

**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

- A. Contract Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. This section consists of retention and protection of trees during the construction of the project.

**1.3 DEFINITIONS AND REFERENCE STANDARDS**

- A. Drip Line: The outermost edge of the tree's canopy or branch spread. The area within a tree's drip line is all the ground under the total branch spread.
- B. Significant Tree: Trees with a trunk twelve inches (12) in diameter or greater.
- C. City Forester / Office of the City Forester: The City agency responsible for trees and shrubs in public parks, parkways, and other public property. Denver's street trees are under regulation of the City Forester.
- D. Project Consulting Arborist: An independent consultant with a degree in forestry, horticulture, or arboriculture, an American Society of Consulting Arborists (ASCA) registered consulting arborist, an International Society of Arboriculture (ISA) Certified Arborist, and / or a consultant with at least five years (5) field experience in tree preservation or on-site monitoring of public works or construction projects involving tree retention and protection.
- E. Tree Protection Zone: The Tree Protection Zone is the area above and below grade around each tree where construction activities are limited or restricted to prevent injury to preserved trees.
  - 1. The Tree Protection Zone shall extend one and one-half foot (1.5') from the base of the trunk for every one inch (1") of tree diameter. The diameter of the tree shall be measured at four and one-half feet (4.5') above grade (referred to as diameter breast height).
  - 2. For areas with groups or groupings of trees, if the distance between trees is less than thirty feet (30'), the Tree Protection Zone may be combined and treated as one contiguous Tree Planting Zone to create a more clearly defined and manageable Tree Protection Zone.
- F. 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: American National Standard for Tree Care Operations.
  - 2. ANSI A300: Tree, Shrub, and Other Woody Plant Management – Standard Practices.
  - 3. Guide for Plant Appraisal – Current Edition: Authored by the Council of Tree and Landscape Appraisers; published by the International Society of Arboriculture.

#### 1.4 QUALITY CONTROL

- A. As established by Chapter 57 of the Denver Revised Municipal Code, the City Forester, or an approved designee from the Office of the City Forester, shall be responsible for ensuring that all construction activities are in compliance with established standards for removal, maintenance, and planting of trees with the goal of promoting the health, safety, welfare, and quality of life of the residents of the city through the development of a sustainable community forest and, specifically, the preservation of trees.
- B. At its discretion, the City may hire a Project Consulting Arborist to conduct daily observation of the Contractor's field crews during the critical phases of the project, such as: demolition of existing concrete, root pruning, construction of retaining walls, and construction of new curb or sidewalk in Tree Protection Zones.
- C. Motorized equipment and trailers, including tractors, bobcats, bulldozers, rubber-tired excavators, tracked excavators, trucks, cars, and carts shall not be allowed access within Tree Protection Zones. Should access be necessary within designated Tree Protection Zones the City Forester or Project Consulting Arborist shall be notified and shall approve of the access and driving surface prior to its use.
- D. Materials and supplies shall not be stockpiled or stored within the Tree Protection Zone unless otherwise approved by the City Forester. Should temporary storage be necessary within designated Tree Protection Zones, the existing grade shall be covered with twelve inches (12") of wood mulch with overlapping three quarter inch (3/4") thick plywood on top to help distribute the weight of equipment and to minimize soil compaction and rutting. Plywood and/or mulch are not acceptable bridging materials for driving over exposed tree roots.
- E. 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 of any sign, cable, wire, nail, swing, or any other material to trees 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 City Forester or Project Consulting Arborist.

#### 1.5 SUBMITTALS

- A. Tree Protection Plan: Submit a tree protection plan based on the contract drawings for approval by the City Forester or Project Consulting Arborist.
- B. Proposed methods and schedule for implementing tree and other plant protection shall be submitted for approval.
- C. Proposed methods, materials, and schedule for root pruning, branch pruning, and other tree maintenance shall be submitted for approval.
- D. Construction Schedule: Contractor shall submit construction schedule which includes a time frame for work near existing plants. Approval of such shall be obtained from the City Forester or Project Consulting Arborist prior to commencement of construction near Tree Protection Zones.

