



Town of Bennett

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Bennett HWY 79 Widening Trial Project Project Manual

Proposal Number:

RFP 20-005

April 13, 2020

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1.01 CONDITIONS AND REQUIREMENTS

- A. Division 1 - General Requirements govern work under all divisions of Specifications.

1.02 SCHEDULE OF DRAWINGS, SPECIFICATIONS AND ADDENDA

- A. Drawings: See index on drawings.
- B. Project Manual: HWY 79 Widening Trail Project, dated April 13, 2020.
- C. Addenda: All Addenda issued prior to bidding.

1.03 EXAMINATION OF SITE

- A. Failure to Visit Site: Will not relieve Contractor from necessity of furnishing materials or performing work that may be required to complete work in accordance with drawings and Specifications without additional cost to Owner.

1.04 CONTRACTS

- A. Single Contract: All work under this contract will be executed under one prime contract between Owner and General Contractor.

1.05 CONTRACTOR USE OF PREMISES

- A. Limitations: Operations of the General Contractor shall be limited to areas where work is indicated.

1.06 COORDINATION

- A. General: Coordinate work of various sections of Specifications to assure efficient and orderly sequence of installation of construction elements, with provisions for accommodating work performed.

1.07 ACCESS/STAGING

- A. The only site access available for construction traffic/use is off Muegge Way & Hwy 79, Coordinate approved staging area and access with Town of Bennett Public Works. Care should be taken not to work outside the project area and to minimize disturbance in the R.O.W. Stake property corners, if necessary, to delineate the property boundaries and get necessary permits for work within the R.O.W..

END OF SECTION

1.01 RELATED REQUIREMENTS

- A. Summary of Work: Section 01010.
- B. Field Engineering: Section 01050.
- C. Quality Control: Section 01400.
- D. Contract Closeout: Section 01700.

1.02 COORDINATION

- A. Coordinate scheduling, submittals, and work of the various Sections of Specifications to assure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.
- B. Coordinate work of various Sections having interdependent responsibilities for installing, connecting to, and placing in service, all underground utilities.
- C. Coordinate space requirements and installation of mechanical and electrical work which are indicated diagrammatically on Drawings. Follow routing shown as closely as practicable.
- D. Coordinate completion and clean up of work of separate Sections in preparation for Completion of Work.
- E. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

1.03 INSPECTION COORDINATION

- A. The Contractor is required to coordinate his work schedule with the Landscape Architect so that key inspection points, as determined by the Landscape Architect may be observed. If the Contractor fails to provide reasonably adequate notice or proceeds without the required inspection, the work shall be re-exposed or redone in its entirety. No extra compensation will be awarded to the Contractor when he is required to redo work due to his failure to coordinate inspections with the Landscape Architect.
- B. In the event that the Contractor schedules an inspection and the inspector arrives at the designated time and location and the work is not ready for inspection or has already been performed and an additional inspection will have to be made, the Contractor shall bear the cost of the initial "wasted" inspection. The cost of the "wasted" inspection shall be deducted directly from partial and final payments made to the Contractor and shall be based on the actual time and materials billing rates then in effect.

END OF SECTION

PART 1 - GENERAL

1.01 DESCRIPTION

A. Related Work:

1. Earthwork: Section 02200.
2. Asphaltic Concrete Paving: Section 02510.

B. Work Included: The Contractor shall be responsible for all cutting, fitting and patching including related excavation and backfill, required to complete the work or to:

1. Make its parts fit together properly.
2. Uncover portions of the work to provide for installation of ill-timed work.
3. Remove and replace defective work.
4. Remove and replace work not conforming to requirements of Contract Documents.
5. Provide routine penetrations of non-structural surfaces for installation of piping and electrical conduit.

1.02 QUALITY ASSURANCE

A. Notification of Landscape Architect: Notify Landscape Architect well in advance of executing any boring, cutting or alteration which affects:

1. The work of the Owner or any separate contractor.
2. The structural value or integrity of any element to the Project.
3. The integrity of effectiveness of weather - exposed or moisture-resistant elements or systems.
4. The efficiency, operational life, maintenance or safety of operational elements.
5. The visual qualities of sight-exposed elements.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Comply with Specifications and standards for each specific product involved.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Inspect existing conditions of the Project, including elements subject to damage or to movement during boring, cutting and patching.
- B. After uncovering work, inspect the conditions affecting the installation of products, or performance of the work.
- C. Report unsatisfactory or questionable conditions to the Landscape Architect; do not proceed with the work until the Landscape Architect has provided further instructions.

3.02 PREPARATION

- A. Provide adequate temporary support as necessary to assure the structural value or integrity of the affected portion of the work.
- B. Provide devices and methods to protect other portions of the project from damage.
- C. Provide protection from the elements for that portion of the project which may be exposed by boring, cutting and patching work, and maintain excavations free from water.

3.03 BORING, CUTTING AND PATCHING

- A. General: Openings in construction which are required by other contractors shall be left by crafts involved. It is the responsibility of various contractors to supply in advance, proper and sufficiently detailed information. In event of failure to supply this advance information, all cutting as may be required shall be done only after concurrence of Landscape Architect and at expense of negligent party.

- B. Cutting:
 - 1. Execute cutting and demolition by methods which will prevent damage to other work, and will provide proper surfaces to receive installation or repairs.
 - 2. Execute excavating and backfilling by methods which will prevent settlement or damage to other work.
 - 3. Employ the installer or fabricator of work on this project to perform boring, cutting and patching for:
 - a. Boring under existing track surface for sleeves to accommodate:
 - 1. An electrical sleeve for irrigation control wire.
 - 2. A 6" sleeve for Irrigation mainline.
 - 4. Cut asphalt, concrete or masonry using a masonry saw or core drill as applicable.

- C. Fitting:
 - 1. Execute fitting and adjustment of products to provide a finished installation to comply with specified products, functions, tolerances and finishes.
 - 2. Fit work airtight to pipes, sleeves, ducts, conduit and other penetrations through surfaces.

- D. Patching: See Section 02510 and Section 03300.

- E. Finishing:
 - 1. Where surfaces are exposed, finish with same materials specified in finish schedule or material that is on constructed surfaces as required.
 - 2. Refinish entire surfaces as necessary to provide an even finish to match adjacent finishes:
 - a. For continuous surfaces, refinish to nearest intersection.
 - b. For an assembly, refinish the entire unit.

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Field engineering services required for proper execution and completion of work under this contract.
- B. Related Sections:
 - 1. Record Documents: Section 01700 Contract Closeout.

