City of Thornton

Skylake Ranch Open Land Improvements
Project No. 20-27A

Thornton, Colorado

BID Technical Specifications

March 2024

VALERIAN

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Prepared for the
City of Thornton, Colorado

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City of Thornton GUIDELINES for NATIVE SEED LANDSCAPE AREAS INSTALLATION, MAINTENANCE, ACCEPTANCE & PREFERRED MIXES – OCTOBER 2023

City of Thornton PRAIRIE DOG RELOCATION INFORMATION

SECTION 01 00 00
PROJECT PROTECTION, MAINTENANCE & ACCEPTANCE

PART 1: GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Special Conditions sections and the City of Thornton Standards and Specifications, apply to work of this Section. In the event of conflict(s) between this Section, the Drawings and the General and Special Conditions of the Contract, the stricter contents shall govern.

PART 2: PRODUCTS

2.1 MATERIALS:

A. Protection, maintenance and repair of project work site and completed improvements prior to Initial Acceptance.

B. Weekly on-site coordination meeting required as directed by the Owner.

C. Related Work Specified Elsewhere:

1. All technical specification sections apply to this section as they relate to specified materials, methods and products.
2. Means methods and materials needed for the maintenance and repair of completed improvements prior to Initial Acceptance shall comply with materials specifications as noted for initial installation.
3. Means and materials needed for protection, maintenance and repair that have not been specified for initial installation shall be approved by the city prior to purchase and installation.

PART 3: EXECUTION

3.1 ON-GOING PROTECTION AND MAINTENANCE DURING CONSTRUCTION:

A. Contractor shall be responsible for providing on-going protection and maintenance of completed site improvement work as required and as specified in this section, up to the time of Initial Acceptance. Areas and work items damaged by weather, traffic, vandalism, theft, or any other foreseeable or unforeseeable cause(s) shall be repaired at the Contractor's expense prior to Initial Acceptance. This construction period maintenance shall continue as needed until Initial Acceptance of the completed construction phase of the contract, at which time a date will be established for the official start of the guarantee period as defined in this section.

B. Contractor will provide and maintain adequate barriers, fencing, signage, protective wrapping as required allowing continuous access to parking lots and existing buildings during construction and to maintain all installed/completed site construction elements in a finished like new condition until Initial Acceptance.

C. If the irrigation system is not available for proper watering at the time of installation, provide and maintain temporary piping, hoses and lawn watering equipment as required to convey water from sources and to keep new and existing plant material, seed and turf areas sufficiently watered. Failure of the irrigation system shall not relieve the Contractor of the responsibility to provide the required water.

D. Keep all areas free of debris. Watering, mowing, rolling, edging, trimming, fertilization, spraying and pest control, as may be required, shall be included in the maintenance period. Street gutters shall be included within the debris/siltation removal program.

E. Watering, mowing, rolling, edging, trimming, fertilization, spraying and pest control, as may be required, shall be included in the maintenance period.

F. Watering: The city shall pay for all water use except for supplemental winter water following Initial Acceptance. However, any excessive water consumption, as determined by the city, shall be paid for by the Contractor, at current Thornton rates.

G. Weed control: Areas of disturbance including new native seed shall be maintained in a weed-free condition. Obtain city approval before using recommended legally approved herbicides.

H. Materials found to be dead, missing, unhealthy, in poor condition, or inoperable during the construction period shall be replaced immediately. The Owner shall be the sole judge as to the condition of the material. Replacement or repair of materials prior to Initial Acceptance does not waive the normal warranty. Restored work areas shall be well established and free of bare spots and weeds to the satisfaction of the Owner, prior to Initial Acceptance.

   Replacement shall be performed in accordance with the original specifications and its costs are considered included in the Base Bid price.

3.2 INITIAL ACCEPTANCE:

A. Substantial Completion may be issued before native seed establishment meets applicable contract and city standards, but Initial Acceptance will not occur until seed establishment standards, in the sole opinion of the city, have been met.

B. After Substantial Completion has been issued and at the completion of all construction operations under this Contract, and prior to the beginning of the post-construction warranty period, an inspection will be performed (or Initial Acceptance walk-through). The city will, upon 7 days advance notice, make inspection of the work to determine

acceptability. The city will prepare a “punch list” of items improperly installed, inadequately sized or otherwise deficient. The “punch list” deficiencies shall be corrected not more than 21 Calendar Days after the inspection.

C. At the time of this inspection:

1. All product certifications and quantities shall have been received by and approved by the city.
2. All debris and litter shall be cleaned up and all walkways and curbs shall be cleaned of soil and debris left from planting operations.

The inspection will not occur until these conditions are met.

D. Prior to the date of the walk-through and as a condition of receiving Initial Acceptance, the Contractor shall convey to the city the job record set of all changes made to all plans during the construction period, labeling said prints “As-Built”. All turnover items noted in other specification sections shall be delivered prior to this inspection.

E. Replacement or repair of materials prior to Initial Acceptance does not waive normal warranty. At the time of this inspection, areas disturbed by Project construction and Improvements installation shall have been suitably restored. The city shall have received and approved all product certifications and quantities.

F. Work requiring corrective action shall be performed within the first 21 days after the Initial Acceptance inspection. If corrective work is not completed within the timeframe stated in the General Conditions or 21 days whichever is the least, then another walk-through will be required and a new “punch list” of deficiencies, as well as an equivalent extension of the guarantee period, will be required at no additional cost to the city.

G. The improvements will be initially accepted by the city when all improvements and punch list items are satisfactorily completed in accordance with the terms of the approved Construction Drawings, and applicable city Standards and Specifications. If, after the inspection, the city is of the opinion that all work has been performed as per the contract documents, the city will give the Contractor written notice of Initial Acceptance signifying commencement of the guarantee period.

H. The city will maintain all work items and areas following Initial Acceptance. The Contractor shall be responsible for one-time irrigation winterization, subsequent spring start-up including adjustments and any other work item noted in other specifications sections like winter watering. As appropriate, Owner shall be notified in advance to be present to document winter water in writing as part of the Final Acceptance process.

3.3 FINAL ACCEPTANCE:

A. The Contractor shall guarantee improvements for one (1) year, as described in the General Conditions with asphalt guaranteed for two (2) years. On or before 45 days prior to the expiration of the guarantee period, the city and Contractor shall conduct a

final inspection of the Work. The Contractor shall give at least 48-hour notice to the city to request this inspection.

B. The city will prepare a list of defects discovered during such final inspection ("punch list") and submit the punch list to the Contractor. Repairs and corrections shall be completed within 21 Calendar Days of notification. Additional defects discovered subsequent to the final inspection of the Work but prior to the date of Final Acceptance (as hereafter defined) shall also be submitted to the Contractor for repair at the cost and expense of the Contractor. When Thornton determines that all "punch list items" and any other defects are corrected and all phases of the project have been deemed by the city to be dutifully completed, the city shall issue the Final Acceptance of the project.

PART 4: MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

A. No separate measurement shall be made for work under this Section.

4.2 PAYMENT

A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Contract price.

END OF SECTION 01 00 00

SECTION 01 01 00
SUMMARY OF WORK

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Contract Description

B. Project Location

C. Project Description

D. Project Milestones

E. Traffic Control/Lane Closures

F. Work Included

G. Summary of Submittals

1.2 CONTRACT DESCRIPTION

This project will be bid on a unit price basis as specified in the Bid Proposal and the Schedule of Contract Items and Prices. The bid proposal, special conditions and general conditions of the contract apply to the work in this section. Contractor and subs shall be licensed in the city of Thornton.

1.3 PROJECT LOCATION

The project is located in Adams County, City of Thornton, 11890 Holly Street, Thornton, Colorado 80233.

1.4 PROJECT DESCRIPTION

The work consists of but not limited to provide all labor, equipment, materials, coordination of inspections/approvals and permits required for the completion of the work described in the Contract Documents.

The project entails concrete and stabilized crusher fines trails. The new concrete trails will connect to the existing Union Ditch Regional Trail and replace the existing concrete trails to meet ADA compliance. A new crosswalk with lighting will be provided at 118th Avenue to connect to the Union Ditch Trail on the east side of Jasmine Street. Site restoration will include clearing and grubbing the existing landscape with native seeding. Other amenity improvements include tree pruning, a nature exploration zone, a boulder scramble to connect the concrete trail to the social trail, a crossing over the existing ditch, benches,

shade structures, pet waste stations, trail lighting, rail fence and park sign.

Contractor to obtain building permit for the shade structures.

Future improvements include an underground irrigation system, electrical service, shrub and tree planting areas.

1.5 PROJECT MILESTONES

A. The Contractor shall start work no later than 14 calendar days after notice to proceed and the project shall be completed 90 days from mobilization.

B. Contractor shall submit a project schedule 5 days after Notice to Proceed. Schedule of Construction and Completion: per the General Conditions and subject to Owner's approval.

1.6 TRAFFIC CONTROL/PEDESTRIAN CLOSURES

A. Provide traffic/pedestrian control signage, construction fencing, barriers, and other approved means as needed within work areas near sidewalks and trails for public safety. See section 015200 Traffic and Pedestrian Control.

1.7 WORK INCLUDED:

A. The principal features of the Bid Work include:

1. Permitting, and coordination of inspections and approvals.
2. Site preparation & demolition, including but not limited to:
    a. Vehicular & pedestrian traffic control; sediment & erosion control.
    b. Protection of existing trees, landscape and hardscape.
    c. Tree removals.
    d. Removal of existing site improvements.
    e Debris removal daily.
    f Watering.
    g. Clearing and grubbing.
    h. Tree pruning.

3. Concrete trails/trail rumble strip
4. Stabilized crusher fines and paving
5. Nature exploration zone
6. Shade structures
7. Site furnishings: Benches, trash receptacles, feature boulders, pet waste station, playground sand, vertical log feature, log border, open space sign
8. Solar lighting
9. Ditch crossing
10. Boulder scramble
11. Boulder retaining wall
12. Gravel maintenance strip

13. Open 3-rail fence
14. Native seeding

1.8 SUMMARY OF REQUIRED SUBMITTALS:

A. Submittals: See Appendix

PART 2 – PRODUCTS – Not Used

PART 3 – EXECUTION – Not Used

PART 4 – MEASUREMENT AND PAYMENT – Not Used

END OF SECTION 01 01 00

SECTION 01 02 50
MEASUREMENT AND PAYMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Measurement and payment criteria applicable to Work performed using a unit price method.

1.2 BID ITEMS

A. Contractor shall make no separate measurement or payment for any labor, equipment, and materials required for each Bid Item, unless otherwise specified. The Pay Unit price shall include all of Contractor's costs for that Item.
B. Refer to Bid Form under separate cover for all Bid Items.

PART 2 – PRODUCTS – Not Used

PART 3 – EXECUTION – Not Used

PART 4 – MEASUREMENT AND PAYMENT – NOT USED

END OF SECTION 01 02 50

SECTION 01 31 13
COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Special Conditions sections and the City of Thornton Standards and Specifications, apply to work of this Section. In the event of conflict(s) between this Section, the Drawings and the Special Conditions of the Contract, the stricter contents shall govern.

1.2 SUMMARY

A. This Section includes requirements for project and construction coordination, supervision, and administration for the Work, including but not necessarily limited to:
   1. Coordination.
   2. Administrative and supervisory personnel.
   3. General installation provisions.
   4. Cleaning and protection.
   5. Utilities and site work.

1.3 GENERAL COORDINATION

A. General:
   1. The Contractor shall ensure that each entity involved in the performance of the Work shall cooperate in the overall coordination of the Work; promptly, when requested by the Contractor, furnish information concerning the entity's portion of the Work; and respond promptly and reasonably to the decisions and requests of persons designated with coordination, supervisory, administrative, or similar authority.
   2. The Contractor shall, where necessary, prepare memoranda for distribution to each party involved outlining special procedures required for coordination. Include such items as required notices, reports, and attendance at meetings.
   3. Prepare similar memoranda for the Owner and separate Contractors where coordination of their work is required.

B. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction work. Such administrative activities include, but are not limited to, the following:
   1. Preparation of schedules
   2. Installation and removal of temporary facilities
   3. Delivery and processing of submittals
   4. Progress meetings
   5. Project close-out activities

C. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water and materials. Salvage

materials and equipment involved in performance of, but not actually incorporated in, the Work. Refer to other sections for disposition of salvaged materials that are designated as the City's property.

D. Site Utilization: In addition to the site utilization limitations and requirements shown on the Contract Drawings and indicated by the Contract Documents, administer the allocation of available space equitably among entities needing access and space, so as to produce the best overall efficiency in the performance of the Work. Schedule deliveries so as to minimize the space and time requirements for storage of materials and equipment on the site; but do not unduly risk delays in the Work.

E. Where necessary, schedule additional coordination meetings for this purpose on an as-needed basis.

F. Layout: It is recognized that the Contract Documents are diagrammatic in showing certain physical relationships of the various elements and systems and their interfacing with other elements and systems. Establishment and coordination of these relationships is the exclusive responsibility of the Contractor. Do not scale the Contract Drawings. Layout and arrange all elements to contribute to safety, efficiency and to carry the harmony of design throughout the Work. In case of conflict or un-dimensioned locations, verify required positioning with the Owner. The Contractor shall provide surveying for the layout of all improvements including both horizontal and vertical control..

G. Substrate Examination: The Contractor shall ensure that the subcontractor of each element of the Work examines the conditions of the substrate to receive the work, dimensions and spaces adjacent, tolerances, interfacing with other elements and services, and the conditions under which the Work will be performed. The Contractor shall require each subcontractor to notify the Contractor in writing of conditions detrimental to the proper or timely completion of the Work, and ensure that they do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to the subcontractor.

1.4 COMPLETE SYSTEMS

A. It is the intent of the Contract Documents that the system be complete and functional to provide the intended or specified performance. The Contractor shall provide all incidental items and parts necessary to achieve this requirement.

1.5 COMPATIBILITY

A. Provide products and equipment which are compatible with other work requiring mechanical interface including connections, control devices, water, drain and other piping connections. Verify requirements and other interface requirements before ordering equipment and resolve conflicts that may arise.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION PROCEDURES

A. Require the subcontractor of each major component to inspect both the substrate and conditions under which work is to be performed. Do not proceed until unsatisfactory conditions have been corrected in an acceptable manner.

B. Inspect materials or equipment immediately upon delivery and again prior to installation. Reject damaged and defective items. Re-check measurements and dimensions before starting each installation.

C. Manufacturer's Instructions: Comply with manufacturer's installation instructions and recommendations, to the extent that those instructions and recommendations are more explicit or stringent than requirements contained in Contract Documents.

D. Installation:
   1. Provide attachment and connection devices and methods necessary for securing work. Secure work true to line and level. Allow for expansion and building movement.
   2. Install each component during weather conditions and the Work status that will ensure the best possible results. Isolate each part of the completed construction from incompatible materials as necessary to prevent deterioration.
   3. Coordinate work with required inspections and tests, to minimize the necessity of uncovering completed construction for that purpose.

E. Visual Effects: Provide uniform joint widths in exposed work. Arrange joints in exposed work to obtain the best visual effect. Refer questionable choices to the Owner for final decision.

F. Mounting Heights: Where mounting heights are not indicated, install individual components at standard mounting heights recognized within the industry for the particular application indicated. Refer questionable mounting height decisions to the Owner for final decision.

3.2 CLEANING AND PROTECTION

A. During handling and installation, clean and protect construction in progress and adjoining materials in place. Apply protective covering where required to ensure protection from damage or deterioration prior to achieving substantial completion.

B. Clean and maintain completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

PART 4 - MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

A. No separate measurement shall be made for work under this Section.

4.2 PAYMENT

A. No separate payment will be made for work under this Section. The cost of the work described in this Section shall be included in the Contract price.

END OF SECTION 01 31 13

SECTION 01 50 00
CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

PART 1 – GENERAL

1.1 TEMPORARY SANITARY FACILITIES

A. To be provided as necessary at the contractor's expense.

B. Sanitary Facilities: provide and maintain in a neat and sanitary condition in strict compliance with the requirements of all applicable codes, regulations, laws and ordinances.

C. See General Conditions.

1.2 TEMPORARY PROTECTIVE FACILITIES

A. Protective Devices and Facilities: provide and maintain as required for protection of public and protection of workers on project.

1. Fire Protection Equipment: provide and maintain fire extinguishers and active fire hydrant as required, maintain fire lanes to hydrant and other equipment as necessary for proper protection during construction.
2. Provide temporary walks, roadways, trench covers, barricades, bulkheads, railings, danger lights and signals, etc., required for project work by federal, state and municipal safety laws and building codes.
4. Maintain temporary protective facilities in good condition throughout term of work. Remove at completion of work. Repair and replace work damaged thereby.
5. Provide temporary fencing to protect buildings, trees, landscaping and other existing items.

1.3 PROTECTION OF WORK IN PLACE

A. Work in Place: when subject to injury because of operations being carried on adjacent, cover, board up, or substantially enclosed with adequate protection.

1. Construct forms of protection in manner that, upon completion, entire work will be delivered to owner in undamaged condition.

2. Provide temporary fencing or barricades as required to protect all finished landscape work including sod and seed from harm due to other workmen and the public including trampling. Maintain protection until initial acceptance.

1.4 TEMPORARY CONSTRUCTION FENCE

A. Temporary Construction Fence: locate and in other areas at contractor's discretion and as required by regulatory requirements.

1. 48” minimum height orange plastic ‘Sentry Secura’ safety fence by Tenax Corporation with approx. 1 ½” x 1 ¼” mesh openings. OR 48" height orange plastic VISI® perimeter fence with approx. 1" x 3.75" mesh openings, as manufactured by Conwed Plastics, or approved equal. Posts shall be spaced at max. 8-feet on center or as directed by the owner.
2. At completion of exterior work remove fences from the site. Patch surfaces which are to remain damaged by fence posts after removal.
3. Maintenance of fencing is required daily.

1.5 ACCESS

A. Limit site access to necessary routes to perform the work.

1.6 TEMPORARY CONTROLS

A. General: comply with local codes, ordinances and regulations.

B. Dust: when construction procedures result in dust which becomes a nuisance to the owner, private property owners, or traffic, dust abatement shall be performed by the contractor, at the contractor's expense to remedy the dust nuisance to the satisfaction of the owner within one (1) hour of notification by the owner.

C. Water: control flow of water at site to prevent damage to owner's property, private property, or public/private facilities.

D. Debris: continually police work to prevent collection and/or scattering of debris which is uncovered, loosened or caused by prosecution of work.

E. Pollution: take precautions to prevent spilling and littering of water polluting substances. Do not dump any foreign materials into any portion of the sewer and storm sewer collection systems.

1. Burning of debris or any other air polluting methods or equipment shall not be allowed.

F. Erosion: provide any and all necessary procedures to prevent erosion damage to owner's property and/or to adjacent properties.

G. Snow: remove snow and ice from temporary walkways as required to maintain a safe surface at all times.

H. The costs associated with all "Temporary Controls" noted in this Section shall be the responsibility of the contractor.

I. Unless noted for salvage, provide proper off-site disposal of removed materials at the end of each working day.

1.7 CLEANUP

A. General: maintain project and site in clean and orderly condition. Clean areas daily. Remove waste materials, debris and rubbish from site daily.

B. Areas: clean prior to start of finish work and continue cleaning as required. Control cleaning operations so that dust and other particles will not adhere to surfaces.

C. The costs associated with all "cleanup" noted in this Section shall be the responsibility of the contractor.

PART 2 – PRODUCTS – Not Used

PART 3 – EXECUTION – Not Used

PART 4 – MEASUREMENT AND PAYMENT

A. All work detailed in this Section 015000 is not to be bid separately, but as work incidental to contractor mobilization.

END OF SECTION 01 50 00

SECTION 01 52 00
TRAFFIC AND PEDESTRIAN CONTROL

PART 1 - GENERAL

1.1 DESCRIPTION: Provide traffic control to complete the work shown and specified.

1.2 RELATED REQUIREMENTS

A. Drawings and general provisions of the Contract, including General and Special Conditions sections and the City of Thornton Standards and Specifications, apply to work of this Section. In the event of conflict(s) between this Section, the Drawings and the General and Special Conditions of the Contract, the stricter contents shall govern.

B. Comply with the City of Thornton Traffic Engineering Requirements.

1.3 PERMITS: Obtain appropriate traffic control permits from the City of Thornton prior to any work in the street rights-of-way or limits of work.

PART 2 - PRODUCTS

2.1 TRAFFIC CONTROL

Provide barricades and temporary signage for pedestrian, bicycle and automobile detours and traffic control to maintain smooth flow of traffic, and public safety.

PART 3 - EXECUTION

3.1 TRAFFIC CONTROL

A. When construction under this contract is along streets or bike trails, through traffic shall be maintained at all times.

B. Provide and maintain signage and barricades as defined under Part 2 Products in working order.

C. Provide additional traffic control as directed by the Owner.

PART 4 - MEASUREMENT AND PAYMENT

A. Measurement: Traffic and pedestrian control will not be measured but will be a lump sum item.

B. Payment: The lump sum price shall include all of the Contractor's costs including labor, materials, and equipment necessary to control traffic in the Right of Way and/or within the limits of work, in accordance with an approved Traffic Maintenance Plan.

END OF SECTION 01 52 00

SECTION 01 57 13
EROSION AND SEDIMENTATION CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Special Conditions sections and the City of Thornton, apply to work of this Section. In the event of conflict(s) between this Section, the Drawings and the General and Special Conditions of the Contract, the stricter contents shall govern.

1.2 SUMMARY

A. This section consists of requirements for the installation and maintenance of erosion and sedimentation prevention and protection measures during the construction of the project from just prior to the start of earth disturbance until final site stabilization. The cost of maintaining, repairing, and/or replacement of damaged BMP's will be at the Contractors expense.

PART 2 - PRODUCTS

REFER TO MEASUREMENT & PAYMENT

PART 3 - EXECUTION

3.1 PROJECT REVIEW

A. At the beginning of the project and prior any site disturbances the contractor shall install all erosion control measures as needed.

B. The contractor may submit modifications to the erosion control measures in a written proposal to the Owner for approval a minimum of 10 days prior to construction.

3.2 SILT FENCE: See City of Thornton Detail. Silt fence shall be installed prior to any grubbing or grading activity. Refer to details for installation directions. Refer to layout drawings for location. Owner shall approve fencing and location before final installation.

A. Posts: Erect where indicated; space not more than 10 feet on center. Extend all posts equal distance above grade.

B. Brace Wire: Secure brace wire to each post. Prior to attachment, tuck or roll filter fabric around brace wire. Secure filter fabric to brace wire with wire ties 8" O.C.

C. Fabric: Attach to posts as approved by Owner, on uphill side of posts. Embed fabric in shallow trench as indicated.

D. Upon completion, posts and fabric shall be plumb. Maintain silt fence in plumb position and in good condition.. Replace broken posts, ripped fabric, and re-attach broken fabric to post connections. Remove built-up silt after a storm, also inspect on a weekly basis to maintain in proper condition. Sediment shall be removed from behind the fence when it accumulates to one-half the exposed geotextile height, or when directed by the Owner.

E. Removal: Upon completion of the work of this contract, the silt fence shall be left in place with all caught foreign debris removed and disposed of in accordance with the General and Special Conditions. Silt fence shall be removed only after the vegetation has been established as determined by the Owner.

3.3 VEHICLE TRACKING PAD: See City of Thornton Detail

3.4 TEMPORARY CONSTRUCTION FENCE:

A. Contractor shall install temporary construction fencing using 48” minimum height orange plastic ‘Sentry Secura’ safety fence by Tenax Corporation with approx. 1 ½” x 1 ¼” mesh openings. OR 48" height orange plastic VISI® perimeter fence with approx. 1" x 3.75" mesh openings, as manufactured by Conwed Plastics, or approved equal. Posts shall be spaced at max. 8-feet on center or as directed by the Owner.

B. Contractor shall contact all utility service companies prior to finalizing fence location and post locations for certification of current utilities and with field staff. Prior to any soil disturbance, Contactor shall locate pothole post locations planned within five (5) feet of known utilities. Contractor shall submit fencing plan and typical details to Owner at least seven days before planned execution for review and acceptance.

C. Contractor is responsible for all maintenance within the temporary construction fencing area including, but not limited to, mowing, watering, and tree protection zones. Maintenance of fencing is required daily

3.5 UNFORESEEN CONDITIONS

A. The Contractor shall design and implement erosion and sediment control measures for correcting conditions unforeseen during the design of the project, or for emergency situations, that may develop during construction. The costs for any additional erosion control measures shall be born by the contractor.

3.6 MAINTENANCE

A. The Contractor shall continuously maintain all erosion and sediment control features so that they function properly during construction and work suspensions until the project is accepted. Properties adjacent to the site of any disturbance shall be protected from sediment deposition.
B. Erosion control measures shall remain upon completion of the project unless otherwise directed by the Owner. If removed, the area in which these features were constructed shall be returned to a

condition similar to that which existed prior to its disturbance. At the completion of the Contract, removed salvageable temporary erosion control items shall become the property of the Contractor.

C. Sediment removed during the maintenance of erosion control features shall be used in or on embankment as approved by the Owner's or legally disposed of offsite.

PART 4 - MEASUREMENT AND PAYMENT

A. Measurement will be made by the contract unit specified for Erosion and Sedimentation Control. 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 Owner, and in accordance with the Specifications.

B. In addition to all other necessary permits, the contractor shall obtain all required permits related to stormwater management and erosion control including but not limited to the CDPHE Construction Stormwater Discharge Permit and the City of Thornton Construction Permit

C. Erosion Control Plan, Implementation and Permitting will not be measured but will be a lump sum item.

END OF SECTION 01 57 13

SECTION 02 41 00
DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Special Conditions sections and the City of Thornton Standards and Specifications, apply to work of this Section. In the event of conflict(s) between this Section, the Drawings and the General and Special Conditions of the Contract, the stricter contents shall govern.

1.2 SUMMARY

A. This Section includes the requirements for installation of:
   1. Tree Protection Fence

1.3 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.

B. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to the City in a condition ready for re-use.

C. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.4 PROJECT CONDITIONS

A. Keep dust to a minimum at removal areas. Use water trucks as necessary.

B. Ensure safety of persons in demolition area. Provide temporary barricades as required per the General and Special Conditions.

1.5 PRE-CONSTRUCTION MEETINGS

A. Preconstruction meeting shall be conducted with the Owner and the selected contractor.

B. Owner and contractor to determine staging area for the project..

1.6 INFORMATIONAL SUBMITTALS

A. Proposed Protection Measures: Submit report, including drawings, that indicates the measures proposed for protecting individuals and property. Indicate proposed locations and construction of barriers.