- E. Maintenance Schedule: Submit maintenance schedule to the Project Manager for approval by City Forester or Project Consulting Arborist.
- F. Watering plan and schedule: Submit a watering plan and schedule to the Project Manager for approval by the City Forester prior to the start of work that details watering of trees on the Project Site. The below information shall be included:
  - 1. Area of the project site to be watered and how watering will be phased based on construction.
  - 2. Number of trees to be watered and total caliper inches. Identify the amount of water to be applied based on total caliper inches.
  - 3. Schedule for watering during the duration of the project.
- G. Watering log: Submit a tree watering log that provides the following information:
  - 1. Tree(s) watered, identified by the City site identification number.
  - 2. Number of gallons of water applied to each tree during every watering period.
  - 3. oil moisture level readings, on a scale of one to ten (1 – 10) throughout the Critical Root Zone for each tree.
  - 4. Dates of each watering.

## PART 2 - PRODUCTS

### 2.1 TREE PROTECTION FENCE

- A. Orange plastic safety fencing – minimum of forty-eight inches (48”) in height, heavy duty T-posts.
  - 1. Twelve (12) gauge wire.
- B. Galvanized Chain-link – Six feet (6’) in height.

### 2.2 ROOT BARRIER

- A. Eight (8) mesh (0.028-inch or greater) copper wire screen.
- B. “Tyvar BioBarrier” as manufactured by Fiberweb, Inc. [www.biobarrier.com](http://www.biobarrier.com) or approved equal.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. If it appears any work may cause damage to the branches of a tree, the Contractor shall contact the Project Manager and the City Forester. The Project Manager and City Forester will make the determination as to whether such damage is likely and pruning is necessary.
- B. 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 the Contractor to the Project Manager for review and approval by the Office of the City Forester.

- C. Where work is proposed within a tree protection zone, the Contractor shall submit a work plan on how the work within these areas will be accomplished. The work shall be approved by the City Forester prior to the start of work. The methods for work in these areas can include the following:
  - 1. Compressed air excavation tool.
  - 2. Water excavation.
  - 3. Directional boring.
  - 4. Hand digging.
  - 5. Other methods approved by the City Forester.

### 3.2 TREE PROTECTION FENCING

- A. Tree protection fence shall be installed prior to any site activity and shall remain in place and maintained in condition in which they were installed until its removal is authorized by the City Forester or the Project Manager.
- B. Tree protection fencing should be installed 1-foot behind the existing curb in areas where the street surface will be removed and replaced.
- C. Tree protection fences shall be constructed as follows:
  - 1. Plastic fencing shall have the top secured to metal T-posts with twelve-gauge (12) wire woven through the top of fencing along the entire length. Heavy duty T-posts shall be placed so that wire and fence are taut.
  - 2. Chain link fence shall have posts installed no less than ten feet (10') on center, at a depth of twenty-four inches (24") minimum. Installation of post shall not result in injury to tree surface roots; root flares or branches.
  - 3. Chain link fence may be required by the Office of the City Forester where heavy construction activity is adjacent to existing trees. Fencing shall be installed to surround the trees within the limits of work.

### 3.3 TREE PROTECTION SIGNS

- A. A standard Forestry tree protection sign shall be mounted on tree protection fencing at fifty-foot (50') intervals, unless otherwise approved by the Project Manager or City Forester.
  - 1. The contractor shall request signs from the Project Manager a minimum of forty-eight (48) hours prior to the installation of tree protection fencing.

### 3.4 DEMOLITION

- 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 shall be done in a manner that will minimize ground disturbance and vibration.
  - 2. Curbs and sidewalks within designated Tree Protection Zones shall be removed in a manner approved by the City Forester. When removing existing sidewalks and curbs, care shall be taken to avoid injury to roots located under, over, or adjacent to paved surfaces.
  - 3. Roots and root-trunk flares growing over curbs shall not be injured during breaking of curbs and removal of debris. Wood and bark tissues shall not be injured by equipment.