1.02 SUBMITTALS

- A. Quality Control Submittals:
 - 1. Surveyor or Engineer: Submit name and address of surveyor or professional engineer to be employed by Contractor to Landscape Architect for acceptance before beginning work at site.
 - 2. Documentation and Records: Surveyor or engineer shall maintain complete and accurate log of control and survey work as it progresses. On request of Landscape Architect submit documentation to verify accuracy of field engineering work.
 - 3. Completion Certificate: Upon completion of work, submit certificate to Landscape Architect signed by surveyor or engineer certifying that elevations and locations are in conformance with Contract Documents. Note any items of non-conformance.
 - 4. Structural Engineered stamped plans for the pavilion piers / footings.

1.03 QUALITY ASSURANCE

- A. Qualifications: Contractor shall employ land surveyor or professional engineer registered in State of Colorado and acceptable to Owner.
- B. Surveyor or Engineer: Responsible for location of major site elements; establishment of horizontal and vertical controls; installation of control stakes as required; and final certification that finish grading has been completed within tolerances specified.

PART 2 - PRODUCTS

Not Applicable.

PART 3 - EXECUTION

3.01 PROJECT SURVEY REQUIREMENTS

- A. Reference Points: Owner's Representative will identify existing control points and property line stakes indicated on drawings and site survey. Immediately upon entering project, locate and maintain bench marks and all other grades, lines, levels and dimensions. Report any errors or inconsistencies to Owner's Representative before commencing work.
- B. Permanent Bench Marks: Surveyor or engineer shall establish minimum of two (2) permanent bench marks on site, referenced to data established by survey control points.
- C. Preservation of Monuments and Stakes: Carefully preserve monuments, bench marks, property markers, reference points, and stakes.
 - 1. In case of his destruction of these, the Contractor shall be charged with expense of replacement and shall be responsible for any mistake or loss of time that may be caused.
 - 2. Protect permanent monuments or bench marks which must be removed or disturbed until properly referenced for relocation.
 - 3. Furnish materials and assistance for proper replacement of such monuments or bench marks.
- D. Layout and control by Surveyor or Engineer:

1. Site: Establish lines, levels and locations by instrumentation. Set control stakes for finish grading. Reset stakes as required during progress of work.
- E. Completion: Upon completion of work, surveyor or engineer shall survey site to verify that locations and elevations required by Contract Documents have been achieved within specified tolerances.
- F. Each Subcontractor: Provide complete engineering layout for work to be performed under his subcontract, including grades, elevations, and all other engineering required to perform his scope of work.

END OF SECTION

1.01 PERMITS AND FEES

- A. See General Conditions.
- B. The Contractor shall be responsible for obtaining and paying for all permits and licenses required to perform the specified work.

1.02 CODES AND ORDINANCES

- A. Compliance: All contractors shall comply with all applicable codes, ordinances and regulations in effect at time of bid opening including but not necessarily limited to the following:

- Applicable local codes and ordinances.
- Governing fire department requirements.
- Utility company requirements.
- State Department of Labor Requirements.
- State Department of Health Requirements.
- National Fire Protection Association Standards.
- State and Federal Safety and Health Laws.
- NFPA 70 - National Electrical Code.
- CDOT regulations for work within HWY 79 R.O.W.

1.03 DISCREPANCIES

- A. If discrepancies occur between Contract Documents, local codes, local utility requirements, etc., most stringent requirements shall apply.

END OF SECTION

1.01 QUALITY ASSURANCE

- A. Reference Standards: For products or workmanship specified by association, trade or federal standards, comply with requirements of standard, except when more rigid requirements are specified or are required by applicable codes.
 - 1. No provision of any referenced standard specification, manual or code (whether or not specifically incorporated by reference in the Contract Documents) shall be effective to change duties and responsibilities of Owner, Contractor or Landscape Architect or any of their consultants, agents or employees from those set forth in Contract Documents, nor shall it be effective to assign to Landscape Architect or any of his consultants, agents or employees any duty or authority to supervise or direct furnishing or performance of work or any duty or authority to undertake responsibilities contrary to provisions of General Conditions.
- B. Effective Date: Date of standard is that in effect as of documents date except when specific date is specified or when standard is part of applicable code which includes edition date.
- C. Copies: When required by individual sections, obtain copy of standard. Maintain copy at job site during work.

END OF SECTION

1.01 PRECONSTRUCTION CONFERENCE

- A. Site Mobilization Conference: Meeting will be scheduled by the Owner's Representative at the site immediately prior to Contractor move-in. Representatives of Contractor, Owner, Landscape Architect and Consultants will be present. Job site procedures to include the following items will be discussed:
1. Procedures for maintaining project record documents.
 2. Owner's requirements.
 3. Construction facilities and controls.
 4. Temporary utilities.
 5. Security and housekeeping procedures.
 6. Materials testing.
 7. Services of the Geotechnical Engineer.
 8. Field Engineering.
 9. Communications with Landscape Architect and his consultants.
 10. Access to and use of site.

1.02 PROGRESS MEETINGS

- A. Meetings: Contractor will schedule regular periodic meetings at Contractor's job site field office. Representatives of Owner and Landscape Architect will be invited to attend. Also invited as appropriate to items under discussion, will be selected subcontractors and suppliers and consultants. The following items will be discussed:
1. Review of work progress since previous meetings.
 2. Field observations, problems, conflicts.
 3. Problems which impede construction schedule.
 4. Review of off-site fabrication, delivery schedules.
 5. Corrective measures and procedures to regain projected schedule.
 6. Revisions to construction schedule.
 7. Plan progress, schedule during succeeding work period.
 8. Coordination of schedules.
 9. Maintenance of quality standards.
 10. Review submittal schedules; expedite as required.
 11. Review proposed changes for effect on other trades, construction schedule and completion date.
 12. Coordination of separate contracts.
 13. Other business as required.
- B. Agenda and Minutes: Contractor shall establish agenda, and keep and distribute minutes of progress meetings and lists of those present and others as directed.
- C. Persons Representing Contractor at Meetings: Have authority to commit Contractor to solutions agreed upon in meetings. To maximum extent possible, assign same person or persons to represent Contractor at meetings throughout progress of work.
- D. Coordination Meetings: Progress meetings shall in no way be considered substitute for Contractor/subcontractor coordination meetings.

END OF SECTION

1.01 RELATED REQUIREMENTS

- A. List of Subcontractors:
 - 1. General Conditions.

- B. Products List:
 - 1. Section 01600 Materials and Equipment.

- C. Progress Schedule:
 - 1. General Conditions.

- D. Performance Bond/Labor and Material Payment Bond:
 - 1. Instructions to Bidders.
 - 2. General Conditions.

- E. Insurance Certificates:
 - 1. General and Supplementary Conditions.

- F. Applications for Payment:
 - 1. General Conditions.