B. Inventory: Submit a list of items to be removed and salvaged and deliver to the Owner prior to start of demolition.

C. Preconstruction Photographs: Submit digital photographs prior to Work commencing.

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.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect existing conditions to remain which may include but not limited to structures, pavement, trails, utilities, irrigation, landscape, trees and vegetation. Any damage to existing conditions during construction shall be repaired or replaced at the contractors cost and to the satisfaction of the Owner.

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 Owner.

3.3 RESTORATION

A. Backfilling: Ensure that areas to be filled are free of standing water, frost, frozen material, vegetation, including roots and debris. Place fill materials in accordance with Section “Earth Moving”.

B. Grading:
   1. Restored Areas: Grade surface to blend with original contours and provide free drainage flow. All ruts and depressions where any amount of standing water collets shall be re-graded to a smooth natural appearance to ensure positive drainage.

3.4 DISPOSAL

A. Remove trash, debris and waste materials, haul and legally dispose of it off the property. All recyclable materials shall be hauled to nearest recycling center.

B. Salvaged Material: All salvaged material remains the property of the City. Store or deliver as directed by the Owner.

3.5 FIELD QUALITY CONTROL

A. Comply with safety requirements for demolition, ANSI A10.6-83.

PART 4 - MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

A. Measurement will be based on the percentage complete for the unit bid contract amount for Demolition.

4.2 PAYMENT

A. Payment shall be made under:

Pay Item	Pay Unit
Remove & Dispose Exist Concrete	SF
Remove & Dispose Exist Asphalt	SY
Remove & Dispose Exist Tree	EA
Tree Protection Fence	LF

B. Payment will be made at the contract unit price, and shall include required materials, tree protection fence, installation, maintenance, tree removal, fence removal, transportation, equipment, labor, excavation, stockpiling, salvage existing trees to be used on site, disposing, hauling off, watering, dust control as required in accordance with the Contract Drawings and Specifications. The price shall include sawing or otherwise effectively cutting the existing paving smoothly and squarely in a manner satisfactory to the Owner. The price shall include the removal and offsite disposal of all materials including any base course deemed unsuitable by the Owner. No payment will be made for the removal and/or replacement of any paving damaged by the Contractor beyond the authorized limits of removal.

END OF SECTION 02 41 00

SECTION 03 30 00
CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Special Conditions sections and the City of Thornton Standards and Specifications, apply to work of this Section. In the event of conflict(s) between this Section, the Drawings of the General and Special Conditions of the Contract, the stricter contents shall govern.

B. Related Report Documentation:

GEOTECHNICAL ENGINEERING STUDY AND PAVEMENT THICKNESS DESIGN PROPOSED SKYLAKE RANCH OPEN SPACE LAND IMPROVEMENTS THORNTON PROJECT NO. 20-27 A NEAR THE SOUTHEAST CORNER OF EAST 119TH AVENUE AND HOLLY STREET THORNTON,COLORADO

SUMMARY

C. This Section of the Work includes furnishing, placing, shoring, bracing, and anchorage of formwork, concrete reinforcement, accessories, and placing concrete in connection with cast-in-place concrete installation including installation of control and expansion joints, concrete curing and concrete finishing

D. Note: All references below shall be from the most current edition.

E. American Concrete Institute (ACI):
1. ACI 117 - Standard Tolerances for Concrete Construction and Materials.
2. ACI 301 - Specifications of Structural Concrete for Buildings.
3. ACI 304 - Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.
4. ACI 305 and 306 - Hot and Cold Weather Protection for Concrete.
5. ACI 315 - Details and Detailing of Concrete Reinforcement.
6. ACI 318 - Building Code Requirements for Reinforced Concrete.
7. ACI 347 - Recommended Practice for Concrete Formwork.

F. American Society for Testing and Materials (ASTM):
1. ASTM A615 - Deformed and Plain Billet-Steel for Concrete Reinforcement.
2. ASTM A1064 / A1064M-17 - Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
3. ASTM C33 - Concrete Aggregates.
4. ASTM C94 - Ready-Mixed Concrete.
5. ASTM C150 – Portland Cement.
6. ASTM C260 - Air Entraining Admixtures for Concrete.
7. ASTM C494 - Water Reducing Admixtures for Concrete.
8. ASTM C618 - Fly Ash Mineral Admixture for Concrete.

9. ASTM C672 - Scaling Resistance of Concrete Surfaces Exposed to Deicing Chemicals.
10. ASTM C979 - Pigments for Integrally Colored Concrete
11. ASTM C1059 - Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete
12. ASTM-C1315 - Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete

G. Concrete Reinforcing Steel Institute (CRSI) - Manual of Standard Practice.

H. Colorado Department of Transportation (CDOT) - Standard Specifications for Road and Bridge Construction.

I. National Ready Mixed Concrete Association (NRMCA).

J. City of Thornton Standards & Specifications.

1.2 QUALITY CONTROL

A. Pre-Construction Conference: Conduct conference at location approved by the Owner.
1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
   a. Contractor's superintendent.
   b. Independent testing agency responsible for concrete design mixtures.
   c. Ready-mix concrete manufacturer.
   d. Concrete subcontractor.
   e. Special concrete finish subcontractor.
2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, joint-filler strips, semi-rigid joint fillers, forms and form removal limitations, shoring and reshoring procedures, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, concrete repair procedures, and concrete protection.

1.3 SUBMITTALS

A. Qualification Data: Installer to document for Owner’s Representative experience on projects of similar scope and scale successfully completed within the past five (5) years.

B. Product Data and Material Certificates: For each type of product and material indicated on the plans and in this specification.

C. Mix Designs:

1. Submit substantiating data for each concrete mix design specified for use to the Owner not less than four (4) weeks prior to first concrete placement. Data for each mix shall, as a minimum, include the following:
    a. Mix identification designation (unique for each mix submitted).
    b. Statement of intended use for mix.
    c. Mix proportions.
    d. Admixtures (must be approved by the Owner).
    e. Aggregates
    f. Wet and dry unit weight.
    g. Entrained air content.
    h. Design slump.
    i. Strength qualification data.

D. Submit shop drawings for fabrication, bending and placement of concrete reinforcement. Comply with ACI Detailing Manual SP 66. Include all accessories specified and required to support reinforcement.

E. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
    1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.

F. Field quality-control reports.

G. Minutes of Pre-Construction conference.

1.4 DELIVERY, STORAGE AND HANDLING

A. General: Materials handling and batching shall conform to applicable provisions of ASTM C94.

B. Reinforcing: Unload and store reinforcing bar so they are kept free of mud and damage.

C. Project-Site Mixing: Not allowed without prior approval from the Owner. If allowed, submit process description to the Owner for approval prior to construction.

D. Hauling Time for Concrete: Deliver and discharge all concrete transmitted in a truck mixer, agitator, or other transportation device not later than one and one-half (1-1/2) hours, or three-hundred (300) revolutions of the drum after the initial mixing water has been added, whichever is earliest.

E. Extra Water:
    1. Deliver concrete to site in exact quantities required by design mix.
    2. Should extra water be required for workability before depositing concrete, and the water/cement ratio of accepted mix design will not be exceeded, the General Contractor's superintendent shall have the sole authority to authorize addition of water. Additional water shall not exceed one (1) gal/cu. yd. Any additional water added to mix after leaving batch plant shall be indicated on truck ticket and

signed by person responsible.

3. Where extra water is added to concrete, it shall be mixed thoroughly for thirty (30) revolutions of drum before depositing.
4. Water may be added at the site only once for each batch.
5. A full set of tests shall be performed after addition of water. Excessive slump or other out of range tests will be cause for rejection.

1.5 PROJECT CONDITIONS

A. Environmental Requirements:
   1. Cold Weather Placement:
      a. If the daily temperature drops below forty degrees (40°) F for three (3) days prior to concrete placement or the temperature is expected to drop below forty degrees (40°) F on the day of the concrete placement, then comply with ACI 306R for preparation, protection, and curing of concrete.
      b. The mixed concrete temperature shall be between 50 and 90 ºF at the time of placement. Water, aggregates, or both shall be heated when necessary under such control and in sufficient quantities to avoid fluctuations in the temperature of the concrete of more than 10 ºF from batch to batch.
      c. If approved by the Owner, an accelerating admixture may be used. Admixtures shall meet requirements of Part 2. Calcium Chloride and other chloride-type accelerating admixtures are not allowed.
   2. Hot Weather Placement:
      a. When placing concrete in hot weather, follow recommendations of ACI 305R.
      b. Placing of concrete during hot weather shall be limited by the temperature of the concrete at the time of placing. Mixed concrete which has a temperature of 90 ºF or higher, shall not be placed.
      c. When air temperatures on the day of placement are expected to exceed ninety degrees (90°) F, mix ingredients shall be cooled before mixing. Flake ice or well-crushed ice of a size that will melt completely during mixing may be substituted for all or part of mix water.
      d. If approved by the Owner, a retarding admixture may be used. Admixtures shall meet requirements of Part 2.

1.6 RIGHT OF WAY WORK

A. Contractor shall obtain all necessary permits when working with in the Right of Way.

B. Contractor shall preserve and protect all permanent land survey control markers. Per the General Contract Conditions Article 319 “Preservation of Permanent Land Survey Control Markers”.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

A. Hand Placed Steel Forms: Hand placed steel forms are only to be used for sections that are straight and have no bend, radii, or curvature in the sections to be used.

B. Wood Forms: Forms shall be made of solid one side grade, sound, undamaged lumber with straight edges.
   1. Curved elements (bends, radii, or curvature) shown on plans are to be constructed with smooth-curved plywood forms. Faceted forms composed of straight sections will not be accepted.

C. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
   1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

2.2 CONCRETE MATERIALS

A. Provide materials in accordance with ACI 301, unless amended or superseded by requirements of this section or general notes on structural drawings.
   1. General: Ready-mixed Concrete: ASTM C94. On-site mixed concrete not allowed.
   2. Cement: ASTM C150. Type II
   3. Fly ash: ASTM C618 Class F.
   4. Aggregate: ASTM C33.
      a. All sand and aggregates to meet C-33 Table 3 for Class 4S “Severe Weathering Region”.
         1) Fine Aggregate: Clean, natural sand.
         2) Coarse Aggregate: Clean gravel or crushed stone.
   5. Water: ASTM C 94/C 94M, clean and not detrimental to concrete.

2.3 FIBROUS REINFORCING

A. Fibrous reinforcing shall be used in Portland cement concrete used for curb, gutter, sidewalks, curb turn fillets, cross pans, RTD Bus Pad, and driveway apron.

B. The following shall be submitted to the Engineer.
   1. One copy of manufacturer's printed product data, clearly marked, indicating proposed fibrous concrete reinforcement materials. Printed data should state 1.5 lbs of fiber to be added to each cubic yard of each type ofconcrete.
   2. One copy of manufacturer's printed batching and mixing instructions.
   3. One copy of a certificate prepared by the concrete supplier stating that the approved fibrous concrete reinforcement materials at the rate of 1.5 pounds per cubic yard were added to each batch of concrete delivered to the project site. Each certificate shall be accompanied by one (1) copy of

each batch delivery ticket indicating amount of fibrous concrete reinforcement material added to each batch of concrete.

C. Fibrous concrete reinforcement shall consist of:

1. One hundred (100) percent virgin polypropylene fibrillated fibers specifically manufactured for use as concrete reinforcement, containing no reprocessed olefin materials. Fibrous concrete reinforcement shall be as manufactured by Fibermesh Company, 4019 Industry Drive, Chattanooga,Tennessee 37416, or approved equivalent. Substitutions may be considered at the discretion of the Engineer.

2.3 ADMIXTURES

A. General: Unless specified, no admixtures may be used without specific approval of the Owner.

B. Prohibited Products: Calcium chloride or admixtures containing more than one half of one percent (0.05%) chloride ions or thiocyanates are not permitted.

C. Air-Entraining Admixture: ASTM C260.

D. Water Reducing Admixture: ASTM C494, Type A.

E. High Range Water Reducing Admixture (Superplasticizer): ASTM C494, Type F or G.

F. Warm Weather Admixtures: ASTM C494. Use of admixtures will not relax warm weather placement requirements.

G. Cold Weather Admixtures: ASTM C494. Use of admixtures will not relax cold weather placement requirements.

2.4 CONCRETE MIX

All Concrete mixes from the approved list or submitted for approval shall meet the following criteria:

1. Mix concrete in accordance with ASTM C94 and ACI 301 Chapter 3.
2. Cement Content: Type II cement, minimum of five hundred twenty-eight (528) pounds per cubic yard.
3. Fly ash: Class F per CDOT Standard Specifications for Road and Bridge Construction Section 701.02. Fly ash shall not exceed twenty (20%) of total cementitious material by weight unless approved by the Owner.
4. Maximum water-cement ratio: 0.44.
5. Slump: Four inches (4”) maximum when hand placed.
6. Air Entrainment: Five percent (5%) to eight percent (8%).
7. Aggregate Size: three quarter inches (3/4”), maximum.
8. Concrete for Footings, Walls, and Interior Slabs-on-Grade shall be Class B or Class D, as approved by the Owner.

2.5 ACCESSORIES

A. Expansion Joints:
   1. Interior Use or Exterior Use Where Sealants are Specified: Bituminous saturated fiber conforming to ASTM D1751, one half inch (1/2") thick. Provide manufacturer's certification of compatibility with specified sealants where required.
   2. Exterior Use Where Sealants are not Specified: Pre-molded asphalt and fiber conforming to ASTM D994, one half inch (1/2") thick.
   3. Joint Sealant: Per CDOT's approved joint and crack sealant list. Where concrete color additive is used, sealant color to match adjacent concrete.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

A. Requirements of Regulatory Agencies: Comply with all applicable provisions of the state and local building and safety codes.

B. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer, unless otherwise approved by the Owner.

C. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
   1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").

D. Testing: All testing shall be completed by the Contractor at their expense unless otherwise specified by the contract.

E. Testing Agency Qualifications: Engage a qualified testing agency to perform material evaluation tests and to design concrete mixtures. Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
   1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

F. Testing Frequency: Obtain at least one composite sample for each one hundred (100) cubic yards, or fraction thereof of each concrete mixture placed each day.
      a. When frequency of testing will provide fewer than five (5) compressive-strength tests for each concrete mixture, testing shall be conducted from at least five (5) randomly selected batches or from each batch if fewer than five (5) are used.

2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one (1) test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one (1) set of four (4) standard cylinder specimens for each composite sample.
5. Compressive-Strength Tests: ASTM C 39/C 39M; test one specimen at seven days and two specimens at twenty-eight (28) days. and keep one for backup in the event a sample should break.
    a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at twenty-eight (28) days.

G. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than two-hundred (200) psi.

H. Test results shall be reported in writing to Owner, concrete manufacturer, and Contractor within forty-eight (48) hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at twenty-eight (28) days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both seven (7) and twenty-eight (28) day tests.

I. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Owner.

J. Concrete work will be considered defective if it does not pass tests and inspections.

K. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

L. Prepare test and inspection reports.

M. Record of Work: A record shall be kept by the Contractor listing the time and date of placement of all concrete for the structure. Such record shall be kept until the completion of the project and shall be available to the Owner for examination at any time.

N. Mockups: Prior to starting any concrete work, provide a sample panel using materials indicated for project work. For each type, color and finish of concrete specified, build panel at the site of full thickness and approximately ten feet (10') linear at a minimum, including reinforcement, expansion joints, control joint, scales, fillers, and one radial edge. Provide the workmanship proposed for the work. Correct and replace sample

panel until the Owner's acceptance of the work. Retain panel(s) during construction as a standard for completed paving work.

1. Build panel approximately one-hundred (100) sq. ft. in the location indicated or, if not indicated, as directed by the Owner.
2. Approved mockups may become part of the completed Work if approved prior to the construction of the mock up and is undisturbed at time of Substantial Completion.
3. Notify the Owner a minimum of seven (7) days in advance of dates and times when mockups will be constructed.
4. Obtain the Owner's written approval of the mockups before starting construction.
5. If the Owner determines that the mockup does not meet the requirements, demolish and remove from the site and cast another until the mockup is approved.
6. Maintain the mockups during construction in an undisturbed condition as a standard for judging the completed Work.
7. Demolish and remove mockups when directed by the Owner.

O. Tolerances:
   1. Formed Surfaces and Building Lines: Conform to ACI 301 4.3.
   2. Slab Finishing Tolerances:
      a. Elevation and Cross-slope: In conformance with grading plans and ADA.
      b. Thickness: Plus, three eighths-inch (3/8"), minus one quarter-inch (1/4").
      c. Surface: Gap below ten feet (10') long, unleveled straightedge not to exceed one eighty -inch (1/8").
      d. Lateral Alignment and Spacing of Dowels: one-inch (1").
      e. Vertical Alignment of Dowels: one quarter-inch (1/4").
      f. Joint Spacing: three-inches (3").
      g. Contraction Joint Depth: Plus, one quarter-inch (1/4"), no minus.
      h. Joint Width: Plus, one eighth-inch (1/8"), no minus.
   3. Embedded Items: Unless noted otherwise on drawings, tolerances shall be as follows:
      a. Anchor Bolts:
         1) Adjacent anchor bolts in a group receiving a single fabricated setting piece: Plus or minus (+/-) one-eighth inch (1/8").
         2) Location and alignment of anchor bolt groups from designated location and alignment: Plus or minus (+/-) one-eighth inch (1/8").

3.2 PREPARATION OF SUBGRADE

A. Excavate to required depth in accordance with geotechnical report. Remove soft, yielding material and replace with select fill. Compact to minimum ninety-five percent (95%) Standard Proctor within two percent (2%) of optimum moisture.

B. Refer to Division 31 Section: Earth Moving for requirements for subgrade testing and proof-rolling.

C. Maintain subgrade in a compacted condition until concrete is placed.

3.3 FORMS

A. Metal or uniform warp free lumber forms; coated with form release agent. Obtain approval of the Owner for alignment and grade of forms a minimum of forty-eight (48) hours prior to placing concrete. Any concrete work installed without obtaining approval from the Owner shall be subject to removal and replacement at the discretion of the Owner, at no cost to the City.

B. Construct formwork to maintain tolerances in accordance with ACI 301.

C. Verify lines, levels, and measurement before proceeding with formwork.

D. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
   1. Class A, one eighth inch (1/8”) for smooth-formed finished surfaces.
   2. Class B, one-quarter inch (1/4”) for rough-formed finished surfaces.

E. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

F. Form Tie Holes: Form tie holes are to be filled with grout and finished to match adjacent concrete surface**.**

G. Elements shown as curved on plans are to be formed with flexible form material to form smooth curve transitions. Disjointed, poorly transitioned form alignments will not be accepted. Curved sections formed with straight facets will not be accepted.

H. Contractor shall notify the Owner a minimum of forty-eight (48) hours in advance of placing concrete for review of formwork. Contractor shall make correction within twenty-four (24) hours of review. If formwork is not in place at time of the scheduled inspection, then the Contractor will be responsible for compensation of the Owner’s time and expenses per the General Contract Conditions.

I. Minimize form joints. Symmetrically align form joints and make watertight to prevent leakage of mortar.

J. Provide chamfer strips on all exposed corners or as indicated on construction documents.

K. Do not apply form release agent other than specified materials where concrete surfaces receive special finishes or applied coatings which may be affected by agent. Soak contact surfaces of untreated forms with clean water. Keep surfaces wet prior to placing concrete.

L. Coordinate work of other Sections in forming and setting openings, slots, recesses, chases, sleeves, bolts, dowels, anchors, and other inserts and embedded materials.

M. Do not remove forms, shoring and bracing until concrete has sufficient strength to support its own weight, and construction and design loads which may be imposed upon it.

N. During cold weather, remove ice and snow from forms. **Do not** use deicing salts. Do not use water to clean out completed forms unless formwork and construction proceed within heated enclosure. Use compressed air to remove foreign matter.

3.4 REMOVING AND REUSING FORMS

A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than fifty degrees (50°) F for twenty-four (24) hours after placing concrete. Concrete must be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.
   1. Leave formwork for structural elements that supports weight of concrete in place until concrete has achieved at least seventy percent (70%) of its twenty-eight (28) day design compressive strength.
   2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by the Owner.

3.5 SHORES AND RESHORES

A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.
   1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.

B. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.6 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."

3.7 STEEL REINFORCEMENT

A. Install steel reinforcement only in locations shown on Contract Drawings.

B. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

C. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

D. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

3.8 CONCRETE PLACEMENT

A. Contractor's Review: Contractor shall inspect forms and reinforcing prior to concrete placement to assure accurate placement of embedded items and overall acceptability.

B. Owner's Review: Contractor shall provide minimum of forty-eight (48) hours' notice to the Owner to allow review of forms and reinforcement before concrete is placed and to observe placing of concrete.

C. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated.
   1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
   2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
   3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least six inches (6") into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

E. Deposit and consolidate concrete for concrete pavements in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
2. Maintain reinforcement in position on chairs during concrete placement.
3. Screed slab surfaces with a straightedge and strike off to correct elevations.
4. Slope surfaces as indicated on drawings.
5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
6. Allow time for bleed water to appear, then scrape or push off all bleed water. Do not work water into surface.
7. Final level, light bull float, but do not trowel surface.
8. Broom or drag surface or other specified finish, per Subsection 3.8 this Section.
9. Do not use evaporative retarders as finishing aid.

F. Cold-Weather Placement: Comply with ACI 306R. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
1. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
2. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
3. Comply with concrete protection temperature requirements of ACI 306R. Record concrete temperatures during specified protection period at intervals not to exceed sixteen (16) hours and no less than twice during any twenty-four (24) hour period.

G. Hot-Weather Placement: Comply with ACI 305R.
1. Spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.
2. Protect to prevent rapid drying. Start finishing and curing as soon as possible.

H. Ensure reinforcement, inserts, embedded parts and formed joints are not disturbed during concrete placement.

3.9 CONCRETE FINISHING

A. Form Finish: Use form material to impart smooth, hard, uniform texture, and arrange form panels in orderly and symmetrical pattern with minimum seams. Repair and patch defective areas and completely remove and smooth all fins and other projections.

B. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.10 CONCRETE CURING AND SURFACE TREATMENTS

A. General:
   1. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Maintain concrete with minimal moisture loss at a relatively constant temperature for the period necessary for hydration of the cement and hardening of concrete.
   2. Curing shall commence as soon as free water has disappeared from the concrete surface after placing and finishing. The curing period shall be seven days for all concrete unless test cylinders, made and kept adjacent to the structure and cured by the same methods, are tested with the average compressive strength equal to seventy percent (70%) of the specified twenty-eight (28) day strength.
   3. Curing shall be in accordance with ACI 301 procedures. Avoid rapid drying at the end of the curing period. During hot and cold weather, cure concrete in accordance with ACI 305R and ACI 306R.

B. Curing Methods: Perform curing of concrete by moisture curing, by moisture-retaining cover curing, by curing compound, or by combinations thereof, as herein specified and in accordance with ACI 308.1. Coordinate with and choose a curing method that is compatible with the requirements for subsequent material usage on the concrete surface.
   1. Provide moisture retaining cover curing as follows: Cover concrete surfaces with a moisture-retaining cover for curing concrete, placed in widest practical width with sides and ends lapped at least three inches (3”) and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
   2. Provide curing and sealing compound to interior slabs left exposed, and to exterior slabs, walks and curbs as follows:
      a. Apply specified curing and sealing compound to concrete slabs as soon as final finishing operations are complete. Apply uniformly in continuous operation by power-spray or roller in accordance with manufacturer’s directions. Recoat areas subjected to rainfall within three hours after initial application.
      b. Maintain continuity of coating and repair damage during period.
      c. Do not use membrane curing compounds on surfaces which are to be covered with materials applied directly to concrete: liquid floor hardener, waterproofing, damp proofing, painting, and other coating and finish materials.

C. Curing Formed Surfaces: Where wooden forms are used, cure formed concrete surfaces by moist curing with forms in place for full curing period or until forms are removed. When forms are removed, continue curing by methods specified above for specified curing time.

D. Curing Unformed Surfaces:
   1. Cure unformed surfaces, such as slabs, floor topping, and other flat surfaces by application of appropriate curing method.

3.11 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by the Owner.
   1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.

3.12 FORM REMOVAL

A. Removal of Forms: Supplement and Modify ACI 301 as follows:
   1. ACI 301 4.5.4: Formwork not supporting weight of concrete such as sides of grade beams, walls, and similar parts of the work, may be removed after cumulatively curing at not less than fifty degrees (50°) F for twenty-four (24) hours after placing the concrete provided:
      a. The concrete is sufficiently cured to be undamaged by form removal.
      b. Required shores and supports are so arranged that they will not be loosened or disturbed during form removal.
      c. Supplemental curing and protection is provided for exposed concrete surfaces.

3.13 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by the Owner. Remove and replace concrete that cannot be repaired and patched to the Owner's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one-part portland cement to two and one-half parts fine aggregate passing a Number sixteen (#16) sieve, using only enough water for handling and placing. Achieve approval of the Owner prior to any patching as to location of patches and patch material.

C. Patch Testing: On a portion of the work which will, in the finished condition, be concealed, test patch materials and methods and obtain the Owner’s approval prior to patching concrete surfaces needing repair that will be visible in the final construction.

D. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
   1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than one half inch (1/2”) in any dimension to solid concrete. Limit cut depth to three quarter inches (3/4”). Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.

2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color and texture. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by the Owner.

E. Repairing Unformed Surfaces: Test unformed surfaces, such tops of walls, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped for trueness of slope and smoothness; use a sloped template.
1. After obtaining approval of the Owner, repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks more than one-one hundredths inch (0.01”) wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
   a. If, after repairs are complete, the Owner deems the repairs did not successfully correct the original deficiencies, the pavement or concrete element in question is to be removed and replaced per Subsection 3.13. E.1. above.
2. After concrete has cured at least fourteen (14) days, test for low and high spots in finished surface. Areas that do not conform to the tolerances set forth in Division 32 and in other reference standards identified in this specification are to be sawcut to the nearest joint as approved by the Owner, defective concrete removed, and new conforming paving reinstalled. Color and finish is to match adjacent concrete.
3. If approved by the Owner, repair random cracks and single holes one inch (1”) or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least seventy-two (72) hours.

