.

END OF SECTION

SECTION 2221
EXCAVATING, BACKFILLING, AND COMPACTING

PART 1 GENERAL

- 1.01 RELATED DOCUMENTS: The General Contract Conditions, Drawings and other Division - 1 Specification sections apply to Work of this section.
- 1.02 WORK INCLUDED
- A. Construct and complete:
 - 1. Excavation for footers, utility corridors, storm sewer facilities, and drainage lines as shown in the construction plans.
 - 2. Backfilling of trenches and structures.
 - 3. Compacting of backfilled areas.
- 1.03 RELATED WORK
- A. Section 01570: Traffic and Pedestrian Control
 - B. Section 02050: Removals
 - C. Section 02100: Site Preparation
 - D. Section 02200: Earthwork
 - E. Section 02238: Pavement Removal and Replacement
 - F. Section 01400: Quality Control
 - G. Special Provisions: Geotechnical Investigation
- 1.04 PROJECT CONDITIONS
- A. Existing Conditions: Contractor shall visit, inspect, and become familiar with the site and the work required under this section. Underground obstructions known to the Owner, except service lines are noted on the Drawings in their approximate locations. These locations may prove to be inaccurate, and other obstructions not shown may be encountered. Regardless, it shall be the responsibility of the Contractor to protect and restore all underground obstructions encountered.
 - B. All excavations shall be protected from the entry of storm and snowmelt runoff, and shall be adequately barricaded to achieve the highest level of public safety possible. Pedestrian and vehicular traffic shall be maintained as established elsewhere in these specifications.
- 1.05 WARRANTY: Backfill: Settlement of backfill around structures and within utility trenches within the warranty period shall be corrected by the Contractor at no cost to the Owner. Moreover, any structures damaged by settlement shall be restored to their original condition or replaced by the Contractor at no cost to the Owner.

1.06 REFERENCE STANDARDS

- A. Mount Werner Water, Standard Specifications for Water and Wastewater Utilities, March 2005 or latest edition.
- B. City of Steamboat Springs, Standard Specifications for Water and Wastewater Utilities, latest edition.
- C. Colorado Department of Transportation Road and Bridge Standards, 2005 or latest edition.

PART 2 - PRODUCTS

2.01 BEDDING: Where required by the project Plans and Details, bedding under and around pipes and structures shall conform to CDOT Standard Specifications Section 703.03 for Class 6 Aggregate Base Course, except that asphaltic material will not be an allowed as aggregate.

2.02 BACKFILL

- A. Utility Trench Backfill Material (General): Within the Backfill zone as identified on the Details, on-site excavated material used for backfill shall conform to CDOT Standard Specifications Section 703.08 for Class 2 Structure Backfill and to Utility District Water and Sewer Standard Specifications, and shall exclude rock or rock fragments larger than 6 inches as measured in the greatest dimension. The Testing Engineer and/or Project Engineer shall approve all backfill material, and may, at their option, require the Contractor to import a more suitable material.
- B. Utility Trench Backfill Material for public road crossing: For utility trenches that cross a public road, structure backfill (flow-fill) meeting Colorado Department of Transportation Road and Bridge Standards, 2005 Section 206.02 requirements shall be used for the top one foot of backfill. Refer to Section 02238 Pavement Removal and Replacement.
- C. Structure Backfill Material: Backfill material within the structure excavation limits defined by CDOT Standard Plan No. M-206-1 for inlets, manholes, vaults, and other structures shall conform to CDOT Standard Specifications Section 703.08 for Class 2 Structure Backfill, and shall exclude rock or rock fragments larger than 3 inches as measured in the greatest dimension. Beyond this zone, rock or rock fragments up to 6 inches in diameter will be allowed. The Testing Engineer and/or Project Engineer shall approve all backfill material, and may, at their option, require the Contractor to import a more suitable material.

PART 3 - EXECUTION

3.01 EXCAVATION

- A. General: Except where otherwise shown on the approved Drawings and except when the Testing Engineer and/or Project Engineer gives written direction to do otherwise, all excavations shall be made by open cut to the depth required to construct the pipelines and structures as shown on the Drawings. The length of trench or size of excavation permitted to be open at any one time may be limited when, in the opinion of the Owner, such limitation is necessary for the safety and convenience of the public. The Contractor shall perform all excavation of every description and of whatever substances encountered to the depths indicated on the Drawings or as otherwise specified. During excavation, material suitable for backfilling shall be piled in an orderly manner to a sufficient distance from the banks to avoid overloading and to prevent slides or cave-ins. Unless otherwise specified on the

Drawings, or as directed by the Owner, all excavated materials not suitable for backfill shall be removed from the site. Such grading shall be done as may be necessary to prevent surface water from flowing into trenches or excavations and any water accumulating therein shall be removed by pumping or by other approved methods. No trench shall be left open overnight unless otherwise specified in the Special Provisions.

- B. Any larger than 6 inch rocks and boulders or unsuitable material encroaching on the limits of the trench excavation shall be removed and shall be included as part of the work required for the related construction item. No additional payment will be made for additional excavation and related backfill.
- C. Excavation Support: Excavations shall be adequately supported and the safety of the workers provided for as required by the most recent Occupational Safety and Health Administration (OSHA) "Safety and Health Regulations for Construction." These regulations are described in Subpart P, Part 1926 of the Code of Federal Regulations. Sheeting and shoring shall be utilized where required to prevent any excessive widening or sloughing of the excavation that may be detrimental to human safety, the ongoing work, or to any existing structure, roadway, or sidewalk. Excavated material shall not be placed nearer than two (2) feet from the sides of the excavation. Heavy equipment shall not be used or placed near the sides of the excavation unless the excavation is adequately braced.
- D. Preparation of Foundation: When the excavation is in firm earth, care shall be taken to avoid excavation below the established grade plus the required specified over depth to accommodate the bedding material. If soft or otherwise unsuitable foundation material is encountered in the bottom of the excavation, the Owner may order its removal and its replacement with stabilization material to provide a suitable foundation. The fact that the excavation bottom is wet will not necessarily be considered as evidence of instability. However, any water accumulating therein shall be removed by pumping or by other approved methods and the dewatered condition maintained for regular assessment of stability of the excavation.

3.02 BEDDING

- A. General: After completion of the excavation and proper preparation of the foundation, bedding material shall be placed on the excavation bottom for support of the work. The extent of bedding above and below pipes, and under structures, shall be in accordance with the Plans and Details. Placement of the bedding shall insure the filling of all voids, shall be in 6-inch maximum lifts throughout the bedding zone, and may be accomplished using any means and methods necessary to protect the facilities and insure continuous support of the installation.
- B. Pipe Bedding: Bell holes shall be excavated below each pipe joint. All pipes shall be installed in such a manner as to insure full support of the pipe barrel over its entire length. After the pipe is adjusted for line and grade and the joint is made, the bedding material shall be carefully placed to insure the filling of all voids and continuous support of the pipe.

3.03 BACKFILLING

- A. General: Backfill material shall be placed in 6 to 8-inch lifts throughout the backfill zone. Placement of the backfill may be accomplished using any means and methods necessary to protect the facilities and to conform to the compaction requirements as specified herein.
- B. Subterranean Structures: Under no conditions shall construction vehicles pass over subterranean structures until such time as the first lift of backfill has been placed, moistened and compacted as

directed herein. All damages, remedial measures, excavation and backfill necessary to verify the condition of subterranean structures resulting from the Contractor's failure to place backfill as directed above shall be at the Contractor's expense.

3.04 COMPACTION

- A. All work shall conform to geotechnical recommendations, reference Special Provisions.
- B. Footing and Structures: Unless otherwise specified in the project geotechnical report, footings and structure bases shall bear on a minimum of 2 feet of properly recompacted fill materials or on the natural clays or sands and gravels approved by the Testing Engineer and/or Project Engineer and prior to placement of the foundation forms. The exiting 2 feet of fill materials that are to be recompacted beneath the footings shall be uniformly placed in 6 to 8 in lifts and be compacted to at least 100% of the maximum standard Proctor density and within 2% of the optimum moisture content determined in accordance with ASTM D698. All fill placed against the sides of the footings to resist lateral loads shall be compacted to 100% of the maximum standard Proctor density and near the optimum moisture content. The wall backfill materials shall be placed in uniform lifts and compacted to at least 95% of the maximum standard Proctor density and near the optimum moisture content.
- C. Pavement Section: The base course and pit run materials placed in roadways shall be uniformly placed and compacted in 4 to 6 inch loose lifts to at least 95 percent of the maximum modified Proctor density and within +/- 2 percent of optimum moisture content as determined by ASTM D-1557/AASHTO T – 180. The pavement subgrade areas shall be scarified to a depth of at least 15 inches; the exposed materials shall be moisture conditioned by bringing the scarified soils to within +/- 2 percent of the optimum moisture content; and then recompact the properly moisture treated soils to at least 95% of the maximum standard Proctor density determined in accordance with ASTM D-698/AASHTO T-99.
- D. Compaction: After the backfill material has been brought to the specified moisture content and placed in the prescribed lifts, the material shall be compacted using the compaction equipment specified herein in accordance with the following requirements:
 - 1. General: Contractor shall furnish the appropriate compaction equipment necessary to achieve the specified compactions for the various material types.
 - 2. Sheepsfoot compactors shall not be used for compacting fill within one foot above subterranean structures placed during construction. Hand-operated compaction equipment shall be used to compact fill above subterranean structures and within two feet of retaining walls, manholes, inlets or other vertical structures within the project.
 - 3. Sheepsfoot compactors shall be utilized to achieve adequate bonding of cohesive materials as opposed to smooth-drum compactors.
 - 4. Vibratory-type compactors or other construction techniques as approved by the Testing Engineer and/or Project Engineer shall be utilized on all sand and gravel materials. Vibratory plate compactors shall not be used on or within two feet of any clay layers.
 - 5. Damages or delays in construction caused by the Contractor's failure to comply with these restrictions shall be remedied at the Contractor's expense.

3.05 COMPACTION QUALITY CONTROL

A. Testing - General:

1. Contractor shall provide such equipment and facilities as the Owner may require for conducting field tests and for collecting and forwarding samples.
2. Any material used by the Contractor may be tested at any time during their preparation or use. When requested by the Testing Engineer and/or Project Engineer, Contractor shall furnish the required samples without charge and make sufficient arrangements to permit the testing.
3. Tests shall be made by an accredited testing laboratory selected by the Owner. Except as otherwise provided, sampling and testing of all materials and the laboratory methods and testing equipment shall be in accordance with the latest standards and tentative methods of the American Society for Testing Materials (ASTM).
4. Where additional or specific information concerning testing methods, sample sizes, etc. is required, such information is included under the applicable sections of the Specifications.

B. Fill and Backfill Tests

1. Control tests of fill and backfill shall be made as determined by the Testing Engineer and/or Project Engineer.
2. Notification: Contractor shall notify the Testing Engineer and/or Project Engineer at least 24 hours prior to filling and backfilling operations.
3. Test Results: The testing laboratory will have a period of 24 hours after field-testing to report the final results. Results will be reported verbally with written confirmation later provided to the Contractor, Owner, and Project Engineer.

C. Compliance

1. Contractor retains the right to have tests performed at his own expense on any material, at any time, for his own information and job control.
2. Compliance of compaction requirements shall be based on tests specifically directed by, and performed in the presence of the Testing Engineer and/or Project Engineer. The Contractor shall be liable for any corrective action deemed appropriate by the Testing Engineer and/or Project Engineer, including, but not limited to, the complete removal and replacement of defective material.
3. Any modification of or elaboration on these test procedures which may be included for specific materials under the respective sections in the Specifications shall take precedence over these procedures.

3.06 FINISH GRADING

- #### A. General: Cut and fill areas as indicated or required to permit finishing to the finish grades indicated. Refer to 02260 Fine Grading for additional information

- B. Subgrade under Sidewalk, Curb, Gutter and Slabs-on-Grade: Finish grade to bearing surface as required. Tolerance (+/-) 0.05 foot.
- C. Subgrade Under Paving: Finish grade to bottom elevation of aggregate base course or other material to be placed. Tolerance: (+/-) 0.05 foot.
- D. Subgrade Under Landscaped Areas: Finish grade to elevations indicated. Tolerance (+/-) foot.