- G. Project Record Documents:
 - 1. Section 01700 Contract Closeout.

- H. Warranties:
 - 1. Section 01700 Contract Closeout.

- I. Final Paperwork:
 - 1. Section 01700 Contract Closeout.

- J. Contractor's Quality Control System:
 - 1. Section 01400 Quality Control.

1.02 GENERAL

- A. Submittals: Made early enough to account for processing described below and reasonable period for review by Landscape Architect.

1.03 SUBMITTALS LIST, SCHEDULE AND PRODECURES

- A. Submittal: Within fifteen (15) days after award of contract, and before any items are submitted for review, submit to Landscape Architect two (2) copies of submittal list and schedule.

- B. Schedule: Compile complete schedule of all submittals anticipated to be made during progress of work.
 - 1. Include list of each type of item for which Contractor's drawings, shop drawings, product data, Certificates of Compliance, samples, warranties or other types of submittals are required.
 - 2. On acceptance by Landscape Architect, Contractor shall adhere to schedule except when specifically otherwise permitted.

- C. Code Designation: On schedule, designate each item with number code utilizing Specification Section five (5) digit numbers.
 - 1. Each Submittal: Marked with same code designation.

- D. Coordination: Coordinate schedule with subcontractors and materials suppliers.

- E. Revisions: Revise and update schedule as necessary to reflect conditions and sequences. Promptly submit any revised schedules to Landscape Architect for review.
- F. Transmittals: Include transmittal letter with each submittal, identify item by above code designation and reference to Specification Section. Use separate transmittal for each submittal.
 - 1. Each Submittal: Have chronological submittal number.
 - 2. Resubmittals: Have original submittal number and letter in alphabetical order for each resubmittal.
- G. Deviations: Clearly mark and note any deviations from Contract Documents in submittals.

1.04 SHOP DRAWINGS

- A. Shop Drawings: Make particular note of field-measured dimensions, as-built conditions, and conditions requiring special coordination with other contractors and requirements of activities of Owner.
- B. Subcontractor: Submit drawing PDF's (in scale) and specified number of samples to Contractor.
- C. Contractor:
 - 1. Review shop drawings for accuracy, completeness, and conformity with Contract Documents. Make notes and corrections on sepia tracings and prints.
 - 2. Stamp with Contractor's stamp/date. Signature of individual who reviewed shop drawings is required below Contractor's stamp.
 - 3. Print as required for Contractor's record.
 - 4. Send drawing PDF's (in scale) to Landscape Architect.
 - 5. Shop drawings not stamped and signed by Contractor will be returned.
- D. Landscape Architect:
 - 1. Check drawings by making notes and corrections on sepia tracings and prints, stamp "No Exceptions Taken", "Revise and Resubmit", "Rejected", etc. as required.
 - 2. In event that shop drawings require consultant's check, route PDF's and print through consultant and back to Landscape Architect as necessary. Consultant will retain one (1) set of prints.
 - 3. Retain one (1) set of prints for record and transmit one (1) set to Owner if required.
 - 4. Return Redlined PDF's to Contractor.
- E. Contractor:
 - 1. Send redlined PDF's to subcontractor.
- F. Subcontractor:
 - 1. Print necessary copies for record, distribution, etc.
- G. Resubmittal: In event shop drawings have to be resubmitted to Landscape Architect, original sepia tracings and prints shall be returned directly to Contractor. Subcontractor shall make his corrections and re-route new PDF's and prints as outlined above.
- H. References: Reference shop drawings to applicable drawings and Specification Sections to facilitate ease and accuracy of checking.

1.05 PRODUCT DATA

- A. Subcontractor: Submit six (6) copies of brochure material and any required samples.
- B. Routing: Routing will be as indicated above for shop drawings with Landscape Architect retaining two (2) copies for file and returning four (4) copies to Contractor for his file and distribution to subcontractor as applicable.

C. Reference: Reference product data to applicable drawings and Specification Sections to facilitate ease and accuracy of checking.

D. When contents of submitted literature from Manufacturers includes data not pertinent to submittal, clearly indicate which portion of contents is being submitted for review.

1.06 JOB SITE DOCUMENTS

A. Documents: Keep complete set of accepted shop drawings or product data at jobsite.

1.07 FIELD MEASUREMENTS

A. Field Measurements: Responsibility of Contractor.

1.08 CERTIFICATES OF COMPLIANCE

A. Certificates:

1. Where Certificates of Compliance are specified, show on each certification, name and location of work, name and address of Contractor, quantity and date or dates of shipment or delivery to which certificate applies, and name of Manufacturer.
2. Certification: In form of letter or company standard forms.
3. Certificates: Signed by officer of Manufacturer.
4. Laboratory Test Reports: Show date of testing, specified requirements for which testing was performed, and results of tests.

END OF SECTION

1.01 RELATED REQUIREMENTS

- A. Cost of Testing: General Conditions.

1.02 TESTING

A. General:

1. The Contractor is responsible for providing all test data needed to verify that any off-site material he is providing for the job meet the contract requirements. The Owner will provide testing to determine that the work is performed in accordance with the Specifications and to check that material specifications are met. Any tests ordered at Owner's direction which show that the subject Contractor supplied material or installation does not meet the Contract requirements shall be paid for by the Contractor. The Contractor shall pay all cost associated with making failed tests including, but not limited to, field labor and laboratory testing. The cost of failed tests will be deducted directly from partial and final payments made to the Contractor. The Owner will not pay for any tests ordered by the Contractor.
2. The Contractor shall provide the manpower and equipment necessary to explore selected portions of the project for testing. No extra compensation will be awarded for these services.
3. The Contractor is required to coordinate his work schedule with the Landscape Architect so that key testing points, may be observed. If the Contractor fails to provide reasonably adequate notice or proceeds without the required testing, the subject work shall be re-exposed or redone in its entirety, while the inspector is present. No extra compensation will be awarded to the Contractor when he is required to redo work due to his failure to coordinate testing with the Landscape Architect.
4. Do not use materials or equipment represented by samples until tests, if required, have been made and materials or equipment found to be acceptable.
5. Do not incorporate any product into work which becomes unfit for use after acceptance thereof.

- B. Testing: Materials or equipment proposed to be used may be tested at any time during their preparation or use. Furnish required samples without charge and give sufficient notice of placing of orders to permit testing. Products may be sampled either prior to shipment or after being received at site of work.

- C. Tests: Made by accredited testing laboratory selected by Owner. Except as otherwise provided, sampling and testing of materials and laboratory methods and testing equipment shall be in accordance with latest standards and tentative methods of ASTM.