F. Perform structural repairs of concrete, subject to the Owner’s approval, using epoxy adhesive and patching mortar.

G. Repair materials and installation not specified above may be used, subject to Owner approval.

3.14 CLEANING

A. Perform cleaning during installation of the Work and upon completion of the Work. Remove all excess materials, debris, and equipment from the site. Repair any damage resulting from installation of the concrete.

B. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

3.15 PROTECTION

A. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.

B. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material.

3.16 ACCEPTANCE

A. Concrete work will be accepted when it meets the specified strength and all other requirements of this specification.

PART 4 - MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

A. Measurement will be made by the contract unit specified for Cast-in-Place Concrete. 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 Owner, and in accordance with the Specifications.

4.2 PAYMENT

A. Payment shall be made under:

Pay Item	Pay Unit
Ditch Crossing (incl. footing)	EA
Shade Structure Caisson	EA

B. Payment will be made at the contract unit price, and shall include required materials, transportation, equipment, labor, excavation, stockpiling, structural backfill, steel reinforcement, form finish, disposing, hauling off, watering, dust control, compaction, sub-grade preparation, formwork, placing of concrete, footings, caissons, reinforcing, joints, curing, finishing, testing, repair and all other items required to complete the work as required in accordance with the Contract Drawings and Specifications.

END OF SECTION 03 30 00

SECTION 26 56 70
SOLAR-POWERED EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. This work shall consist of the installation of trail light poles, luminaires, and foundations in conformance with the plans. All work shall be done in accordance with these specifications, the National Electrical Code, and in conformity with the details as shown in the plans.

1.2 SUBMITTALS

A. No luminaire submittals shall be required as they will be provided by the City of Thornton.

PART 2 - PRODUCTS

2.1 TRAIL LIGHT – 4 TOTAL

A. Lighting materials for the light fixtures as shown on the plans shall be the following as furnished by the City of Thornton:

Solar Powered LED
Model No: SCL2-SPMU-BK-T5-WW-TD2200
Manufacturer: First Light Technologies
www.firstlighttechnologies.com
Phone: 844.279.8754

2.2 SOLAR LIGHT – 1 TOTAL

A. Lighting materials for the light fixtures as shown on the plans shall be the following as furnished by the City of Thornton:

Solar Powered LED
Model No: SCL2-SPMU-BK-T4-WW-TD2200
Manufacturer: First Light Technologies
www.firstlighttechnologies.com
Phone: 844.279.8754

PART 3 - EXECUTION

3.1 POLES

A. All poles shall be plumb when installation is complete.
B. All necessary hardware and attachments shall be bagged and secured within each pole.

3.2 POLE FOUNDATIONS

Refer to drawings for Trail light pole foundations.

PART 4 - MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

A. Measurement will be made of the actual number of lights installed and accepted at each project location where shown on the drawings or as directed the Owner in accordance with the Specifications.

4.2 PAYMENT

Payment will be made under:

Pay Item	Pay Unit
Trail Light (installation only)	EA
Solar Light (installation only)	EA

Payment for this item will include trail and solar lighting shall include installation of the pole, foundation, anchor bolts, hardware, luminaire, attachments, replacement of surface materials in kind to match existing grade, and pole painting as required and in conformance with the Owner for a fully operational trail and solar light until Final Acceptance, and other items necessary to complete the work as shown on the Drawings and in accordance with the Specifications.

END OF SECTION 26 56 70

SECTION 31 11 00
CLEARING & GRUBBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Special Conditions sections and the City of Thornton Standards and Specifications, apply to work of this Section. In the event of conflict(s) between this Section, the Drawings and the General and Special Conditions of the Contract, the stricter contents shall govern.

1.2 SUMMARY

A. This Section includes requirements for removing and disposing of vegetation and debris including chemical weed management before seeding into a no-till bed.

1.3 DEFINITIONS

A. The term “clearing” refers to removing and disposing trees, brush, stumps, logs, grass, weeds, roots, decayed vegetable matter, poles, stubs, rubbish, refuse dumps, sawdust piles, and loose boulders of one cubic yard (1 yd^3) or less existing outside of the construction limits, debris resting on or protruding through the ground surface, or appearing on the construction limits before final acceptance of the work. Clearing also includes removing and disposing of obstructions, such as fences, bridges, buildings, and other incidental structures within the construction limits and shown on the Site Demolition Plans.

B. The term “grubbing” refers to removal from the area within the construction limits and proper disposal of all objectionable matter defined above under clearing, which is embedded in the underlying soil. Grubbing also includes removing and properly disposing of sidewalks, driveways, catch basins, drop inlets, manholes, curbing, retaining walls, utilities, foundations, paved floors, underground tanks, and portions of plants to be removed that are below grade, and other structures within the construction limits.

C. Subsoil: All soil beneath the topsoil layer of the soil profile and typified by the lack of organic matter and soil organisms.

D. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil and is the zone where plant roots grow, and ; reasonably free of subsoil, clay lumps, gravel, and other objects more than two-inches (2”) in diameter; and free of subsoil and weeds, roots, toxic materials, or other non-soil materials.

E. Plant-Protection Area: Area surrounding shrub beds or massings, or other vegetation or sensitive areas to be protected during construction, and indicated on Contract Drawings.

F. Tree-Protection Area: Area surrounding individual trees or groups of trees to be protected during construction.

G. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 SUBMITTALS

A. Existing Conditions: Documentation of existing conditions, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.
   1. Use sufficiently detailed digital photographs or videos.
   2. Include plans and notations to indicate specific damaged conditions of existing construction, site elements, and landscape.

1.5 PROJECT CONDITIONS

A. Traffic: all traffic control shall be in conformance with the MUTCD

1.6 DELIVERY STORAGE AND HANDLING

A. All materials except for stripped topsoil and those materials indicated to remain or to be stockpiled, shall remain the property of the City. All other materials shall be removed at the Contractor's expense.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PROTECTION

A. Protect existing site conditions from damage during construction.
   1. Restore existing conditions damaged by Contractor during the work of this Contract to their original condition, as acceptable by Owner.

3.2 CLEARING

A. Remove brush and vegetation from areas designated to be cleared. As directed by Owner, trim low hanging, unsound, or unsightly branches on existing trees and shrubs designated to remain.

3.3 GRUBBING

A. Remove all stumps, roots, and debris a minimum of twelve-inches (12”) below finish grade in all areas as required. Backfill and compact stump and root holes to a maximum of eighty-five percent (85%) in landscape areas and ninety-five percent (95%) under hardscape.

3.4 DISPOSAL

Haul and dispose of all removed materials, trash, debris and waste materials legally inside and outside of the City's property.

Part 4 - MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

A. Measurement will be made of the actual number of square feet of clearing and grubbing and clearing and grubbing in the tree protection zones needed at the locations shown on the Drawings or as directed by the Owner, and in accordance with the Specifications.

4.2 PAYMENT

A. Payment will be made under:

Pay Item	Pay Unit
Clearing and Grubbing	AC

B. Payment will be made at the unit price and shall include:

The unit price shall include removal of vegetation in areas to be regraded, including chemical weed management before seeding and all other work necessary such that a relatively clear dirt surface remains on the site. Payment will be made at the contract unit price, and shall include required materials, transportation, equipment, labor. The unit price shall include all clearing and grubbing, including all other work necessary to ensure a clear dirt surface remains on the site. Price shall include the removal and offsite disposal of all materials. No payment will be made for the removal of any brush and vegetation damaged by the Contractor beyond the authorized limits of removal.

END OF SECTION 31 11 00

SECTION 31 20 00
EARTH MOVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Special Conditions sections and the City of Thornton Standards and Specifications, apply to work of this Section. In the event of the conflict(s) between this Section, the Drawings and the General and Special Conditions of the Contract, the stricter contents govern.

1.2 SUMMARY

A. This Section includes the requirements for excavation, re-grading, stripping and stockpiling of topsoil, filling, backfilling, compaction, hauling, and legal off-site disposal of spoil materials to meet the required lines and grade as specified to complete the work.

1.3 DEFINITIONS

A. Excavation: The removal of material encountered to subgrade or over-excavation and subsequent disposal or placement of materials removed.

B. Unclassified Excavation: The term “unclassified excavation”, as used herein, includes the excavation of all materials required for the work obtained within construction limits of project, including bedrock, surface boulders, wasted sections of concrete, asphalt or other debris including historic landfills that may be encountered. All excavation will be considered unclassified regardless of the nature of material encountered.

C. Classified Excavation: The term “classified excavation”, as used herein, defines the soil conditions that are expected to be encountered and makes provisions for measurement and payment of any rock encountered at an agreed upon unit price.

D. Unauthorized Excavation: Inadvertent or purposely removing materials beyond indicated subgrade elevations or dimensions without specific direction of the Owner. Unauthorized excavation, as well as remedial work resulting from unauthorized excavation shall be at Contractor’s expense.

E. Unsuitable Materials: For the purposes of classified excavation, unsuitable material shall be defined as material below subgrade elevation that exhibits excessive pumping or that does not meet density requirements due to unsatisfactory material as determined by Owner.

F. Subgrade: The undisturbed earth or the compacted soil layer immediately below proposed pavement and topping materials.

G. Structure: Walls, foundations, slabs, pavement or other man-made stationary features occurring above or below ground surface.

H. Structural Fill: The term “structural fill”, as used herein, includes soil materials used for general site filling under pavements or structures.

I. Rough Grade: Cutting and filling the earth for preparation of finish grade. Elevation shall be within +/- one-tenth (.10’) of a foot to the elevation indicated for that point.

J. Finished Grade: Any surface which has been cut to or built to the elevation indicated for that point. Elevation shall be +/- five one-hundredths (.05’) of a foot from required elevation.

1.4 PROJECT CONDITIONS

A. Protection of Persons and Property: The Contractor is responsible for installing barricades and posting warning lights with all open excavations occurring as part of the work.
   1. Protect structures, utilities, walkways, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

B. Environmental Requirements: Blasting is not permitted. Employ jack hammering and other loud noises and methods sparingly; comply with all applicable noise abatement ordinances or regulations. Onsite burning is not allowed.

C. Existing Benchmarks: Carefully preserve and maintain existing benchmarks, vertical/horizontal control, monuments, property line pipes and pins, and other reference points. If disturbed or destroyed, restore or replace at no additional cost to the City.

D. Frost Protection: When freezing temperatures may be expected, do not excavate to the full depth indicated unless the footing or slabs are to be poured immediately after the excavation has been completed. If placing of concrete is delayed, protect the bottoms of excavations from frost until concrete is placed.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: All fill material, regardless of intended use category, must be clean and free from organic matter, roots, brush or other vegetation, trash, debris or other detrimental substances, and rocks or unbroken lumps larger than three-inches (3”).
   1. The Contractor is responsible for furnishing load tickets and providing a daily log of cubic yards of soil materials imported or exported.

B. Satisfactory Soils: Shall be free of rock or gravel larger than 3 inches (75 mm) in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter. Clean, on-site, natural soils, or imported materials, as approved by the Owner.

Unsatisfactory Soils: Soil Classification Groups A-2-6, A-2-7, A-4, A-5, A-6, and A-7 according to AASHTO M 145, or a combination of these groups

C. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

C. On-Site Topsoil: The top four-inches (4”) minimum of organic material in the excavation zone shall be stripped stockpiled prior to other earthwork operations. All stockpiled topsoil shall be reused on site unless otherwise noted.

2.2 GEOTEXTILES

A. A. Subsurface Drainage and Separation Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288. Utilize Mirafi 140N.

2.3 ACCESSORIES

A. Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, six-inches (6”) wide and four (4) mils thick, continuously inscribed with a description of the utility.

B. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of six-inches (6”) wide and four (4) mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to thirty-inches (30”) deep.

C. Tape: Colored as follows:
1. Red: Electric.
2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where the Work of this Section will be performed for compliance with requirements and conditions affecting installation and performance.

3.2 GENERAL PROCEDURES

A. Comply with Division 01 Section “Erosion and Sedimentation Control” and all local, state and national erosion control requirements.

3.3 FIELD QUALITY CONTROL

A. Testing and inspections shall be coordinated and paid for by the Contractor.

B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.

C. Field tests will be performed at the following locations and frequencies at a minimum:
   1. Paved Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every two thousand (2,000) sq. ft. or less of paved area or building slab, but in no case fewer than three (3) tests.
   2. Landscaped areas: At least one test every twenty thousand (20,000) sq. ft or less of disturbed landscaped area, but in no case fewer than two (2) tests.

D. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; re-compact and retest until specified compaction is obtained.

3.4 GROUND SURFACE PREPARATION

A. Complete clearing and grubbing operations in accordance with Division 31 Section “Clearing and Grubbing”. Where new material is to be placed on compacted subgrade, scarify ground surface until surface is free from ruts, hummocks or other uneven features, which would prevent uniform compaction and bond between old and new material.

3.5 STRIPPING AND STOCKPILING TOPSOIL

A. Strip all topsoil from the excavation zone for new facilities (four-inches (4”) in depth for all disturbed areas). Stockpile topsoil in locations indicated on the Drawings or as directed by the Owner.

3.6 EXCAVATION

A. Stability of excavations: Comply with local codes, ordinances, and requirements of agencies having jurisdiction to include the latest revision to OSHA standards.

B. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.
2. Remove rock to lines and grades indicated to permit installation of permanent construction without exceeding the following dimensions:
    a. Twenty-four inches (24”) outside of concrete forms other than at footings.
    b. Twelve-inches (12”) outside of concrete forms at footings.
    c. Six-inches (6”) outside of minimum required dimensions of concrete cast against grade.
    d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
    e. Six-inches (6”) beneath bottom of concrete slabs-on-grade.
    f. Six-inches (6”) beneath pipe in trenches, and the greater of twenty-four inches (24”) wider than pipe or forty-two inches (42”) wide.

C. Classified Excavation: Excavate to subgrade elevations. Material to be excavated will be classified as earth and rock. Do not excavate rock until it has been classified and cross sectioned by the Owner and approved by the Owner. The Contract Sum will be adjusted for rock excavation according to unit prices included in the Contract Documents. Changes in the Contract Time may be authorized for rock excavation.
1. Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; together with soil, boulders, and other materials not classified as rock or unauthorized excavation.
    a. Intermittent drilling; ram hammering; or ripping of material not classified as rock excavation is earth excavation.
2. Rock excavation includes removal and disposal of rock. Remove rock to lines and subgrade elevations indicated to permit installation of permanent construction without exceeding the following dimensions:
    a. Twenty-four inches (24”) outside of concrete forms other than at footings.
    b. Twelve-inches (12”) outside of concrete forms at footings.
    c. Six-inches (6”) outside of minimum required dimensions of concrete cast against grade.
    d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
    e. Six-inches (6”) beneath bottom of concrete slabs-on-grade.
    f. Six-inches (6”) beneath pipe in trenches, and the greater of twenty-four inches (24”) wider than pipe or forty-two inches (42”) wide.

3.7 INSPECTION

A. Subgrade and Rough Grade Inspection:
1. Contractor shall notify Owner when excavations have reached required subgrade.
2. If Owner determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
3. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices.

4. For hardscape subgrade preparation, proof-roll subgrade in locations identified with a pneumatic-tired and loaded ten (10-wheel), tandem-axle dump truck weighing not less than fifteen (15) tons to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
    a. Completely proof-roll subgrade in one direction. Limit vehicle speed to three (3) mph.
    b. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by the Owner, and replace with compacted backfill or fill as directed.
5. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by the Owner, without additional compensation.

3.8 SPECIAL CONDITIONS

A. Cold Weather Protection: Protect excavation bottoms against freezing when atmospheric temperature is less than thirty five degrees (35°) F.

B. Dust Control: Provide dust control to alleviate dust nuisance to the public, to adjacent properties and other work underway at the project site.

C. Unanticipated Conditions: Notify the Owner immediately upon finding subsurface or other conditions which are not shown or which cannot be reasonably assumed from existing surveys. Secure Owner's instructions before proceeding with further work in such areas.

D. Unsatisfactory Soils: Remove or otherwise correct unsanitary, sour, or otherwise unsatisfactory soil. Remove contaminated or unsuitable material from under paved areas.

E. Additional Excavation: When excavation has reached required subgrade elevations, the Contractor shall contact the testing agency, which will make an observation of conditions. If unsuitable bearing materials are encountered at required subgrade elevations, carry excavations deeper and replace excavated material as directed by the testing agency.

3.9 FILL AND BACKFILL

A. General: Place soil material in layers to required subgrade elevations, for each area classification listed below, using materials specified in this Section.
    1. Under grassed areas, use satisfactory, excavated or borrow material.
    2. Under walks and pavements, use satisfactory, excavated or borrow materials, or a combination to meet structural fill requirements.

B. Backfill excavations as promptly as work permits, but not until completion of the following:
    1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
    2. Surveying locations of underground utilities for Record Documents.

3. Testing and inspecting underground utilities.
4. Removing concrete formwork.
5. Removing trash and debris.
6. Removing temporary shoring and bracing, and sheeting.
7. Installing permanent or temporary horizontal bracing on horizontally supported walls.
8. Acceptance of subgrade by Owner.

C. Place backfill on subgrades free of mud, frost, snow, or ice.

3.10 PLACEMENT AND COMPACTION

A. Ground Surface Preparation: Remove vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placement of fills.

B. Place backfill and fill materials in layers not more than eight-inches (8”) in loose depth for material compacted by heavy compaction equipment, and not more than four-inches (4”) in loose depth for material compacted by hand-operated tampers, each layer to be compacted to meet requirements herein.

C. Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

D. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698:

1. Under exterior flatwork, slabs, steps, and pavements, scarify and recompact top 8 inches (300 mm) of existing subgrade and each layer of backfill or fill soil material at 95 percent.

2. Under lawn or unpaved areas, scarify and recompact top 8 inches (150 mm) below subgrade and compact each layer of backfill or fill soil material at 95 percent.

E. Control soil and fill compaction, providing minimum percentage of density specified. Correct improperly compacted areas or lifts as directed if soil density tests indicate inadequate compaction.

F. Soil Moisture Control

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to optimum or to 3 percent over optimum moisture content for clay soils, or within 2 percent of optimum moisture content for granular soils.

1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.

2. Remove and replace, or scarify and air dry otherwise satisfactory soil material that exceeds optimum moisture content beyond the tolerances described above and is too wet to compact to specified dry unit weight

3.11 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
   1. Stockpile soil materials away from edge of excavations. Do not store within drip line of existing trees or within Tree Protection Fencing. Refer to Division 01 Section “Tree Retention and Protection”.

3.12 PLACING STOCKPILED TOPSOIL

Refer to Section “Topsoil”.

3.13 FINISH GRADING

A. General: Uniformly grade areas within project limits of grading under this section, including adjacent transition areas. Smooth finished surface within specified tolerances, compact with uniform levels or slopes between points where elevations or contours are indicated or between such points and existing grades.

B. Subgrade tolerances are as follows:
   1. Lawn, Seeded, and Unpaved Areas: Finish areas to receive topsoil to within not more than +/- five one-hundredths (0.05’) of a foot above or below required subgrade elevations.
   2. Pavements: Shape surface of areas under pavement to line, grade, and cross-section, with finish surface not more than five one-hundredths (0.05’) of a foot above or below required subgrade elevation.

C. Under no circumstances shall variations from specified grade elevations create any ponding or retention of water on intermediate pavement levels, or finished surfaces.

3.14 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
   1. Scarify or remove and replace soil material to depth as directed by Owner; reshape and re-compact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
   1. Restore appearance, quality, and condition of finished surfacing to match adjacent work.

3.15 MAINTENANCE

A. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, reshape, and compact to required density prior to further construction.

B. Settling: Where settling is measurable or observable at excavated areas during general project warranty period, remove surface (pavement, lawn, or other finish), add backfill material, compact, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.16 DISPOSAL OF EXCESS AND WASTE MATERIALS

A. Removal from City's Property: Remove waste materials, including materials not allowed for fill, backfill or site grading as specified within, trash, contaminated materials, and debris, and legally dispose of it off City's property at Contractor's expense for hauling and recycling.

B. Remove any excess fill material from the site, unless otherwise directed by the Owner.

C. Removal of unsuitable material and its replacement as directed will be paid on basis of Conditions of the Contract relative to changes in work.

PART 4 - MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

Measurement will be made by the contract unit specified for Earth Moving. 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 Owner, and in accordance with the Specifications.

4.2 PAYMENT

A. Payment will be made at the contract unit price, and shall include required materials, transportation, equipment, labor, excavation, stockpiling, disposing, hauling off, importing fill, re-transporting to fill locations (from locations of excavation or from onsite stockpiles), watering, compaction, sub-grade preparation, measuring of subgrade to bring within tolerances, backfilling, dust control, erosion and sediment control, rough grading, fine grading, or any additional items as required in accordance with the Contract Drawings and Specifications.

B. Payment will be made under:

Pay Item	Pay Unit
Earthwork	LS

C. If the Contractor fails to complete construction within the approved contract time, payment will not be made for pay items for the period of time after expiration of the approved contract time. These items shall be provided at the Contractor's expense.

D. The cost for any corrective actions required by the City due to contractor's failure to obtain or comply with applicable Permits will be borne by the Contractor, including fines and penalties. In the case of failures on the part of the Contractor in controlling erosion, sedimentation, and/or water pollution, the City may provide the necessary corrective actions. All corrective action costs, including Project engineering costs, will be charged to the Contractor, and appropriate deduction will be made from the Contractor's monthly pay estimate.

END OF SECTION 31 20 00

SECTION 32 13 13
CONCRETE WALKS, CURBS, AND MISCELLANEOUS FLATWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Special Conditions sections and the City of Thornton Standards and Specifications, apply to work of this Section. In the event of conflict(s) between this Section, the Drawings and the General and Special Conditions of the Contract, the stricter contents shall govern.

1.2 SUMMARY

A. This Section includes requirements for furnishing, placing, shoring, bracing, and anchorage of placing concrete flatwork for the concrete pads including installation of control and expansion joints, concrete curing and concrete finishing.

Note: All references below shall be from the most current edition.

B. American Concrete Institute (ACI):
   1. ACI 117 - Standard Tolerances for Concrete Construction and Materials.
   2. ACI 301 - Specifications of Structural Concrete for Buildings.
   3. ACI 304 - Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.
   4. ACI 305 and 306 - Hot and Cold Weather Protection for Concrete.
   5. ACI 315 - Details and Detailing of Concrete Reinforcement.
   6. ACI 318 - Building Code Requirements for Reinforced Concrete.
   7. ACI 347 - Recommended Practice for Concrete Formwork.

C. American Society for Testing and Materials (ASTM):
   1. ASTM A615 - Deformed and Plain Billet-Steel for Concrete Reinforcement.
   2. ASTM C33 - Concrete Aggregates.
   3. ASTM C94 - Ready-Mixed Concrete.
   4. ASTM C150 - Portland Cement.
   5. ASTM C260 - Air Entraining Admixtures for Concrete.
   6. ASTM C494 - Water Reducing Admixtures for Concrete.
   7. ASTM C672 - Scaling Resistance of Concrete Surfaces Exposed to Deicing Chemicals.
   8. ASTM-C800 - Curing Compound, Concrete, for New and Existing Surfaces.
   9. ASTM C1059 - Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete
   10. ASTM-C1315 - Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete

D. Concrete Reinforcing Steel Institute (CRSI) - Manual of Standard Practice.

E. Colorado Department of Transportation (CDOT) – Standard Specifications for Road and Bridge Construction, latest edition

F. National Ready Mixed Concrete Association (NRMCA)

G. City of Thornton Standards & Specifications.

This specification represents Thornton's minimum standards in regards to installation, movement, cracking, finish, replacement requirements, and overall appearance of concrete flatwork. This specification is not a complete specification, but is intended to supplement Project specific specifications. In the event of a conflict between this specification and any other project or nationally recognized specification including, but not limited to, ADA, AASTHO, COT standards, and CDOT standards, the more stringent specification shall apply.

This specification is applicable for exterior flatwork including, but not limited to, sidewalk, curb and gutter, cross pans, handicap ramps, and general exterior flatwork such as plazas. This specification is not applicable to bus pads, railroad crossings, or road pavements.

The following minimum standards shall apply to all Work performed. Any concrete not within these minimum standards shall be replaced or, in Thornton's sole discretion, ground smooth. The Contractor shall perform all repair or replacement Work at no cost to Thornton.

A. Deviation from Design Slope

Deviation from design slope in any direction shall not exceed plus or minus 0.25%. Notwithstanding the foregoing, in no case shall deviation from design slope cause water to pond.

B. Surface Tolerance within Design Slope

1. Deviation of Pavement in Longitudinal Direction:

Except at curb and gutter transitions to inlets, the gap below a 10' straightedge resting longitudinally on high spots shall not exceed ¼". On tangent roadway alignments and curves with greater than 1,000', and on sharp vertical curves and horizontal curves with radius of 1,000' or less. The total maximum allowable defection shall be 0.25" from the edge of the straightedge with allowance made for curve deflection. Should the length of the longitudinal segment or segments being measured not accommodate a 10' straightedge, a shorter straightedge shall be used and the allowable gap shall be proportioned accordingly.

2. Deviation of Pavement in Transverse Direction:

The gap below a 10' straightedge resting on high spots shall not exceed ¼". Should the width of the transverse direction being measured not

accommodate a 10’ straightedge, a shorter straightedge shall be used and the allowable gap shall be proportioned accordingly.

3. Deviation in Surface Tolerance of Ramps, Sidewalks, Curb and Gutter, and Intersection Cross Pans:

   In any direction, the gap below a 10’ straightedge resting on high spots shall not exceed ¼”. Should the length of the direction being measured not accommodate a 10’ straightedge, a shorter straightedge shall be used and the allowable gap shall be proportioned accordingly.

C. Movement of ramps, sidewalks, curb and gutter, and intersection crosspan occurring after placement, but before the end of the Warranty Period:

1. Lateral, (horizontal) movement shall not exceed ¼” from original approved lines.

2. Differential settlement or heaving, in any direction, within a monolithic segment or between adjacent segments separated by a control joint, expansion joint, or construction joint, shall not exceed ¼” in any 10’ length.

   Any concrete not within the ¼” tolerance shall be replaced or ground smooth at Thornton’s sole option, by the Contractor at no cost to Thornton. Notwithstanding the above, any settlement or heaving that causes water to pond shall be cause to remove and replace, or with Thornton’s approval to grind the concrete, to restore proper drainage.

D. Cracks

All concrete shall be installed with tooled or saw cut control joints meeting requirements of the Project specifications and/or Thornton standards. Joints at construction joints shall be tooled. Joints shall be tooled or cut while concrete is still green and prior to the appearance of any shrinkage cracks and shall be made to a depth of at least ¼” of the total thickness of the concrete. Cracks of any size, width, or length that does not fall within the width of the tooled or saw cut control joint are not acceptable. All concrete panels or segments with cracks not within the tooled or saw cut joints shall be replaced by the Contractor at no cost to Thornton.