END OF SECTION

SECTION 02232

AGGREGATE BASE COURSE

PART 1 GENERAL

- 1.01 **RELATED DOCUMENTS:** The General Contract Conditions, Drawings and other Division - 1 Specification sections apply to Work of this section.
- 1.02 **WORK INCLUDED:** The work specified herein shall consist of furnishing and placing of Aggregate Base Course and Well Graded Pit Run materials in conformity with the construction plans.
- 1.03 **RELATED WORK**
- A. Section 02200: Earthwork
 - B. Section 02221: Excavating, Backfilling, and Compacting For Utility Systems
 - C. Section 02513: Asphalt Pavement
 - D. Section 02515: Concrete Paving
 - E. Section 02521: Concrete Unit Pavers
 - F. Section 01400: Quality Control
 - G. Special Provisions: Geotechnical Investigation
- 1.04 **SUBMITTALS:**
- A. An Aggregate Base Course sieve analysis shall be submitted by the Contractor for review by the Testing Engineer and/or Project Engineer prior to delivery to the site,
 - B. Prior to proof rolling, a weigh ticket from an approved scale shall be furnished by the Contractor to the Testing Engineer and/or Project Engineer to substantiate the proof roll vehicle weight.
- 1.05 **REFERENCE STANDARDS**
- A. CDOT Standard Specifications Section 304; Aggregate Base Course.
 - B. CDOT Standard Specifications Section 703.03; Aggregate for Bases.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Aggregate Base Course, where required or indicated in the plans and specifications, shall conform to CDOT Standard Specifications Section 703.03 for Class 6 Aggregate Base Course.

- B. Well Graded Pit Run, where required or indicated in the plans and specifications, shall conform to CDOT Standard Specifications Section 703.03 for Class 3 Aggregate Base Course.

PART 3 EXECUTION

3.01 GENERAL

- A. Placing. If the required compacted depth of the aggregate base course exceeds 6 inches, it shall be constructed in two or more layers of approximately equal thickness. The maximum compacted thickness of any one layer shall not exceed 6 inches. When vibratory or other approved types of special compacting equipment are used, the compacted depth of a single layer may be increased to 8 inches upon request, provided that specified density is achieved and written approval is given.
- B. Mixing. The Contractor shall mix the aggregate by methods that insure a thorough and homogenous mixture.
- C. Shaping and Compaction. Compaction of each layer shall continue until a density of not less than 95 percent of the maximum density determined in accordance with AASHTO T 180 has been achieved. The surface of each layer shall be maintained during the compaction operations so that a uniform texture is produced and the aggregates are firmly keyed. Water shall be uniformly applied during compaction in the quantity necessary for proper consolidation. The surface of the base course will be tested with a 10 foot straightedge, or other approved device. The surface shall be tested prior to the application of any primer or pavement. The variation of the surface from the testing edge of the straightedge between any two contacts with the surface shall not exceed ¼ inch. All irregularities exceeding the specified tolerance shall be corrected to the satisfaction of the Testing Engineer and/or Project Engineer at no additional cost to the Owner. The above compaction and straightedge requirements shall not apply to shoulder gravel. Compaction of shoulder gravel shall be accomplished by wheel rolling, as directed.
- D. Proof Roll
 1. Prior to paving any street designated to be accepted as a public City street, the Contractor shall conduct a proof roll witnessed by the Testing Engineer, Project Engineer and City Engineer. Prior to proof roll, Testing Engineer shall submit test results to City Engineer for review and approval.
 2. The proof roll may be conducted after the required compaction has been obtained and the subgrade has been shaped to the required cross-section.
 3. Proof roll on road sub grade will be conducted with a loaded tandem axle pneumatic tire dump truck with 15 tons loaded on truck unless other equal or greater weight or different type of truck is approved by the Testing Engineer and/or Project Engineer and City Engineer. The loaded truck shall be driven over the area to be tested at a speed, pattern, and number of cycles to be determined by the City Engineer
 4. No loose material allowed on top of subgrade. Subgrade shall be packed and smooth on top with optimum moisture content.
 5. Sub grade shall not have any deflection in surfaces for proof roll to pass.

6. Temperature must be above 32 degrees for a minimum of 48 hours before any proof roll on road sub grade is conducted.
7. The proof roller shall be operated in a systematic manner so that a record may be readily kept of the area tested and the working time required for the testing.
8. Areas that are observed to have soft spots in the subgrade, where deflection is not uniform or is excessive as determined by the Testing Engineer and/or Project Engineer, shall be ripped, scarified, dried or wetted as necessary and recompact to the requirements for density and moisture at the Contractor's expense. After recompaction, these areas shall be proof rolled again and any failures again corrected at the Contractor's expense.

END OF SECTION

SECTION 02236

CRUSHER FINES PAVING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS: The General Contract Conditions, Drawings and other Division - 1 Specification sections apply to Work of this section.

1.02 WORK INCLUDED: The work of this section consists of constructing crushed aggregate pavement.

1.03 RELATED WORK:

- A. Section 02100 Site Preparation
- B. Section 02200 Earthwork
- C. Section 02221 Eacavating, Backfilling, and Compacting
- D. Section 02242 Geotextiles
- E. Section 01400: Quality Control

1.04 SUBMITTALS:

- A. Submit sieve analysis of material to ensure it meets grading requirements.
- B. Submit sample of crushed aggregate screenings for approval, one-half (½) cubic foot.
- C. Sieve analysis and color of crushed aggregate screenings shall be approved in writing by the Testing Engineer and/or Project Engineer prior to delivery of any material to the project site.

PART 2 - PRODUCTS

2.01 DELIVERY, STORAGE, AND HANDLING: Protect all materials from damage during delivery and moisture.

2.02 PRODUCT CONDITIONS:

- A. Use lightweight hauling equipment. Exercise care in using equipment, avoiding damage to existing facilities.
- B. Review installation procedures and coordinate aggregate paving work with other work affects.
- C. All hard surface paving, including concrete walks and asphalt paving must be completed prior to installation of aggregate paving.
- D. Do not use frozen materials or materials mixed or coated with ice or frost.
- E. Do not build on frozen work or wet, saturated or muddy subgrade.

F. Crusher Fine Screenings:

1. Clean, hard, durable particles or fragments of ¼ inch minus select brown/gray crushed granite or basalt. Fines shall be evenly mixed throughout the aggregate. When produced from gravel, fifty percent (50%) by weight, of the material retained on a Number four (4) sieve shall have one fractured face.
2. The portion retained on the Number four (4) sieve shall have a maximum percentage of wear of fifty (50) at five hundred (500) revolutions as determined by AASHTO T96-77
3. The portion passing a Number forty (40) sieve shall have a maximum liquid limit of twentyfive (25) and a maximum plasticity index of seven (7), as determined by AASHTO T89-81, respectively.
4. The crushed aggregate screenings shall be free from clay lumps, vegetable matter, and deleterious material.

2.03 GRADING REQUIREMENTS: Grading requirements are as follows: Percentage of Weight Passing a Square Mesh Sieve, AASHTO T11-82 and T27-82

<u>Sieve Designation</u>	<u>Percent Passing</u>	<u>Sieve Designation</u>	<u>Percent Passing</u>
3/8 inch	100	No. 30	25 - 50
No. 4	90 – 100	No. 50	25 - 35
No. 8	55 – 80	No. 100	20 - 25
No. 16	40 – 70	No. 200	5 - 15

PART 3 - EXECUTION

- 3.01 Vegetative Removal: Systemic herbicide shall be applied, as per manufacturer's instructions, to all weeds and grasses within trail alignment to ensure that they be removed/killed completely before any construction on top of existing trail.
- 3.02 Subgrade Preparation: Prior to placing any pavement, shape, fill, grade, and compact the subgrade, to ninety-five percent (95%) Standard Proctor Density. Where excavation to the finished grade elevation results in subgrade of unsuitable soil, the ~~City of Aurora Project Manager~~ project engineer or testing engineer may designate the unsuitable material to be removed and replaced with approval material. Approved material for backfilling shall be Class four (4) aggregate base course, or other material approved by the Testing Engineer and/or Project Engineer.
- 3.03 GEOTEXTILE FABRIC:
- A. Install fabric between the compacted subgrade and crushed aggregate screenings across the entire width of trail to receive aggregate in addition to twelve inches (12") past the edges. Overlap ends of rolls a minimum of eighteen inches (18").
 - B. Areas on which geotextile fabric is to be placed shall have uniform slope, be reasonably free from mounds and windows, and free of any debris or projections, which could damage the material.
 - C. The material shall be loosely laid, not stretched. Adjacent strips shall overlap by a minimum of eighteen inches (18").
- 3.04 PLACING CRUSHED AGGREGATE:
- A. Place the crushed aggregate on prepared subgrade, and rake smooth using a steel fine rake to desired grade and cross section. Place, to avoid segregation, in one layer of four inches (4") maximum thickness. Do not apply deeper than four inches (4") in one lift.
 - B. Unless otherwise notes on the Plans, slope the crusher fine surface at 2% cross slope toward the downhill side for drainage.
- 3.05 COMPACTION: Immediately compact aggregate into smooth, firm surface with self-propelled, vibratory roller of sufficient weight. Maintain proper moisture content per proctor submitted by the Testing Engineer. Rolling shall continue until all material is firmly locked and keyed together. The appearance and surface shall be uniform with all ridges removed. Surface shall not vary more than one-half inch (½") when measured with a ten foot (10') straight edge applied parallel to the centerline. Correct any variation by loosening, reshaping, and re-rolling. When finished, compacted trail shall be a minimum of four inches (4") deep in all locations.
- 3.06 FINISHING:
- A. At completion of surfacing, remove excess spoils from along trail edge and deposit on site as directed Project Engineer.
 - B. Rake along all trail edges to ensure finished appearance and positive drainage away from trail and into any new drainage structures.

- C. Finished surface shall be smooth, uniform, and solid. Dried, compacted pavement material shall be firm all the way through with no spongy areas. Loose material shall not be present on the surface initially. Adjacent surface shall be graded flush with crusher fine surface.
- D. Significant irregularities shall be smoothed out prior to final acceptance of work.

END OF SECTION

**SECTION 2238
PAVEMENT REMOVAL AND REPLACEMENT**

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Protection of existing pavement.
- B. Removal and replacement of pavement structures that may include surface, base, and sub base courses as required for trench and test hole excavation or as otherwise required by the Project Engineer.
- C. Installation and removal of temporary pavement structures consisting of base course.
- D. Only contractors with proven experience in the type of work to be performed shall be allowed to construct bituminous pavements.

1.02 RELATED WORK

- A. Section 02200: Earthwork
- B. Section 02221; Excavating, Backfilling, and Compacting
- C. Section 02232; Aggregate Base Course
- D. Section 01705; Cutting and Patching
- E. Section 01400; Quality Control

1.03 SUBMITTALS:

- A. Submit references and proof of experience to the Project Engineer prior to scheduling installation of bituminous pavement.
- B. Submit method of cutting and removing pavement as well as equipment and method to be used for pavement replacement to the Project Engineer prior to performing the removal.
- C. Submit gradation report for subgrade and road base and submit mix design for flowfill and asphalt mix design prior to replacement to the Project Engineer for review and approval.
- D. Submit to the Project Engineer the name and phone number of the person responsible for maintaining the traveled surface prior to performing the excavation.

1.04 REFERENCE STANDARDS

- A. CDOT Standard Specifications Section 401; Plant Mix Pavements – General
- B. CDOT standard Specification Section 403; Hot Bituminous Pavement.

- C. CDOT Standard Specification Section 206.02; Structural Backfill (flowfill).

PART 2 - PRODUCTS

2.01 Materials:

- A. Pit Run: 2-½ inch minus. Class 1 Aggregate Base Course per Section 02232
- B. Base Course: ¾ inch minus. Class 6 Aggregate Base Course per Section 02232
- C. Surface Course: Bituminous pavement shall meet the requirements of Sections 401.01 to 401.06 of the CDOT Standard Specifications, 5/8 inch mix, unless otherwise approved by the City Engineer.
- D. Structural Backfill (flowfill): Flowfill shall meet the requirements of CDOT Standard Specification Section 206.02

PART 3 - EXECUTION

- 3.01 PROTECTION OF EXISTING PAVEMENT: The pavement adjacent to an excavation shall be protected from damage caused by movement of construction equipment or other work. Planking, mats or other appropriate means of protection shall be used. Any paved surface damaged due to the Contractor's activities shall be replaced or repaired at no expense to the Owner. The area to be replaced or repaired shall be as designated by the Project Engineer.

3.02 CUTTING AND REMOVAL

- A. Pavement shall be neatly cut along the lines shown on the Drawings or as approved in the field by the Project Engineer. Pavement shall be cut by saw, or other method as approved by the Project Engineer. The area cut shall be of the minimum width to reasonably accommodate the smallest acceptable compaction method.
- B. Care shall be exercised so that adjacent pavement outside the cut will not be disturbed or damaged. Excavated pavement shall be removed and disposed of off site. Removed pavement may not be used as trench backfill.

- 3.03 BASE COURSE: Construct a base course section per Section 02232. The thickness of the base course section shall be 12-inches unless directed otherwise.