1. Specific information concerning testing methods, sample sizes, etc., is included under applicable Sections of Specifications.
2. Any modification of, or elaboration on, these test procedures included for specific materials under their respective Sections in Specifications shall take precedence over these procedures.

1.03 TESTS PAID FOR BY OWNER

- A. Control Tests of Fill and Backfill: At such times and in such numbers as specified in Sections 02200 and 02221.
- B. Control Test of Asphalt Paving Base and Finish Courses: At such times and in such numbers as specified in Section 02511 Asphaltic Concrete Paving.

1.04 OTHER TESTING

- A. Following Testing: Performed at expense of installing contractor:

1. Other Tests: Any other tests required by Contract Documents not listed in Article above.
2. Any additional tests required because of any tests that fail subject to the following conditions:
 - a. Quantity and Nature of Tests: Determined by Landscape Architect.
 - b. Tests: Taken in presence of Landscape Architect.

- c. Proof of Noncompliance: Contractor liable for corrective action which the Landscape Architect feels is required including complete removal and replacement of defective material.
 - 3. Material Substitution: Any tests of material or equipment offered as substitute for specified item on which test may be required in order to prove its compliance with Specifications.
 - B. Contractor: May have tests performed on material and equipment for his own information and job control so long as Owner does not assume responsibility for costs or for giving them consideration when appraising quality of materials.
- 1.05 TEST REPORTS
- A. Reports of tests made by testing laboratories shall be distributed by testing laboratory as follows:
 - 1 Copy - Contractor.
 - 1 Copy - Applicable Supplier or Subcontractor.
 - 1 Copy - Landscape Architect.
 - 1 Copy - Applicable Engineer.
 - 1 Copy - Owner.Other Copies - As Directed.
- 1.06 CONTRACTOR'S QUALITY CONTROL SYSTEM
- A. Quality Control: Establish system to perform sufficient inspection and tests of all items of work, including that of subcontractors, to ensure conformance to Contract Documents for materials, workmanship, construction, finish, functional performance and identification.
 - 1. Control System: Establish for all construction except where Contract Documents provide for specific compliance tests by testing laboratories and engineers employed by Owner.
 - 2. Control System: Specifically include all testing required by various Sections of Specifications.
 - B. Quality Control System: Means by which Contractor assures himself that construction complies with requirements of Contract Documents.
 - 1. Controls: Adequate to cover all construction operations and keyed to proposed construction schedule.
 - C. Records: Maintain correct records on appropriate form for all inspections and tests performed, instructions received from Landscape Architect and actions taken as result of those instructions.
 - 1. Records: Include evidence that required inspections or tests have been performed (including type and number of inspections or tests, nature of defects, causes for rejection, etc.) proposed or directed remedial action, and corrective action taken.
 - 2. Document inspections and tests as required by each Section of Specifications.

END OF SECTION

1.01 TEMPORARY ELECTRICITY

A. Service and Distribution:

1. Contractor may connect to existing service with Owner's permission.
2. Provide temporary wiring, outlets, lights, etc. as required for construction power and lighting during construction period.
3. Properly ground service and distribution system in accordance with NEC. Provide ground fault interrupters as required by code.
4. Remove temporary electrical service and wiring upon completion of work.
5. Distribution equipment and wiring devices for temporary power and lighting need not be new, however, installation shall conform to safe general practice as required by OSHA.
6. Contractor shall be responsible for any damage done to the permanent wiring or fixtures as a result of use of same.

- B. Electrical Consumption: Owner will pay for electricity used through temporary and permanent systems.

1.02 TEMPORARY HEAT AND ENCLOSURES

- A. Temporary Heat: Provide temporary heat necessary for execution of work. Install, maintain and operate temporary heating apparatus in manner to facilitate work, so work can continue and so finished work will not be damaged.

1.03 TEMPORARY WATER

- A. Temporary Water: Contractor may connect to existing system with Owner's permission.

1. Provide service, temporary connections, plumbing, piping, etc. necessary to convey same to places needed.
2. Owner will pay for water used through temporary and permanent systems.

1.04 TEMPORARY SANITARY FACILITIES

- A. Toilet Facilities: Provide and maintain, in neat and sanitary condition, adequate chemical toilet facilities for use of employees engaged on work, in compliance with requirements of applicable codes, regulations, laws and ordinances. Existing toilets may not be utilized.

1.05 FIELD OFFICE AND OTHER TEMPORARY STRUCTURES

- A. Field Office: Provide and maintain suitable temporary field office.

1. Telephone Service: Install telephone in field office. Pay for installation, maintenance, removal and other charges for use of telephone.
2. Make office and telephone available for use by Landscape Architect.

- B. Temporary Structures: Provide temporary structures and storage areas as required.

1. Remove offices and other temporary structures from site upon completion of work.

1.06 TEMPORARY PROTECTIVE FACILITIES

- A. Provide and maintain protective devices and facilities for protection of public and general protection of workmen on project.

1. Provide warning signs against hazards created by construction.
 - a. Danger Lights: Keep lighted each night from sundown to sunrise.
2. Provide and maintain fire extinguishers and active fire hydrants where required. Maintain fire lanes to hydrants and other equipment as necessary for proper fire protection during construction.

3. Provide temporary walks, roadways, trench covers, barricades, bulkheads, railings, danger lights and signals, etc. required for work by applicable 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.

1.07 TRACK BRIDGING AND RUNWAYS

- A. Contractor shall photograph/video the site prior to mobilization. Contractor needs to protect existing surfaces to remain with sufficient fabric material, plywood and planking, not only immediately beneath the bridging but laterally beyond for a minimum distance of 30'. Fabric, plywood and planking should combine a minimum depth of 2". Cover, with a significant quantity of earth from infield excavation, to a depth required, to protect the impact of equipment movement overhead, from affecting the surface and structural integrity of the track itself. Every time the "bridge" is removed, clean as necessary to restore to its original condition, so that it is made fully functional for activities as required. Any damage will be subject to repair and/or replacement and repair as determined by an Owner's Representative.
- B. Runways, Guard Rails, and Similar Temporary Construction: Provide and maintain for safe performance of Contract.
 1. Provide facilities of type and arrangement as required for their specific use, substantially constructed, strongly supported, and well secured.
 2. Comply with applicable safety laws and codes.

1.08 PROTECTION FOR WORK IN PLACE

- A. Work in Place: When subject to injury because of operations being carried on adjacent, cover, board up, or substantially enclose with adequate protection.
 1. Construct forms of protection in manner than, upon completion, entire work will be delivered to owner in undamaged condition.

1.09 CONSTRUCTION FENCE

- A. Construction Fence: Provide temporary fence as required for security and protection of the public.
 1. Fencing: Orange vinyl with steel posts and top wire support.
 2. At completion of work, remove fences from the site.