E. Damaged Concrete

All chipped, scratched, grooved, spalled, pitted, honeycombed, vandalized, or concrete damaged in any way shall be replaced by the Contractor at no additional cost to Thornton.

F. Surface Finish

1. The Contractor shall screed, float, and trowel smooth all concrete prior to final finish. The surface finish of all concrete shall be uniform, even, level, and esthetically pleasing as shall be determined by Thornton. The quality of the surface finish shall be equivalent to that routinely achievable by a highly competent concrete finisher comparable to a journeyman skill level.

2. All concrete flatwork shall have light broom finish unless otherwise specified. The broom grooves shall be straight to a tolerance of 1/2" maximum lateral deviation (¼" either side of a straight edge) in any 5' length and not more than 1/16" in depth. The Contractor shall clean the broom between each pass so that broom finish is clean, consistent, and esthetically pleasing. If concrete finish becomes rough, uneven, deeply grooved, or in any way visually unpleasing in the sole opinion of Thornton, the Contractor shall replace the affected panels at no cost to Thornton.

G. Replacement of all Defective Concrete

All replaced concrete shall be uniformly tied into the existing concrete on each side of the replaced concrete section and shall adhere to all specifications and tolerances. Removal of concrete for replacement shall be to the nearest existing control joint, construction joint, or expansion joint in either direction, or if prior approval is obtained from Thornton to a new saw cut joint; provided however, no resulting sidewalk or curb and gutter segments shall be less than 5' from control joint to control joint in length. All edges shall be saw cut cleanly with no chips or spalling in existing concrete to remain. Saw cut edges shall be parallel and perpendicular to the existing work. Saw cut joints shall not over cut into existing material to remain. Should any concrete become chipped, cracked, or damaged in any way during removal, the Contractor shall remove and replace this damaged concrete back to the next control joint at no additional cost to Thornton. Curb and gutter replacement and segments shall be tied to existing curb and gutter on each side of the replaced segment with two (2) dowels (#4 rebar x 2' long), one (1) placed under the gutter section and one (1) placed under the curb section of the repair. These dowels will be epoxy anchored into the existing curb and gutter by means of drilling horizontally a 1' long hole with a diameter as recommended by the epoxy manufacturer for #4 rebar and anchoring the dowels in the hole using Hilti HY-150 or approved equal epoxy adhesive. The remaining 1' of the dowel will be embedded in the replacement curb and gutter section. The dowels will be evenly spaced in the pan section of the curb and gutter so as to provide a minimum of 2 ½" of concrete cover on all sides.

H. Curing and Weather Protection

All concrete shall be cured and protected from the weather per Project specifications or per Thornton Standard Specifications sections 607 and 608, whichever is more stringent.

1.3 QUALITY CONTROL

A. Pre-Construction Conference: Conduct conference at location approved by the Owner.
   1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with concrete to attend, including the following:
      a. Contractor's superintendent.
      b. Independent testing agency responsible for concrete design mixtures.
      c. Ready-mix concrete manufacturer.
      d. Concrete subcontractor.
      e. Special concrete finish subcontractor.
   2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semi-rigid joint fillers, forms and form removal limitations, shoring and reshoring procedures, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, concrete repair procedures, and concrete protection.

1.4 SUBMITTALS

A. Qualification Data: Installer to document for Owner’s Representative experience on projects of similar scope and scale successfully completed within the past five (5) years.

B. Product Data and Material Certificates: For each type of product and material indicated on the plans and in this specification.

C. Mix Designs:
   1. Submit substantiating data for each concrete mix design specified for use to the Owner not less than four (4) weeks prior to first concrete placement. Data for each mix shall, as a minimum, include the following per section 2.7.B:
      a. Mix identification designation (unique for each mix submitted).
      b. Statement of intended use for mix.
      c. Mix proportions.
      d. Aggregates.
      e. Admixtures (must be approved by the Owner)
      f. Wet and dry unit weight.
      g. Entrained air content.
      h. Design slump.
      i. Strength qualification data.

D. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
   1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.

E. Field quality-control reports.

F. Minutes of Pre-Construction conference.

1.5 DELIVERY, STORAGE AND HANDLING

A. General: Materials handling and batching shall conform to applicable provisions of ASTM C94.

B. Reinforcing: Unload and store reinforcing bars so they are kept free of mud and damage.

C. Project-Site Mixing: Not allowed without prior approval from the Owner. If allowed, submit process description to the Owner for approval prior to construction.

D. Hauling Time for Concrete: Deliver and discharge all concrete transmitted in a truck mixer, agitator, or other transportation device not later than one and one-half (1-1/2) hours from batch time, or three hundred (300) revolutions of the drum after the initial mixing water has been added, whichever is earliest.

E. Extra Water:
1. Deliver concrete to site in exact quantities required by design mix.
2. Should extra water be required for workability before depositing concrete, and the water/cement ratio of accepted mix design will not be exceeded, the General Contractor's superintendent shall have the sole authority to authorize addition of water. Additional water shall not exceed one (1) gallon/cu. yd. Any additional water added to mix after leaving batch plant shall be indicated on truck ticket and signed by person responsible.
3. Where extra water is added to concrete, it shall be mixed thoroughly for thirty (30) revolutions of drum before depositing.
4. Water may be added at the site only once for each batch.
5. A full set of tests shall be performed after addition of water. Excessive slump or other out of range tests will be cause for rejection.

1.6 PROJECT CONDITIONS

A. Environmental Requirements:
1. Cold Weather Placement:
a. If the daily temperature drops below forty degrees (40°) F for three (3) days prior to concrete placement or the temperature is expected to drop below forty degrees (40°) F on the day of the concrete placement, then comply with ACI 306R for preparation, protection, and curing of concrete.
b. The mixed concrete temperature shall be between 50 and 90 ºF at the time of placement. Water, aggregates, or both shall be heated when necessary under such control and in sufficient quantities to avoid fluctuations in the temperature of the concrete of more than 10 ºF from batch to batch.
c. If approved by the Owner, an accelerating admixture may be used. Admixtures shall meet requirements of Part 2. Calcium Chloride and other chloride-type accelerating admixtures are not allowed.
2. Hot Weather Placement:

a. When placing concrete in hot weather, follow recommendations of ACI 305R.
b. Placing of concrete during hot weather shall be limited by the temperature of the concrete at the time of placing. Mixed concrete which has a temperature of 90 ºF or higher, shall not be placed.
c. When air temperatures on day of placement are expected to exceed ninety degrees (90°) F, mix ingredients shall be cooled before mixing. Flake ice or well-crushed ice of a size that will melt completely during mixing may be substituted for all or part of mix water.
d. If approved by the Owner, a retarding admixture may be used. Admixtures shall meet requirements of Part 2.

1.7 RIGHT OF WAY WORK

A. Contractor shall obtain all necessary permits when working with in the Right of Way.

B. Contractor shall preserve and protect all permanent land survey control markers. Per the General Contract Conditions Article 319 “Preservation of Permanent land Survey Control Markers”.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

A. Hand Placed Steel Forms: Hand placed steel forms are only to be used for sections that are straight and have no bend, radii or curvature in the sections to be used.

B. Wood Forms: Forms shall be made of solid one side grade, sound, undamaged lumber with straight edges.
1. Curved elements (bends, radii, or curvature) shown on plans are to be constructed with smooth-curved plywood forms. Faceted forms composed of straight sections will not be accepted.

C. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

2.2 CONCRETE MATERIALS

A. Provide materials in accordance with ACI 301, unless amended or superseded by requirements of this section or general notes on structural drawings.
1. General: Ready-mixed Concrete: ASTM C94. On-site mixed concrete not allowed.
2. Cement: ASTM C150. Type II
3. Aggregate: ASTM C33.
a. All sand and aggregates to meet C-33 Table 3 for Class 4S “Severe Weathering Region”.

1) Fine Aggregate: Clean, natural sand.
2) Coarse Aggregate: Clean gravel or crushed stone.

4. Water: ASTM C 94/C 94M, clean and not detrimental to concrete.

2.3 ADMIXTURES

A. General: Unless specified, no admixtures may be used without specific approval of the Owner.

B. Prohibited Products: Calcium chloride or admixtures containing more than 0.05% chloride ions or thiocyanates are not permitted.

C. Air-Entraining Admixture: ASTM C260.

D. Water Reducing Admixture: ASTM C494, Type A.

E. High Range Water Reducing Admixture (Superplasticizer): ASTM C494, Type F or G.

F. Warm weather admixtures: ASTM C494. Use of admixtures will not relax warm weather placement requirements.

G. Cold Weather Admixtures: ASTM C494. Use of admixtures will not relax cold weather placement requirements.

2.4 CONCRETE MIX

A. All Concrete mixes from the approved list or submitted for approval shall meet the following criteria.
1. Mix concrete in accordance with ASTM C94 and ACI 301 Chapter 3.
2. Cement Content: Type II cement, minimum of five hundred twenty-eight (528) pounds per cubic yard.
3. Maximum water-cement ratio: 0.44.
4. Slump: Four inches (4”) maximum when hand placed.
5. Air Entrainment: five percent (5%) to eight percent (8%).
6. Aggregate Size: three quarter-inch (3/4”) maximum.
7. Concrete for Exterior Flatwork, including Pavement, Curb and Gutter, and Drainage Pans shall be Class P, as approved by the Owner.

2.5 FIBROUS CONCRETE REINFORCEMENT

A. Shall be one hundred percent (100%) virgin polypropylene, fibrillated fibers containing no reprocessed olefin materials and specifically manufactured to an optimum gradation utilizing twenty-five (25) individual fiber designs for use as concrete secondary reinforcement. Volume per cubic yard shall be one and one-half (1.5) pounds, or in accordance with manufacturer’s recommendations. Fiber manufacturer must document evidence of five (5) year satisfactory performance history, compliance with applicable building codes and ASTM C1116 Type III 4.1.3 and ASTM C1116 Performance Level I.
1. Fibrous concrete reinforcement shall be utilized in all flatwork applications.

2.6 EXPANSION JOINT MATERIAL

A. Interior Use or Exterior Use where sealants are specified: Bituminous saturated fiber conforming to ASTM D1751, one half-inch (1/2") thick. Provide manufacturer's certification of compatibility with specified sealants where required.

B. Pre-molded closed cell polyethylene foam backer rod if required.

C. Joint Sealant: ASTM D 5893 Type NS, Silicone per CDOT's approved joint and crack sealant list. Where concrete color additive is used, sealant color to match adjacent concrete.

2.7 SLIP JOINTS

A. Speed Dowel Model PSD09/#4TX, 9" long sleeve to accommodate 18" smooth steel round bar, 5/8" diameter. Manufactured by Sika/Greenstreak, or approved equal.

2.8 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately nine (9) oz./sq. yd. dry.

B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

C. Spray Curing and Sealing Compound: White, Waterborne, Membrane-Forming ASTM C 1315, Type two (2), Class A, dissipating.

2.9 RELATED MATERIALS

A. Chemical Surface Retarder: Water-soluble, liquid, set retarder with color dye, for horizontal concrete surface application, capable of temporarily delaying final hardening of concrete to a depth of one eighth-inch (1/8") to one quarter-inch (1/4") to match the Owner's sample.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

A. Requirements of Regulatory Agencies: Comply with all applicable provisions of the state and local building and safety codes.

B. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer, unless otherwise approved by Owner.

C. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
   1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").

D. Testing: The City will be responsible for all QA Testing.

E. Testing Agency Qualifications: Engage a qualified testing agency to perform material evaluation tests and to design concrete mixtures. Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
   1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

F. Testing Frequency: Obtain at least one composite sample for each one hundred (100) cubic yards, or fraction thereof of each concrete mixture placed each day.
      a. When frequency of testing will provide fewer than five (5) compressive-strength tests for each concrete mixture, testing shall be conducted from at least five (5) randomly selected batches or from each batch if fewer than five (5) are used.
   2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one (1) test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
   3. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
   4. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one (1) set of four (4) standard cylinder specimens for each composite sample.
   5. Compressive-Strength Tests: ASTM C 39/C 39M; test one specimen at seven days and two specimens at twenty-eight (28) days and keep one for backup in the event a sample should break.
      a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at twenty-eight (28) days.

G. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than two-hundred (200) psi.

H. Test results shall be reported in writing to Owner, concrete manufacturer, and Contractor within forty eight (48) hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at twenty eight (28) days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both seven (7) and twenty eight (28) day tests.

I. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Owner.

J. Concrete work will be considered defective if it does not pass tests and inspections.

K. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

L. Prepare test and inspection reports.

M. Record of Work: A record shall be kept by the Contractor listing the time and date of placement of all concrete for the structure. Such record shall be kept until the completion of the project and shall be available to the Owner for examination at any time.

N. Mockups: Prior to starting any concrete work, provide a sample panel using materials indicated for project work. For each type, color and finish of concrete specified, build panel at the site of full thickness and approximately ten feet (10') by 10 feet (10'), including expansion joints, control joint, scales, fillers, and one radial edge. Provide the workmanship proposed for the work. Correct and replace sample panel until Owner's acceptance of the work. Retain panel(s) during construction as a standard for completed paving work.
   1. Build panel approximately one-hundred (100) sq. ft. in the location indicated or, if not indicated, as directed by the Owner.
   2. Approved mockups may become part of the completed Work if approved prior to the construction of the mock up and is undisturbed at time of Substantial Completion.
   3. Notify the Owner a minimum of seven (7) days in advance of dates and times when mockups will be constructed.
   4. Obtain the Owner's written approval of the mockups before starting construction.
   5. If the Owner determines that the mockup does not meet the requirements, demolish and remove from the site and cast another until the mockup is approved.
   6. Maintain the mockups during construction in an undisturbed condition as a standard for judging the completed Work.
   7. Demolish and remove mockups when directed by the Owner.

O. Tolerances: Comply with tolerances in ACI 117, the Contract Drawings, and as follows:
   1. Elevation and Cross-slope: In conformance with grading plans and ADA.
   2. Thickness: Plus, three eighths-inch (3/8"), minus one quarter-inch (1/4").
   3. Surface: Gap below ten feet (10') long, unleveled straightedge not to exceed one eighth -inch (1/8").
   4. Lateral Alignment and Spacing of Dowels: one-inch (1").
   5. Vertical Alignment of Dowels: one quarter-inch (1/4").
   6. Joint Spacing: three-inches (3").
   7. Contraction Joint Depth: Plus, one quarter-inch (1/4"), no minus.
   8. Joint Width: Plus, one eighth-inch (1/8"), no minus.

3.2 PREPARATION OF SUBGRADE

A. Excavate to required depth in accordance with geotechnical report. Remove soft, yielding material and replace with select fill. Compact to minimum ninety-five percent (95%) Standard Proctor within two percent (2%) of optimum moisture.

B. Refer to Division 31 Section: Earth Moving for requirements for subgrade testing and proof-rolling.

C. Maintain subgrade in a compacted condition until concrete is placed.

3.3 FORMS

A. Metal, plastic, or uniform warp free lumber forms, coated with form release agent. Slope forms to give slabs positive drainage and stake securely. Obtain approval of the Owner for alignment and grade of forms a minimum of forty-eight (48) hours prior to placing concrete. Any concrete work installed without obtaining approval from the Owner shall be subject to removal and replacement at the discretion of the Owner, at no cost to the City.

B. Radii shall be continuous and flowing to avoid angular intersections in the horizontal alignment, radial forming shall use bender board or approved equal as directed by the Owner.

3.4 REMOVING AND REUSING FORMS

A. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

3.5 STEEL REINFORCEMENT

A. Install steel reinforcement only in locations shown on Contract Drawings.

B. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

C. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

D. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

3.6 CONCRETE PLACEMENT

A. Prior to placing any new sections of concrete pavement, the entire subgrade shall be scarified to a depth of 6-inches. In areas where existing pavement is to be removed and replaced the existing compacted subgrade may be reused if the subgrade meets

specified compaction. In areas of existing subgrade that do not meet the specified compaction, materials shall be removed, replaced and compacted to meet the specified proctor density. Adjust moisture content and compact as hereinafter specified.

B. Contractor's Review: The Contractor shall inspect forms and reinforcing prior to concrete placement to assure accurate placement embedded items and overall acceptability.

C. Owner's Review: Contractor shall provide minimum of forty-eight (48) hours' notice to the Owner to allow review of forms and reinforcement before concrete is placed and to observe placing of concrete.

D. Do not place concrete on frozen surfaces.

E. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

F. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.

G. Do not add water to concrete during delivery.

H. Deposit and spread concrete in a continuous operation between transverse joints. Do not use vibratory equipment to move concrete into place.

I. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
   1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels, and joint devices.

J. Screed paving surface with a straightedge and strike off.

K. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

L. Curbs and Gutters: Use design mixture for automatic machine placement. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing.

M. Slip-Form Paving: Use design mixture for automatic machine placement. Produce paving to required thickness, lines, grades, finish, and jointing.
   1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of slip-form paving machine during operations.

N. Cold-Weather Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:
   1. When air temperature has fallen to or is expected to fall below forty degrees (40°) F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than fifty degrees (50°) F and not more than eighty degrees (80°) F at point of placement.
   2. If subgrade is frozen, as determined by Geotechnical Engineer and/or Owner, thaw subgrade to depth of eight (8") prior to placing concrete.
   3. Do not use frozen materials or materials containing ice or snow.
   4. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.

O. Hot-Weather Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:
   1. Cool ingredients before mixing to maintain concrete temperature below ninety degrees (90°) F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
   2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
   3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.7 CONCRETE FINISHING

A. Allow time for bleed water to appear, then scrape or push off all bleed water. Do not work water into surface.

B. Final level, light bull float, but do not trowel surface.

C. After darbying or bullfloating, stop finishing until bleeding has ceased and until concrete can support foot pressure with only about one eighth-inch (1/8") indentation. During or after the first floating, check planeness of surface with a ten foot (10') straightedge applied at not less than two different angles, and then cut down all high spots and fill all low spots to achieve a true plane within one eighth-inch (1/8") in ten feet (10').

D. Finishes:
   1. Medium Broom Finish: Provide a medium broom finish for all exterior concrete unless otherwise noted. Immediately after float finishing and tool work, roughen surface with fiber-bristle broom to match the approved mockup panel. Confirm direction or pattern of broom finish with the Owner prior to commencing slab placement.

E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a three eighths-inch (3/8") radius. Final concrete finish to completed following jointing. Surface/edging tool marks are not acceptable.

F. Do not use evaporative retarders as finishing aid.

3.8 CONCRETE CURING AND SURFACE TREATMENTS

A. General:
   1. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Maintain concrete with minimal moisture loss at a relatively constant temperature for the period necessary for hydration of the cement and hardening of concrete.
   2. Curing shall commence as soon as free water has disappeared from the concrete surface after placing and finishing. The curing period shall be seven days for all concrete unless test cylinders, made and kept adjacent to the structure and cured by the same methods, are tested with the average compressive strength equal to seventy percent (70%) of the specified twenty-eight (28) day strength.
   3. Curing shall be in accordance with ACI 301 procedures. Avoid rapid drying at the end of the curing period. During hot and cold weather, cure concrete in accordance with ACI 305R and ACI 306R.

B. Curing Methods: Perform curing of concrete by curing and sealing compound, by moisture curing, by moisture-retaining cover curing, or by combinations thereof, as herein specified. Coordinate with and choose a curing method that is compatible with the requirements for subsequent material usage on the concrete surface.
   1. Provide curing and sealing compound to exterior slabs, walks, curbs, etcetera as follows:
      a. Apply specified curing and sealing compound to concrete slabs as soon as final finishing operations are complete. Apply uniformly in continuous operation by power-spray or roller in accordance with manufacturer's directions. Recoat areas subjected to rainfall within three hours after initial application.
      b. Maintain continuity of coating and repair damage during period.
   2. Provide moisture curing by one of the following methods:
      a. Keep concrete surface continuously wet by covering with water.
      b. Continuous water-fog spray.
      c. Covering concrete surface with specified absorptive cover, thoroughly saturating cover with water and keeping it continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with 4-inch lap over adjacent absorptive covers.
   3. Provide moisture retaining cover curing as follows: Cover concrete surfaces with a moisture-retaining cover for curing concrete, placed in widest practical width with sides and ends lapped at least 3-inches and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

C. Curing Formed Surfaces: Where wooden forms are used, cure formed concrete surfaces by moist curing with forms in place for full curing period or until forms are removed. When forms are removed, continue curing by methods specified above for specified curing time.

3.9 JOINT

A. Construct joints true to line with faces perpendicular to surface.

B. Expansion Joints: Expansion joint material shall be provided at the following locations and shall be in place prior to the placing of concrete:
   1. As shown on the Contract Drawings; or
   2. At each end of curb return.
   3. Between sidewalk and driveway slabs or service walks.
   4. Between new concrete and existing concrete.
   5. Between new concrete and fixed vertical objects.
   6. At maximum one hundred twenty foot (120') spacing.
   7. Provide half-inch (1/2”) thick by depth of the slab material, allow half-inch (1/2”) thickness for joint sealer.
   8. As directed by Owner.
   9. Thoroughly clean all surfaces prior to installation of sealant material.

C. Slip Joints:
   1. To be used at all Expansion Joints except at buildings, curbs, ramps and stairs.
   2. Dowels to be placed no closer than twelve-inches (12”) from edge of concrete and twenty-four-inches (24”) on-center.
   3. Attach bases to the face of concrete forms using a double-headed nail or self-tapping screw.
   4. Center of base shall be centered on form.
   5. Prior to placing concrete, Speed Dowel sleeve shall be slipped over base.
   6. Concrete shall not be placed directly over the Speed Dowel System. Place concrete minimum eighteen-inches (18”) from Speed Dowel system and work concrete around the Speed Dowel System.
   7. Concrete forms shall be removed with bases still attached. Bases may be reused.
   8. Install slip dowels to the full depth of the embedded Speed Dowel sleeve and proceed with next concrete pour.
   9. Greasing of dowels is not required. Embedded Speed Dowel Sleeve accommodates expansion and shrinkage movements that may occur.
   10. Bent or badly sheared slip dowels shall not be used. Saw cut dowels recommended, deburr ends.
   11. Place edge forms plumb. Out of plumb forms may result in misaligned dowels.

D. Contraction (Control) Joints in Walks: Contraction joints shall be formed with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut one eighth-inch (1/8”) wide joints into concrete that has hardened sufficiently that cutting action will not tear, abrade, or otherwise damage surface, but before development of random contraction cracks. Saw cut joints shall be spaced at a distance equal to the width of the walk, but not over ten feet (10’) unless approved by the Owner. Depth of joints shall be one-fourth (1/4) the slab thickness.
   1. Tooled joints will not be allowed on concrete trails, unless directed by the Owner.

E. Curb and Gutter Contraction (Control) Joints: Space curb and gutter joints not more than twelve foot six-inches (12’-6”) on center, and align them with sidewalk joints.

Contraction joints shall be tooled. Form plane of weakness by inserting and later removing a metal divider, finish with an edger or groover, or by saw cutting a previously tooled joint.

3.10 FORM REMOVAL

A. Remove forms after concrete surface is hard enough so as not to be damaged in any way. Reasonable care is to be used in removing forms. Repair minor defects with high strength grout as per the Owner's direction. Plastering will not be permitted on exposed faces.

3.11 CLEANING

A. Perform cleaning during installation of the Work and upon completion of the Work. Remove all excess materials, debris, and equipment from the site. Repair any damage resulting from installation of the concrete.

B. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

3.12 PROTECTION AND REPAIR

A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Owner.

B. Drill test cores, where directed by the Owner, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.

C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material.

3.13 ACCEPTANCE

A. Concrete work will be accepted when it meets the specified strength and all other requirements of this specification at Initial & Final Acceptance.

PART 4 - MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

A. Concrete Paving: Measurement shall be the actual number of square feet of concrete paving installed placed and accepted at the locations shown on the Contract Drawings, or as directed by the Owner, and in accordance with the Specifications.

4.2 PAYMENT

A. Payment shall be made under:

Pay Item	Pay Unit
Sidewalk Ramps	SY
Concrete Trail (6'-0'')	SF
Concrete Trail (8'-0')	SF
Concrete Trail (10'-0'')	SF
Concrete Rumble Strip	LF

4.3 PAYMENT

A. Concrete Paving: Payment shall be made at the square foot price and shall include labor, materials, and incidental work and equipment required to construct this item in accordance with the Drawings and Specifications, including subgrade preparation, excavation, embankment, formwork; formwork of rumble strip; concrete joint at existing paving; fibrous reinforcing; dowels; finishing; joints; protective coatings; curing; sweeping; washing; cleanup, compaction, dowelling, expansion jointing, concrete placement, scoring, curing and testing.

END OF SECTION 32 13 13

SECTION 32 15 40
CRUSHED STONE PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Special Conditions sections and the City of Thornton Standards and Specifications, apply to work of this Section. In the event of conflict(s) between this Section, the Drawings and the General and Special Conditions of the Contract, the stricter contents shall govern.

1.2 SUMMARY

A. This Section includes requirements for demolition, earthwork, grading, furnishing, and placement of crushed stone paving.
   1. Furnish and place crushed stone paving at a depth of 6'', bonded with fine aggregate and mixed-in stabilizer, constructed on a prepared underlying base course in accordance with these specifications and in conformity with the dimensions, typical cross section, and the lines and grades shown on the Contract Drawings. Crusher Fines Paving will be used as shown on the Contract Drawings.

1.3 REFERENCES

A. ASTM C117 – Test Method for Materials Finer than No. 200 (75-um) Sieve in Mineral Aggregates by Washing.

B. ASTM C136 – Method for Sieve Analysis of Fine and Coarse Aggregates.

C. ASTM D4318 – Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils.

1.4 SUBMITTALS

A. Material Analysis: Contractor shall provide copies of the following test data required by ASTM:
   1. ASTM C136 - Sieve Analysis.
   2. ASTM C127 - Specific Gravity and Absorption.
   3. ASTM C131 - L.A. Abrasion.

B. Samples: Provide a one (1) quart sample of material for approval.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws if applicable.

B. Bulk Materials:
   1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas, plant materials or within critical root zones.
   2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
   3. Accompany each delivery of bulk materials with appropriate certificates.