3.04 TEMPORARY TRAVEL SURFACE:

- A. If bituminous pavement is not replaced within 24 hours following backfill completion, the Contractor shall install additional material to match the existing traveled surface. For cuts other than bisecting road cuts (cuts perpendicular to the travel lanes), the additional material shall be base course. For bisecting road cuts, the additional material shall be structural backfill (flowfill).
- B. The Contractor shall maintain the traveled surface as necessary to keep it even with the adjacent pavement, smooth, free from soft spots and dust free. The Contractor shall provide

the Owner with the name and phone number of the person responsible for maintaining the traveled surface prior to performing the excavation. The Contractor shall be available for maintenance on a 24 hr. basis. Just prior to bituminous pavement replacement, the Contractor shall remove and dispose of the additional base course.

3.05 BITUMINOUS PAVEMENT REPLACEMENT

- A. Prior to installation of bituminous pavement, cut and remove additional pavement to provide a clean, straight and uniform line without sharp jogs. The edge of the existing pavement shall be cut back from the damaged area so that at least one foot of bituminous pavement will be placed upon undisturbed material outside of the actual trench excavation area on each side of the trench.
- B. Replaced pavement shall have a minimum thickness of 4-inches or match the existing pavement thickness where the design is greater. Pavement shall be placed in two equal lifts and compacted to 95-percent of maximum density. Pavement shall be placed in accordance with the appropriate requirements of Section 401.07 to 401.20 of the CDOT Standard Specifications.
- C. Where a temporary travel surface was used, the temporary travel surface shall be excavated to a depth of four inches below the travel surface and replaced with bituminous pavement such that the pavement is flush with the adjacent pavement and maintains the design cross-slope of the surface. The temporary travel surface must be replaced with pavement within one week of installation unless otherwise approved by the City of Steamboat Springs Streets Superintendent. If the replacement occurs at a time when hot bituminous pavement is not available, cold bituminous pavement shall be utilized. The cold patch shall be replaced promptly once hot bituminous pavement is available.

3.06 MILL AND OVERLAY: Where the pavement removal and replacement extends longitudinally along an existing roadway for an extended length as determined by the City of Steamboat Springs Streets Superintendent, the full lane width shall be milled and overlaid with a minimum thickness of 1 ½ inches to match the cross slope and grades of the existing pavement.

END OF SECTION

SECTION 2242 GEOTEXTILES

PART 1 GENERAL

- 1.01 RELATED DOCUMENTS: The General Contract Conditions, Drawings and other Division - 1 Specification sections apply to Work of this section.
- 1.02 DESCRIPTION: Work Included: Provide all fabric, complete in place, as shown on the Drawings or directed by the Project Engineer.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Drainage: Fabric for use in subsurface drainage applications and building foundations where high permeability is of importance shall be MIRAFAI 140N, a surface conforming, non-woven polypropylene fabric as manufactured by MIRAFAI, Inc.
- B. Riprap: The fabric required beneath riprap shall be according to the following applications or as specifically noted on the Drawings.
1. Application 1: Where soil retention and free passage of water are of primary importance, and where the fabric is to be covered with a minimum of 3 inches of select fine material prior to placement of riprap, the fabric shall be MIRAFAI 140N as in 2.1 A. above.
 2. Where increased strength may be necessary, or when a covering of select fines is not specified prior to riprap placement, the fabric shall be MIRAFAI 600X as manufactured by MIRAFAI, Inc.
- C. Stabilization: Fabric for use in ground stabilization situations where separation, confinement and load distribution are of primary importance shall be MIRAFAI 500X or 600X, a surface conforming woven polypropylene fabric as manufactured by MIRAFAI, Inc. MIRAFAI 600X shall be used where higher than normal installation stresses are anticipated such as in bog or very wet areas.
- D. Pavement Reinforcement: Fabric for use as asphaltic pavement reinforcement shall be a 100 percent needle punched non-woven polypropylene such as PETROMAT, Paving Grade, as manufactured by Phillips Fibers Corporation.
- E. Crusher Fines Trails: Fabric for use under crusher fines or other soft surface trails shall be MIRAFAI 140 S weed Suppression fabric or approved equal. If paving shall support routine vehicular traffic a geogrid shall be used. Use Tensar BX1200 or approved equal per manufacturers recommendations.
- F. Concrete Unit Pavers: Fabric for use under pavers shall be Mirafi 500X Interlocking Concrete Paver Stabilization Geotextile, by Mirafi, 888.795.0808 or approved equal.

PART 3 EXECUTION

- 3.01 **PREPARATION:** The surface upon which the fabric is to be placed shall in general be free from trees, stumps, large rocks and other protruding objects which could damage the fabric. Areas on which geotextile fabric is to be placed shall have uniform slope, be reasonably free from mounds and windows, and free of any debris or projections, which could damage the material. The Project Engineer will determine the appropriate degree of preparation required prior to fabric placement.
- 3.02 **INSTALLATION:** Installation of all fabric shall be per the manufacturer's written recommendations and as directed by the Project Engineer. In riprap applications the Project Engineer shall inspect and approve the placement of select fine materials on top of fabric prior to the Contractor commencing final placement of riprap. For soft surface trails, install fabric between the compacted subgrade and crushed aggregate screenings across the entire width of trail to receive aggregate in addition to twelve inches (12") past the edges. Overlap ends of rolls a minimum of eighteen inches (18").

END OF SECTION

SECTION 02260

FINE GRADING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. The General Contract Conditions, Drawings and other Division - 1 Specification sections apply to Work of this section.

1.02 DESCRIPTION

- A. Work Included: Execute finish grades complete, as shown, and as specified.

1.03 RELATED WORK

- A. Section 02200 – Earthwork
- B. Section 02515 – Concrete Paving
- C. Section 02623 – Culvert
- D. Section 02933 – Revegetation

1.04 QUALITY ASSURANCE

- A. General: Perform work in accordance with all applicable laws, codes and regulations required by local governing agencies.
- B. Applicable Standards: Apply the current or latest edition of the State Department of Highways, Division of Highways, State of Colorado, Standard Specifications for Road and Bridge Construction.
- C. Testing Agency: Testing agency, selected and paid for by the Owner will confirm compaction densities. Contractor required to set roadway hubs to determine adherence to grading criteria set forth in Section 02200.
- D. Soils Report: Refer to Site Geotechnical Report.
- E. Field Density Tests: Intervals not exceeding 2 ft. fill height with compaction tests made by Testing Agency.
- F. Overcutting: Replace and compact all overcut material to required percent compaction.

1.05 LAYOUT AND SURVEY

- A. Licensed Surveyor or Civil Engineer: Employ a licensed surveyor or civil engineer to stake out lines and levels.
- B. Discrepancies: Right is reserved to make minor adjustments as necessary if discrepancies are found.

1.06 SITE MAINTENANCE

- A. Standing Water: Keep site free of standing water at all times. Provide and maintain ditches, grading or pumping as necessary to prevent erosion, softening of compacted surfaces and formation of mud in trenches and excavation.
- B. Dust: Assume full responsibility for all alleviation or prevention of dust nuisance on or about the site.
- C. Bulkheading and Shoring: Provide as necessary, and maintain temporary slopes during construction.

PART 2 PRODUCTS

- 2.01 TOPSOIL: Refer to Section 02925
- 2.02 IMPORTED FILL: Refer to Section 02200 - Earthwork

PART 3 EXECUTION

3.01 GENERAL

- A. Suspension of Work: If grading is suspended, disturbed areas shall be brought to required grade and immediately seeded and mulched.
- B. Verification of Previous Work: Verify that all areas to receive imported topsoil have been completed prior to commencement of fine grading.

3.02 MOISTURE CONTENT

- A. Inadequate Moisture Content: Add water and thoroughly mix into fill material until the moisture necessary is uniformly dispersed throughout.
- B. Excessive Moisture Content: Aerate fill material by blading or other acceptable methods until moisture content is uniformly reduced to achieve required compaction.

3.03 COMPACTION: Refer to Section 02200 – Earthwork.

3.04 FINISH GRADING

- A. General:
 - 1. Grade smooth all planting areas after weeding, soil preparation, and soil conditioning have been completed and soil has been thoroughly water settled and prior to seeding or planting.
 - 2. Provide all grades for natural runoff of water without low spots or pockets. Accurately set flow line grades at 2% minimum gradient unless otherwise noted in Drawings. Finish grades shall pitch away from structures. In no case shall drainage from the project site be so altered or controlled as to result in damage from erosion or flooding, or the potential for damage, to adjacent property or to any portion of the work executed under this Contract.
 - 3. Finish grades shall be smooth, even and on a uniform plane with no abrupt changes of surface. Slope uniformly between given spot elevations.
 - 4. Grades not otherwise indicated shall be uniform levels or slopes between points where elevations are given, or between points established by walks, paving, curbs or catch-basins.

5. Tops and toes of all slopes shall be rounded to produce a gradual and natural-appearing transition between relatively level areas and slopes.
6. Prior to acceptance of grades, hand rake to smooth, even surface, free of debris, clods, rocks and vegetable matter greater than 0.5 inch.

B. Grades:

1. Finished Grades of Shrub and Groundcover Areas: 1 in. below top of adjacent pavement, headers, curbs, or walls unless otherwise indicated on the Drawings.
2. Finished Grades of Lawn and Grass Areas: ½ in. below top of adjacent pavement, curbs or headers.
3. Tolerance: Refer to Section 02200 – Earthwork.

3.05 CLEAN-UP

- A. Keep all areas of work clean, neat and orderly at all times.
- B. Clean up and remove all equipment, deleterious materials and debris from the entire work area prior to Final Acceptance.

END OF SECTION

SECTION 2261 RIPRAP

PART 1 GENERAL

- 1.01 **WORK INCLUDED:** The work under this section shall include the foundation preparation for riprap, riprap material requirements and the placing of the rock riprap in the areas noted on the Drawings or directed by the Project Engineer.
- 1.02 **RELATED DOCUMENTS:** The General Contract Conditions, Drawings and other Division - 1 Specification sections apply to Work of this section.
- 1.03 **RELATED WORK:**
1. Geotextiles, Section 2242
- 1.04 **SUBMITTALS**
- A. The Project Engineer shall approve the riprap source prior to transporting and placing riprap at its point of use.

PART 2 PRODUCTS

- 2.01 **MATERIALS:** The riprap shall be durable and of suitable quality to assure permanence in the climate in which it is to be used. The stone shall be sound and dense, free from cracks, seams and other defects that would tend to increase deterioration from weathering. The stone shall be clean and free from organic matter. The stone shall be angular with fractured faces, nearly rectangular in shape with a breadth or thickness at least 1/3 its length. Thin slab-type stones and flaking rock shall not be used. The stone shall have a specific gravity of at least 2.50. The gradation of the riprap is dependent on the stone size as shown on the Drawings. If no stone size is shown on the Drawings, the stone size shall be 12 inches. The stone size designated shall be equal to d_{50} . The stone shall have one of the gradations specified in the following table.

d_{50} (inches)	% Smaller than Given Size by Weight	Intermediate Rock Dimension (inches)
6	70-100	12
	50-70	9
	35-50	6
	2-10	2
9	70-100	15
	50-70	12
	35-50	9
	2-10	3
12	70-100	21
	50-70	18
	35-50	12
	2-10	4
18	70-100	30
	50-70	24
	35-50	18
	2-10	6
24	70-100	42
	50-70	33
	35-50	24
	2-10	9

- 2.02 ALTERNATE MATERIALS: If local rock is not available that is angular with fractured faces, nearly rectangular in shape with a breadth or thickness at least 1/3 its length, as required in 2.1, rounded river rock may be used with specific approval of the Project Engineer. The use of river rock may require that channel side slopes be flattened, and in all cases, the required gradation shall be increased by at least 25%.