1.11 TARP - Not required.

1.12 PROJECT IDENTIFICATION SIGN - Not required.

1.13 ACCESS

- A. Limit access to necessary routes to perform the work.
 1. See Section 01010 for limitations on access to site.

1.14 TEMPORARY CONTROLS

- A. General: Comply with local codes, ordinances and regulations.
- B. Noise: Minimize noise near residential areas. Properly muffle equipment. Do not operate noisy equipment after hours.
- C. Dust: Control when construction procedures result in dust which becomes nuisance to Owner, private property or traffic.
- D. Water: Control flow of water at site to prevent damage to Owner's private and public facilities. Under no circumstances shall water be allowed to flow unrestricted from the construction area.

- E. Debris: Continually police work to prevent collection and scattering of debris uncovered, loosened, or caused by prosecution of work.
 - F. Pollution: Take precautions to prevent spilling and littering of water polluting substances. Do not dump any foreign materials into sewer and storm sewer collection systems.
 - 1. Burning of debris or any other air polluting methods or equipment not allowed.
 - G. Erosion: Provide facilities necessary to prevent erosive damage to Owner's property and to adjacent properties.
- 1.15 CLEAN UP
- A. General: Maintain project and site in clean and orderly condition. Periodically clean interior areas. Regularly remove waste materials, debris and rubbish from site.

END OF SECTION

1.01 RELATED REQUIREMENTS

- A. General Conditions.

1.02 PRODUCTS

- A. Products: Include material, equipment and systems.
 - 1. Comply with Specifications and referenced standards as minimum requirements.
 - 2. Components Supplied in Quantity within a Specification Section: Same and interchangeable.

1.03 TRANSPORTATION AND HANDLING

- A. Transportation: Transport products by methods to avoid product damage; deliver in undamaged condition in Manufacturer's unopened containers or packaging, dry.
- B. Handling: Provide equipment and personnel to handle products by methods to prevent soiling or damage.
- C. Inspection: Inspect shipments to assure products comply with requirements, quantities are correct, and products are undamaged.
 - 1. Reject damaged and defective items.
- D. Each Subcontractor: Be responsible for hoisting and stocking of his materials and equipment on site.
 - 1. Material Stocking: Coordinated with Contractor's superintendent.

1.04 STORAGE AND PROTECTION

- A. Storage: Store products in accordance with Manufacturer's recommendations, with seals and labels intact and legible. Store sensitive products in weathertight enclosures; maintain within temperature and humidity ranges required by Manufacturer's recommendations.
 - 1. Store loose granular materials on solid surfaces in well drained area; prevent mixing with foreign matter.
- B. Exterior Storage Protection:
 - 1. Fabricated Products: Place on sloped supports above ground.
 - 2. Cover products subject to deterioration with impervious sheet covering; provide ventilation to avoid condensation.
- C. Inspection: Arrange storage to provide access for inspection. Periodically inspect to assure products are undamaged, and are maintained under recommended conditions.

1.05 INSTALLATION

- A. Pre-Installation Conferences: Hold pre-installation meeting at site before installation of each unit of work which requires coordination with other units of work. Installer and Manufacturer's representatives of particular work and affected work shall attend.
 - 1. Notify Landscape Architect of meeting time.
 - 2. Discuss coordination of work with other work including shop drawings, product data, possible conflicts, compatibility concerns, acceptability of substrates, protection, etc.
 - 3. Record significant discussions at each meeting, agreements, disagreements and final plan of action. Distribute record to those in attendance and to Landscape Architect.
 - 4. Do not proceed with unit of work until pre-installation meeting is successfully concluded with agreed upon plan of action.
- B. Inspection of Substrates: Require installer of each major unit of work to inspect substrate to receive work and conditions under which work is to be performed.

1. Installer: Report unsatisfactory conditions to General Contractor in writing with a copy to Landscape Architect.
 2. Do not proceed with work until unsatisfactory conditions have been corrected to satisfaction of installer.
- C. Manufacturer's Instructions: Where installations include manufactured products, comply with Manufacturer's applicable instructions and recommendations for installation, to extent that these instructions and recommendations are more explicit or more stringent than requirements specified or indicated.
1. Notify Landscape Architect of any conflicts between Manufacturer's instructions or recommendations and requirements specified or indicated.
- D. Measurements and Dimensions: Recheck as integral step of starting each installation.
- E. Climatic Conditions and Project Status: Install each unit of work under conditions to ensure best possible results in coordination with entire project.
- 1.06 PRODUCTS LIST
- A. Submittal: Within fifteen (15) days after Notice of Award, transmit three (3) copies of list of major products which are proposed for installation, including name of manufacturer.
1. Tabulate products by specifications section number, title, and article number.
 2. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards.
- B. Landscape Architect: Will promptly reply in writing whether there is reasonable objection to listed items. Failure to object to listed item shall not constitute waiver of requirements of Contract Documents.
- 1.07 PRODUCTS OPTIONS
- A. Products Specified by Reference Standards or by Description Only: Any product meeting those standards.
- B. Products Specified by Naming One or More Manufacturers with Substitution Paragraph: Products of named manufacturers meeting specifications. Submit request for substitution for any manufacturer not specifically named.
1. Products of acceptable manufacturers are subject to requirements of specifications for specified product.
- C. Products Specified by Naming One or More Manufacturers: Products of named manufacturers meeting specifications; no options, no substitutions.
1. Products of acceptable manufacturers are subject to requirements of specifications for specified product.
- D. Products Specified by Naming Only One Manufacturer: No option, no substitution allowed.
- 1.08 LIMITATION ON SUBSTITUTIONS
- A. General Conditions specifies times for submitting requests for substitutions.
- 1.09 REQUESTS FOR SUBSTITUTIONS
- A. Submittal: Submit two (2) copies of each request. Submit separate request for each substitution.
1. Identify products by specifications section and article numbers.
 2. Provide manufacturer's name and address, trade name of products, and model or catalog number.
 3. List fabricators and suppliers as appropriate.

- B. Documentation: Document each request with complete data substantiating compliance of proposed substitution with requirements of Contract Documents:
 - 1. Attach Product Data as specified in Section 01300.
 - 2. Give itemized comparison of proposed substitution with specified product, listing variation, and reference to specification section and article numbers.
 - 3. Give quality and performance comparison between proposed substitution and specified product.
 - 4. List availability of maintenance services and replacement materials.
 - 5. State effect of substitution on construction schedule, and changes required in other work or products.