C. Rejection of material.
   1. Evidence of inadequate protection or improper handling or storage shall be cause for rejection.
   2. Any product or material exhibiting signs of damage due to nonconformity to specifications or due to delivery, storage or handling shall be rejected by the Owner. Contractor shall be responsible for hauling off-site and disposing of according to general conditions and codes of the governing jurisdiction.

1.6 PROJECT CONDITIONS

A. Environmental requirements: Work shall occur only when weather and soil conditions permit in accordance with locally accepted practice.

B. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with proposed crushed stone paving areas by field measurements before proceeding with work.

C. Interruption of Existing Services or Utilities: Do not interrupt services or utilities to facilities occupied by Owner or others.

D. Existing Conditions:
   1. Utilities: Determine location of existing and proposed underground utilities. Perform work in a manner to avoid damage. Hand excavate, as required.
   2. Excavation: Maintain grade stakes set by others until removal is mutually agreed upon by parties concerned.

E. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained.

1.7 MAINTENANCE SERVICE

A. General: Maintain Work in accordance with the General and Special Conditions.
   1. Maintenance Period: Begin maintenance immediately after Work is completed. Maintain areas until Initial Acceptance.

1.8 WARRANTY

A. See Division 01 Section “Warranty”.

PART 2 - PRODUCTS

2.1 CRUSHED STONE PAVING

A. Type: Crushed granite stone or gravel. Shall be unused material free of shale, lay, friable materials, organics and debris.
   1. Size Range: 3/8 inch maximum

Sieve Size	Percent Passing
2 inch	100
3/8 inch	100
No. 4	85
No. 8	63
No. 16	50
No. 30	39
No. 50	29
No. 100	18

   2. Color: Grey Breeze for the trail tan breeze for the nature exploration zone, or as approved by the Owner.

B. Stabilizer by Stabilizer Solutions Inc or approved equal. 3/8 minus Grey Crusher Fines 15 lbs. Stabilizer Organic Binder per ton (per Stabilizer Solutions Specifications)

2.2 GRAVEL MAINTENANCE STRIP

A. Type: 3/4'' Cheyenne Grey free from deleterious materials and not larger than 1''. Shall be unused material free of shale, lay, friable materials, organics and debris.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where the Work of this Section will be performed for compliance with requirements and conditions affecting installation and performance.
   1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within the work area.
   2. Verify that final grades are completed in accordance with the drawings.

B. Proceed with installation only after unsatisfactory conditions have been corrected and approved by Owner.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities, turf areas, existing landscape areas, and trees from damage.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of

C. Install edging of type and in locations shown on drawings. Obtain acceptance of layout by Owner before excavating or installing. Make minor adjustments as required.

3.3 PLACEMENT OF CRUSHED STONE PAVING

A. Cut earthwork to width of trail/area to receive crusher fines paving to approximate depth section as specified on the Contract Drawings. Remove, haul and dispose of excess material off site, or use on-site with approval of Owner.

B. Complete excavation required in sub-grade before fine grading and final compaction of sub-grade is performed. Extend sub-grade compaction one foot (1') beyond proposed edge of crushed stone paving or as indicated on drawings.
   1. Where earth moving is required the sub-grade shall be compacted to ninety five percent (95%) standard proctor within two percent (2%) of the optimum moisture.
   2. Keep areas being graded or compacted shaped and drained during construction. Ruts greater than or equal to 1 inch deep in sub-grade shall be graded out and reshaped as required, and re-compacted before crushed stone paving placement.
   3. If the trail is part of a cross slope it should drain in the direction of the slope no greater than two percent (2%). Ensure that no low spots exist so that ponding does not occur.

C. Prior to placement of Crushed Stone Paving material, the sub-grade shall be proof rolled. Where soft spots are detected, scarify subgrade beneath Crushed Stone Paving trail to a minimum of six-inch (6") depth. Moisture treat and compact to a minimum ninety five percent (95%) proctor density as determined by ASTM D698 or AASHTO T-99. Take moisture density tests every two hundred fifty (250) lineal feet of trail or proof roll. Treat and compact sub-grade, leaving it 5-inches below final grade for placement of Crushed Stone Paving. Compact material and retest by proof rolling to achieve approval of Owner.

D. Install crushed stone paving only after excavation and construction work which might injure it have been completed, and after edging has been completely installed on the compacted sub-grade. Install crushed stone paving, over compacted base course in areas indicated on plan.

E. Spread crushed stone evenly to fifty percent (50%) of specified depth. Avoid segregation of aggregate and contamination with lower courses or sub-grade.

F. Compact to ninety-five percent (95%) of maximum density as determined by ASTM D1557.
   1. Maintain surface course moisture content within plus/minus three percent (± 3%) of optimum. Add water to quarry fines paving as required to achieve optimum moisture content and a uniform, compacted surface conforming to the finish grades indicated.
   2. Compact areas inaccessible to rolling by mechanical tamping.

G. Protect crushed stone paving from soil or other contaminates during and following installation.

H. Placement of Geotextile Fabric: Lay straight and even with width. Overlap fabric edges a minimum of 6" and pleat at curves. No geotextile fabric shall be applied until subgrade is approved by Owner. Secure with fabric to bed at edges and every 48” maximum.

I. Spread and compact additional crushed stone paving to achieve the required minimum compacted thickness per compaction requirements in this section

J. Do not allow traffic on stabilized crushed stone paving for two days.

3.4 MAINTENANCE AND REPAIRS:

A. Crusher Fines Paving:
   1. Before initial acceptance walk-through, areas that do not compact, become eroded or are degraded in visual quality and/or performance as determined by the Owner are to be removed and/or repaired. Obtain approval of repair methods from Owner prior to affecting repairs.

3.5 CLEANUP AND PROTECTION

A. All areas shall be clean at the end of each workday.

B. The contractor shall maintain protection during installation, curing, and maintenance periods.
   1. Erect temporary fencing or barricades and warning signs as required protecting newly installed Crushed Stone Paving areas from traffic, other trades, and trespassers. Maintain fencing and barricades throughout initial maintenance period and remove with approval of Owner.

C. Project completion: All debris, soil, trash, and excavated and/or stripped material resulting from Crushed Stone Paving operations and unsuitable for or in excess of requirements for completing work of this Section shall be disposed of off-site.

D. Maintain protection during installation and maintenance periods. See Division 1. Treat, repair or replace damaged work as required.

E. Refer to Division 1 Section “Quality Assurance”.

PART 4 - MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

A. Measurement will be made of the actual number of square feet of stabilized crusher fines paving placed and accepted at the locations shown on the Drawings or as directed by the Owner, and in accordance with the Specifications.

4.2 PAYMENT

Pay Item	Pay Unit
Stabilized Crusher Fines Trail (6'-0'')	SF
Crusher Fines Paving	SF
Gravel Maintenance Strip	SF

Payment will be made at the contract unit price, and shall include receiving, coordinating and storing crusher fines and gravel materials, coordination and placing of the stabilizer materials, storing, placing the paving, coordination of the final placement, transportation, equipment, labor, excavation, grading, stockpiling, disposing, hauling off, watering, dust control, landscape fabric installation, landscape renovation as required in accordance with the Contract Drawings and Specifications.

END OF SECTION 32 15 40

SECTION 32 20 00
SITE FURNISHINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Install open 3-rail fence, open space signage, steel bench, trash receptacle, boulder, pet waster station, vertical feature log, log border, shade structure and play sand.

1.2 QUALITY ASSURANCE

A. Contractor Qualifications: Install work using skilled persons, proficient in the trades required, in a neat, orderly and responsible manner with recognized standards of workmanship. Contractor shall have not less than 5 years successful experience with installation of similar work. Submit lists of three projects completed in the last two years of similar complexity to this project number including owner's name and telephone number, name of project, Landscape Architect and telephone number.

1.3 PRODUCT DELIVERY, HANDLING AND STORAGE
Deliver, handle and store materials in manner to prevent damage or deterioration. Deliver and store packaged materials in original, unopened, labeled containers. The Contractor is responsible for damage and subsequent repairs or replacement.

1.4 GUARANTEE
Guarantee all proposed items placement as specified in the General and Special Contract Conditions. Guarantee all materials for length of manufacturer's warranty or as specified in the General Contract Conditions, whichever is greater.

PART 2 - PRODUCTS

SEE DRAWINGS FOR LOCATION AND ADDITIONAL INFORMATION FOR FURNISHINGS

2.1 Open 3-Rail Fence
See Detail

2.2 Open Space Signage
See Detail

2.3 6' Steel Bench
Model No.: 68-511SSK-2AR S-1 Embedment
Manufacturer: DuMor
Representative: Rocky Mountain Recreation
Phone: (303) 783-1452
Color: Black
Or approved equal

2.4 Trash Receptacle
Model No.: 432-55/S-1 W/CVR-30-FTO
Manufacturer: DuMor
Representative: Rocky Mountain Recreation
Phone: (303) 783-1452
Color: Black
Or approved equal

2.5 Feature Boulder
See Detail

2.6 Pet Waste Station
See Detail

2.7 Vertical Feature Log – Installation & Transport Only
See Detail
Contractor to coordinate with the Owner for salvaged log locations
Log Retrieval from two locations: Riverdale Ballfields & Grandview Pond
All logs must be approved for Owner approval

2.8 Log Border – Installation & Transport Only
See Detail
Contractor to coordinate with the Owner for salvaged log locations
Log Retrieval from two locations: Riverdale Ballfields & Grandview Pond
Pine & Spruce are potential alternatives with bark where possible
Chamfer log border edge
Remove all branches less than 6'' in diameter
Trim branches to no longer than 18'' in depth
Add Alternate #3: Contractor to provide all logs for the log border
All logs must be approved for Owner approval

2.9 Shade Structure
Model No.: 8'X12' Marana
Manufacturer: Classic Recreation Systems Inc
Representative: GR Marolt & Associates
Roof Type: HR-36
Add Alternate #2: Switch the HR-36 with a Standing Seam Roof
Phone: (303) 762-1090
Frame Color: RAL 9017 9840-91743R
Roof Color: McElroy Galvalume Pus
Contractor shall provide color swatches for final approval before installation for the frame and roof colors
Or approved equal

2.10 Play Sand
Type: USGA Warrior Sand
Company: All American Sports Material
Phone: (970) 539-4550
Or approved equal

2.11 Boulder Table – Add Alternate #1
See Detail

PART 3 - EXECUTION

3.1 INSPECTION
Inspection of the work to determine the completion of contract, exclusive of the possible repair and replacement of equipment under the normal one (1) year warranty from initial acceptance of the project, will be made by the Owner upon written notice requesting such inspection submitted by the Contractor at least ten (10) days prior to the anticipated date.

3.2 INSTALLATION

A. The manufactured and fabricated accessories specified herein shall be installed in accordance with the manufacturers' instruction and/or Contract Drawings and shall include all means necessary for a complete installation as shown on the Drawings or as otherwise noted by the Owner.

B. All site furnishings shall be installed at the locations shown on the Drawings or as otherwise noted by the Owner.

PART 4 - MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

A. Measurement shall be the open 3-rail fence, open space sign, 6’ steel bench, trash receptacles, solar light, feature boulder, vertical feature log, log border shade structure, and play surfacing-sand to be installed.

4.2 PAYMENT

A. Payment will be made under:

Pay Item	Pay Unit
Open 3-Rail Fence	LF
Open Space Signage	EA
6’ Steel Bench	EA
Trash Receptacle	EA
Feature Boulder	EA
Vertical Feature Log	EA
Log Border	LF
Shade Structure	EA
Play Sand	SF

Pay Item	Pay Unit
Add Alternate #1: Boulder Table	EA
Add Alternate #2: Standing Seam Roof	EA
Add Alternate #3: Log Border-Contractor Provided Logs	LF

B. Payment shall be made at the unit price and shall include storing and installing the rail fence, coordination with the rail fence installer & manufacturer, coordination of placement and install of the Thornton open space sign and footings, bench manufacturer coordination, bench, add alternate standing seam roof, trash receptacle and shade structure final locations, final rail fence and locations, installation and coordination for the final locations of the boulders, vertical feature logs, log borders and the sand play surfacing, installation of the rail fence, salvage and retrieve existing logs, travel to retrieve the existing logs, coordination with the Owner related to the storage and delivery of the materials and all other related and necessary materials and incidental work and equipment required in accordance with the Drawings and Specifications.

END OF SECTION 32 20 00

SECTION 32 80 00
IRRIGATION SYSTEMS
PHASE 2 – FOR INFORMATION ONLY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Special Conditions sections and the City of Thornton Standards and Specifications, apply to work of this Section. In the event of conflict(s) between this Section, the Drawings and the General and Special Conditions of the Contract, the stricter content shall govern.

1.2 SUMMARY

A. This Section includes the requirements for the installation of an underground irrigation system including the following:
   1. Trenching, stockpiling excavation materials, refilling and compacting trenches.
   2. Complete irrigation system including but not limited to piping, valves, fittings, heads and wiring, sensors, backflow preventer(s), Automatic Irrigation Controller(s) and final adjustments to insure complete coverage.
   3. Water and electrical connections.
   4. Replacement of unsatisfactory materials.
   5. Cleanup, inspections, and approval.
   6. Testing and Irrigation Audit, Winterization, Spring Start Up and DBC Extended Warranty.

1.3 REFERENCES

A. Conform to requirements of reference information listed below except where more stringent requirements are shown or specified in Contract Documents.
   1. American Society for Testing and Materials (ASTM) - Specifications and Test Methods specifically referenced in this Section.
   2. Underwriters Laboratories (UL) - UL Wires and Cables.
   3. National Sanitation Foundation (NSF) – Piping and backflow prevention.
   4. American Water Works Association – Piping and backflow prevention.
   5. City of Thornton irrigation design guidelines and Standards & Specifications.

1.4 QUALITY CONTROL

A. Special Requirements.
   1. Tolerances: Specified depths of mains and laterals and pitch of pipes shall be installed per the Contract Drawings and specifications.
   2. Compaction: Settlement of trenches is cause for removal of finish grade treatment, refilling, compaction, and repair of finish grade treatment.

3. Coordination with Other Contractors: Protect, maintain, and coordinate work with work under other Sections.
4. Damage to other Improvements: Contractor shall replace or repair damage to grading, soil preparation, seeding, planting and/or new site features done under other Sections during Work associated with installation of irrigation system at no additional cost to the City.
5. Damage or Disturbance to the Existing Irrigation Components: Damage to existing components as a result of work being performed by the Contractor will require the Contractor to replace the damaged components to the City's current standards, at no additional cost to the City.
6. Water Delivery Interruption: When working on an existing irrigation system, the Irrigation Contractor shall contact the Owner and inform them seventy-two (72) hours in advance of any water interruption that is required. The maximum irrigation system interruption is to be no more than seventy-two (72) hours during the growing season, without prior approval from the Owner. The contractor shall make all necessary provisions including material, equipment, labor, delivery and scheduling as required to complete all points of connection, upgrades, and improvements within seventy-two (72) hours.
7. Watering: The Contractor is responsible for following all City of Thornton native seed & irrigation guidelines rules and regulations for seed establishment.
8. Permits: Work involving plumbing for installation of copper piping, ductile iron piping, backflow preventer(s), and related Work shall be executed by licensed and bonded plumber(s). Secure a permit at least forty-eight (48) hours prior to start of installation. Work involving high voltage electrical wiring, grounding and related Work shall be executed by licensed and bonded electrician. Secure a permit at least forty-eight (48) hours prior to start of installation

B. Pre-Construction Conferences and Site Meetings:
1. Contractor shall schedule and conduct a pre-construction conference to review in detail quality control and construction requirements for equipment and materials used to perform the Work. Conference shall be scheduled not less than ten (10) days prior to commencement of Work. All parties required to be in attendance shall be notified no later than seven (7) days prior to date of conference. Contractor shall notify qualified representatives of each party concerned with that portion of Work to attend conference, including but not limited to the Owner, Thronton Parks Superintendent, Contractor's Superintendent, and Installer.
2. Prior to commencement of Work, Contractor shall schedule an on-site conference with Owner, and any other parties designated by Owner to discuss tree protection requirements, staging locations, traffic control, and equipment access. Provide a minimum of seven (7) days notice prior to date of conference.
   a. Identify on Contact Drawings all existing locations of components.
   b. Verify the operation of each component.
   c. Provide documentation of existing components and conditions to the Owner prior to starting Work.
3. Contractor shall schedule on-site conferences the frequency of which is to be determined by the Owner and any other parties designated by the Owner to review project progress.

4. Contractor shall record Meeting Minutes of each conference and distribute to all parties in attendance within three (3) days of conference.

1.5 SUBMITTALS

A. Prepare and make submittals in accordance with conditions of the Contract prior to installation of any irrigation equipment:

B. Material List: Submit a PDF file of complete list of materials, and cut sheets indicating manufacturer, model number and description of all materials and equipment to be used. Show appropriate dimensions and adequate detail to accurately portray intent of construction.

C. Shop Contract Drawings: If applicable, submit shop Contract Drawings for pumps, backflows and assemblies. Include plumbing and foundation/support systems if the installation differs from the manufacturer's recommended installation.

D. Mock Ups:
1. Valve assembly: Provide a completely built electrical valve assembly. This mockup, to include electric valve, service tee, lateral valve riser length as required for mainline depth, and male thread by spigot outlet adapter. The mock up may be incorporated into the work toward the end of the project.
2. Swing joints: Provide a swing joint assembly for each detail shown (e.g. - quick coupler, rotors and pop-up spray head) or as directed by the Owner
3. Drain valves: Provide a mock up including the service tee, required fittings, and drain valve.
4. Other: Mock ups that may be requested by the Owner.

E. Operation and Maintenance Manual: Coordinate scheduling/precipitation instructions with the City's operations staff. Submit one (1) digital copy in PDF format to the Owner including:
1. Winterization and spring start-up procedures.
2. Cut sheets of products.
3. Manufacturer's inspection and maintenance instructions for backflow preventer (if applicable).
4. Manufacturer's maintenance and operation instructions for pump station (if applicable).

F. Warranty: Submit one (1) year written warranty, in accordance with WARRANTY/GUARANTEE section.

G. CONTRACT RECORD DRAWINGS
1. Prior to the installation of irrigation system, the Contractor will provide on-site copies of original irrigation design Contract Drawings "Record Contract Drawings". Contractor to revise Record Contract Drawings in red ink as Work progresses to show any changes to the plan and include field dimensions. Record Contract Drawings shall be brought up-to-date prior to any Pay Application Submittals that contain irrigation installation. Should the Contractor choose to utilize GPS for the purposes of documenting Work in progress, a hard copy print will need to be

provided prior to Pay Application Submittal. A print of Record Contract Drawings shall be available at Project Site for review by the Owner at any time during the project.

2. Record Contract Drawings shall encompass entire scope of work including any altered existing equipment and altered zones, and notate the Automatic Irrigation Controller zone number, type of irrigation, GPM, operating PSI for any altered or added zone.
3. Preparation of Contract Record Drawings: Dimension from two permanent points of reference (building corners, sidewalk, road intersections or permanent structures) the location of the following items:
    a. Point of connection.
    b. Isolation Valves
    c. Drain Valves
    d. Backflows
    e. Bypass lines
    f. Service lines

4. Routing of irrigation mainline. Provide dimensions for each one-hundred linear feet (100 L.F.) maximum along each routing and for each change of direction.
5. Routing of non-pressure lateral lines, layout and size.
6. Sprinkler control valves.
7. Quick coupling valves.
8. Drain valves
9. Flow Sensor and Master Valve (Hydrometer)
10. Rain sensor
11. Wire splice boxes
12. Control wire routing if not with pressure mainline.
13. Gate valves.
14. Air relief valves.
15. Sleeves.
16. Flush valves.
17. Power service drop.
18. Grounding rods
19. Other related equipment as directed.

H. Make dimensions accurately at the same scale used in the original Contract Drawings, or larger. Notes and dimension lettering must be legible.

I. The irrigation legend must be changed to accurately reflect the irrigation equipment installed, if such equipment is not the same as originally specified on the contract documents. This includes flow rates, effective spray diameter/radius and operating pressure of all sprinkler heads.

J. The Owner will not certify any pay request submitted by the Contractor if the Contract Record Drawings are not current, and processing of pay request will not occur until Contract Record Drawings are updated.

K. Contract Record Drawings: Prior to the substantial completion walk, the Contractor shall provide a digital copy of the irrigation design with record installation information

that reflects all changes made over the course of the construction project. Contract Record Drawings shall include details of any revisions as per actual installation. Deliver and submit to the Owner for review the following items:

1. Digital Contract Record Drawings in both PDF and AutoCAD format (include any related X-ref files, plot files and pen settings.) Make any additional changes to the file as directed by the Owner prior to final submittal and approval.

L. Request for Substantial Completion or Initial Acceptance will not be processed until all Contract Record Drawing prints and digital files have been received and approved by the Owner.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packing and Shipping: Deliver all components to job site in original unopened packaging containers prominently displaying manufacturer's name, volume, quantity, contents, instructions, and conformance to local, state, and federal law. Remove and replace cracked, broken, or contaminated items or elements prematurely exposed to moisture, inclement weather, snow, ice, temperature extremes, fire, or jobsite damage.

B. Handling, Storage, and Delivery of PVC Pipe:
1. Exercise care in handling, loading and storage of PVC pipe.
2. Provide forty-eight (48) hours advance notice of delivery to the Owner for observation of unloading and handling of PVC materials during delivery.
3. All PVC pipe shall be transported in a vehicle which allows length of pipe to lie flat so as not to subject it to undue bending or concentrated external loads. All sections of pipe that have been dented or damaged shall be discarded, and shall be replaced with new piping.

C. Storage and Protection: Deliver, unload, store, and handle materials, packaging and bundling products in dry, weatherproof condition in manner to prevent damage, breakage, deterioration, intrusion, ignition, and vandalism.

D. Only materials and equipment meeting project specifications and to be used as part of Project shall be stored on site. Owner to may verify at any time during construction period.

1.7 JOBSITE CONDITIONS

A. Existing Conditions:
1. Soil Conditions: The Contractor is responsible for investigating the type of soil and conditions in which lines are to be installed. No extra payment will be allowed due to difficulty in trenching, unless approved by the Owner.
2. Contractor is responsible for understanding the scope of related operations as specified and indicated in the Contract Drawings and Specifications before beginning Work under this Section.
3. Report unsatisfactory conditions in writing to the Owner within twenty-four (24) hours of discovery. Commencement of installation means acceptance of existing conditions by the Contractor.

B. Protection of Property:
   1. Protect buildings, walks, walls, and other property from damage. Erect and maintain barricades, warning signs and lights, and provide guards as necessary or required to protect all persons on the site. Damage caused to asphalt, concrete, monuments, structures or other building material surfaces shall be repaired or replaced at no cost to the City. Restore disturbed areas to original condition.
   2. The Contractor is responsible for potholing of all existing utilities, irrigation lines or any other underground improvements that may be damaged due to the installation of Irrigation Systems.

C. Protection of Existing Trees:
   1. Refer to Division 01 Section “Tree Retention and Protection”.
   2. Consult with the Owner prior to trenching or boring within the tree protection zones. All trenching or work within tree protection zone of any tree shall be dug by hand or by other methods as directed by the Owner so as to prevent damage to limbs or branches and root system.
   3. Directional boring that is permitted within tree protection area must occur at thirty-six inches (36”) below grade and may not take place anywhere within four feet (4’) of the drip line. Any exception must be agreed upon by the Owner.

D. Protection and Repair of Underground Lines:
   1. Request utility locates seventy-two (72) hours in advance of any excavations by calling the Utility Notification Center of Colorado at 811. Take whatever precautions are necessary, including pot holing to verify location and depth to protect these underground lines from damage. If damage does occur, all damage shall be repaired by the Utility Owner. All costs of such repairs shall be paid by Contractor.
   2. The Contractor is required to contact all private utility companies including City Departments to locate all private utilities. The request for locates shall be a minimum of seventy two (72) hours prior to proceeding with any excavation. If, after such requests private utilities are encountered and damaged by the Contractor these shall be repaired at no cost to the City. If the Contractor damages staked or located private utilities, they shall be repaired by the Utility Owner at the Contractor’s expense.

E. Replacement of Paving and Curbs: Any damage due to work that occurs adjacent to or crosses existing roadways, paths, trails, curbing, sidewalks, etc. shall be restored to original condition at the contractors expense, and the satisfaction of the Owner.

1.8 WARRANTY/GUARANTEE

A. Provide a one year written warranty for material and installation from date of Initial Acceptance plus DBC extended warranty.

B. Expenses due to vandalism before Initial Acceptance shall be the Contractor’s responsibility.

C. Any settling of backfilled trenches that occurs during warranty period shall be repaired at no expense to the City, including complete restoration of damaged property.

D. The Contractor is responsible to monitor and coordinate Automatic Irrigation Controller scheduling and maintenance with the Owner for any seeding under the Contractor's warranty.

E. Owner reserves the right for Parks Operations Staff to make temporary repairs during the warranty period as necessary to keep systems in operating condition without voiding the Contractor's warranty, nor relieving the Contractor of their responsibilities.

F. The Contractor shall make repairs and replacements within three days of notification. If the Contractor fails to make repairs within three days, the City will make such repairs at the Contractor's expense.

1.9 TURN OVER ITEMS

A. Where applicable, furnish the following maintenance items to City prior to Final Acceptance:
   1. Two (2) sprinkler heads for each size and type specified.
   2. Two (2) nozzles for each type of head and spray pattern.
   3. Two (2) head adjustment tools for each type of head installed.
   4. Two (2) valve keys for operating each type of manual valve. (Manual drain valves, isolation valves).
   5. Two (2) valve keys and hose swivels for each type of quick coupling valve.
   6. One (1) handheld PRO 400 Amada TDR graphic

1.10 MAINTENANCE DURING PROJECT CONSTRUCTION

A. Within Limits of Construction: Contractor shall fence, water, and keep weed free any turf, trees and any plantings within the limits of construction. Contractor is responsible for maintenance which includes picking up trash, weed control and mowing of turf and native areas within the limits of construction. Contractor is responsible for watering existing landscape within limits of construction. Turf and plants affected by mainline work or irrigation water service shutdown during irrigation season shall receive watering per Parks' schedule, with no interruption of watering greater than seventy-two (72)-hours. Contractor is responsible for maintenance until Initial Acceptance is granted.

B. Outside Limits of Construction: Coordinate Automatic Irrigation Controller scheduling and maintenance operations with Owner for portions of City property unaffected by construction.