4. During the removal of concrete, all exposed root systems and soil areas shall not be disturbed.
5. Motorized equipment and trailers, including but not limited to tractors, skid steers, bulldozers, rubber-tired excavators, tracked excavators, trucks, cars, and carts are to be limited to access on the existing paved areas only. Access is not allowed behind the curb within Tree Protection Zones.

### 3.5 CONSTRUCTION IN TREE PROTECTION ZONES

- A. If access within designated Tree Protection Zones is approved by the City forester or Project Consulting Arborist the existing grade shall be covered with twelve inches (12") of wood mulch and overlapping sheets of three-quarter inch (3/4") thick plywood placed on top of the wood mulch to help distribute the weight of equipment and to minimize soil compaction and rutting.
- B. 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. Construct new sidewalks on, or above, the existing grade instead of excavating into root zones. The new grade shall not interfere with sheet-flow drainage.
  3. Protect exposed roots from contamination by stabilization materials and concrete.
  4. Locate concrete washouts away from Tree Protection Zones. Washout runoff shall be strictly contained within the washout area and shall not flow into Tree Protection Zones or proposed new planting areas.
  5. When excavating for the construction of inlets, excavated soil shall be deposited in trucks and hauled off or deposited temporarily on three quarter inch (3/4") thick plywood outside the Tree Protection Zones. Excavated and fill soil shall not be deposited, even temporarily, on unprotected natural grade.
  6. After proper root-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 until the final grade is established.
- C. Where possible, construction should be relocated to prevent damage to existing roots. Where relocation of walks is not possible, walks should be constructed in a manner with the least amount of impact/damage to roots including but not limited to raised, narrowed, curbed, ramped, bridged, cantilevered, use of pylons, root break out zones, root channeling, structural cells to prevent cutting and removing major roots (e.g. roots greater than two inches in diameter).
- D. Grading within the Tree Protection Zone shall be performed by hand or a method approved by the City Forester. Any fill material that needs to be placed in the Tree Protection Zone shall be limited to a maximum of one inch (1") of fill material over the area. 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 by hand to a maximum depth of one inch (1") from the finished grade prior to placing fill material, to ensure proper incorporation of fill material. Any filling operation should not occur during water saturated soil conditions.
- E. 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.

- F. 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 scoring (as shown on the Contract Documents) 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 eighty percent (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.
1. Where appropriate, and under the direction of the City Forester or Project Consulting Arborist, root restricting barriers can be installed with a minimal amount of disturbance away from sidewalks, curbs, and streets.
  2. In areas where roots need to be removed for construction of drain inlets, roots shall be pruned 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.
    - b. Prune roots as specified.
    - c. Protect exposed roots as specified.
  3. Concrete or chemicals spilled within Tree Protection Zones should be completely removed. Contaminated soil shall be completely removed at the time of the spill and removed by hand and/or air spade tool without disturbance to root systems. Appropriate soil should be added as necessary to restore the grade. Contact the Project Manager and City Forester immediately in the event of a spill within a Tree Protection Zone.

### 3.6 IRRIGATION OR UTILITY INSTALLATION

- A. 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 City Forester or Project Consulting Arborist, 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. See Article 3.9 – Injuries to Existing Plants – Damage Penalties of this section for definition of high value trees and shrubs.
- B. All irrigation lines in Tree Protection Zones indicated on construction plans shall be approved by the City Forester or Project Manager prior to installation. No irrigation lines shall be located within ten feet (10') of any existing tree trunk without prior approval of City Forester or Project Manager.
- C. Wherever trenching exposes roots extending through the trench wall, those roots shall be hand pruned immediately, refer to Root Pruning. All trenches within shall be closed within twelve hours (12); if this is not possible, the trench walls shall be covered with burlap and kept moistened. Prior to backfilling, the Contractor shall contact the City Forester, Project Consulting Arborist, or Project Manager to inspect the condition and treatment of roots injured by trenching.