1.10 CONTRACTOR REPRESENTATION

- A. Request for Substitution: Representation that Contractor has investigated proposed product and has determined that it is equal to or superior in all respects to specified product:
 - 1. Contractor will provide same warranty for substitution as for specified product.
 - 2. Contractor will coordinate installation of accepted substitute, making such changes as may be required for work to be complete in all respects.
 - 3. Contractor waives claims for additional costs related to substitution which may later become apparent.

- B. Replacement: If substituted products do not meet or exceed above requirements, whether before, during, or after incorporated into work, Contractor shall, at no additional cost to Owner, replace substituted products with products originally specified.

END OF SECTION

1.01 PROJECT RECORD DOCUMENTS

- A. Project Site Record Documents: Maintain at project site one (1) record copy of the following:
 - 1. Drawings.
 - 2. Specifications.
 - 3. Addenda.
 - 4. Accepted Shop drawings, Product Data and Samples.
 - 5. Change Orders.
 - 6. Other Modifications to Contract.
 - 7. Field Test Records.
- B. Record Documents: Do not use record documents for construction purposes. Maintain documents in clean, dry legible condition, apart from documents used for construction.
- C. Record Information: Label each document "Record Document".
 - 1. Mark information with contrasting color using ink.
 - 2. Keep each record current. Do not permanently conceal any work until required information is recorded.
- D. Drawings: Record the following information on drawings.
 - 1. Horizontal and vertical location of underground utilities.
 - 2. Field changes of dimension and detail.
 - 3. Changes by change order or field order.
 - 4. Details not on original contract drawings.
- E. Specifications: Record the following information on Specifications:
 - 1. Manufacturer, trade name, catalog number and supplier of products and items of equipment actually installed.
 - 2. Changes by change order or field order.
 - 3. Other matters not originally specified.
- F. Shop Drawings: Maintain shop drawings as record documents recording changes made after review as specified for drawings above.
- G. Submittal: At completion of project, transfer record documents to autocad disk to be furnished by the Landscape Architect and transmit to the Landscape Architect with transmittal letter containing date, project title and number, Contractor's name and address, title and number of each record document, and certification that each document is complete and accurate. Submittal shall be signed by Contractor.

1.02 CLOSEOUT PROCEDURES

- A. Procedures: The following project closeout procedure defines responsibilities of Contractor, Owner and Landscape Architect in closing project:
 - Step 1 Contractor advises Landscape Architect in writing that he has reached "Substantial Completion" and provides list of items to be completed or corrected. Closeout may be conducted by areas or portions of work if requested by Owner.
 - Step 2 Landscape Architect inspects work to determine if it is substantially complete, and issues Certificate of Substantial Completion plus "Punch List" of items to be completed or corrected.
 - Step 3 Contractor completes and/or corrects all punch list items and notifies Landscape Architect in writing that his work is ready for final inspection. At this time, final application for payment is submitted.
 - Step 4 Landscape Architect makes final inspection.
 - Step 5 Owner issues Notice of Acceptance.

1.03 FINAL PAPERWORK

- A. Final paperwork: Prior to release of final payment, Contractor shall deliver the following items to Landscape Architect:

Inspection Certificates, as applicable.
Contractor's Warranty of Materials and Workmanship.
Maintenance Manuals and Parts Lists, as specified.
All Guaranties, Warranties and Submittals, as specified.
Receipts for Extra Materials Delivered to the Owner.
Miscellaneous Keys, Switches, Etc.
Final Application for Payment.
Consent of Surety to Final Payment.
Project Record Documents.

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

1.04 INSPECTION CERTIFICATES.

- A. Each subcontractor shall, upon completion of the work, secure in triplicate, certificates from any state or local governing bodies having jurisdiction in dictating that the work is in strict accordance with the applicable codes and deliver same to the Contractor for transmittal to the Landscape Architect.

1.05 WARRANTIES

- A. Two (2) Year Correction Period: Remedy any defects due to faulty materials or workmanship and pay for any damage to other work resulting therefrom, which shall appear in work within a period of two (2) years from the date of Notice of Acceptance and in accordance with the terms of any special warranties provided in the Contract Documents. The Owner shall give notice of observed defects with reasonable promptness.
- B. Warranty: Upon completion of work, the Contractor shall deliver to the Landscape Architect, in duplicate, a written warranty based on the provisions of the Contract Documents properly signed and notarized.
1. Warranty shall be addressed to the Owner.
 2. Provide separate written warranties from specific subcontractors.
- C. Subcontractor Warranties: Include labor and materials signed by Manufacturer or subcontractor as case may be and countersigned by subcontractor.
1. Address warranty to Owner.
 2. Deliver to Landscape Architect upon completion of project and before or with submission of request for final payment.
- D. Extended Warranties: Deliver in duplicate extended warranties as specified and dated from the date of Notice of Acceptance and signed by subcontractors and manufacturers.
- E. Manufacturer Warranties: Deliver in duplicate Manufacturer's warranties as specified and dated from date of Notice of Substantial Completion signed by Manufacturer.
1. Manufacturer's Warranties: Supplement and not replace implied and express warranties provided for by Uniform Commercial Code. Any statements in Manufacturer's warranties denying or limiting responsibility for such implied and express warranties shall be void.

1.06 MISCELLANEOUS KEYS, SWITCHES AND WRENCHES

- A. Submittal: At completion of project, account for all loose keys, adjustment keys and wrenches keys for electric switches, etc. and turn over to Contractor for transmittal to Owner.

1.07 OPERATING AND MAINTENANCE DATA

A. Not Required.

1.08 DEMONSTRATIONS

A. Not Required.

END OF SECTION

SECTION 02115

SITE CLEARING

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes the following:

1. Clearing and grubbing.
2. Removing above-grade existing improvements to include utilities, as identified or interfering with proposed construction.
3. Removing below-grade existing improvements to include utilities, as identified or interfering with proposed construction.

B. Related Sections:

1. Earthwork: Section 02200.

C. Related Documents:

1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section, to also include the following:
2. Geotechnical Engineering Report

D. The Contractor will remove, wholly or in part and satisfactorily dispose of all foundations, fences, old pavements, abandoned pipelines, and any other obstructions which are not designated or permitted to remain, except for utilities and for those items which other provisions have been made for removal. All salvable material will be clearly marked by the Project Manager and shall be removed, without necessary damage, in sections or pieces which may be readily transported and will be stored in locations approved by the Project Manager. These materials may include, but shall not be limited to, manhole frames and covers, inlet grates, fence material, culverts, walkway, roadway, and parking appurtenances and irrigation systems and appurtenances. The Contractor will be required to replace any materials lost from improper storage methods or damaged by negligence. Removal of sign panel will include all work necessary to remove the panel and its attachment hardware from the existing installation. Concrete adhering to sign posts will be removed; pedestals and bases will be removed to one foot (1') below the surrounding ground or subgrade.