C. Additional Maintenance During Warranty Period:
   1. Make repairs and replacements needed due to defective workmanship and materials.
   2. Winterization: Include cost in bid for winterizing complete system at conclusion of irrigation season (during which system received Initial Acceptance) within three (3)-days of notification by the City. System shall be voided of water using

compressed air. Coordinate with the Thornton Parks Operations Supervisor and the Owner to be present during the winterization procedures. The Contractor shall notify all persons that are to be present a minimum of forty eight (48) hours prior to the winterization of the system.

3. Spring Start Up: To take place the following season within three (3) days of notification by the City. Open, operate, adjust system and make any necessary repairs. Coordinate with the Thornton Parks Operations Supervisor and the Owner to be present during the spring start up procedures. The Contractor shall notify all persons that are to be present at the spring start up a minimum of forty-eight (48) hours prior to starting of the system.

PART 2 - PRODUCTS

2.1 GENERAL

A. Equipment must have performance characteristics to operate per the design conditions indicated. If any discrepancy or conflict exists between the quantities of equipment listed in the schedule and quantities shown on the Contract Drawings, the greater quantity shall govern.

B. All material shall be of the highest grade possible and where applicable, shall be marked accordingly and shall be new.

2.2 PIPE AND PIPE FITTINGS

A. Ductile Iron Pipe

1. Ductile Iron Pipe: Centrifugal cast ductile iron in metal molds for water pipe In accordance with ANSI C151 and AWWA A21.51 with asphaltic exterior coating and interior lining and coating in accordance with ANSI C151 and AWWA A21.51. Rubber-Gasket joints shall conform to ANSI/AWWA C111/A2.11.

B. Ductile Iron Fittings

1. All ductile iron fittings shall be made of class 350 ductile iron and shall have slanted, deep bell, rubber gasket style made in accordance with ASTM A-536, Grade 65-45-12 & AWWA C153. All fittings shall have a minimum of five (5) degree freedom of pipe deflection within the bell end.
2. All ductile iron pipe fittings, joint restraints and mainline isolation gate valves shall carry a minimum 10-Year warranty on any defective replacement products and labor replacement costs. Prior to the installation of pipe fittings, joint restraints and mainline gate valves, the manufacturer shall provide documentation stating the above warranty information in writing and signed by the Manufactures Representative.
3. All ductile iron fittings and joint restraints shall have a fusion bonded epoxy coating on interior and exterior of the product surface, average of ten to twelve mm (10-12) thickness. Epoxy coating shall conform to the requirements of CSA Z245.20-20 and NSF 61 for water services. Tar/bitumen coating will not be approved.

C. Copper Pipe and Fittings:
   1. Pipe: Type K, rigid, hard tempered.
   2. Fittings - Wrought copper, solder joint type. Joints - Soldered with solder, forty five percent (45%) silver, fifteen percent (15%) copper, sixteen percent (16%) zinc, and twenty four percent (24%) cadmium and solidus at 1125° F and liquids at 1145° F.

D. Main and Lateral Lines:
   1. Main Lines (pressurized, downstream of backflow prevention units):
      a. Class 200 PVC BE, size one inch (1") through two inch (2").
      b. Class 200 PVC RT/Gasketed, size two and one-half inches (2-1/2") and larger.
      c. Velocities in PVC mainline shall not exceed five feet (5') per second.
      d. All PVC pipe shall conform to the requirements of Type 1-ASTM-D-2241.
   2. HDPE pipe
      a. Pressure rating DR 11 two hundred (200) PSI
      b. PE4710, ASTM F714.
         1) May be used by approval of the Owner for portions of irrigation system that require boring such as below trees and paving.
      c. HDPE to PVC mainline and laterals require epoxy coated repair coupler with joint restraints and stainless-steel pipe stiffener.
   3. PVC Lateral Lines
      a. Class 200 PVC BE, size one-inch (1") to three-inch (3") inch.
      b. Velocities in PVC mainline shall not exceed five feet (5') per second.
      c. All PVC pipe shall conform to the requirements of Type 1-ASTM-D-2241.
   4. Poly Lateral Lines:
      a. One hundred (100) PSI High Density NSF Polyethylene Piping – one inch (1") minimum diameter.
      b. Velocity of water flow in polyethylene pipe shall not exceed seven and one half (7-1/2) feet per second.

E. Sleeving:
   1. Horizontal sleeves under paved surfaces: Class 160 PVC.
   2. Vertical sleeves for access to drains and valves: Class 160 PVC.
   3. Horizontal sleeving for boring applications: DR 11 HDPE.

F. Brass Pipe and Fittings:
   1. Brass Pipe: Eighty-five percent (85%) red brass, ANSI Schedule 40 threaded pipe.
   2. Fittings: Medium brass, threaded one hundred twenty five (125) pound class.

G. Pipe and Fittings:
   1. Identification Markings: Identify all pipe with following indelible markings:
      a. Manufacturer's name.
      b. Nominal pipe size.
      c. Schedule of class.
      d. Pressure rating.
      e. NSF (National Sanitation Foundation) seal of approval.
      f. Date of extrusion.

2. Class 200 PVC Pipe (pressurized mainline one and one-half inches (1-1/2”) and smaller):
    a. Pipe will be assembled with Schedule 80 PVC fittings and solvent welded using ASTM-F-656 purple primer followed with heavy bodied ASTM-D-2564 cement.

3. Class 200 PVC Pipe (pressurized mainline two inches (2”) and larger):
    a. Manufactured from virgin Polyvinyl Chloride compound in accordance with ASTM D2241 and ASTM D1784; cell classification 1254-B, Type 1, Grade 1.
    b. All fittings, service tees and pipe restraints shall be epoxy-coated ductile iron fittings.
4. Class 200 PVC Pipe (all lateral lines)
    a. Pipe will be assembled with Schedule 40 PVC fittings and solvent welded using ASTM-F-656 purple primer followed with heavy bodied ASTM-D-2564 cement.
5. High Density Polyethylene (HDPE)
    a. Must meet ANSI/AWWA C906, ASTM F714/D3035. Materials used for the manufacture of polyethylene pipe and fittings shall be made from PE 4710 high density polyethylene resin compound meeting cell classification 445574C/E per ASTM D3350. Certification ANSI/NSF 61/14. All fittings shall be installed using butt-fused fittings, thermo-fused fittings/couplings, or flanged adapters and must be approved by the Owner.
6. Flexible Plastic Pipe (non-pressure lateral lines):
    a. Manufactured from virgin polyethylene in accordance with ASTM D2239, designated as PE 3408. Maximum size two inches (2”); minimum size one inch (1”).
    b. Fittings: Manufactured in accordance with ASTM D2609; PVC Type 1 cell classification 12454-B.
    c. Clamps: All stainless-steel worm gear screw clamps. Use two (2) clamps per joint on all insert fittings.
    d. Risers for Pop-up Heads: Shall be swing pipe, 0.49 ID, operating pressure of eighty (80) PSI.

2.3 VALVES

A. Gate Valve or Isolation Valve:
1. Valve for one and one-half inch (1-1/2”) and smaller mainline (solvent-weld): Shall be cast iron body, threaded ends, left-hand opening, square nut operated, rubber resilient seated, FIPT joint AWWA gate valve with clear waterway equal to full diameter of pipe. Able to withstand continuous working pressure of one hundred fifty (150) PSI. Wheel type handle is unacceptable.
2. Valve for two inch (2”) and larger mainline: Shall be epoxy coated interior and exterior ductile iron body which meets ASTM A-536, Grade 65-45-12, push-on, left-hand opening, square nut operated, resilient wedge, mechanical joint AWWA C153 gate valve with clear waterway equal to full diameter of pipe. Able to withstand continuous working pressure of two- hundred fifty (250) PSI. Wheel type handle is unacceptable.

B. Automatic Control Valve:
   1. Automatic Valve for Potable Water System: Rain Bird PEB Series Valve having manual flow adjustment and both internal and external manual bleed. PRS-D shall be used if pressure at the heads is greater than ten pounds over the optimal pressure as stated on the plans or measured in the field.
   2. Automatic Valve for Non-Potable Water System: Rain Bird PESB Series. PRS-D shall be used if pressure at the heads is greater than ten (10) pounds over the optimal pressure as stated per the manufactures catalog, plans or measured in the field.
   3. Valve Riser: Epoxy coated ductile iron riser with integral stainless-steel angle valve or approved equal.
   4. Install one flexible marker tag on each valve. Mark each tag with indelible ink indicating zone number. Tags shall be: Potable water systems (yellow), Non-potable systems (purple)

C. Manual Drain Valve:
   1. Drain Valve: Mueller Oriseal #H-10283 or AY McDonald, one inch (1") 3061 with brass swing joint assembly, or approved equal.

D. Quick Coupling Valves:
   1. Rain Bird as presented on plans and installation details., designed for working pressure of one hundred fifty (150) PSI; one inch (1") FIP. Size as shown on drawing.
   2. Quick Coupling Valves immediately after the backflow shall be used for winterization and shall be constructed of all brass swing joint and fittings. All other Quick Coupling Valve swing joints shall be constructed as shown on the details.

E. Master Valve & Flow Sensor Assembly:
   1. Baseline Hydrometer as presented on plans and installation details.

F. Valve Boxes:
   1. All valve boxes will have a stainless steel hex bolt locking system.
   2. Isolation Valves, Quick Coupling Valves, Drain Valves, Wire Splices and Ground Rods: Carson Brooks, Model #910-10, ten inch (10") round box.

   3. Electric Control Valve Box: Shall have locking cover branded with the zone numbers.
      a. Three-quarter inch (3/4") through one-inch (1") valves: Carson, Model #1015 standard box with bolt down T-cover.
      b. One and one-half inch (1-1/2") and 2" valves: Super Jumbo (17x30 box) Carson (13x24) 1220 jumbo valve box with bolt down T-cover

   4. Box color for valves:
      a. Green for potable systems.
      b. Purple for non-potable systems.

5. Gravel Leveling Bed and Drainage Sump in Valve Boxes: three quarters inch (3/4”) crushed gravel covered in geo-textile fabric, as indicated on Contract Drawings.

G. Air Relief Valve: On mainlines three inches (3”) or larger, as per plan: Bermad C31 2-inch combination vacuum/air release valve or approved equal.

H. Pressure Regulating Valve (where system pressures exceed one-hundred (100) PSI):
1. Bermad 420 pressure regulating master valve for two and one-half inch (2-1/2”) and larger mainlines.
2. Watts LFN55B pressure regulating valve for three-quarter inch (3/4”) thru one and one-half inch (1-1/2”) backflows.

2.4 SPRINKLER HEADS

A. Heads: Provide fabricated riser units of the type and size as indicated on the Contract Drawings. Heads of a specific type or function in the system shall be of the same manufacturer and shall be marked with the manufacturer’s name and identification in such a position that they can be identified without being removed from the system.
1. Pop-Up Sprinkler Heads in native grass areas and flower bed areas: Rain Bird RD-12-S- -F series.
2. Pop-Up Sprinkler Heads for trees in native areas; Rain Bird RD-12-S-F series with specified rotary nozzles as indicated on contract drawings.
3. Pop-Up Sprinkler Nozzles shall be Rain Bird MPR Series nozzle. Strip series, rotary, and VAN nozzles may be used for specific approved applications at the direction of the Owner.
4. Gear Driven Heads: As specified per Contract Drawings. Steel risers are permitted on twelve-inch (12”) rotor heads used in native areas.

B. Connections to Lateral Pipe:
1. Pop-up Heads: Shall be one-half inch (1/2”) swing pipe
2. Gear Driven Heads: Shall be manufactured PVC swing joints with dual O-rings as per detail.

2.5 AUTOMATIC CONTROL SYSTEMProvide Baseline controller unit as presented on the plans and installations details.

A. Electrical Control Wiring:
1. Standard Low Voltage Wire Systems for Existing Systems:
a. Electrical Control Wire for 24VAC Solenoid: Golf Course Sprinkler Wire - #12 to #14 AWG UL approved direct burial solid conductor copper wiring with polyethylene insulation 0.045-inch thickness.
b. Electrical Common Wire: Golf Course Sprinkler Wire - #12 AWG UL approved direct burial solid conductor copper wiring with polyethylene insulation 0.045-inch thickness.
c. Wire Colors: Consistent color system throughout.
1) Control Wires – Black.
2) Common Wires – White.
3) Spare Control Wires – Red.

4) Spare Common Wires – Purple.
5) Master Valve/Hydrometer Solenoid Wires – Green and Blue.
6) Tracer Wire – Yellow.

B. Miscellaneous control wiring materials:

1. Materials for both standard and two wire systems.
   a. Data Wires: Paige 7171D-A direct burial shielded and armored signal cable with polyethylene jacket (NO SUBSTITUTIONS)
      1) Data Wire connections and splices shall be made with Ranger Servi-Seal.
   b. Control Wire and Flow Sensor Cable connections and splices shall be made with 3M DBR/Y-6M direct bury splice, or approved equal, UL listed dry splice methods.
   c. Spare Wire and wire ends shall be capped with 3M DBR/Y.
   d. Mainline Tracer Wire: One (1) continuous AWG UL #12 tracer wire as detailed above all mainline
   e. Splice Box: Carson 910-10 ten-inch (10”) round box.

2.6 MISCELLANEOUS MATERIALS

A. Rain Sensor: Hunter wired Rain-Clik with by-pass or approved equal. Rain sensor shall be installed per manufacturer’s recommendations.

PART 3 - EXECUTION

3.1 PREPARATION

A. Utility Locates: Contact Utility Notification Center of Colorado at or 8-1-1 or 1-800-922-1987 prior to any excavation, for the marking of underground member utilities. The indication of utilities on the Contract Drawings does not relieve the Contractor of the responsibility for utility location. Contractor is responsible for potholing all utility locations to verify the depth and locations. Potholing related to irrigation installation shall be considered incidental to irrigation installation and will not be paid for separately. Route trenches to avoid existing utilities. Verify with the Owner any required relocation prior to installation.

B. Landscape Plan Review and Coordination: Contractor will be held responsible for coordination between landscape and irrigation system installation. Landscape material locations shown on the Landscape Plan shall take precedence over the irrigation system equipment locations. If irrigation equipment is installed in conflict with the landscape material locations shown on the landscape plan, the Contractor will be required to relocate the irrigation equipment, as necessary, at Contractor’s expense.

C. Pressure Verification: Contractor shall verify Gallons Per Minute flow at the project site, prior to commencing Work or ordering irrigation materials, and submit findings in writing to the Owner. If Contractor fails to verify tap size, static water pressure and flow prior to commencing Work or ordering irrigation materials, Contractor shall assume

responsibility for all costs required to make system operational and the costs required to replace any damaged landscape material. Damage shall include all required material costs, design costs, labor costs and plant replacement costs.

D. Inspection: Examine areas and conditions under which Work of this Section is to be performed. Do not proceed with Work until unsatisfactory conditions have been corrected.
   1. Grading operations, with the exception of fine grading, shall be completed and approved by Owner before staking or installation of any irrigation system begins.

E. Layout: Layout and stake system before beginning installation. Staking shall occur as follows:
   1. Mark, with paint, routing of pressure supply line and flag heads for all new zones. Contact the Owner forty-eight (48) hours in advance and request review of staking. The Owner will review staking and direct changes if required. Review does not relieve installer from coverage problems due to improper placement of heads after staking.
   2. Valve boxes and mainline will not be located in ball fields, and multi-use sport fields, recovery zones, or below playground equipment.
   3. If project has significant topography, free form planting beds, or other amenities which could require alteration of irrigation equipment layout as deemed necessary by the Owner, do not install irrigation equipment in these areas until the Owner has reviewed equipment staking.
   4. The Owner may request the City Forester's approval of proposed trenching prior to start of trenching.
   5. Review backflow prevention device location and operation with the Owner prior to mainline installation.

3.2 EXCAVATION AND BACKFILL

A. Install mainline pipe and wire sleeving under existing asphalt paving, concrete walks and critical root zones (CRZ) by directional boring. Pot-hole existing utilities for location and depth in advance of boring operations. When pot-holing in cross streets: include all permits, traffic control, backfill, compaction and surface restoration as required by the City of Thornton Transportation Engineering Standards and Specifications. Compact backfill at bore pits around the end of sleeves to ninety-five percent (95%) compaction in landscape areas. Contractor to provide temporary construction fencing where trenching occurs.

B. Excavation:
   1. Trenching:
      a. Trench excavation shall follow, as much as possible, the layout shown on Drawing. Dig trenches straight and support pipe continuously on bottom of trench. Trench bottom shall be clean and smooth with all rock and organic debris removed. Comply with OSHA standards for all trenching and excavation.
      b. Trenching within tree protection zone (TPZ): Accomplish by hand or other method that will not damage limbs or branches. Refer to Division 01 "Tree Retention and Protection" for additional precautions.

2. Clearances and Depths:
    a. Main pressure line: Make trenches of enough width to properly assemble and position pipe in trench. Clearances:
        1) Mainline and Lateral Piping clearance: Minimum clearance shall be one inch (1") horizontally on both sides of the pipe.
        2) Line Clearance: Provide minimum six inches (6") of clearance between each line, and minimum twelve inches (12") of clearance between lines of other trades.
        3) Installation of multiple runs of piping in common trench is prohibited.

    b. Pipe and Wire Depth to finish grade:
        1) Pressure Supply Piping: Twenty-six inches (26") from the top of pipe, maximum variation +/- one inch (1").
        2) PVC Sleeving: At specified pipe or wire depth.
        3) Non-pressure Piping (gear driven heads): Eighteen inches (18") from top of pipe, maximum variation two inches (2").
        4) Non-pressure Piping (pop-up heads):
            a) Turf zones: eighteen inches (18") from top of pipe.
            b) Native seed zones: Twenty-four inches (24") from top of pipe, maximum variation two inches (2")
        5) Control Wiring and Two-Wire Decoder Cable: Side of pressure main when installed in the same trench; twenty-four (24) inches deep when installed separately from the mainline trench.

3. Vibratory Plow: Not permitted without written authorization of the Owner.

3.3 INSTALLATION OF IRRIGATION EQUIPMENT

A. Locate all equipment in designated crusher fines bed shown on the Drawings. Deviations shall be reviewed and approved by the Owner prior to installation.

B. Service Line Piping (copper or ductile iron piping from water meter to connection to backflow prevention device) - When pipe installation is not in progress, or at the end of each day, close pipe ends with tight plug or cap.
    1. Ductile Iron Pipe – Provide and install full pipe length protective polyethylene factory- formed sleeves around all piping to be buried. Pipe shall be bedded per Thornton Water current standards and specifications.
    2. Copper piping – Installation shall match specifications for copper service line as required by Thornton Water and in accordance with City of Thornton Building Codes.

C. Sleeving:
    1. Install sleeving under any hard surface prior to surface being installed to accommodate piping and wiring.
    2. Minimum depth to top of pipe shall be determined by depth of mainline and lateral lines.
    Sleeving depth shall match pipe and wire depth for all pressure and non-pressure piping installed under all hardscape surfaces, asphaltic concrete, or concrete paving.

3. Sleeving under existing walks or concrete pavement shall be done by boring or hydraulic driving. Where cutting of asphalt and/or concrete is necessary, it shall be done per the Contract Drawings and Details and/or per the City of Thornton Right of Way Standards. Where cutting of concrete is necessary remove the entire concrete section or "stone". Obtain permission to cut walks from the Owner.
4. Compact backfill material in three uniform using mechanical tamping devices under pavement.
5. Do not allow sleeves to become filled with soil or other undesirable material. Tape ends of sleeves until commencement of pipe installation.
6. Mark sleeves on hard surfaces with a three inch (3") by three inch (3") "X" as per plans in a manner to ensure easy location in the future.
7. Sleeve size requirements for wire and pipe, control wire shall be placed in sleeving separate from pipe sleeving:
    a. 1" to 1-1/4" Pipe: 2" PVC
    b. 1-1/2" to 2" Pipe: 4" PVC
    c. 2-1/2" to 3" Pipe: 6" PVC
    d. 4" Pipe: 8" PVC
    e. 1 to 25 Control Wires: 2" PVC
    f. 26 to 50 Control Wires: 3" PVC
    g. Flow Sensor Cable: 2" PVC
8. HDPE pipe shall be used for sleeving purposes when directional boring takes place under any existing hard surfaces, walks, roadways, trees, etc. HDPE pipe may be used as the irrigation mainline under existing hard surfaces, walks, roadways, trees, etc in lieu of sleeving.
    a. All connections between HDPE pipe sections are to be made with fusion welded fittings per the manufacturer's recommendations.
    b. All connection fittings between HDPE and PVC or any other pipe material being used are to be made a minimum of twenty-four inches (24") away from any hard surface or tree drip line.
        1) Fittings to be used as couplings between HDPE and PVC shall be an epoxy coated repair coupler with joint restraints and stainless-steel pipe stiffener, installed as specified per the Contract Drawings and Manufacturer's recommendations.

D. Installation of Piping:
1. PVC Mainlines:
    a. Ensure that pipe is placed at a consistent depth and on a level base free of rocks and stones. Place manual drain valves at low points and dead ends of pressure supply piping to insure complete drainage of system. When pipe laying is not in progress, or at end of each day, close pipe ends with tight plug or cap. Perform Work in accordance with good practices prevailing in piping trades.
    b. Install mainlines a minimum of twenty-four inches (24") off any hard surface and thirty-six inches (36") away from swales.
    c. Solvent Weld PVC Pipe (required on all pipe two inch (2") or smaller): Lay pipe and make all plastic to plastic joints in accordance with manufacturer's

recommendations. Do not install pipe when air temperature is below forty degrees (40°) F.

d. Gasketed End Pipe (required on all pipe two and one-half inches (2-1/2”) or larger): Lay pipe and make pipe-to-fitting or pipe-to-pipe joint, following the manufacturer’s recommendations. Install joint restraint fittings and pipe restraints on all fittings and adjacent pipe runs per manufacturer’s recommendations and per the Approved Plan.

2. PVC Lateral Lines:

a. Ensure that pipe is placed at a consistent depth and on a level base free of rocks and stones. Place manual drain valves at low points and dead ends of pressure supply piping to ensure complete drainage of the system. When pipe laying is not in progress, or the end of each work day, close pipe ends with tight plug or cap. Perform Work in accordance with good practices prevailing in piping trades.

b. Install lateral lines a minimum of twelve inches (12”) off any hard surface and thirty-six inches (36”) away from swales.

c. Solvent Weld PVC Pipe (required on all lateral lines): Lay pipe and make all plastic to plastic joints in accordance with manufacturer’s recommendations. Do not install pipe when air temperature is below forty degrees (40°) F.

E. Joint restraints on all gasketed PVC mainline pipe two and one-half inches (2-1/2”) and larger: Install joint restraints per the plans and or manufacturer’s recommendations.

1. Joint restraints shall be installed as shown on the plans or per the manufacturer’s recommendations. Prior to backfilling any joint restraints the Owner shall be present to verify that the restraints were installed in the proper locations and that all bolts have been tightened to the manufacturer’s recommendations. Any restraints that are buried prior to inspection shall be excavated to allow for review and inspection at no additional cost to the City.

F. PVC Pipe Deflection

1. Solvent welded pipe will meet manufacturers recommendations.
2. Gasketed pipe will not exceed 0.48’ or one (1) degree offset per 20’ length.

G. Flexible Plastic (Polyethylene) Pipe: Lay pipe and assemble fittings according to manufacturer’s recommendations and per Contract Drawings and Details.

H. Control Wiring:

1. Standard Low Voltage Control Wire:

a. Install one control wire for each control valve on standard low voltage wire systems.

b. On standard low voltage wire systems install a total of five spare fourteen (#14) AWG UFUL control wires and one spare common wire from Automatic Irrigation Controller pedestal to the end of each leg of mainline. Label spare wires at Automatic Irrigation Controller and wire splice box.

c. Make all splices and electric control valve connections using 3M DBR/Y connectors

2. Bury control wiring between Automatic Irrigation Controller and electric valves in pressure supply line trenches, strung as close as possible to mainlines with such wires to be consistently located to one side of pipe, or in separate trenches.
    a. For standard low voltage wire systems bundle all twenty-four (24) volt wires at ten-foot (10') intervals.
3. Provide an expansion loop at every mainline change of direction, every electric control valve location (in valve box), and every five hundred feet (500').
    a. Form expansion loop in each control valve box by wrapping twenty-four inches (24") of wire around a one-inch (1") pipe and withdrawing pipe.
4. Install all control wire splices not occurring at control valve in a separate Carson Industries Model #910-10 body with 910-4 bolt down T-cover wire splice valve box.
5. Wire Testing:
    a. Existing wiring indicated to remain on documents is to be ohm-tested for continuity prior to construction. Contractor to produce report and copy the Owner of the results of such testing.
    b. New wiring: All new wiring to be tested for proper resistance prior to connection to valves and controller(s) for continuity. The Contractor is to produce the report and copy the Owner of the results of such testing.

I. Installation of Valves:
1. Electric Control Valves: Install electric control valves as detailed on the Contract Drawings.
    a. Electric Control Valves for two-wire system: Install electric control valves as detailed on the Drawings. Install one valve decoder module (Toro SB-DAC-1 per valve box.
2. All low volume irrigation shall be zoned independently from turf, and product applications may not be mixed within zone.
3. Quick Coupling Valves: Install quick coupling valves as detailed on the Contract Drawings.
4. Drain Valves: Install manual drain valves at all low points in pressure supply line, whether indicated on the Contract Drawings or necessitated by actual conditions, to ensure proper drainage of the mainline.
5. Isolation/Gate Valves: Install as detailed in locations shown on the Contract Drawings.
6. Valve Boxes: Install one valve box for each type of valve as detailed. Install compacted gravel leveling bed after compaction of subgrade and prior to setting of valve box.
    a. Install filter fabric over gravel prior to setting valves boxes. Ensure that filter fabric extends a minimum of six inches (6") from the bottom and no more than six inches (6") from the top of box. Secure the filter fabric to the side of box with grey tape.
    b. Install valve boxes flush with finish grade and square to adjacent surface features and one another
    c. When valve boxes are grouped together, allow at least twenty-four inches (24") between valve box sides.
    d. Install valve boxes a minimum of eighteen inches (18") away from any hard surface.

e. Cutting of valve box to give clearance for piping or valves is not permitted.