PART 3 EXECUTION

- 3.01 PREPARATION: Earth surfaces on which the rock riprap is to be placed shall be trimmed and graded to conform to the lines or sections shown on the Drawings. Surfaces which are below grade shall be brought to grade by filling with well-compacted materials similar to the adjacent materials.
- 3.02 INSTALLATION: Dumped riprap composed of stone meeting the requirements of this Specification shall be placed by equipment on the surfaces and to the depths indicated on the Drawings or as staked on the ground. The riprap shall be placed to the full course thickness in one operation and in such a manner as to avoid displacement of the underlying materials. The riprap shall be delivered and spread so that the mass of stone in place shall be well-graded with the larger rocks uniformly distributed and the smaller rocks and spalls filling the voids between the larger rocks. The finished riprap shall be free from concentrations of small and large stones. Placing riprap by means likely to cause segregation of the various sizes will not be permitted. Hand placing or rearranging of individual stone by mechanical equipment may be required to the extent necessary to secure the results specified above. The finished surface of the riprap shall be slightly below the adjacent ground surface and shall slope toward the center of the riprap installation. Riprap placed at bridge abutments, wingwalls and at stream channels shall be keyed into the existing slope along the upstream edge. The key shall have dimensions equal to 2 "T" deep by 2 "T" wide, where "T" equals the designated mat thickness.⁴

END of SECTION

SECTION 02513

ASPHALT PAVING

PART 1 GENERAL

- 1.01 RELATED DOCUMENTS: The General Contract Conditions, Drawings and other Division - 1 Specification sections apply to Work of this section.
- 1.02 WORK INCLUDED:
- A. The work specified herein shall consist of furnishing and placing of Asphalt Pavement in conformity with the project Plans and Details.
 - B. Prior to paving any road to be designated as a public City street, Contractor must obtain approval from the City Engineer that the subgrade testing and proof roll have been satisfactorily completed.
- 1.03 RELATED WORK:
- A. Section 02200; Earthwork
 - B. Section 02221; Excavating, Backfilling, and Compacting
 - C. Section 02232; Aggregate Base Course
- 1.04 SUBMITTALS: Contractor shall submit an Asphalt Pavement mix design including aggregate gradation, asphalt grade, and filler and bituminous material composition for review by the Testing Engineer and/or Project Engineer prior to delivery to the site.
- 1.05 REFERENCE STANDARDS:
- A. CDOT Standard Specifications Section 401; Plant Mix Pavements-General.
 - B. CDOT Standard Specifications Section 403; Hot Bituminous Pavement.
- 1.06 PREPAVING INSPECTION: Prior to paving Contractor shall contact City Engineer, Testing Engineer, and Project Engineer to perform a pre-paving inspection (Proof Roll Section 3.010 of Section 02232). It is Contractor's responsibility to coordinate inspection and confirm that City approval is granted prior to paving.

PART 2 PRODUCTS

- 2.01 MATERIALS:
- A. Asphalt Pavement shall conform to CDOT Standard Specifications Section 401. The Gradation shall conform to Type SX as shown in CDOT Table 703-4 in accordance with the 2005 Standard Specifications (Blue Book) for Road and Bridge construction.
 - B. Binder shall conform to CDOT Standard Specifications 702. The binder shall conform to PG 58-28 as shown in CDOT Table 702-1.

PART 3 EXECUTION

3.01 GENERAL: Construction requirements associated with the furnishing and placing of Asphalt Pavement shall be in accordance with CDOT Standard Specifications Section 400.

END OF SECTION

SECTION 02515

CONCRETE ROADWAY PAVING

PART 1 GENERAL

- 1.1 RELATED DOCUMENTS: The General Contract Conditions, Drawings and other Division - 1 and Division - 2 Specification sections apply to Work of this section.
- 1.2 WORK INCLUDED: The work specified herein shall consist of furnishing and placing of concrete pavement for roadways and other miscellaneous driveable surfaces subject to vehicular traffic such as bus pull-outs, dumpster pads, driveways and accesses, aprons, and in conformity with the construction plans.
- 1.3 RELATED WORK:
- A. Special Provisions: Geotechnical Investigation
 - B. Section 01400: Quality Control
 - C. Section 02200: Earthwork
 - D. Section 02221: Excavating, Backfilling, and Compacting
 - E. Section 02232: Aggregate Base Course
 - F. Section 02513: Asphalt Pavement
 - G. Section 02516: Concrete Paving for Curb, Gutter, Sidewalk and Trail Surfaces
- 1.4 SUBMITTALS:
- A. Contractor shall submit a Concrete Pavement mix design including aggregate gradation, concrete class, admixtures, and sealant for review by the Testing Engineer and/or Project Engineer prior to delivery to the site.
- 1.5 APPLICABLE REFERENCE STANDARDS:
- A. CDOT Standard Specifications Section 412; Portland Cement Concrete Pavement
 - B. CDOT Standard Specifications Section 601; Structural Concrete
 - C. CDOT M&S Standards, Latest Edition
- 1.6 QUALIFICATION OF INSTALLERS: Throughout the progress of installation of the Work of this section, provide at least one person who shall be thoroughly familiar with the specified requirements, completely trained and experienced in the necessary skills, and who shall be present at the site and shall direct all work performed under this section.
- 1.7 PRE-PAVING INSPECTION: Prior to paving the Contractor shall contact City Engineer, Testing Engineer, and Project Engineer to perform a pre-paving inspection. See also proof roll Section 02232 - 3.010. It is the Contractor's responsibility to coordinate inspection and confirm that City approval is granted prior to paving.

PART 2 PRODUCTS

- 2.1 MATERIALS:
- A. Concrete Roadway Pavement shall conform to the requirements of CDOT Standard Specifications Section 412 and 601. Concrete shall be CDOT Class P, unless otherwise directed by Project

Engineer. When directed by Project Engineer and approved by the City Engineer, Contractor shall utilize CDOT Class E (fast track pavements) in lieu of CDOT Class P.

- B. Downtown Streetscape Colored Concrete: See approved Downtown Streetscape Master Plan
- C. Joint Fillers: Preformed expansion joint filler material shall be bituminous fiber type conforming to ASTM D1751. Filler for each joint shall be furnished as a single piece for the full depth and thickness required.
- D. Self-Leveling Sealant: Shall be a pourable silicone sealant per CDOT Standard Specifications Section 705 and installed per CDOT M&S Standards, Standard Plan No. M-412-1
- E. Dowels and Tie-Bars: Dowels and tie-bars at slab joints shall conform to AASHTO M254 for the coating and to ASTM A615, grade 60 for the core material and shall be epoxy coated, smooth, and lightly greased, precoated with wax or asphalt emulsion, or sprayed with an approved material for their full length.
- F. Grout: Grout shall be a nonshrink, ready-to-used, non-metallic aggregate product requiring only the addition of water at the job site, and shall have the following attributes:
 - 1. Be capable of producing a flowable grouting material having no drying shrinkage or settlement at any age,
 - 2. The compressive strength of grout 2" cubes shall be no less than 5,000 psi at age seven days and 7,500 psi at age 28 days.

PART 3 - EXECUTION

3.1 GENERAL:

- A. Construction requirements associated with the furnishing, placing, and curing of Concrete Pavement shall be in accordance with CDOT Standard Specifications Section 412 and Sections 601.
- B. Finished Product: Shall be in close conformity with lines, grades and typical cross sections shown on the Drawings, as required to match existing adjacent sidewalk, or as established by the Engineer.

3.2 GENERAL INSTALLATION:

- A. Radii Edges: All concrete shall include ½" radii on all exposed edges.
- B. Finishing of formed concrete surfaces shall conform to CDOT Standard Specifications Section 601.14.
- C. Walls and slab surfaces to be covered by earth backfill shall receive a Class 1 Ordinary Surface Finish.
- D. All bands, trench grates surrounds, and pavement exposed to public view shall receive a light broom finish.

- E. All integrally colored cast in place concrete shall be mixed and installed according to manufacturer's instructions and specifications
- F. Protection: Use all means necessary to protect the materials of this section before, during, and after installation and to protect the work and materials of other trades.
- G. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Project Engineer at no additional cost to the Owner.

3.3 FORM WORK:

- A. Project Engineer shall inspect and approve the forms prior to Contractor installing concrete paving.

3.4 DOWEL INSTALLATION:

- A. Smooth dowel bars shall be placed in the forms at each expansion and construction joint. One half of the dowel length shall be coated with a bond breaker of an approved covering.
- B. Dowels shall be made up in "dowel baskets", or other approved assembly, such that dowels can be set level and parallel to one another and parallel to the length of the slab. Dowel basket assemblies must be anchored to the subgrade to prevent movement during concrete placement. Placement tolerances for dowels shall be per CDOT Standard M-412-1.
- C. When dowels are placed in existing concrete for a construction joint, the dowel bar shall be epoxy grouted within the drilled hole.

3.5 JOINTS:

- A. Contraction joints, 1/8 inch wide, shall be constructed at the intervals noted on the Drawings or as directed by the Project Engineer. Contraction joints shall be placed equal to the width of a travel lane width if not otherwise specified on the Drawings. The joints shall be constructed to a minimum depth of 1/3 the concrete depth by saw cutting. Cutting shall commence after the concrete is sufficiently hard so that the blade does not dislodge aggregate and that the edges of the cut do not ravel and shall be done within 18 hours of finishing. Contractor shall clean saw cuts with compressed air to remove associated debris. Where saw cuts abut other construction and saw cutting is impeded, the joint shall be tooled out from the obstruction the required distance.
- B. Expansion joints, 1/2 inch wide, by full slab depth, shall be installed at each side of structures, at ends of curb returns, at all curb ramps, at 25-ft intervals along the curb, or as noted on the Drawings. Expansion joints shall be installed at maximum 100-ft intervals along attached sidewalks and trails and at maximum 300-ft intervals along detached sidewalks and trails.
- C. Install smooth dowel bars at both construction and expansion joints.
- D. Isolation joints shall be formed around all appurtenances such as manholes, fire hydrants, utility poles, sidewalk underdrains, midblock ramps and extending into and through the width of a roadway or driveable surface. Preformed expansion joint filler 1/4 inch thick shall be installed in these joints. Contractor shall attempt to locate isolation joints to intersection expansion or contraction joints in a symmetrical manner.

- E. Tie-bar size and spacing used for joint construction shall be installed in accordance with CDOT M&S Standard M-412-1
 - F. All joints within the roadway/vehicular surface areas shall be sealed with a self-leveling sealant as approved by the project engineer. Self-leveling sealant shall be applied to the top of the joint filler material for expansion joints.
- 3.6 **FINISHED PRODUCT:** Finished product shall be in close conformity with lines, grades, and typical cross sections shown on the Drawings, as required, to match existing adjacent sidewalk or as established by the Project Engineer.

END OF SECTION

SECTION 02516

CONCRETE PAVING FOR SIDEWALKS, TRAILS, CURBS, GUTTERS, AND BANDS SURFACES

PART 1 GENERAL

- 1.1 RELATED DOCUMENTS: The General Contract Conditions, Drawings and other Division – 1 and Division - 2 Specification sections apply to Work of this section.
- 1.2 WORK INCLUDED: The work specified herein shall consist of furnishing and placing of concrete pavement for sidewalks, trails, curbs, gutters, paving bands, valley pans, and splash curbs, and in conformity with the construction plans.
- 1.3 RELATED WORK:
 - A. Special Provisions: Geotechnical Investigation
 - B. Section 01400: Quality Control
 - C. Section 02200: Earthwork
 - D. Section 02221: Excavating, Backfilling, and Compacting
 - E. Section 02232: Aggregate Base Course
 - F. Section 02515: Concrete Roadway Paving
- 1.4 SUBMITTALS:
 - A. Contractor shall submit a Concrete Pavement mix design including aggregate gradation, concrete class, admixtures, and sealant for review by the Testing Engineer and/or Project Engineer prior to delivery to the site.
- 1.5 APPLICABLE REFERENCE STANDARDS:
 - A. CDOT Standard Specifications Section 412; Portland Cement Concrete Pavement
 - B. CDOT Standard Specifications Section 601; Structural Concrete
 - C. CDOT Standard Specifications Section 608; Sidewalks and Bikeways
 - D. CDOT Standard Specifications Section 609; Curb and Gutter
 - E. CDOT M&S Standards, Latest Edition
- 1.6 QUALIFICATION OF INSTALLERS: Throughout the progress of installation of the Work of this section, provide at least one person who shall be thoroughly familiar with the specified requirements, completely trained and experienced in the necessary skills, and who shall be present at the site and shall direct all work performed under this section.
- 1.7 PRE-PAVING INSPECTION: Prior to paving Contractor shall contact City Engineer, Testing Engineer, and Project Engineer to perform a pre-paving inspection proof roll in accordance with Section 02232. It is the Contractor's responsibility to coordinate inspections and confirm that City approval is granted prior to paving.