E. Where portions of structures are to be removed, the remaining parts will prepared to fit new construction. The work will be done in accordance with plan details and in such a manner that materials to be left in place will be protected from damage. All damage to portions of structures which are to remain in place will be repaired by the Contractor at his expense. Reinforcing steel, projecting from the remaining structure, will be cleaned and aligned to provide bond with new extension. Dowels are to be securely grouted with approved grout. Depressions resulting from the removal of structures, footings, and other obstructions, shall be filled and compacted with clean fill materials so as to eliminate hazards of cave in, accumulation and ponding of water.

1.02 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Permits: Obtain all required permits

1.03 PROJECT CONDITIONS

A. Construction Traffic: Conduct site-clearing operations to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities to include adjacent project areas under construction or temporary access. Do not close or obstruct public streets, walks, or other occupied or used facilities without permission from authorities having jurisdiction.

B. Protection of Existing Improvements: Provide protection necessary to prevent damage to existing Improvements indicated to remain in place. Provide necessary fencing or barricades.

1. Protect all improvements on adjoining properties and on Owner's property.

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2. Restore damaged improvements to their original condition, as acceptable to property Owners, or Authorities having jurisdiction.
- C. Existing Bench Marks and Monuments: Carefully preserve and maintain existing benchmarks, horizontal/vertical control monuments, property line pipes and pins and other reference points. If disturbed or destroyed, restore or replace at no additional cost to Project Manager by Contractor.
- D. 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.
- E. Excess Materials: Arrange for disposition of unsuitable materials, waste materials, and materials not allowed by specifications for fill, backfill, or site grading in accordance with local requirements. Location of dump, length of haul, and disposal expenses are Contractor's responsibility.
- F. Salvage Improvements: Carefully remove items indicated to be salvaged and store on Project Manager's premises where indicated or as directed by specifications, construction plans and/or by Project Manager.

PART 2 - PRODUCTS

Not Required.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verification of Conditions: Examine areas and conditions under which the work of this section will be performed. Do not proceed with the work until unsatisfactory conditions have been corrected. Commencement of work implies acceptance of all areas and conditions.

3.02 SITE CLEARING

- A. General: Remove shrubs, grass, and other vegetation or obstructions, as required, to permit installation of new construction. Remove similar items elsewhere on site or premises as specifically indicated. Removal includes digging out and off-site disposal of existing sod and topsoil.
 1. Strip topsoil to whatever depths encountered in a manner to prevent intermingling with underlying subsoil or other objectionable material. Remove heavy growths of grass from areas before stripping.
 2. Dispose of topsoil as specified for disposal of waste material at Contractor's expense.
- B. Clearing and Grubbing: Clear site except areas that are to be undisturbed of trees, shrubs, and other vegetation, as defined herein. The term clearing and grubbing means the scalping and removal of on-grade and below grade vegetable growth, organic materials, trash, rubbish and other obstructions, interfering with paving and fill areas.
- C. Completely remove stumps, roots, and other debris protruding through ground surface or conflicting with proposed construction. All areas with proposed appurtenances and utilities shall be cleared and grubbed to a minimum depth of 5' below existing ground surface.
- D. Fill depressions caused by clearing and grubbing operations with satisfactory soil material, unless further excavation or earthwork is indicated.
 1. Place fill material in horizontal layers not exceeding 6" loose depth, and thoroughly compact each layer to a density equal to adjacent original ground, or as identified with referenced subsurface investigation report and specifications within.
- E. Removal of Existing Improvements: Remove existing above-grade and below-grade improvements and utilities as necessary to facilitate proposed construction or future construction within identified limits.
 1. Abandonment and Removal: Removing all abandoned underground piping or conduits

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interfering with construction is included under this Section, abandonments to include plugging of conduit, shall meet specifications of governing agency having jurisdiction over utility.

- F. The Contractor shall notify all public utility companies and determine the location of all existing underground utilities prior to proceeding with construction. All work performed in the area of existing public utilities shall be performed according to the requirements of those agencies. The Contractor shall be responsible for locating any existing utility (including depth) which may conflict with the proposed construction. The Contractor shall protect, at his own expense, all existing utilities and be responsible for their repair if they are damaged during construction.
- G. All known existing utilities are shown in approximate locations on the plans. The actual location may vary from the plans, especially in the case of underground permanent and temporary utilities. This Contractor shall pothole and determine the horizontal and vertical location of utilities that may be critical to his operation. Whenever Contractor discovers a discrepancy in locations, he shall contact the Project Manager immediately.
- H. Contractor shall have lines identified prior to construction by utility company determining depth and horizontal location. Contractor shall be responsible for repair if damages occur during construction.

3.03 DISPOSAL OF WASTE MATERIALS

- A. Burning on Property: Burning is not permitted on property.
- B. Removal to Project Manager's Storage Area: Transport excess and salvageable materials to location designated by Project Manager.

3.04 CLEANING

- A. Remove excess materials, debris, and equipment in accordance with General and Supplementary Conditions. Keep public or private ways, access roadways, streets and driveways used as access or egress to or from project site free from materials falling from trucks. Promptly clean streets, roadways, etc. to the satisfaction of the Project Manager and public or private Authorities having jurisdiction. A wheel wash area is to be used for removal of debris from vehicles, prior to leaving the site.

END OF SECTION

SECTION 02200

EARTHWORK

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes the following:

1. Provide excavation, rough grading, subgrade preparation, overlotting, filling, backfilling, compaction and disposal of spoil materials as shown on the Drawings to meet line and grade specified herein, or as specified to complete the Work. All spoil material shall be stockpiled or hauled and disposed as directed by the Project Manager.
2. Material excavated shall be defined as "unclassified excavation" and shall include all excavation performed under this item regardless of material encountered except for contaminated material requiring special handling and disposal.
3. All site work and excavation shall be completed as detailed on the accepted plans.

B. Related Sections:

1. Selective Clearing: Section 02115.
2. Trenching, Backfill, Compacting for Utilities: Section 02221.
3. Topsoil, Fine Grading & Soil Preparation: Section 02920.

C. Related Documents:

1. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section, to also include the following.
2. Survey Control Monumentation Record and Topography Survey, prepared by the Project Surveyor.
3. Geotechnical Engineering Report

1.02 REFERENCE STANDARDS

- A. Comply with the requirements of the reference standards noted herein, except where more stringent requirements are listed herein or otherwise required by the Contract Documents to include specifications of the City of Denver for installation of storm sewers and other earthwork provisions.

1.03 DEFINITIONS

- A. Excavation consists of removal of material encountered to subgrade or over-excavation elevations indicated and subsequent disposal or placement of materials removed.