J. Valve Box Identification Branding:
   a. Brand Lids as follows in two inch (2") high minimum letters:
      1) Isolation/Gate Valve "GV"
      2) Quick Coupler Valve "QC"
      3) Manual Drain Valve "DV"
      4) Air Relief Valve "AR"
      5) Master Valve "MV"
      6) Flow Sensor "FS"
      7) Wire Splice Box "SB"
      8) Grounding Rod "GR"
      9) Filter "FIL"

3.4 BACKFLOW PREVENTION

A. Backflow Prevention Device: Contractor must meet all applicable laws, rules and codes, including but not limited to Uniform Building codes and applicable amendments Plumbing Codes and State Water Regulations. Assemblies must be installed per the manufacturer's specifications. Backflow devices shall not be installed within the public right-of-way.
   1. Install in strict accordance with current requirements of Thornton Water. Connections to the Thornton Water System are to have an approved assembly for the type of protection they provide, either isolation or containment.
   2. Successful Testing of backflow assembly by a certified Backflow Prevention Assembly Tester is Contractor's responsibility and any cost shall be considered incidental. Test reports shall be forwarded to Thornton Water in accordance with the State of Colorado regulations. Copies of the report, the tester's certification and the certification of the testing equipment used are to be forwarded to the Owner.
   3. Request for final payment will not be certified or processed until certification reports have been filed with Thornton Water and received by the Owner.

3.5 INSTALLATION OF SPRINKLER HEADS

A. Install sprinkler heads where designated after the Owner has approved staking. Set to finish grade as detailed.
   1. Spacing of heads shall not exceed the maximum indicated on the Contract Drawings unless re-staked or as directed by the Owner. In no case shall the spacing exceed maximum recommended by manufacturer.
   2. Install gear driven heads on swing-joint risers as detailed. Swing joints to non-pressure lines shall be set at no more than forty-five degrees (45°) or less than ten degrees (10°).
   3. Install pop-up heads on swing pipe as detailed.
   4. Adjust part circle heads for proper coverage. Adjust heads to correct height after sod is installed. Plant placement shall not interfere with intended sprinkler head coverage, piping, or other equipment. The Owner may request nozzle changes or adjustments without additional cost to the City.

3.6 BACKFILLING

A. Do not begin backfilling operations until all piping and system components have been inspected by authorized Thornton Parks Operations Staff or by the Owner. Backfilling shall not be done in freezing weather unless authorized by the Owner.
   1. Leave trenches slightly mounded to allow for settlement after backfilling is completed.
   2. Trenches shall be finish graded and sodded or seeded prior to walk-through of system by the Owner.
   3. Materials: Excavated material is generally considered satisfactory for backfill purposes. Backfill material shall be free of trash, organic matter, frozen materials, and stones larger than one inch (1") in maximum dimension. Material not suitable for backfill shall be hauled away. Contractor shall be responsible for providing suitable backfill if excavated material is unacceptable or not sufficient to meet backfill, compaction, and final grade requirements.
   4. Do not leave trenches open for a period of more than forty-eight (48) hours. Open excavations shall be protected in accordance with OSHA regulations.
   5. Compact backfill utilizing the following methods in landscape areas:
      a. Mainline Pipe: Backfill and mechanically compact in three uniform lifts, utilizing optimum moisture content for the soil type.
      b. Secondary Pipe: Backfill in two uniform lifts and hydraulically or mechanically compact each.
      c. Puddling or ponding and/or jetting is prohibited within twenty feet (20') of building or foundation walls.

3.7 RAIN SENSOR

A. Rain Sensor: Install in accordance with manufacturer's instructions, and as shown on the Contract Drawings.
   1. Install rain sensor(s) prior to starting any irrigation schedules for new sod or seed programs.
   2. Install rain sensor(s) a minimum of fifteen (15) feet above grade, mount to a light pole, building or approved structure that is not shielded by tree canopies or structures and not effected by irrigation overspray.
   3. All rain sensor(s) to be set at one eighth inch (1/8") inch prior to being installed or irrigation begins.

3.8 ADJUSTING

A. Upon completion of installation, "fine-tune" entire system by regulating valves, adjusting arcs and radius, and setting pressure reducing valves at proper and similar pressure to provide optimum and efficient coverage. Flush and adjust all sprinkler heads for optimum performance and to prevent overspray onto walks, roadways, and buildings as much as possible. Heads of same type shall be operating at same pressure within plus or minus ten percent (10%).

B. If it is determined by the Owner or Thornton Parks Operations Staff that irrigation adjustments will provide improved coverage and water distribution, the Contractor shall make such adjustments prior to Initial Acceptance. Adjustments may include but not

limited to changes in nozzle sizes, degrees of arc, and control valve flow control regulations. Adjustments shall be completed at no additional costs to the City.

C. All sprinkler heads shall be set perpendicular to finish grade or within allowable limits shown on Contract Drawings.

D. Areas that do not conform to designated operation requirements, due to unauthorized changes or poor installation practices, shall be immediately corrected at no additional cost to the City.

3.9 FIELD QUALITY CONTROL

A. Flushing: After piping, risers, and valves are in place and connected, but prior to installation of sprinkler heads, quick coupler assemblies, and hose valves, thoroughly flush piping system under full head of water pressure from dead end fittings. Maintain flushing for five (5) minutes through furthermost valves. Cap risers after flushing.

B. Testing Pressurized Mainline: Prior to installing any plant materials (sod, seed, trees, shrubs, perennials) arrange and conduct pressure test(s) in the presence of the Owner. Arrange for testing a minimum of forty eight (48) hours in advance. The contractor is responsible to supply the hydrostatic test pump and all other equipment required to complete the test.
   1. Set in place, cap and pressure test all piping under paving, in presence of the Owner prior to backfilling and paving operations.
   2. After installation and backfilling of all control valves, fill pressure supply line with water, and pressurize to forty (40) PSI over the static pressure or one hundred twenty (120) PSI, whichever is greater, for a test period of two (2) hours. Testing pressure not to exceed one hundred forty-five (145) PSI.
   3. All isolation valves, angle valves, ball valves and zone valve flow controls are to remain open during testing.
   4. Leakage, Pressure Loss:
      a. Solvent welded PVC Pipe: Test is acceptable if zero pounds of pressure is evident during the test period.
      b. Gasketed Pipe: Test is acceptable if two (2) pounds of pressure or less is evident during the test period.
   5. Leaks: Detect and repair leaks. Replace defective PVC pipe with new full length pipe section. No pipe splices will be accepted within pipe sleeve. No PVC pressure couplings or slip-fix repair couplings will be allowed.
   6. Retest system until test pressure can be maintained for duration of test.

3.10 COMPLETION INSPECTION

A. An irrigation audit shall be performed as part of the irrigation system Initial Acceptance process with a ‘post establishment’ irrigation schedule provided for city staff use. The audit shall be performed by a Certified Landscape Irrigation Auditor in good standing with the Irrigation Association. Show evidence Owner has received all accessories, charts, record drawings & equipment as required before Initial Acceptance walk-through is scheduled.

B. Arrange for the Owner to be present. Provide a minimum of forty-eight (48) hours of notice in advance of walk-through.

C. Entire system shall be completely installed and operational and trenches shall be finish graded and sod and/or seed in place prior to scheduling of walk-through.

D. Electrically operate each zone in its entirety for the Owner the time of walk-through.

E. A project inspection walk through shall include but is not limited to the following:
   1. Contractor shall adjust, straighten and nozzle all heads prior to walk through. Review operation, coverage, head/nozzle adjustment, and system adjustment per specifications.
   2. Contractor shall have all valves boxes unlocked prior to walk through. Open valve boxes to confirm materials, filter fabric, gravel bedding, wire splices, compaction, elevation, workspace access within boxes, clearance from lid and bedding, locking mechanisms, and zone branding. Interior of boxes should be free of foreign material, only filter fabric shall be visible in the bottom of boxes. All valves must be tagged with zone identification, Christy's valve marker tags or equal and valve box lids must be branded with zone valve identification. Verify connections in all valve and wire splice boxes.
   3. Contractor shall provide documentation that resistance tests for all spare common and hot wires has been performed and the results for ohms reading on each wire tested.
   4. Confirm irrigation heads are at specified elevation and distance(s) from paved surfaces and curbs, plumb and soil compacted.
   5. Inspect concrete size and elevation of pads for backflow assembly, hydrometer, and enclosure pads. Confirm quality of concrete, finishes, access to the Irrigation Controller and spare conduit/sleeving as required for wiring.
   6. Review trench and related excavation repair including backfill, compaction, fine grade, seed, and sod installation.
   7. Review appropriate use of purple valve lids and other product as required for reuse water applications.
   8. Generate a punch list of items to be corrected prior to Initial Acceptance.
   9. Furnish all materials and perform all work required to correct all inadequacies of coverage due to deviations from Contract Documents.

3.11 CLEANING

A. Maintain continuous cleaning operation throughout duration of Work. Dispose of, all trash, waste materials, debris and excess soil generated by installation of irrigation system, off-site, at no additional cost to the City. Contractor shall clear all debris, including, soil, from all paths, walks, roads, and other hard surface areas.

3.12 PROTECTION

A. Restrict vehicular and pedestrian traffic from areas where irrigation has been installed. Erect temporary fencing or barricades and install warning signs as required or directed by the Owner at no additional cost to the City.

PART 4 - MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

A. Measurement will be made by the contract unit specified for Irrigation Systems. 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 Owner, and in accordance with the Specifications.

4.2 PAYMENT

A. Payment will be made at the contract unit price, and shall include required materials, transportation, equipment, labor, irrigation equipment, earthwork, trenching, stockpiling, disposing, hauling off, watering, dust control, fencing, winter watering, winterization, spring startup, erosion and sediment control, fine grading, connection to existing controller and backflow preventor unit. as required in accordance with the Contract Drawings and Specifications.

Pay Item	Pay Unit
1402 Tree Bubblers, 2/tree	EA
5F-B Shrub Stream Bubblers	SF
1812 Spray	SF
Medium Radius 5004 Rotor	SF
Large Radius Falcon Rotor	SF
Irrigation Controller - Baseline BL3200	EA
Irrigation Hydrometer 2" - Baseline BHM	EA
Irrigation Backflow Preventor - Wilkins Zurn 475	EA

END OF SECTION 32 80 00

SECTION 32 91 13
SOIL PREPARATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawing and general provisions of the Contract, including General and Special Conditions sections and the Thornton current Guidelines for Native Seed Landscape Areas, apply to work of this Section. In the event of conflict(s) between the Section, the Drawings and the General and Special Conditions of the Contract, the stricter contents shall govern.

1.2 SUMMARY

A. This Section includes requirements for the preparation of a “No Till” bed for seeding operations. Soil preparation consists of weed control, ripping, fertilizing, soil conditioning, and fine grading the topsoil. Soil preparation as specified herein must precede all seeding.

1.3 DEFINITIONS

A. Fertilizer: A substance that is added to soil to help the growth of plants.

B. Soil Amendment: Any substance which is intended to improve the physical, chemical, or other characteristics of the soil.

C. Soil Conditioner: Combination of slow-release fertilizer and humate.

1.4 SUBMITTALS

A. See Division 01 Section “Submittals” for submittal requirements.

B. Testing Agency Qualifications: The Owner to approve prior to construction.

C. Soils Test Data: See Quality Control.
1. Material Test Reports
    a. Soil analysis for native soils at the project site.

D. Product Data (for each type of product):
1. Include recommendations for application and use.
2. Include test data substantiating that products comply with requirements.
3. Material Certificates: For each type of soil conditioner, soil amendment, and fertilizer before delivery to the site, according to the following:
    a. Manufacturer's qualified testing agency's certified analysis of standard products.
    b. State, Federal and other inspection certificates shall accompany invoice for materials showing source or origin.

E. Samples: For each bulk-supplied material, one (1) quart volume of each in sealed containers labeled with content, source, and date obtained. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of composition, color, and texture.

1.5 QUALITY CONTROL

A. Testing Agency: Retain an independent, state-operated, or university operated laboratory experienced in soil science, soil testing, and plant nutrition; with the experience and capability to conduct the testing indicated and that specializes in the types of tests to be performed.
   1. Laboratories: Subject to compliance with requirements, provide testing of materials in the Section by a qualified testing laboratory approved by the Owner.
   2. Multiple Laboratories: Work may be divided among qualified testing laboratories specializing in physical testing, chemical testing, and fertility testing.

B. Preconstruction Testing
   1. Engage the approved testing agency to perform preconstruction soil analyses on existing on-site soil, imported topsoil, and pre-amended imported soil.
   2. Notify Owner seventy-two (72) hours in advance of the dates and times when laboratory samples will be taken.

C. Soil Sampling Requirements
   1. Sample Collection and Labeling: Have samples taken and labeled by the Contractor in the presence of the Owner and under the direction of the testing agency.
   2. Number and Location of Samples: Minimum of five (5) samples for. Samples shall be collected randomly throughout the areas to receive similar soil preparation, including seed/sod, native seeding, planting beds, and gardens. Provide a site plan of the sampling locations to the Owner for approval, prior to sampling.
   3. Procedures and Depth of Samples: Collect composite samples to a depth of six inches (6”) and combine in a clean plastic container.
   4. Mixing of Samples: Mix samples together thoroughly, removing plant debris and breaking up clods.
   5. Labeling: Label each sample with the date, location keyed to a site plan or other location system, visible soil condition, and sampling depth.

D. Testing Requirements
   1. Soil Texture: Soil-particle, size-distribution analysis by the following methods according to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods":
      a. Sieving Method: Report sand-gradation percentages for very coarse, coarse, medium, fine, and very fine sand; and fragment-gradation (gravel) percentages for fine, medium, and coarse fragments; according to USDA sand and fragment sizes.
      b. Hydrometer Method: Report percentages of sand, silt, and clay.
   2. Fertility Testing: Soil-fertility analysis shall, include the following:
      a. Percentage of organic matter.

b. CEC, calcium percent of CEC, and magnesium percent of CEC.
c. Soil reaction (acidity/alkalinity pH value).
d. Buffered acidity or alkalinity.
e. Lime estimate.
f. Soil texture estimate.
g. Nitrogen ppm.
h. Phosphorous ppm.
i. Potassium ppm.
j. Manganese ppm.
k. Zinc ppm.
l. Iron ppm.
m. Boron ppm.
n. Copper ppm.
o. Sodium ppm
p. Sodium absorption ratio (SAR).
q. Soluble-salts ppm.
r. Presence and quantities of problem materials including salts and metals cited in the Standard protocol. If such problem materials are present, provide additional recommendations for corrective action.
s. Other deleterious materials, including their characteristics and content of each.

E. Recommendations: Based on the test results, provide recommendations for soil treatments, amendments, and conditioners to be incorporated to produce a soil suitable for healthy viable plant growth for the species indicated in the Contract Documents. Include, at a minimum, recommendations for nitrogen, phosphorous, and potassium fertilization, and for micronutrients.
1. Fertilizers and Soil Amendment Rates: See Thornton recommendations.
2. Soil Reaction: State the recommended liming rates for raising pH or sulfur for lowering pH according to the buffered acidity or buffered alkalinity.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and compliance with State and Federal laws if applicable.

B. Bulk Materials:
1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Do not move or handle materials when they are wet or frozen.
4. Accompany each delivery of bulk fertilizers and soil amendments with appropriate certificates.

C. Notify Owner of delivery schedule in advance so material can be inspected upon arrival at the project site. Immediately remove unacceptable material from the project site.

1.7 PROJECT/SITE CONDITIONS

A. General: Do not perform work when climate and existing site conditions will not provide satisfactory results.

B. Vehicular site access shall be limited to the area(s) indicated on the Contract Drawings or as defined by the Owner.

C. Damage to turf, natural areas, pavements, irrigation systems, underground utilities, and other improvements shall be repaired by the contractor at no additional cost to the City.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Soil Amendments:
   1. In “No Till” bed, amendment may include only Biosol or Biosil Forte as soils test indicate.
   2. Mountain peat, aspen humus, gypsum and sand will not be accepted.

PART 3 - EXECUTION

3.1 SITE EXAMINATION

A. Examine the site for compliance with requirements and other conditions affecting performance.
   1. General: Verify that existing site conditions are as specified and indicated on the Contract Drawings before beginning work under this Section.
   2. Grades: Inspect to verify rough grading is within +/- one tenth of one foot (0.1’) of grades indicated and specified.
   3. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within the work area.
   4. Unsatisfactory Conditions: The General Contractor shall notify the Owner in writing of any known unsatisfactory site conditions. If the soil is found to be unfit to support planting as described above, it is to be removed and replaced with clean soil from a source approved by the Owner.

B. Locate all utilities (sewer, water, irrigation, gas, electric, phone, and other conduits and subsurface equipment) prior to commencing work. The Contractor shall be responsible for the protection of all new and existing infrastructure and repair any damages caused by work under this Section at no additional cost to the City.

C. Protect grade stakes set by others until removal is directed by the Owner.

3.2 PREPARATION

A. In general, turf and planting areas shall receive Soil Amendments unless otherwise noted or specified by the Owner. For the purpose of bidding, the Contractor shall assume all areas to receive soil amendments 1800 lbs/AC Biosol mixed into Hydromulch. Once soils tests have been received and determination is if any additional is o be added the site-specific soils the rate to be applied may be adjusted per the price based on the Schedule of Values for Soil Amendment.

B. Weed Seed Eradication: Perform pesticide treatment over the entire area to be planted during the growing season. Allow enough time to successfully complete the entire pesticide treatment process (germinate / terminate) before proceeding with planting.
   1. Water surface one half (1/2") inch per week for two (2) weeks prior to application if natural precipitation does not supply this amount to encourage weed seed germination.
   2. Notify Owner forty-eight (48) hours in advance of each pesticide treatment.
   3. Apply pesticide in accordance with manufacturer's recommendations.
   4. Two (2) weeks after the first pesticide application, review surface for evidence of plant growth.
   5. If there is no evidence of plant growth, obtain the Owner's approval of surface conditions to proceed with Soil Preparation.
   6. If more than 10% of the area to be planted contains new plant growth, the pesticide and watering application shall be repeated until new plant growth is satisfactorily eradicated.
   7. Remove plant debris from treated area by mowing as short as possible.

C. Areas of Compacted Topsoil: Areas within the work limits, or as defined on Contract Drawings or by the Owner, that have vegetation that is sparse, stunted, anemic, weedy or was used as construction staging, a parking area, and/or subjected to heavy use will require ripping to prepare the soil for planting. Scarify compacted soil to an eight-inch (8") minimum depth to loosen topsoil.

D. Areas of Disturbed Topsoil: Areas disturbed but not severely compacted, as determined by the Owner, shall be deep tine aerated or shattered to prepare the soil for revegetation.

E. Areas of Undisturbed Natural Topsoil: Undisturbed sites that are or were supporting healthy plant growth need only surface seedbed preparation prior to sowing seed.

3.3 INSTALLATION OF SOIL AND SOIL AMENDMENTS

A. Proceed with installation only after unsatisfactory conditions have been corrected and approved by the Owner.

B. Beginning of installation means Acceptance of existing conditions by the Contractor.

C. Install topsoil as required in Division 31 section "Earth Moving" and Division 32 Section "Topsoil".

D. Timing: Perform soil preparation just prior to planting operations and in accordance with final planting schedule.
   1. Coordinate with irrigation system installation to avoid damage.

E. Fine Grading in all Landscape Areas:
   1. Complete fine grading for all areas prior to seeding or planting. Allow for natural settlement.
   2. For ground surface areas surrounding buildings to be landscaped, maintain required positive drainage away from buildings.
   3. Finish grade shall be below edge of pavement prior to seeding.
      a. Seeding Areas: Allow one inch (1") for seed.
      b. Planting Beds: Allow four inches (4") for mulch.
   4. Compaction of Surface Grade Prior to Landscape Installation: Firm, but not hard, eighty five percent (85%) standard Proctor density within two percent (2%) optimum moisture.
   5. Native Seed Areas: Aerate edges around trees. Area shall not be graded smooth but left in a rough condition after tilling. Tilling shall occur parallel to the contours only.
   6. Restore planting areas to specified condition if eroded or otherwise disturbed after fine grading and prior to planting.

3.4 INSPECTION

A. Provide notice to the Owner requesting inspection at least seventy-two (72) hours prior to anticipated date of the work.

B. Deficiencies: The Owner will specify deficiencies to the Contractor who shall make satisfactory adjustments and shall again notify the Owner for an additional inspection.

3.5 CLEANING

A. Protect areas adjacent to soil preparation and planting areas from contamination. Keep adjacent paving and construction clean and work area in an orderly condition.

B. Remove debris and excess materials from site. Clean out drainage inlet structures. Clean all paved and finished surfaces that are soiled as a result of work under this Section.

3.6 PROTECTION AND REPAIR

A. Provide and install barriers as required and as directed by the Owner to protect completed areas against damage from pedestrian and vehicular traffic until Acceptance by the City.

B. Protect areas of in-place soil from additional compaction, disturbance, and contamination. Prohibit the following practices within these areas except as required to perform planting operations:
   1. Storage of construction materials, debris, or excavated material.
   2. Parking vehicles or equipment.

3. Vehicle traffic.
4. Foot traffic.
5. Erection of sheds or structures.
6. Impoundment of water.
7. Excavation or other digging unless otherwise indicated.

C. If prepared soil or subgrade is disturbed or contaminated prior to planting, the Contractor shall restore or replace the planting soil as directed by the Owner at no cost to the City.

PART 4 - MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

A. Measurement will be included with Native Seeding.

4.2 PAYMENT

A. Payment will be made at the contract unit price, and shall include required materials, soil preparation, transportation, amendments, equipment, labor, earthwork, stockpiling, disposing, hauling off, watering, dust control, fine grading, as required in accordance with the Contract Drawings and Specifications.

END OF SECTION 32 91 13

SECTION 32 92 20
NATIVE SEEDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

City of Thornton Guidelines for Native Seed Landscape Areas Installation, Maintenance, Acceptance & Preferred Mixes

1.2 DEFINITIONS

A. Finish Grade: Elevation of finished surface of planting soil.

B. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, pesticides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, herbicide, defoliant, or desiccant.

C. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. These include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

D. Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

E. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or top surface of a fill or backfill before planting soil is placed.

F. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

G. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil, but in disturbed areas such as urban environments, the surface soil can be subsoil.

H. Weeds: Including but not limited to Goathead, Bindweed, Twitch, Dandelion, Jimsonweed, Knapweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Bermuda Grass, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Weed, Bent Grass, Wild Garlic, Perennial Sorrel, and Broom

Grass.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.
   1. Pesticides: Include product label and manufacturer's application instructions specific to this Project.

B. Qualification Data: For qualified landscape installer.

C. Product Certificates: For soil amendments and fertilizers, from manufacturer.

D. Material Test Reports: For existing-in-place surface soil.
   1. Soil analysis for each topsoil to be used.
   2. Analysis for manufactured topsoil.
   3. Analysis for each soil amendment.
   4. Analysis for each amended planting soil.

E. Analysis and standards: Wherever applicable, for non-packaged materials, provide two copies of analysis by recognized laboratory made in accordance with methods established by the Association of Official Agriculture Chemists.

F. Seeding schedule: Submit in writing two copies of proposed seeding schedule, indicating dates for topsoil placing, site preparation, pesticide treatments, soil preparation seeding and soil preparation and seed delivery. Schedule all Work during specified planting seasons. Once accepted, revise dates only as approved in writing, after documentation of reasons for delays.

I. Maintenance Instructions: Recommended procedures for maintenance of dryland grasses during a calendar year. Submit before expiration of required initial maintenance periods.

J. Contract Closeout Submittals:
   1. Operating and Maintenance Data: At completion of work, submit one digital copy and two hard copies to the Owner in accordance with Division 01 Section "Contract Closeout'. Include directions for irrigation, aeration, mowing, fertilizing and spraying as required for continued and proper maintenance through full growing season and dormant period.

1.4 QUALITY CONTROL

A. Installer Qualifications: A qualified landscape Installer whose work has resulted in successful dryland grass establishment.
   1. Professional Membership: Installer shall be a member in good standing of

either the Professional Landcare Network or the American Nursery and Landscape Association.

2. Experience: Five years' experience in seed installation in addition to requirements in Division 01 Section "Quality Control."
3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
4. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.
5. Pesticide Applicator: State licensed, commercial.

B. Soil-Testing Laboratory Qualifications: An independent laboratory or university laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.

C. Soil Analysis: See Soil Preparation

D. Preinstallation Conference: Conduct conference at Project site to coordinate the process with other trades, to coordinate equipment movement within planting areas and to avoid soil compaction, to review proposed methods of installation, performance criteria, and maintenance procedures. Review underground utility location maps and plans. This meeting shall be coordinated by the Contractor, and comply with requirements in Division 1.

E. Standards: All materials and methods used during this portion of the work shall meet or exceed applicable federal, state, county, and local laws and regulations. All sod shall be free from insects and disease. Species shall be true to their scientific name as specified.

F. Materials: The Contractor shall submit to the Owner for approval a complete list of all materials to be used during this portion of the work prior to delivery of any materials to the site. Include complete data on source, amount and quality. This submittal shall in no way be construed as permitting substitution for specific items described on the plans or in these specifications unless approved in writing by the Owner.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Seed: Shall be furnished in bags or containers clearly labeled to show the name and address of the supplier, the seed name, the lot number, net weight, origin, the percent of weed seed content, the guaranteed percentage of purity and germination, pounds of pure live seed (PLS) of each seed species, and the total pounds of PLS in the container. Seed that has become wet, moldy or damaged in transit or in storage will not be acceptable.

A. Fertilizer: Deliver inorganic or chemical fertilizer to site in original unopened container bearing manufacturer's guaranteed chemical analysis, name, trade name, trademark, warranty and conformance to state law.

B. Bulk Materials:
   1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
   2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
   3. Accompany each delivery of bulk fertilizers and soil amendments with appropriate certificates.
   4. 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. Material will be inspected upon arrival at project site. Owner will reject any opened or unacceptable materials as described above.

D. Immediately remove unacceptable material from job site.

1.6 PROJECT/SITE CONDITIONS

A. Work scheduling: Proceed with and complete landscape work as rapidly as portions of the site become available, working within the specified planting season and approved schedule.

B. Vehicular accessibility on site shall be as directed by Owner. Repair damage to prepared topsoil and existing surfaces, caused by vehicular access and movement during work under this section, to original condition at no additional cost to the City.

C. Existing conditions:
   1. Utilities: Determine location of underground utilities. Perform work in a manner to avoid possible damage. Hand excavate, as required.
   2. Excavation: Maintain grade stakes set by others until removal is mutually agreed upon by parties concerned. When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, noxious materials or obstructions, notify Owner before planting.
   3. If weeds are present on site, treat with pesticide prior to preparing soil for installing sod as specified in this or other Sections.