PART 2 PRODUCTS

2.1 MATERIALS:

- A. Concrete Pavement shall conform to the requirements of CDOT Standard Specifications Section 412 and 601. Concrete shall be CDOT Class D reinforced with fibrous concrete reinforcing at the rate of 1.5 Lb. Per Cubic Yard, unless otherwise directed by Project Engineer. When directed by Project Engineer and approved by the City Engineer, Contractor shall utilize CDOT Class E (fast track pavements) in lieu of CDOT Class D.
- B. Downtown Streetscape Colored Concrete: See approved Downtown Streetscape Master Plan
- C. Joint Fillers: Preformed expansion joint filler material shall be bituminous fiber type conforming to ASTM D1751. Filler for each joint shall be furnished as a single piece for the full depth and thickness required. Zip-strip is allowed.
- D. Self-Leveling Sealant: Shall be a pourable silicone sealant per CDOT Standard Specifications Section 705.
- E. Dowels and Tie-Bars: Dowels and tie-bars at slab joints shall conform to AASHTO M254 for the coating and to ASTM A615, grade 60 for the core material and shall be epoxy coated, and lightly greased, pre-coated with wax or asphalt emulsion, or sprayed with an approved material for their full length.
 - 1. Tie-bars used for joint construction shall be No. 4 rebar, dowel bars shall be ½ inch diameter and 16-inches in length and installed on 1-ft centers unless otherwise specified in the Drawings.
 - 2. Dowel bars for core trail construction 10-ft and wider shall be ¾ inch diameter, 16-inches in length and installed on 1-ft centers unless otherwise specified in the Drawings.
- F. Reinforced Steel Mats: Non-epoxy coated rebar is acceptable for reinforced steel mats unless otherwise specified in the Drawings.
- G. Grout: Grout shall be a non-shrink, ready-to-used, non-metallic aggregate product requiring only the addition of water at the job site, and shall have the following attributes:
 - 1. Be capable of producing a flowable grouting material having no drying shrinkage or settlement at any age,
 - 2. The compressive strength of grout cubes shall be no less than 5,000 psi at age seven days and 7,500 psi at age 28 days.
- H. Curing Compound: Curing compound shall conform to CDOT Standard Specifications latest edition, applicable sections and/or be listed on CDOT's Approved Product List (APL).
- I. Evaporative Retardant: These compounds will be permitted in conjunction with CDOT Standard Specifications, latest edition. Evaporative retardant shall not be used as a finishing aide. Drag texture shall be installed prior to applying this product.
- J. Fibrous concrete reinforcement:
 - 1. Use 100 percent virgin polypropylene, fibrillated fibers containing no reprocessed olefin materials and specifically manufactured for use as concrete reinforcement and meeting the requirements of ASTM C-1116 (Fiber-Reinforced Concrete and Shotcrete). Manufacturers:

- a) Propex Concrete Systems Corporation, 6025 Lee Highway Suite 425, Chattanooga, TN 37422
- b) New Nycon Inc., 12 Canal St. Suite 102, Westerly, RI 02891
- c) Euclid Chemical Company, 19218 Redwood Rd., Cleveland OH 44110

2. Physical Characteristics:

- a) Specific gravity 0.91
- b) Tensile Strength 70 - 110 ksi
- c) Fiber Length 1/2", 3/4", 1 1/2", 2" per manufacturer

PART 3 - EXECUTION

3.1 GENERAL:

- A. Construction requirements associated with the furnishing, placing, and curing of Concrete Pavement shall be in accordance with CDOT Standard Specifications Section 412 and Sections 601, 608 and 609.
- B. Finished Product: Shall be in close conformity with lines, grades and typical cross sections shown on the Drawings, as required to match existing adjacent sidewalk, or as established by the Engineer.

3.2 GENERAL INSTALLATION:

- A. Radii Edges: All concrete shall include 1/2-inch radii on all exposed edges.
- B. Finishing of formed concrete surfaces shall conform to CDOT Standard Specifications Section 601.14.
- C. Walls and slab surfaces to be covered by earth backfill shall receive a Class 1 Ordinary Surface Finish.
- D. All bands, trench grates surrounds, curb and gutter, splash curb, and pavement exposed to public view shall receive a light broom finish.
- E. All integrally colored cast in place concrete shall be mixed and installed according to manufacturer's instructions and specifications
- F. Protection: Use all means necessary to protect the materials of this section before, during, and after installation and to protect the work and materials of other trades.
- G. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Project Engineer at no additional cost to the Owner.
- H. The Contractor is required to provide and maintain a concrete washout area and shall include this on the construction site management plan.
- I. Removal of Existing Improvements:

- 1. Sawcutting: Where removal is required for reconstruction or replacement with

concrete or paving stone, the existing concrete section shall be saw cut with an abrasive type saw and carefully removed. Saw cuts shall be done to the proper lines to permit placement of new concrete surfaces or paving stones as shown on the Drawings or as directed by the Engineer. Saw cuts shall not deviate from established lines by more than ¼ inch. Cuts for appurtenances such as grates must be of adequate size and proper configuration to allow placement of the appurtenance.

2. Haul Away: The Contractor shall be responsible for haul away and disposal of all removed curb and sidewalk materials to an off-site waste area.

3.3 FORM WORK:

- A. Project Engineer shall inspect and approve the forms prior to Contractor installing concrete paving.

3.4 DOWEL INSTALLATION:

- A. Smooth, epoxy coated dowel bars shall be placed in the forms at each expansion and construction joint. One half of the dowel length shall be coated with a bond breaker of an approved covering.
- B. Dowels shall be made up in “dowel baskets” or other approved assembly, such that dowels can be set parallel to one another and parallel to the length of the slab. Dowel basket assemblies must be anchored to the subgrade to prevent movement during concrete placement. Placement tolerances for dowels shall be per CDOT Standard M-412-1.

3.5 JOINTS:

- A. Contraction joints, 1/8 inch wide, shall be constructed at the intervals noted on the Drawings or as directed by the Project Engineer. Contraction joints on sidewalks and trails shall be placed equal to the width of a trail or sidewalk width if not otherwise specified on the Drawings. Contraction joints on curb and gutter shall be placed at a maximum of 12-ft intervals; consideration shall be given to joint spacing if attached sidewalk exists. The joints shall be constructed to a minimum depth of 1/3 the concrete depth by saw cutting or tooled if directed by the Project Engineer. Cutting shall commence after the concrete is sufficiently hard so that the blade does not dislodge aggregate and that the edges of the cut do not ravel and shall be done within 18 hours of finishing. Where saw cuts abut other construction and saw cutting is impeded, the joint shall be tooled out from the obstruction the required distance. All saw-cuts shall be thoroughly cleaned out with compressed air and the Contractor is responsible for containing and disposing all dust and residue material associated with saw-cutting.

1. For core trail construction 10-ft wide and greater, smooth dowel bars shall be placed at all contraction joints.

- B. Expansion joints, ½ inch wide, by full slab depth, shall be installed at each side of structures, at ends of curb returns, at all curb ramps, at 100-ft intervals along the curbs, gutters, pans and bands, at all rigid surface intersections, or as noted on the Drawings. Expansion joints shall be installed at maximum 100-ft intervals along attached sidewalks and trails and at 300-ft intervals along detached sidewalks and trails and at all construction joints. For core trails 10-ft and wider expansion joints shall be installed at maximum 200-ft intervals, or as noted on

the Drawings.

- C. Install smooth dowel bars at both construction and expansion joints.
- D. Isolation joints shall be formed around all appurtenances such as manholes, catch basins, lighting structures, utility poles, etc., extending into and through the width of a sidewalk, trail, or curb. Preformed expansion joint filler ¼ inch thick shall be installed in these joints. Contractor shall attempt to locate isolation joints to intersection expansion or contraction joints in a symmetrical manner.

3.6 CONSOLIDATION:

- E. For core trail construction 10-ft wide and greater concrete consolidation shall generally comply with the applicable practices and recommendations of ACI 309, and as specified herein
 - 1. Internal (hand held immersion) Vibrators: During all phases of operation, maintain a frequency of 8,000 – 12,000 vibrations per minute.
 - 2. Surface Vibrators (non-roller): During all phases of operation, maintain a frequency of 3,000 – 6,000 vibrations per minute.
 - 3. Do not vibrate forms or reinforcement. Do not use vibrators to transport concrete horizontally inside the forms.
- F. Equipment: Provide adequate number of units and power source at all times. Maintain spare units on hand to ensure adequacy. If, in the opinion of the Engineer, the equipment being used is not adequate to accomplish proper consolidation, the Engineer may order delay in further placement of concrete until such equipment is available for use at the location of placement of concrete.
- G. Procedures: Limit duration of vibration to time necessary to produce satisfactory consolidation without causing segregation of aggregates. Spacing between insertions of a hand held immersion vibrator which is used to consolidate shall not exceed twice the radius of action as shown in table 5.1.4 of ACI 309. Under no circumstances shall the points of insertion during the consolidation phase be more than 18" apart.

- 3.7 FINISHED PRODUCT: Finished product shall be in close conformity with lines, grades, and typical cross sections shown on the Drawings, as required to match existing adjacent sidewalk or as established by the Project Engineer.

END OF SECTION

SECTION 02521

CONCRETE UNIT PAVERS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. The General Contract Conditions, Drawings, and Division - 1 Specification sections, apply to Work of this section.

1.01 DESCRIPTION

- A. Provide all labor, materials and equipment necessary to install new concrete unit paver sidewalks.

1.02 RELATED SECTIONS

- A. See Colorado Department of Transportation's 2011 Standard Specifications for Road and Bridge Construction
- B. See Project Special Provisions and Standard Special Provisions

1.02 REFERENCES

American Society of Testing and Materials (ASTM):

- A. C 33, Specification for Concrete Aggregates.
- B. C 136, Method for Sieve Analysis for Fine and Coarse Aggregate.
- C. C 140, Sampling and Testing Concrete Masonry Units.
- D. C 144, Standard Specification for Aggregate for Masonry Mortar.
- E. C 936, Specification for Solid Interlocking Concrete Paving Units.
- F. C 979, Specification for Pigments for Integrally Colored Concrete.
- G. D 698, Test Methods for Moisture Density Relations of Soil and Soil Aggregate Mixtures Using a 5.5-lb (2.49 kg) Rammer and 12 in. (305 mm) drop.
- H. D 1557, Test Methods for Moisture Density Relations of Soil and Soil Aggregate Mixtures Using a 10-lb (4.54 kg) Rammer and 18 in. (457 mm) drop.
- I. D 2940, Graded Aggregate Material for Bases or Subbases for Highways or Airports.

1.04 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in the manufacture of concrete interlocking pavers for a minimum of three (3) years.
- B. Installation shall be by a contractor and crew with at least three (3) years of experience in placing interlocking concrete pavers on projects of similar nature or dollar cost.
- C. Installation Contractor shall conform to all local, state/provincial licensing and bonding requirements.

1.05 SUBMITTALS

- A. Submit copies of product drawings and data in accordance with General Conditions.
- B. Submit full size sample sets of concrete paving units to indicate color and shape selections.
- C. Submit a sample of bedding
- D. Submit product information for polymer joint sand
- E. Submit test results from an independent testing laboratory for compliance of paving unit requirements to ASTM C 936.
- F. Indicate layout, pattern, and relationship of paving joints to fixtures and project formed details.

1.06 MOCK-UPS

- A. Install a section of pavers identified within the plans no less than 7' in length and shall be fill an entire area from back of curb to back of curb. The mock-up location area is to be approved by Owners Representation, the area will be integral to the scope of work as described in Article 3.02. The mock-up shall be the standard from which the work will be judged. Consideration shall be given with regard to differences in age of materials from time of mock-up erection to time of actual product delivery.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver concrete pavers to the site in steel banded, plastic banded, or plastic wrapped cubes capable of transfer by fork lift or clamp lift. Unload pavers at job site in such a manner that no damage occurs to the product.
- B. Sand shall be covered with waterproof covering to prevent exposure to rainfall or removal by wind. The covering shall be secured in place.
- C. Coordinate delivery and paving schedule to minimize interference with normal use of buildings adjacent to paving.

1.08 ENVIRONMENTAL CONDITIONS

- A. Do not install sand or pavers during heavy rain or snowfall.
- B. Do not install sand and pavers over frozen base materials.
- C. Do not install frozen sand.

PART 2 PRODUCTS

2.01 CONCRETE UNIT PAVERS

- A. Concrete pavers for the US Highway 40 Medians shall be supplied by Borgert Products, Inc., St. Joseph, MN: (320) 363-4671 or approved equal.
- B. Product names/shape, color, overall dimensions, and thickness shall be:
 - 1. Concrete Unit Pavers:
 - a. All pavers shall be 60mm thickness.
 - b. Field Pattern: Herringbone, Holland Stone Series, Golden Brown Color
 - c. Soldier Course/Paver Band: Holland Stone Series, Golden Brown Color
 - d. Reference construction plans for pattern and layout
- C. Pavers shall meet the following requirements set forth in ASTM C 936, Standard Specification for Interlocking Concrete Paving Units:
 - 1. Average compressive strength of 8,000 psi (55 MPa) with no individual unit under 7,200 psi (50 MPa).
 - 2. Average absorption of 5% with no unit greater than 7% when tested in accordance with ASTM C 140.
 - 3. Resistance to 50 freeze-thaw cycles when tested in accordance with ASTM C 67.
- D. Pigment in concrete pavers shall conform to ASTM C 979.
- E. Materials shall be manufactured in individual layers on production pallets.
- F. Materials shall be manufactured to produce a solid homogeneous matrix in the produced unit.

2.02 VISUAL INSPECTION

- A. All units shall be sound and free of defects that would interfere with the proper placing of units or impair the strength or permanence of the construction.
- B. Minor cracks incidental to the usual methods of manufacturing, or chipping resulting from customary methods of handling in shipment and delivery, shall not be deemed grounds for rejection.

2.03 SAMPLING AND TESTING

- A. Manufacturer shall provide a minimum of three (3) years testing backup data showing manufactured products that meet and exceed ASTM 936-82 when tested in compliance with ASTM C-140.