### 3.7 EXPOSED ROOTS

- A. Exposed tree roots shall not be driven over. Plywood and/or mulch are not acceptable bridging materials for driving over exposed tree roots.

B. ROOT PRUNING

- C. Tree roots shall not be pruned or cut unless their removal is unavoidable. The City Forester or Project Manager shall be notified prior to any operation known or suspected to involve cutting of more than:
- D. All roots needing to be pruned or removed shall be cut cleanly with sharp hand tools, with oversight by the City Forester or Project Consulting Arborist. No wound dressings shall be used.
- E. Recommended root pruning tools:
  - 1. Scissor-type lopper.
  - 2. Scissor-type pruner.
  - 3. Large and small hand saws.

3.8 PROJECT SITE MONITORING

- A. The Tree Protection Zones 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 the Contractor.
- B. Specific monitoring schedules shall be reviewed at the construction meetings and modified as deemed necessary by the appropriate parties.

3.9 INJURIES TO EXISTING PLANTS - DAMAGE PENALTIES

- A. Any plants designated as requiring retention or protection that are partially injured or lost due to Contractor neglect or improper construction activities will result in a penalty as determined by the City Forester, as described in Chapter 57 of the Denver Revised Municipal Code.
- B. Tree Appraisal: All trees that are damaged during construction will be evaluated and appraised by the City Forester.
  - 1. 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.).
    - d. Location factors as described in the most current addition of "Guide for Plant Appraisal". Photographs may be taken of certain trees and shrubs to document debilitating condition factors.
- C. Fines: 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 Zones. This fine shall be independent of any applicable damage penalty for the appraised value of the tree.

3.10 TREE MAINTENANCE DURING CONSTRUCTION

- A. Tree Maintenance: Proper maintenance shall include, but not be limited to, structural and remedial pruning, watering, mulching, remediating soil compaction, fertilization, insect and disease control, soil and tissue analysis, and aeration.

1. Tree Watering during construction shall consist of the following minimum requirements for all trees within a Tree Protection Zone:
  - a. Minimum watering requirements shall be twenty (20) gallons of water per diameter inch of every tree in the Tree Protection Zone.
  - b. Watering frequency shall be based on the average soil moisture level throughout the Tree Protection Zone.
    - 1) An average of six (6) "Average" on a soil moisture meter shall be maintained during the duration of Construction.
    - 2) Readings shall be taken every two (2) weeks at a minimum during the Construction period and at a minimum of four (4) locations throughout the Tree Protection Zone.
    - 3) Readings shall be taken at a depth of eight inches (8").
    - 4) All readings, locations and dates of each shall be recorded and provided to the Project Manager and City Forester every month and prior to any pay application being approved for payment.
  - c. Depending on weather conditions the City Forester or Project Consulting Arborist may approve less frequent watering.
  
- B. The timing duration and frequency of necessary maintenance practices should be determined and approved by the City Forester or Project Consulting Arborist, based on factors associated with the site and affected plants.

#### PART 4 - MEASUREMENT AND PAYMENT

##### 4.1 MEASUREMENT [Consultant to select A or B]

- A. Measurement will be based on the percentage complete for the lump sum contract amount for Tree Retention and Protection.
- B. Measurement will be made by the contract unit specified for Tree Retention and Protection. Measurement shall include the actual number of units of specified material(s) placed and accepted at the locations shown on the Contract Drawings, or as directed by the Project Manager, and in accordance with the Specifications.

##### 4.2 PAYMENT

- A. Payment will be made at the [contract unit] [lump sum contract] price, and shall include required materials, transportation, equipment, and labor, <Insert additional items> required to establish tree protection, and remove the tree protection at the end of the project as required in accordance with the Contract Drawings and Specifications. Payment will also include the maintenance of the tree protection throughout the duration of the project as well as the labor, materials and equipment required to restore the site to its original condition at the completion of the project.

**END OF SECTION 01 56 39**