D. Coordination:
   1. Coordinate with construction of utilities on site. Do not begin placing topsoil until underground work is completed in the area.
   2. Coordinate seeding with Contractor(s) approved schedule. Limit construction access to areas where topsoil has been placed if placement is completed more than 3 days prior to commencement of landscaping in the area. Limit fine grading to areas that can be prepared for planting within twenty four (24) hours after fine grading.
   3. Coordinate with Contractors work requiring access to site.
   4. Coordinate with installation of underground irrigation system.

1.7 WARRANTY

A. Refer to the Guidelines for Native Seed Landscape Areas Installation, Maintenance, Acceptance & Preferred Mixes.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Seed Mix:
The specific seed mix shall be PBSI Native Prairie Mix or approved equal. Contractor shall refer to the City of Thornton Guidelines for Native Seed Landscape Areas Installation, Maintenance, Acceptance & Preferred Mixes.

B. Soil Preparation: Refer to Soil Preparation Specification.

C. Fertilizer: Inorganic mixture with following chemical composition: (37-7-0) with fifty percent (50%) sulfur coated urea (no iron), or as recommended by testing lab based on soil sample results.

D. Water: The contractor is responsible for watering.

2.2 PESTICIDES

A. General: Pesticide, use as recommended by professional applicator, registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by Owner and authorities having jurisdiction.

PART 3 - EXECUTION

Refer to the City of Thornton Guidelines for Native Seed Landscape Areas Installation, Maintenance, Acceptance & Preferred Mixes

METHOD OF MEASUREMENT

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

The Contractor shall furnish the Engineer with seed certifications and analysis, fertilizer analysis, and bag weight tickets prior to placing any seed or fertilizer.

Any seed or fertilizer placed by the Contractor without the Owner approval will not be paid for.

The work associated with Landscape Restoration is to be paid by lump sum for all work associated with repair, adjustments, and replacement of existing landscaping and existing irrigation systems reset and accepted by the Owner as complying with the plans and specifications. Work shall be done in accordance with City of Thornton Standard Specifications.

BASIS OF PAYMENT

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

Payment will be made under:

Pay Item	Pay Unit
Native Upland Seeding (incl. prep)	AC

Payment will be made at the contract unit price, and shall include required materials, transportation, equipment, labor, earthwork, stockpiling, disposing, hauling off, watering, dust control, erosion and sediment control, soil preparation, fine grading, furnishing and installation of seeds and seed establishment, mulches installation and maintenance of temporary protection by fencing or other means, watering and all maintenance required until Final Acceptance of the work as required in accordance with the Contract Drawings and Specifications.

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

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

END OF SECTION 32 92 20

SECTION 32 93 00
TREES, PLANTS, AND GROUNDCOVERS
PHASE 2- FOR INFORMATION ONLY

PART 1 - GENERAL

1.1 RELATED DOCUMENTD

A. Drawings and general provisions of the Contract, including General and Special Conditions sections and the City of Thornton Standards and Specifications, apply to work of this Section. In the event of conflict(s) between the Section, the Drawings and the General and Special Conditions of the Contract, the stricter contents shall govern.

1.2 DEFINITIONS

A. ANSI: American National Standards Institute. Z60.1 is the national standard for nursery stock.

B. Backfill: The earth used to replace or the act of replacing earth in an excavation.

C. Balled and Burlapped Stock: Plants dug with firm, natural balls of earth in which they were grown wrapped with burlap, tied, rigidly supported, and drum laced with twine with the root flare visible at the surface of the ball as recommended by ANSI Z60.1.

D. Bare-Root Stock: Plants with a well-branched, fibrous-root system developed by transplanting or root pruning, with soil or growing medium removed, and with not less than the minimum root spread according to ANSI Z60.1 for type and size of plant required.

E. Diameter at Breast Height (DBH): Defined as the diameter at four and one-half feet (4 ½') above the soil line.

F. Caliper: Trunk diameter is measured six-inches (6") from the ground; if the caliper is greater than four-inches (4"), the measurement is taken at twelve-inches (12") from the ground.

G. Cane: A cane shall be considered a primary stem which starts from the ground or at a point close to the ground at a point not higher than one-fourth (1/4) the height of the plant, and which reaches the minimum height stated in the plant size specification.

H. Central leader: Also referred to as leader or the dominant leader. A continuation of the main trunk located more or less in the center of the crown, beginning at the lowest main scaffold branch and extending to the top of the tree.

I. Circling root(s): One or more roots whose diameter is greater than ten percent (10%) of the trunk caliper circling more than one-third of the trunk. Circling roots are unacceptable.

J. Clear Trunk: The portion of the trunk below the main crown which may include shortened temporary branches.

K. Co-dominant: Two or more vigorous, upright branches or stems of relatively equal diameter that originate from a common point, usually where the leader was lost or removed. Co-dominant stems are unacceptable.

L. Container-Grown: Healthy, vigorous, well-rooted plants grown in a container, with a well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of plant required.

M. Crown: The portion of a tree beginning at the lowest main scaffold branch extending to the top of the tree. On younger trees, the crown may be comprised of temporary branches.

N. Cultivar: A named plant selection from which identical or nearly identical plants can be produced, usually by vegetative propagation or cloning.

O. Drip Zone: 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.

P. Finish Grade: Elevation of finished surface of planting soil.

Q. Included Bark: Bark embedded in the union between a branch and the trunk or between two or more stems that prevents the formation of a normal branch bark ridge. Included bark is unacceptable.

R. Kinked Root: A main root that is sharply bent. Kinked roots are unacceptable.

S. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also include substances or mixtures intended for use as a plant regulator, defoliant, or desiccant. Some sources classify herbicides separately from pesticides.

T. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

U. Root Collar: Also referred to as the root flare. The base of a tree where the main roots and trunk meet.

V. Scaffold Branches: Large main branches that form the main structure of the crown.

W. Stem-girdling Root: A circling, bent, or straight root that touches or rests on the trunk or root flare that can become a permanent root. Stem-girdling roots are unacceptable.

X. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

Y. Temporary Branch: A small branch that is temporarily retained along the lower trunk of young trees.

Z. Tree Protection Zone: The zone equal to eighteen inches (18") radially from the tree for every one-inch (1") of trunk diameter at breast height.

AA. Trunk: The main stem of a tree, beginning at the root collar and ending at the lowest main scaffold branch.

BB. Taper: The thickening of a trunk or branch toward its base.

1.3 SUBMITTALS

A. Product Data: For each type of product.
   1. Plant Materials: Include quantities, sizes, quality, and sources for plant materials.

B. Product Samples: At a minimum provide the following samples for approval by the Owner, additional product samples may be required at the direction of the Owner.
   1. Mulch: one (1) gallon bag minimum of each type of mulch.
   2. Tree Stakes: one (1) of each type.
   3. Tree Straps: one (1) each.
   4. Guy Material: one (1) linear foot.
   5. Guy Signal: one (1) linear foot.
   6. Tree Wrap: one (1) linear foot.

C. Pesticides: Product label, Safety Data Sheet (SDS) labels and manufacturer's application instructions specific to Project.

D. Proper Identification: All plants shall be true to name as ordered or shown on planting plans and shall be labeled individually or in groups by species and cultivar (as appropriate).

E. Contractor shall provide a complete list of all plant material for approval by the Owner a minimum of ten (10) days prior to delivery. Any substitutions of plant material, including but not limited to size, type, species and variety shall be listed and submitted to the Owner for approval.

F. Contractor shall provide the following certificates:
   1. State Inspection Certificate from the origin nursery.
   2. Certificate from origin state.

3. Quarantine Certificate from origin state.
4. Any Certificates required by the USDA Animal and Plant Health Inspection Service (APHIS) and ANSI-Z-160 and accompanying Rules and Regulations.

1.4 QUALITY CONTROL

A. The Contractor shall arrange for the inspection of plant material upon delivery to the site for compliance with the Specifications and Contract Drawings. The Owner has the right to reject plant material that does not meet Specifications until Final Acceptance. Inspection of materials is primarily for quality, size, form, variety, and damage, but other requirements are not waived even though initial visual inspection results in approval. Rejected material shall be removed from the site within twenty-four (24) hours.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Materials: Deliver materials in original containers with tags showing genus, species and size. Protect materials from damage during delivery and while stored at site. The Owner reserves the right to inspect containers before or after installation to verify compliance with Specifications.

B. Bulk Materials:
1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants or in tree protection zones.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery of bulk materials with appropriate certificates.

C. Trees: Nursery stock shall be harvested and planted during the same growing season. Do not prune, except as approved by the City Forester and the Owner. Protect bark, branches, and root systems from sun scald, drying, sweating, whipping, and other handling and tying damage. Do not bend or tie trees in such a manner as to destroy natural shape. Provide protective covering during delivery. Plant materials delivered without protective covering may be rejected. Do not drop trees during delivery. All trees shall be labeled with a securely attached waterproof tag bearing a legible plant name. Remove all tags and flagging as directed by the Owner.

D. Handle planting stock by the root ball only.

E. Deliver trees after preparations for planting have been completed and install immediately. If planting is delayed more than six (6) hours after delivery, set planting materials in shade, protect from weather and mechanical damage, and keep roots moist.
1. Set balled stock on ground and cover ball with wood chips, or other acceptable material.
2. Do not remove container-grown stock from containers before planting.
3. Water root systems of trees stored on site with a fine-mist spray. Water as often as necessary to maintain root systems in a moist condition.

1.6 PROJECT/SITE CONDITIONS

A. Vehicular accessibility on site shall be as directed by the Owner. Repair damage to prepared topsoil and existing surfaces, caused by vehicular access and movement during work under this section, to original condition at no additional cost to the City.

B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.

1.7 COORDINATION AND SCHEDULING

A. Coordinate installation of planting materials during normal planting seasons for each type of plant material required. Planting materials should be planted between April 15 and October 1, or at the direction of the Owner. If irrigation is not available at the time of planting then the Contractor is responsible for watering of all plant material and no additional cost to the City.

B. Plant trees after final grades have been accepted and prior to seeding unless otherwise authorized by the Owner.

1.8 WARRANTY

A. Warranty: The warranty specified in this Article shall not deprive the City of other rights the City may have under other provisions of the Contract Documents and shall be in addition to, and run concurrently with, other warranties made by the Contractor under requirements of the Contract Documents.

B. Trees, Plants, and Groundcovers shall be warranted for a period of one (1) year after date of Initial Acceptance, against defects including death, structural failures, dieback as determined by the Owner. Warranty shall not cover defects after Initial Acceptance resulting from lack of adequate maintenance, neglect or abuse by City staff.

C. The Warranty shall not be enforced should any plant die due to vandalism after Initial Acceptance.

D. Remedial Actions:
   1. Replace any plant materials that have been excessively pruned, more than twenty percent (20%) percent dead, or in an unhealthy or declining condition in the sole opinion of the Owner immediately upon notice from the Owner during warranty period.
   2. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.

E. All plants shall be true to name and meet all conditions of these specifications. Any plant that is not true to name as indicated by form, leaf, flower, or fruiting characteristics shall be replaced at the Contractor’s expense.

PART 2 - PRODUCTS

2.1 PLANT MATERIALS

A. General: Furnish and install nursery-grown trees and shrubs conforming to the requirements of ANSI-Z-160, with healthy root systems developed by transplanting or root pruning. Provide well shaped, symmetrical, fully branched, healthy, and vigorous stock free of disease, insects, eggs, larvae, girdling, and defects such as sun scald, injuries, abrasions, and disfigurement. Trees of a larger size than that specified in the plant list may be used with a proportionate increase in size of roots and balls, if acceptable to the City Forester and Owner. The use of larger plants shall be covered by the Contractor at no additional cost to the City.

B. Label all plants of each size, caliper and variety and caliper with a securely attached waterproof tag bearing legible designation of botanical and common name.

C. All plants shall be the genus, species, and variety designated on the Contract Drawings. No substitutions will be accepted without the prior written approval of the City Forester and the Owner. Contractor must provide proof of non-availability.

2.2 TREES

A. These specifications shall apply to deciduous, broadleaf evergreen and coniferous species. Note that leaf characteristics will not be evident on deciduous trees during the dormant season.

B. Crown: The form and density of the crown shall be typical for a young specimen of the species/cultivar. Changes in form caused by wind, pruning practices, pests, or other factors shall not substantially alter the form for the species/cultivar. These crown specifications do not apply to plants that have been specifically trained in the nursery to be: topiary, espalier, multi-stem, or clump; or unique selections such as contorted or weeping cultivars.
   1. Trees shall have a single, relatively straight trunk, and central leader, unless noted on plans to be “Multi-trunk” or “Clump”. They shall be free of co-dominant stems and vigorous, upright branches that compete with the central leader. If the original leader has been headed, a new leader at least one-half of the diameter of the original leader shall be present.
   2. Main branches shall be evenly distributed along the central leader, not clustered together. They shall form a balanced crown appropriate for the age of the species/cultivar.
   3. Branch diameter shall be no larger than one-half the diameter of the central leader measured one-inch (1”) above where the branch is attached.
   4. The attachment of the largest scaffold branches shall be free of included bark.
   5. Temporary branches, unless otherwise specified, should be present along the lower trunk below the lowest scaffold branch, particularly for trees less than one-inch (1”) in caliper. These branches should be no greater than three-eighths-inch (3/8”) diameter. Clear trunk shall be no more than thirty percent (30%) of the total height of the tree, unless otherwise noted

C. Trunk: The tree trunk shall be relatively straight, vertical, and free of wounds, except properly made pruning cuts, which shall be closed over or less than three-quarters-inch (3/4") diameter open, sunburned areas, conks (fungal fruiting bodies), wood cracks, bleeding areas, signs of boring insects, galls, cankers, stem-girdling ties, or lesions (mechanical injury).
   1. Trunk caliper and taper shall be sufficient so that the tree will remain vertical without a stake. Trunk caliper at six-inches (6") above the soil media (substrate) surface shall be within the diameter range shown for each container size below and as specified in current edition of ANSI Z60.1.
   2. The cut made when re-growing the top should be just above the major structural roots. The "shank" that results from this procedure should be at a consistent height above the structural roots and no longer than five-inches (5"), to ensure that the trees are consistently planted at the correct depth. The base of the trunk should not have a large pruning cut from re-growing the top.

D. Roots: The root system shall be substantially free of injury from biotic (e. g., insects and pathogens) and abiotic (e. g., pesticide toxicity and salt injury) agents.
   1. The uppermost roots or root collar shall be within the upper two-inches (2") of the soil media (substrate). Depth of the root-ball shall be measured from the top of the ball, which in all cases shall begin at the root flare. Soil above the root flare shall not be included in the root-ball depth measurement, and shall be removed.
   2. The root collar and the inside portion of the root-ball shall be free of defects, including circling, kinked, and stem-girdling roots. Soil removal or root washing near the root collar may be necessary to inspect for the aforementioned root defects.
   3. Roots on the periphery and bottom of the root-ball shall be less than one-eighth-inch (1/8") diameter.
   4. The tree shall be well rooted in the soil media (substrate). Root distribution shall be uniform throughout the soil or media. Structure and growth shall be appropriate for the species/cultivar. When the burlap or container is removed, the root-ball shall remain intact. Trees should have several lateral roots or many fibrous roots spaced evenly around the trunk to provide support so the trees are stable when planted. Trees should have as many small roots as possible. These roots are key to the uptake of sufficient water and nutrients. Fibrous roots can be achieved by root-pruning, using air-pruning containers, or under-cutting or root pruning and transplanting at any stage of production.
   5. As a general rule for young nursery-grown trees, there should be two or more structural roots within one- to three-inches (1" – 3") of the soil surface. "First order lateral roots" is another term that has been used for these roots. If the roots are deeper than three-inches (3") , the stock shall be rejected.
   6. Root-balls that are undersized as specified in current edition of ANSI Z60.1. shall be rejected. Field grown trees for balled and burlap delivery shall have the roots pruned at least six-inches (6") inside the final root-ball size performed within adequate time for the tree to develop fibrous roots at the outer edge of the root-ball prior to harvest and delivery.

E. Leaves: The size, color, and appearance of leaves shall be typical for the time of year and stage of growth of the species or cultivar. Trees shall not show signs of prolonged moisture stress or extended drought as indicated by wilted, shriveled, or dead leaves.

F. Branches: Shoot growth (length and diameter) throughout the crown shall be appropriate for the age and size of the species/cultivar. Trees shall not have dead, diseased, broken, distorted, or otherwise injured branches.

G. All deciduous trees of one species used in formal rows or groupings shall exhibit cultural uniformity, i.e. “matched” in height, crown width and shape, height to first branch, and trunk taper. For this reason, it is desired that these trees be produced by a single grower.

H. Collected Stock: Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated, and only if approved by the City Forester and the Owner.

2.3 TREE-STABILIZATION MATERIALS

A. Trunk-Stabilization Materials:
   1. Deciduous and Evergreen Tree Stakes: Rough-sawn, sound, new softwood with specified wood preservative treatment by pressure process, free of knots, holes, cross grain, and other defects, two-inch (2”) diameter by six feet (6’), pointed at one end.
   2. Guys and Tie Wires: ASTM A 641/A 641M, Class 1, #14 galvanized-steel wire, two-strand, twisted.
   3. Tree-Tie Webbing: UV-resistant nylon webbing with brass grommets, size as indicated.
   4. Safety Signals for Guy and Staking Wire: One-half inch (1/2”) diameter PVC pipe, length as indicated.

B. Tree-Wrap:
   1. Two layers of crinkled paper cemented together with bituminous material, four-inches (4”) wide minimum, with stretch factor of thirty-three percent (33%).
   2. Tree wrap tape: Tape as approved by the City Forester and the Owner.

2.4 PLANT PIT BACKFILL MATERIAL

A. Unless otherwise directed by the Owner, the plant pit backfill material shall consist of the following, thoroughly mixed:
   1. Soil originally excavated from the pit: two thirds (2/3) proportion of total mix.

2.5 MISCELLANEOUS MATERIALS

A. Pre-Emergent Pesticide: As approved by the City Forester and the Owner.

B. Pesticides: EPA registered and approved, and as approved by the City Forester and the Owner.

C. Mulch: Double shredded Western Red Cedar (no fabric).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify actual grade elevations and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.

B. Examine areas to receive landscaping for compliance with requirements and for conditions affecting performance of work of this Section. Do not proceed with installation until unsatisfactory conditions have been corrected.
   1. When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, or obstructions, notify the Owner before planting.
   2. Verify that adequate overhead clearance exists to planting locations.
   3. Suspend planting operations during periods of excessive moisture until acceptable planting conditions exist.
   4. Uniformly moisten excessively dry soil that is not workable.

C. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within the work area. If contamination is present in the soil within a planting area, notify the Owner immediately.
   1. If contamination is discovered during Construction the Owner will determine the best course of action to remediate the contamination, which may include requesting the Contractor perform the removal of contamination and replacement of clean material.
   2. If contamination is determined to be the result of construction operations, Contractor is to remove contaminated material and replace with clean material at the direction of the Owner.

D. Proceed with installation only after unsatisfactory conditions have been corrected and approved by the Owner. Mulch per COT detail.

E. Cooperate with any other contractors and trades, who may be working in and adjacent to the landscape work areas. Examine the Contract Drawings which show the development of the entire site and become familiar with the scope of all work required.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities, turf areas and existing plants from damage caused by planting operations. Repair damage to surrounding areas and site elements noted above resulting from planting operations at no additional cost to the City.

B. Utilities: Contractor shall be responsible locating utilities and, repair of utilities damaged during the work. Determine location of overhead and underground utilities

and perform work in a manner that will avoid damage. Hand excavate, as required. Maintain markings until their removal is mutually agreed upon by the Contractor and the Owner.

C. Layout, stake and label all individual tree locations for approval by the Owner prior to installing trees.

D. Outline planting beds and mark plant locations within the bed(s) for approval by the Owner prior to installing any plant material or mow bands. Make adjustments as directed by the Owner at no additional cost to the City.
   1. If formal arrangements or consecutive order of plants is indicated on Contract Drawings, select stock for uniform height and spread, and number the labels to assure symmetry in planting.

E. Prepare planting area for soil placement and mix planting soil according to Division 32 Section “Soil Preparation”.

3.3 FIELD QUALITY CONTROL

A. Provide quantity, size, genus, species, and variety of trees indicated, complying with current applicable requirements of ANSI Z60.1 “American Standard for Nursery Stock”, and all applicable state and local rules and regulations.

B. Inspection: The Contractor shall arrange for the inspection of plant material upon delivery to the site for compliance with the Specifications and Contract Drawings. The City Forester and Owner have the right to reject plant material that does not meet Specifications until Final Acceptance.

C. Measurements: Measure trees according to the requirements of the ANSI Z-160, with branches and trunks in their normal position. Do not prune to obtain required sizes. Measure main body of tree for height and spread; do not measure branches or roots tip-to-tip.

3.4 EXCAVATION FOR TREES

A. Planting Pits: Excavate by hand or with a backhoe. Scarify sides of tree pit. Tree spade and augers may not be used to dig tree pits.
   1. Balled and Burlapped Trees: Excavate a minimum two times (2X) as wide as ball diameter at base of pit. Excavate a minimum of three to four time (3X – 4X) as wide as ball diameter at top of pit. The base of the root collar shall be three-inches (3”) higher than the grade at which the tree originally grew and finished grade. Slope sides of the pit as shown on the detail.
   2. Container-Grown Trees and Shrubs: Excavate approximately two times (2X) times as wide as container diameter at base of pit. Excavate a minimum of three to four time (3X – 4X) as wide as container diameter at top of pit. Plants shall be set one-inch (1”) higher than finished grade.
   3. Do not excavate deeper than depth of the root ball, measured from the base of the root flare to the bottom of the root ball.

4. If area under the plant was initially dug too deep, add soil to raise it to the correct level and thoroughly compact the added soil to prevent settling.

B. Obstructions:
   1. Utilities: Notify the Owner immediately of utilities that conflict or may potentially conflict with proposed plant locations. In such cases, alternative plant locations will be determined by the Owner.
   2. Notify the Owner prior to planting if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavation.

C. Drainage: Notify the Owner if subsoil conditions show evidence of water seepage or retention in tree or shrub pits.
   1. Fill the pit with water and allow it to completely drain before planting occurs.
   2. If water does not drain out of pit within twenty-four (24) hours, notify the Owner.

3.5 PLANTING TREES AND SHRUBS

A. Balled and Burlapped Stock:
   1. Set balled and burlapped stock plumb and in center of pit.
   2. Remove burlap from top two-thirds (2/3) of balls and partially from sides, but do not remove from under balls. Remove wire baskets and all twine entirely and place to side of hole for confirmation.
   3. Remove pallets, if any, before setting. Do not use planting stock if ball is cracked or broken before or during planting operation.
   4. Place backfill around ball in layers.. When pit is approximately one-half backfilled, water thoroughly to eliminate voids and air pockets prior to placing remainder of backfill. Repeat watering until no more is absorbed. Water again after placing final layer of backfill.
   5. Continue backfilling process. Water again after placing final layer of soil.

3.6 TREE WRAP

A. Inspect tree trunks for injury, improper pruning, and insect infestation and take corrective measures required before wrapping. Wrap trees starting at the base of the trunk and spiral cover trunk to height of first branches. Overlap wrap, exposing half the width, and securely attach without causing girdling. Use black electrical tape to secure. Do not use staples.
   1. All deciduous trees shall be wrapped by November 1st or per the direction of the Owner. All tree wrap shall be removed by May 15.
   2. Contractor shall be responsible for wrapping and unwrapping trees during the warranty period.

3.7 PRUNING OF PLANTS

A. Prune only damaged or dead branches as directed by the Owner.

3.8 TREE STABILIZATION

A. Install site-fabricated trunk stabilization as follows, unless otherwise indicated on Contract Drawings.
   1. Drive stakes into undisturbed grade outside tree pit. Avoid penetrating root balls or root masses.
   2. Securely attach specified wire to stakes.
   3. Support trees with specified wire and tree tie webbing from the tree trunk to each stake. Allow enough slack to avoid rigid restraint of the tree.
   4. For guyed trees: Attach thirty-six inch (36") long by one-half inch (1/2") diameter PVC pipe flagging to each wire.
   5. For staked trees: Attach twenty-four inch (24") long by one-half inch (1/2") diameter PVC pipe flagging to each wire.

3.9 CLEANING

A. Perform cleaning during installation of the work and upon completion of the Work, to the satisfaction of the Owner. Remove all excess materials, debris, and equipment from site. Repair any damage resulting from planting operations.

B. Remove surplus soil, excess subsoil, unsuitable soil, and waste material including trash and debris generated during installation at no additional cost to the City.

3.10 PROTECTION

A. Protect existing utilities, paving and other facilities from damage caused by planting operations. The Contractor shall repair any damage at no additional cost to the City.

B. Restrict vehicular and pedestrian traffic from planted areas. Erect signs and barriers as required or directed by the Owner at no additional cost to the City.

3.11 MAINTENACE

A. The Contractor shall be responsible for maintaining all trees, shrubs, and groundcover until Initial Acceptance is issued.

B. Maintain trees by pruning, cultivating, watering, mulching, winter watering, weeding, wrapping, unwrapping, restoring planting saucers, and resetting to proper grades or vertical position, as required to establish healthy, viable plantings. Control as required to keep trees free of insects and disease. Restore or replace damaged tree wrappings, stakes, guying.

C. During the irrigation season (generally May through September), water may be available from on-site quick couplers. When the system is not charged, it shall be the Contractor's responsibility to supply adequate amounts of water from a water truck or other approved source. Hoses and other watering equipment shall be supplied by Contractor.
   1. Watering Amount: Twenty (20) gallons per caliper-inch.

D. At time of Substantial Completion, verify that tree-watering devices are in good working order and leave them in place. Replace improperly functioning devices.

PART 4 - MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

A. Measurement will be made of the actual number of trees installed and accepted at each project location where shown on the drawings or as directed the Owner in accordance with the Specifications.

4.2 PAYMENT

Payment will be made under:

Pay Item	Pay Unit
Shrubscapes	SF
Deciduous Trees (2'' caliper)	EA

Payment for this item will include all the Contractor's costs of whatever nature to complete the tree planting and irrigation adjustment with the Specifications. Payment shall include: furnishing of shrubs, excavation, storage of shrubs, backfill, soil preparation, staking of trees, guying, fertilizing, wrapping, mulching, discing, raking, spreading, and fine grading, irrigation adjustment; watering until Final Acceptance, and other items necessary to complete the work as shown on the Drawings and in accordance with the Specifications.

END OF SECTION 32 93 00