2.04 BEDDING AND JOINT SAND

- A. Bedding sand shall be clean, non-plastic, free from deleterious or foreign matter. The sand shall be natural or manufactured from crushed rock. Limestone screenings or stone dust shall not be used. When concrete pavers are subject to vehicular traffic, the sands shall be as hard as practically available.
- B. Grading of sand samples for the bedding course shall be according to ASTM C 136. The bedding sand shall conform to the grading requirements of ASTM C 33 as shown in Table 1.

Table 1
Grading Requirements for Bedding Sand

ASTM C 33

<u>Sieve Size</u>	<u>Percent Passing</u>
3/8 in. (9.5 mm)	100
No. 4 (4.75 mm)	95 to 100
No. 8 (2.36 mm)	85 to 100
No. 16 (1.18 mm)	50 to 85
No. 30 (600 μm)	25 to 60
No. 50 (300 μm)	10 to 30
No. 100 (150 μm)	2 to 10

- C. Joint sand shall be RG+ Polymeric Sand, by Techniseal or approved equal. Joint sand shall be per ASTM C-144.

2.07 PAVER EDGE RESTRAINT

- A. Pave Edge, PVC paver edging, by Pave Tech – 1.800.728.3832 or approved equal. Refer to manufacturer’s instructions for installation. Edging or curb and gutter removal and replacement is not included in the Contractor’s unit pricing for this project and will need to be negotiated if it is required.

2.08 GEOTEXTILE FABRIC

- A. Mirafi 140N or Mirafi 150S, by Mirafi, or approved equal. (1.888.795.0808)

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that subgrade preparation, compacted density and elevations conform to the specifications. Compaction of the soil subgrade to at least 95% Standard Proctor Density per ASTM D 698 is recommended. Higher density, or compaction to ASTM D 1557 may be necessary for areas subject to continual vehicular traffic. Stabilization of the subgrade and/or base material may be necessary with weak or saturated subgrade soils. The Owner's Representative should inspect subgrade preparation, elevations, and conduct density tests for conformance to specifications.
- B. Verify that aggregate base materials, thickness, compaction, surface tolerances, and elevations conform to the specifications. Verify that geotextile fabric has been installed in accordance with manufacturer's recommendation and as indicated in the plans.
- C. Verify location, type, installation and elevations of edge restraints (as required) around the perimeter area to be paved.
- D. Verify that base is dry, uniform, even, and ready to support sand, pavers, and imposed loads.
- E. Beginning of bedding sand and paver installation means acceptance of base and edge restraints.

3.02 PAVER INSTALLATION

- A. Spread the sand evenly over the base course and screed to a nominal 2 in. thickness. The screeded sand should not be disturbed. Place sufficient sand to stay ahead of the laid pavers. Do not use the bedding sand to fill depressions in the base surface.
- B. Install paver edge restraint as indicated on construction plans and according to manufacturer's instructions.
- C. Ensure that pavers are free of foreign materials before installation.
- D. Lay the pavers in the pattern(s) as shown on the construction plans. Maintain straight pattern lines.
- E. Joints between the pavers on average shall be between 1/8 in. and 3/16 in. (2 mm to 5 mm) wide.
- F. Fill gaps at the edges of the paved area with cut pavers or edge units.
- G. A 3/8 in. to 1/2 in. gap filled with joint sand shall be installed along the edge where the pavers join the concrete band to allow for expansion.
- H. Cut pavers to be placed along edge with a double blade paver splitter or masonry saw.
- I. Use a low amplitude, high frequency plate vibrator to vibrate the pavers into the sand. Use Table 3 below to select size of compaction equipment:

Table 3

<u>Paver Thickness</u>	<u>Minimum Centrifugal Compaction Force</u>
------------------------	---

60 mm	3000 lbs. (13 kN)
80 mm	5000 lbs. (22 kN)

- J. Vibrate the pavers, sweeping dry joint sand into the joints and vibrating until they are full. This will require at least two or three passes with the vibrator. Do not vibrate within 3 ft. (1 m) of the unrestrained edges of the paving units.
- K. All work to within 3 ft. (1 m) of the laying face must be left fully compacted with sand-filled joints at the completion of each day.
- L. Sweep off excess joint sand when the job is complete.
- M. Wet the joint sand per manufacturers recommendations in order to activate the polymers within the joint sand. Take care to avoid discharge of excess applied water to storm drainage systems.
- N. The final surface elevations shall not deviate more than 3/8 in. (10 mm) under a 10 ft. (3 m) long straightedge.
- O. The surface elevation of pavers shall be 1/4 in. (6 mm) above adjacent drainage inlets, concrete collars, channels, concrete bands and curb and gutters.
- P. The surface elevation of pavers shall be 1/4 in above all adjacent concrete curb and gutter, concrete steps, concrete bands, and building entrances. Final elevations of all concrete pavers shall match existing elevations at all building faces, steps, and miscellaneous building or site materials to remain unless otherwise noted. The final elevations shall not deviate more than 1/4".
- Q. The re-sanding as necessary of paver joints shall be accomplished by contractor for a period of 180 days after completion of work.
- R. The paver surface shall have positive drainage and shall be sloped away from the center of the median as indicated on the drawings and field directed by the Owner's Representative.

3.03 FIELD QUALITY CONTROL AND COMPLETION

- A. After removal of excess sand and mortar, check final elevations for conformance to the drawings.
- B. Contractor shall provide owner with 50 (fifty) additional concrete unit pavers in each style, size, and color to match installation. Additional pavers shall be provided to Owner in accordance with 1.07.

END OF SECTION

SECTION 02601
MANHOLES

PART 1 GENERAL

- 1.01 RELATED DOCUMENTS: The General Contract Conditions, Drawings and other Division - 1 Specification sections apply to Work of this section.
- 1.02 WORK INCLUDED : Furnish and install precast concrete manholes required in conjunction with the project utility work at the locations and grades shown on the Plans and Details.
- 1.03 RELATED WORK:
 - A. Section 02623; Corrugated Metal Pipe
- 1.04 REFERENCE STANDARDS
 - A. CDOT Standard Specifications Section 604; Manholes, Inlets, and Meter Vaults
 - B. CDOT Standard Specifications Section 712.05; Precast Concrete Units
 - C. CDOT Standard Specifications Section 712.06; Frames, Grates, Covers, and Steps
 - D. CDOT Standard Plan No. M-604-20; Manholes

PART 2 PRODUCTS

- 2.01 PRECAST SECTIONS :
 - A. Manhole bases, barrels and cones shall be of precast construction in conformance with CDOT Standard Specifications Section 712.05 and Standard Plan No. M-604-20. Shop drawings of the precast manhole bases shall be submitted by the Contractor for review and approval by the Project Engineer prior to being ordered. Manhole cones and flat-top lids shall be eccentric.
 - B. Cast In Place Bases will be allowed in accordance with CDOT M Standard M-604-20.
- 2.02 FRAMES, GRATES, COVERS, STEPS : Manhole frames, grates, covers, and steps shall be in accordance with CDOT Standard Specifications Section 712.06 and Standard Plan No. M-604-20. Covers shall be furnished with the appropriate wording cast on the cover as directed by the Project Engineer.
- 2.03 MORTAR : Mortar used in repair of precast sections shall be composed of one part Portland Cement, and not more than three, nor less than two, parts of fine aggregate. Hydrated lime or masonry cement shall not be used. Portland Cement shall meet the requirements of ASTM C-150, Type II. Fine aggregate shall consist of well-graded natural sand having clean, hard, durable, uncoated grains, free from organic matter, soft or flaky fragments or other deleterious

substances. The fine aggregate shall be thoroughly washed and shall be uniformly graded from coarse to fine with a minimum of 95% passing a No. 4 sieve and a maximum of seven percent 7% passing a No. 100 sieve.

- 2.04 **JOINT SEALING COMPOUND** : Joints between manhole sections shall be sealed with a flexible joint compound. Joint seal shall be "RAMNEK" or "RUBBERNEK" or an approved equal. The application of priming compound and sealing compound shall be performed in strict conformance with the manufacturer's instruction as to quantity of material, the grade of the materials, and the application temperatures. The compound shall be applied to all manhole joints.

PART 3 EXECUTION

3.01 CONSTRUCTION

- A. Manholes shall be constructed at the locations and to the grades identified on the Plans and shall be so constructed as to form a circle in a horizontal plane. The manhole barrels shall be tight at all joints. CDOT M Standard M-604-20 shall be used for Storm Manholes.
- B. Precast concrete adjustment rings (grade rings) shall be used on top of the cone or flat-top lid to support and adjust the manhole frame to the required final grade. Maximum depth of adjustment rings shall be such that there is not more than 18 inches between manhole steps. Precast adjustment rings and manhole frames shall be grouted in place. Concrete collars poured at final grade around manhole frames shall be prohibited so as to prevent any interference with the proposed surface treatment in the vicinity of the manhole.

- 3.02 **PIPE PENETRATIONS** :Precast manhole sections shall be furnished with knockouts for pipe penetrations that provide a void space around the penetrating pipe large enough to facilitate continuous grouting around the pipe in its final position with non-shrink grout.

- 3.03 **CHANNELIZATION OF FLOW IN BASE** : Channelization of pipe flow through the manhole base shall be made with unreinforced cast-in-place Class B concrete in conformance with CDOT Standard Plan No. M-604-20.

- 3.04 **MARKER POSTS**: Marker posts shall be installed at all storm sewer manholes not located in paved, graveled, or lawn areas.

END OF SECTION

SECTION 02623

CULVERT AND STORM PIPE INSTALLATION

PART 1 GENERAL

- 1.01 RELATED DOCUMENTS: The General Contract Conditions, Drawings and other Division - 1 Specification sections apply to Work of this section.
- 1.02 DESCRIPTION: Furnishing and installation of storm sewer pipe and associated fittings:
- 1.03 RELATED WORK:
 - A. Section 02221; Excavating, Backfilling, and Compacting
 - B. Section 02720; Catch Basin Inlets
 - C. Section 02601; Manholes

PART 2 - PRODUCTS

2.01 Corrugated Metal Pipe

- A. Corrugated Metal Pipe (CMP): Shall conform to AASHTO M36, Type I. Zinc coating shall conform to AASHTO M218. Corrugated steel circular section with annual (circumferential) or helical corrugations. Minimum thickness shall be as follows:

Pipe diameter or equivalent arch	Gage
up to 48 inch	16
54 inch to 66 inch	12
over 66 inch	8

Note that if pipe velocities exceed 10 feet per second, required gage shall be increased by one increment.

- B. Coupling Bands: annular corrugations or helical corrugations to match pipe ends.

2.02 Reinforced Concrete Pipe:

- A. Shall conform to the requirements of AASHTO M 170 for the specified diameters and strength classes.
- B. Elliptical pipe conforming to AASHTO M 207 shall be furnished when required on plans. Arch pipe conforming to AASHTO M 206 shall be furnished when required on plans.
- C. Precast reinforced concrete end sections shall have at least one line of reinforcement conforming to the requirements of AASHTO M 170 equivalent to the square inches per linear foot for elliptical reinforcement in circular pipe, Class III, Wall B.
- D. Coupling Bands: Bands shall be either one or two-piece lap-type of the same material as the pipe. Band width shall be 7 inches for 6-inch through 18-inch diameter pipe, 12 inches for 21-inch through 60-inch diameter pipe and 24 inches for diameters greater than 60-inch. Bands

for use with culverts through water impounding embankments or in other applications where a water tight joint is important shall include a neoprene gasket.

- E. Coating: Bituminous coating material for culverts, where specified, shall conform with the requirements of AASHTO M 190, Type A coating or AASHTO M 243, except that the use of tar base material will not be permitted.
- 2.03 High Density Polyethylene (HDPE) Pipe: The Yampa Street Improvement project allows for use of HDPE with an approved material submittal prior to delivery of this material to the job site.
- 2.04 WASHED ROCK: Angular or rounded, ¼ to 1½ inch, graded stone or acceptable local minerals such as coral, slag, cinders, crushed stone and crushed shells.

PART 3 EXECUTION

3.01 CULVERT INSTALLATION

- A. Excavation: Trenches shall be excavated to a width sufficient to allow for proper jointing of the culvert and thorough compaction of the bedding and backfill under and around the culvert.
- B. Preparation of Pipe: Inspect all pipe and fittings before lowering into the prepared trench to ensure that no cracked, broken, or defective pipe or fittings are being used in the work. Remove any foreign matter and soil from inside the pipe.
- C. Handling: Provide and use proper methods, tools, and facilities for the safe and proper protection of the work. Lower all pipe into the trench in such a manner as to avoid any physical damage to the pipe. Reject all damaged pipe and removed from the jobsite.
- D. Lines and Grades: Pipe shall be laid to the lines, grades, and elevations shown on the Plans. Storm sewer and lateral drain line pipe shall be sloped uniformly in accordance with the Plans to allow for continuous gravity drainage.
- E. Installation of Pipe and Fittings: Pipe and fittings shall be installed in accordance with the manufacturer's instructions. Project Engineer's approval of the pipe installation shall be required prior to backfilling the pipe zone.
- F. Culvert Placement:
 - 1. Unperforated culverts: All culverts shall be installed on a smooth and uniform foundation. Abrupt changes from hard to soft foundation should be avoided. A minimum of 6 inches of well-graded, granular material is to be placed beneath any pipe installed on a soft foundation. Hard or rock foundations are to be over-excavated a minimum of 6 inches and a well-graded, granular backfill or other suitable material installed to the proper grade and to the required density. All culvert installations are to be made in dewatered conditions.
 - 2. Perforated culverts/underdrains: All culverts shall be perforated as specified above. Prior to culvert placement, a drainage fabric shall be laid in the trench to separate the washed rock from the trench bottom and walls. See Geotextiles, Section 2242. The fabric shall be of adequate width to cover the top of the washed rock with a 2 foot overlap. A minimum of 4 inches of washed rock is to be placed beneath the culvert.
- G. Connections
 - 1. Concrete pipe: Concrete pipe sections shall be joined in such a manner that the ends are fully entered and the inner surfaces are reasonably flush and even. Joints shall be made with pipe joint sealing compound unless otherwise directed by the Project Engineer.

2. Corrugated metal pipe:

- a) All connections shall be made with the properly sized band as supplied by the manufacturer.
- b) Connections of drainage laterals into storm sewer mains shall be made using rubber gasketed saddles or fittings oriented to allow the lateral to introduce flows into the main at the invert elevation specified on the plans.
- c) Jointing shall be made using standard of the industry water-tight gasketed joints.
- d) All steel coupling bands and connection hardware shall be galvanized or aluminum coated to prevent galvanic action when unlike materials are connected.
- e) Where aluminum drainage pipe is to be in contact with steel structures or components, contact areas shall be given a heavy bituminous coating, inside and out, for a distance of 12 inches beyond the contact, or bituminous-coated coupling bands shall be used.

H. Backfill

1. Unless otherwise specified, backfill requirements shall be per Section 2221, Trenching, Bedding, and Backfill.
2. Unperforated culverts: Backfill material should preferably be granular; however, cohesive-type material can also be used if careful attention is given to compaction at or very near optimum moisture content. All backfill material is to be compacted to 95 percent of maximum density.
3. Backfill around the pipe and under the haunches shall be placed alternately in 6-inch lifts. The elevation of the backfill on either side of the pipe is to be kept nearly equal at all times during the backfilling process. For the installation of the pipe arches, the material beneath the corners is to be compacted to 100 percent maximum density. Mechanical compaction is to be done by means approved by the Project Engineer. Hydraulic backfilling will not be permitted.
4. For pipe arches, the backfill is to be placed around and over the structure in uniform layers, conforming to the slope of the arch and thoroughly compacted. The material is to be placed from the top of the arch. When backfilling arches without headwalls, the first fill is to be placed midway between the ends of the arch.
5. Perforated culverts/underdrains: The culvert shall be backfilled with washed rock to minimum of 4 inches above the culvert. The washed rock shall be covered with the drainage fabric. Backfill above the fabric shall consist of suitable native material. If suitable native material is not available, pit run shall be imported for backfill. The washed rock placed shall be compacted with a vibratory plate. Other backfill material shall be compacted to 95 percent of maximum density.
6. Paved areas: In existing pavement areas, allowance shall be made for the pavement repair section.

END OF SECTION

SECTION 02720

CATCH BASIN INLETS

PART 1 - GENERAL

- 1.01 **RELATED DOCUMENTS:** The General Contract Conditions, Drawings and other Division - 1 Specification sections apply to Work of this section.
- 1.02 **WORK INCLUDED:** Furnish and install concrete catch basin inlet vaults, frames, and grates at the locations and grades shown on the Plans and Details.
- 1.03 **REFERENCE STANDARDS :**
- A. Colorado Department of Transportation (CDOT) Standard Details M-604-10, M-604-12, and M-604-13.

PART 2 PRODUCTS

- 2.01 **GENERAL:** Catch Basin Inlet vaults, frames and grates shall conform to the CDOT standard details or other details as shown in the construction plans. Catch basins and storm sewer manholes shall incorporate a 24-inch sump extending below the invert of the lowest pipe connecting to the inlet.

PART 3 EXECUTION

- 3.01 **CONSTRUCTION** Inlets shall be constructed at the locations and to the grades identified on the Plans.
- 3.02 **PIPE PENETRATIONS :** Precast catch basin inlets shall be furnished with knockouts for pipe penetrations that provide a void space around the penetrating pipe large enough to facilitate continuous grouting around the pipe in its final position.

END OF SECTION

SECTION 02920

TOPSOIL

PART 1 – GENERAL

- 1.01 RELATED DOCUMENTS : The General Contract Conditions, Drawings and other Division - 1 Specification sections apply to Work of this section.
- 1.02 DESCRIPTION : The work of this section consists of furnishing, stockpiling and placing topsoil on a previously prepared subgrade.
- 1.03 RELATED WORK
- A. Section 02100 – Site Preparation
 - B. Section 02200 - Earthwork
 - C. Section 02260 – Fine Grading
 - D. Section 02920 – Soil Preparation
 - E. Section 02933 – Native Grass Seeding
- 1.04 QUALITY ASSUARANCE: Contractor shall submit soil analysis report for imported topsoil to the State University Agricultural Extension Service or other approved soil testing laboratory. Report shall cover soil textural classification (percentages of sand, silt, and clay), pH and include additive recommendations. Testing will be at the expense of the Contractor. Contractor to amend topsoil per test recommendations with approval of Owner's Representative.
- 1.05 DELIVERY, STORAGE AND HANDLING: Do not deliver or place topsoil in frozen, wet, or muddy condition.

PART 2 - PRODUCTS

- 2.01 ON-SITE TOPSOIL : Topsoil previously stripped and stockpiled under Section 02100.
- 2.02 IMPORTED TOPSOIL
- A. All topsoil shall be a loam or sandy loam. At least 10 days prior to topsoil delivery, notify Owner's Representative of the source(s) from which topsoil is to be furnished. Topsoil shall be furnished by the Contractor and shall be a natural, friable soil representative of productive soils in the vicinity. It shall be obtained from the top 6" of well drained areas.
 - B. Fertile, friable, loamy soil, reasonably free from subsoil, refuse, roots, heavy or stiff clay, stones larger than 1 inch, coarse sand, noxious seeds, sticks, brush, litter, and other deleterious substances; suitable for the germination of seeds and the support of vegetative growth. The pH value shall be between 7.0 and 8.0 and the total salts maximum content shall be 3 MMHOS/CM.
 - C. Soil Texture: Sand, 30 to 50 percent; silt, 30 to 50 percent; clay, 5 to 30 percent.
 - D. Additives: As determined by soil fertility tests. % Organic Content: 2.9% minimum.

PART 3 EXECUTION

3.01 PLACING TOPSOIL

- A. Native Grass and Turfgrass Areas: Scarify compacted subgrade to a 6-inch depth to bond topsoil to subsoil. Place topsoil to a minimum depth of 3-inches after settlement. Topsoil shall be free from weeds, sod, clods and stones larger than 1-inch, toxic substances, litter or other deleterious material. Spread evenly and grade to elevations and slopes shown. Hand rake areas inaccessible to machine grading.
- B. Trees, Shrubs, Perennial and Annual Beds: Scarify compacted subgrade to a 12-inch depth to bond topsoil to subsoil. Fully amend subgrade with 2/3rds topsoil and 1/3rd well rotted manure fertilizer. Topsoil shall be free from weeds, sod, clods and stones larger than 1-inch, toxic substances, litter or other deleterious material. Spread evenly and grade to elevations and slopes shown. Hand rake areas inaccessible to machine grading.
- C. Utilize salvaged topsoil as the top layer to the extent available.

END OF SECTION

SECTION 02933

REVEGETATION

PART 1 - GENERAL

- 1.01 RELATED DOCUMENTS: The General Contract Conditions, Drawings and other Division -1 Specification sections apply to Work of this section.
- 1.02 DESCRIPTION: The work of this section includes soil preparation and revegetation of all areas disturbed by the Contractor. Revegetation shall include application of native seed, lawn seed, sod, fertilizer, mulch, and soil retention blanket. Alternate low water or drought tolerant mixes that will achieve similar coverages are encouraged and may be proposed to Project Engineer as an alternate.
- 1.03 RELATED SECTIONS:
- A. Topsoil – Section 02925
- 1.04 REFERENCES: Reference Standards: Comply with U.S. Department of Agriculture Rules and Regulations under Federal Seed Act and be equal or better in quality than standards for certified seed.
- 1.05 SUBMITTALS:
- A. Quality Control Submittals: Certificates: State, Federal or other inspection certificates shall accompany the invoice for materials showing source or origin. Submit to Project Engineer prior to acceptance of the material.
 - B. Soil Conditioner: Provide soil conditioner analysis performed no more than 3 months prior to deliver to site. Submit 0.5 cubic foot sample of soil conditioner at least 14 days prior to delivery to the site.
 - C. Seed and Fertilizer: Submit seed mix and fertilizer mix to Project Engineer for review and approval prior to application.
 - D. Sod: Submit a sample of the sod proposed to be furnished. The sample shall serve as the standard for the project. Sod furnished which is not compatible with the standard sample will not be accepted.
 - E. Mulch and Soil Retention Blanket: Suppliers shall certify that laboratory and filed testing of their product has been accomplished and that it meets the material requirements contained herein. Test results shall be made available to the Project Engineer upon written request.
- 1.06 QUALITY ASSURANCE:
- A. Source Quality Control:
 - 1. Seed Materials: Subject to inspection and acceptance. Project Engineer reserves the right to reject at any time or place prior to acceptance, any work and seed which in the Project Engineer opinion fails to meet specification requirements.
 - 2. Inspection: Primarily for quality; however, other requirements are not waived even though visual inspection results in acceptance.
 - 3. Inspection will be made periodically during seeding, at completion of seeding and at end of warranty period by Project Engineer.

- B. Testing Requirements: Seed and seed labels shall conform to current State and Federal regulations and be subject to testing provisions of the Association of Official Seed Analysis.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Seed: Deliver seed in sealed standard containers stating correct name and composition on the outside of the container. Seed damaged in transit or storage will not be accepted.
- B. Fertilizer: Deliver inorganic or chemical fertilizer to site in original unopened container bearing manufacturer's guaranteed chemical analysis, name, trade name, trademark and conformance to state law, and bearing name and warranty of producer.
- C. Notify Project Engineer of delivery schedule in advance so material can be inspected upon arrival at project site. Immediately remove unacceptable material from job site.

1.08 PROJECT/SITE CONDITIONS

- A. General: Do not perform work when climate and existing site conditions will not provide satisfactory results.
- B. Existing Conditions: Vehicular accessibility on site shall be as directed by Owner. Repair damage to prepared ground and surfaces, caused by vehicular movement during work under this section, to original condition at no additional cost to the Owner.
- C. Environmental Conditions: Do not drill or sow seed during windy weather or when ground is frozen or otherwise untellable.

1.09 SEEDING SEASONS: Spring thaw to consistent ground freeze

1.10 WARRANTY:

- A. Warranty for Seed or Sod in Irrigated Areas: Warrant areas in seed to be in a healthy, vigorous growing condition, and for consistency and completion of coverage for a period of one year from date of final acceptance as a full stand of grass. After time of seed germination, re-seed any spots where seed has not germinated within the total seeded area. Continue this procedure until a successful stand of grass is growing and accepted by the Project Engineer. During the original warranty period, reseed at once with comparable blend/mix, those areas that have failed to achieve a stand of grass or which in the Project Engineer's opinion are unhealthy. Reseeding will not be required in any season definitely unfavorable for seeding. Reseed in a manner to achieve quality as originally specified.
- B. Warranty for Native Seed in Unirrigated Areas: No warranty will be required.

PART 2 PRODUCTS

2.01 MATERIALS:

- A. Soil Conditioner:
 - 1. Composted material meeting the following requirements:
 - a) Organic matter: 20 – 25%
 - b) Salt content: 4.0 mmhos/cm maximum

- c) pH: 8.5 maximum
- d) Carbon to nitrogen ration of 10:1 to 25:1
- e) N live noxious weed seeds or plants shall be present

2. Mountain peat, aspen hummus, gypsum, uncomposted manure, and sand will not be accepted.

B. Native Grass Seed Mix: Shall consist of a mixture of the following or an approved equal:

- | | |
|----------------------------------|--------------------------------------|
| 1. Smooth Brome (Manchar) | 8 lbs PLS/ac |
| 2. Crested Wheatgrass (Standard) | 6 lbs PLS/ac |
| 3. Hard Fescue (Durar) | 3lbs PLS/ac |
| 4. Western Wheatgrass | 8 lbs PLS/ac |
| 5. Intermediate Wheatgrass | 11 lbs PLS/ac |
| 6. Alsike Clove | 2 lbs PLS/ac |
| 7. Kentucky Bluegrass | 2 lbs PLS/ac |
| 8. TOTAL | 40 lbs PLS/ac (PLS – Pure Live Seed) |

C. Montane Wildflower Mix (Wildflowers and Grasses) Seeding rate - 4 oz/1000 sq. ft.

- 9. 12% Rudbeckia hirta, Black-eyed Susan
- 10. 12% Penstemon strictus, Rocky Mountain Penstemon
- 11. 12% Lupinus alpestris, Mountain Lupine
- 12. 12% Linum perenne v. lewisii, Blue Flax
- 13. 12% Gaillardia aristata, Perennial Blanketflower
- 14. 12% Eriogonum umbellatum, Sulfur Flower
- 15. 10% Penstemon virgatus, Wand Beardtongue
- 16. 4% Viguiera multiflora, Showy Goldeneye
- 17. 3% Machaeranthera bigelovii, Bigelow's aster
- 18. 2% Verbena macdougalii, MacDougal Vervain
- 19. 2% Erigeron speciosus, Showy Fleabane Daisy
- 20. 2% Aster laevis, Smooth Aster
- 21. 1% Allium cernuum, Pink Nodding Onion
- 22. 1% Delphinium ramosum, Showy Larkspur

23. 1% *Chrysopsis villosa*, Silky Golden Aster
 24. 1% *Ipomopsis aggregata*, Scarlet Gilia
 25. 0.25% *Penstemon virens*, Blue Mist Penstemon
 26. 0.25% *Penstemon griffinii*, Griffin's Penstemon
 27. 0.25% *Calochortus gunnisonii*, Mariposa Lilly
 28. 0.25% *Castilleja integra*, Indian Paintbrush
- D. Grass Mix: Seeding rate - 2 lbs/1000 sq. ft.
29. 20% *Bromus anomalus*, Nodding Brome
 30. 20% *Elymus trachycaulus*, Slender Wheatgrass
 31. 8% *Festuca arizonica*, Arizona Fescue
 32. 15% *Oryzopsis hymenoides*, Indian Ricegrass
 33. 10% *Bouteloua gracilis*, Blue Grama
 34. 5% *Poa secunda*, Sandberg's Bluegrass
 35. 5% *Pascopyrum smithii*, Western Wheatgrass
 36. 4% *Koeleria macrantha*, Junegrass
 37. 1% *Elymus elymoides*, Bottlebrush Squirreltail
 38. 1% *Elymus glaucus*, Blue Wildrye
 39. 0.5% *Muhlenbergia montana*, Mountain Muhly
 40. 0.5% *Festuca thurberi*, Thurber's Fescue
- E. Lawn Seed: Shall consist of a mixture of the following or an approved equal:
1. Merion Bluegrass ¼ lb PLS
 2. Bluegrass ¼ lb PLS
 3. Perennial Rye 1/2 lb PLS
- F. Sod: Bluegrass sod shall be nursery grown, 99% Kentucky Bluegrass and 99% weed free. The 1% allowable weed shall not include any undesirable perennial or annual grasses or plants. Soil thickness of sod cuts shall not be less than ¾ inch nor more than 1 inch. Sod shall be cut in uniform strips 18 inches in width and not less than 6 feet long.
- G. Water: Water shall be free of substances harmful to plant growth. Contractor is responsible for furnishing water to establish vegetation.

- H. Fertilizer: The fertilizer shall be standard brand commercial lawn fertilizer having a minimum of 18% available nitrogen, 46% phosphorous, and 0% potash (18-46-0).
- I. Herbicide: Roundup (Glyphosate) as manufactured by Monsanto Company or approved equal.
- J. Mulch:
1. Straw Mulch: Shall consist of straw of oats, barley, wheat, or rye that does not contain seed of noxious weeds. Straw in such an advanced stage of decomposition as to smother or retard the normal growth of the grass, or old dry straw which breaks in the crimping process in lieu of bending will not be accepted.
 2. Hay mulch: Shall consist of good clean field or marsh hay that does not contain seed or noxious weeds. Hay in such an advanced stage of decomposition as to smother or retard the normal growth of grass will not be accepted.
 3. Hydraulic mulch: Wood cellulose fiber for hydraulic mulch shall not contain any substance or factor that might inhibit germination or growth of grass seed. It shall be dyed an appropriate color to allow visual metering of its application. The wood cellulose fibers shall have the property of becoming evenly dispersed and suspended when agitated in water. When sprayed uniformly on the surface of the soil the fibers shall form a blotter-like ground cover that readily absorbs water and allows infiltration to the underlying silt. Weight specifications from suppliers, and for all applications, shall refer only to air-dry weight of the fiber, a standard equivalent to 10 percent moisture. The mulch material shall be supplied in packages having a gross weight not in excess of 100-pounds and shall be marked by the manufacturer to show the air dry weight content.
- K. Soil Retention Blanket.
1. Jute: The blanket shall consist of heavy jute mesh of a uniform open plain weave of unbleached yarn. The yarn shall be of a loosely twisted construction having an average twist of not less than 1.6 turns per inch and shall not vary in thickness by more than one-half its normal diameter. The jute mesh shall be furnished in approximately 90 pound rolled strips and shall meet the following requirements:
 - a) Length - approximately 75 yards
 - b) Width - 48-inches plus 1-inch; 78 warp ends per width of cloth; 41 weft ends per yard.
 - c) Weight of cloth to average 1.22-pounds per linear yard with a tolerance of plus or minus 5 percent.
 2. Coconut: Long-term coconut fiber erosion control blanket shall be a machine-produced 100% biodegradable blanket with a 100% coconut fiber matrix with a functional longevity of up to 24 months. The erosion control blanket shall be C125BN as manufactured by North American Green, 1-800-772-2040, or approved equal.
 3. Plastic Net: The plastic net shall be a biodegradable extruded oriented net with a rectangular mesh opening of approximately 1.5 x 1 strands per square inch and a nominal weight of 2.6 pounds per 100 square feet.
 4. Pins and Staples: Pins or staples shall be made of wire .091 inch or larger in diameter. "U" shaped staples shall have legs 6-inch long and 1-inch crown. "T" shaped pins shall have a minimum length

of 8-inches after bending. The bar of the "T" shall be at least 4 inches long with the single wire and bent downward approximately 3/4-inch.

- L. Tackifier: Shall meet the requirements of CDOT 213.02.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Verify that existing site conditions are as specified and indicated before beginning work under this Section.
- B. Soil condition: Verify that the soil condition is fit to receive planting material. Inspect to verify that earth rendered unfit to receive planting due to concrete, water, mortar, limewater, or any other contaminant dumped on it or any soil not adequately prepared has been removed, replaced to meet the appropriate specification, and approved by the Project Engineer.
- C. Layout: Verify layout of seeding areas as indicated prior to starting seeding operations.
- D. Grades: Inspect to verify that fine grading is within 0.1 foot of grades specified and indicated.
- E. Unsatisfactory Conditions: Report in writing to General Contractor with a copy to the Project Engineer.
- F. Acceptance: Beginning of installation means acceptance of existing conditions by this Contractor.

3.02 PREPARATION

- A. Protection: Contractor is responsible for proper repair to landscape, utilities, fences, pavements and other site improvements damaged by operations under this section. Identify prepared seeding areas requiring protection and erect barriers for proper protection and traffic control.
- B. Erosion Control: Take measures and furnish equipment and labor necessary to control and prevent soil erosion, blowing soil and accumulation of wind-deposited materials on the site throughout the duration of work.
- C. Weed control: Remove annual weeds by tilling. Remove perennial weeds by applying herbicide 1 week before soil preparation and as needed, but no sooner than 3 months before beginning work.
- D. Surface Grade: Remove weeds, debris, clods, and rocks larger than 1/2". Dispose of accumulated debris at direction of Owner. .
- E. Place topsoil in accordance with Section 02925.
- F. Seeding Areas: Remove weeds, debris and rocks larger than 1" which may hinder seeding or subsequent operations. Dispose of accumulated debris at direction of the Owner.
- G. Fine Grading: Perform as required to maintain positive drainage, prevent ponding and direct runoff into catch basins, drainage structures, etc., and to provide smooth well-contoured surface prior to proceeding. A firm weed-free seed bed is required. Tolerance: ± 0.1 foot.

3.03 APPLICATION:

- A. Native Seed

1. General: Accomplish seeding by approved drill-type seeder at a rate of 20 lbs per acre PLS or broadcast at 40 lbs per acre PLS. Drill in a manner such that after surface is raked and rolled, seed shall have 1/4" to 1/2" of cover. Any furrows left by drill seeding shall be rolled to a smooth surface.
2. In areas too small or steep to operate a drill and if approved by the Project Engineer, seeding may be accomplished by broadcast or hydraulic type seeders at twice the rate specified, at no additional cost to the project. Seed by broadcasting or hydroseeding. Broadcast seed shall be raked in at least ¼ inch..
3. Maintenance: Contractor shall be responsible for maintaining and adequately watering seeded areas after the time of seeding. Areas in which there is not an acceptable stand of revegetation shall be reseeded. An acceptable stand of revegetation exists when the revegetation is equal to or better than the pre-construction vegetation.

B. Lawn Seed:

1. General: Seeding shall be accomplished by means of an approved broadcast-type seeder at a rate of 1-pound per 300 sq. ft. PLS. The seeded area shall then be raked to provide about 1/4-inch of cover over the seed unless hydraulic broadcasting and mulching is used. Seed shall not be sown during windy weather or when the ground is frozen or otherwise untillable.
2. Maintenance: The Contractor shall be responsible for maintaining and watering seeded lawn areas after the time of seeding. If areas or patches exist without an acceptable stand of grass, the Contractor shall reseed and maintain until an acceptable stand of revegetation exists. An acceptable stand of revegetation exists when the revegetation is equal to or better than the pre-construction vegetation.

C. Sod:

1. General: The sod shall be laid by staggering joints. On any slopes, the sod shall run parallel to a 90-degree angle to the slope. After installation the sod shall be thoroughly soaked. After soaking, the sod shall be permitted to dry to the point where it is still wet enough for effective rolling. It shall then be rolled in two directions with a lawn roller weighing not less than 150 pounds to secure a tight bond of sod to subgrade and between strips.
2. Maintenance: The Contractor shall be responsible for maintaining and watering sodded areas after the placement of sod. The Contractor shall guarantee the sod and any areas of dead or dying sod shall be replaced and maintained until it is self-sufficient.

D. Fertilizer: Fertilizer shall be tilled into the top 2 inches of the soil at a rate of 300 lbs per AC.

3.04 MULCHING:

A. General:

1. All mulching procedures shall be done after the seeding operation is completed and not in conjunction with seeding
2. Mulching shall not be done in the presence of free surface water resulting from rains, melting snow or other causes.

3. Areas not properly mulched, or damaged due to the Contractor's negligence, shall be repaired and remulched in an acceptable manner at the Contractor's expense. Mulching removed by wind prior to acceptance shall be re-established by the Contractor at his own expense.
 4. The seeded area shall be mulched within 24 hours after seeding. Areas not mulched within 24 hours after seeding must be re-seeded with the specified seed mix at the Contractor's expense.
 5. Remove mulch immediately from trees, shrubs and sod to prevent damage to same.
- B. Hay or straw mulch Application: Apply specified straw at the rate of 2,000 lbs. per acre, crimped into the soil at a right angle to the slope. In areas too steep for crimping, a tackifier, such as Terra Tack or JOTak shall be applied at a rate of 120 lbs per AC in lieu of crimping. An asphaltic tackifier shall not be acceptable.
 - C. Hydraulic mulching: The hydraulic mulching material shall be spray applied to the seeded area at a rate of 1 ton per AC.
- 3.05 EROSION CONTROL BLANKET: Install erosion control blanket on all slopes exceeding 2:1, on the top four feet of any disturbed slope greater than 4:1, and in swales or other areas of concentrated runoff. Reference plans for approximate locations. Install in accordance with manufacturer's instructions.
 - 3.06 CLEANING: Remove debris and excess materials from site. Clean paved and finished areas soiled as a result from work under this section, in accordance with direction given by the Owner. Clean out drainage inlet structures.
 - 3.07 PROTECTION: Provide and install barriers as required and as directed by the Project Engineer to protect seeded areas from damage from pedestrian and vehicular traffic. Contractor is not responsible for malicious destruction of seeding caused by others.
 - 3.08 LIMITATIONS: Contractor will not be paid for revegetation of disturbed areas that resulted from the Contractor's carelessness or negligence in performing the Work.

END OF SECTION