- B. Unauthorized excavation consists of inadvertent or purposely removing materials beyond indicated subgrade elevations or dimensions without specific direction of Project Manager. Unauthorized excavation, as well as remedial work resulting from unauthorized excavation directed by Project Manager, shall be at Contractor's expense.

1. Backfill and compact unauthorized excavations as specified for authorized excavations of same classification, unless otherwise directed by Project Manager.
2. Unauthorized excavation, including deposition of additional excavated materials and other work resulting from slides, cave-ins or remedial work shall be at Contractor's expense.

- C. Additional Excavation: When excavation has reached required subgrade elevations, notify Project Manager, who will make an inspection of conditions. If tests determine that bearing materials at required subgrade elevations are unsuitable, continue excavation until suitable bearing materials are encountered and replace excavated material as directed by testing firm or Contractor.

- D. Subgrade: The undisturbed earth or the compacted soil layer immediately below proposed pavement, slab on grade, slab gravel fill, topping materials or structure.

- E. Structure: Buildings, foundations, slabs, tanks, tunnel, pavement, curbs, or other man-made

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stationary features occurring above or below ground surface.

- F. Structural Fill: The term "structural fill", as used herein, includes soil materials used for fill beneath and within 5'-0" of buildings, including fill used under fill supported slabs and the upper 3'-0" of fill under pavements.
 - G. Trench Backfill: The term "Trench Backfill", as used herein, includes soil materials used for backfilling utility or other trenches outside the building line.
 - H. 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.
- 1.04 QUALITY ASSURANCE
- A. Codes and Standards: Comply with all applicable local, state and Federal rules, regulations and ordinances concerning sloping of excavation, trenching and safety of workers, including the latest OSHA requirements. The Contractor shall obtain all necessary permits as required in the General Condition and/or any permits required by Section 1000 prior to commencement of the work.
- 1.05 PROJECT CONDITIONS
- A. Site Information: Data in subsurface investigation reports was used for the basis of the design and is available to the Contractor for information only. Conditions are not intended as representations or warranties of accuracy or continuity between soil borings. Contractor will be responsible for interpretations or conclusions drawn from this report.
 - 1. Additional test borings and other exploratory operations may be performed by Contractor, at the Contractor's option; however, no change in the Contract Sum will be authorized for such additional exploration.
 - B. Existing Utilities: The Contractor shall notify all public utility companies and determine the location of all existing underground utilities prior to proceeding with construction. All work performed in the area of public utilities shall be performed according to the requirements of these agencies. The Contractor shall be responsible for locating any existing utility (including depth) which may conflict with the proposed construction. The Contractor shall protect, at his own expense, all existing utilities and be responsible for their repair if they are damaged during construction.
 - 1. All known existing utilities are shown in approximate locations on the plans. The actual location may vary from the plans, especially in the case of underground utilities. Whenever Contractor discovers a discrepancy in locations, he shall notify the Project Manager immediately.
 - 2. Demolish and completely remove from site existing underground utilities indicated to be removed. Salvage items are identified on the Drawings and in these specifications. Coordinate with utility companies or agencies for shutoff of services if lines are active.
 - C. Use of Explosives: Use of explosives is not permitted.
 - D. Protection of Persons and Property: Barricade open excavations occurring as part of this work and post with warning lights.
 - 1. Operate warning lights as recommended by authorities having jurisdiction and Project Manager.
 - 2. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
 - E. Verification of Existing Conditions: Visit the site prior to submission of bids. Verify existing conditions, elevations, and contours. In the event of discrepancies between existing conditions and the requirements of the Contract Documents, contact the Project Manager for clarification.
 - F. Existing Bench Marks: Carefully preserve and maintain existing bench marks, 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 Project Manager.

PART 2 - PRODUCTS

2.01 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, brick, debris or other detrimental substances, and rocks or unbroken lumps larger 4". The Owner's Geotechnical Engineer should evaluate any fill used on the site. Fill used should be a non-expansive material similar to the site materials. Imported soils should meet the criteria as recommended in 3.10, F. this section.
 - 1. The site soils are normal for the area and should be removable with normal heavy-duty equipment. Although not encountered during the Geotechnical Engineering study, it is possible on any site in a redeveloped area that hazardous substances may exist in the fill or underlying native materials. During the excavation phase of the project, it is recommended that a representative of the Geotechnical Engineer make frequent observations to verify the condition of the existing fill materials and to determine if there is reason to believe that any of these materials are hazardous.
 - 2. Structural Fill: Provide select, non-expansive, sandy fill with liquid limit, and gradation shown above. If sufficient materials meeting the above requirements are not available from on-site sources, provide additional material obtained from off-site sources and approved by the testing and inspections agency, at no additional cost to the Owner; it is assumed that on-site materials can be used as structural fill.
 - 3. Trench Backfill: The upper 3'-0" of trenches below pavement and fill supported slabs shall be structural fill as specified above. Material conforming to the requirements for overlot fill as specified above may be used for backfilling all other trenches.

2.02 SOURCE QUALITY CONTROL

- A. Fill and Backfill Materials: All fill and backfill should be approved by the Geotechnical Engineer, placed in uniform lifts with a thickness compatible with the type of compaction equipment being used, moisture conditioned to within 2% of optimum and compacted with the appropriate equipment. The following minimum percentages of the maximum dry density as determined by ASTM D698 (Standard Proctor) are recommended:
 - 1. Below foundations 98%
 - 2. Below floor slabs 96%
 - 3. Below paved areas 95%
 - 4. Landscaped area fill 90%
 - 5. Retaining walls 95%
- B. Where relatively clean, free-draining non-proctorable sands or sand and gravel mixtures are used as fill, compact to at least 65% of Relative Density (ASTM D4253 and D4254).

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Site Visit: Visit and inspect site and take into consideration known or reasonable inferable conditions affecting work. Failure to visit site will not relieve Contractor of furnishing materials or performing work required.
- B. Existing Utilities: Locate existing underground utilities in areas of the work. If utilities are to remain in place or be relocated later in construction, provide protection during earthwork operations. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, consult Project Manager immediately for direction. Cooperate with utility companies in keeping respective services and facilities in operation. Repair damaged utilities to the satisfaction of the appropriate utility company.

3.02 SITE CLEARING AND SUBGRADE PREPARATION

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- A. Strip and remove existing pavement materials, vegetation, debris, and other deleterious materials from proposed structure, pavement, ball field, and hockey rink areas. All exposed surfaces should be free of mounds and depressions which could prevent uniform compaction.
- B. If unexpected fills or underground facilities are encountered during site clearing, such features should be removed and the excavation thoroughly cleaned prior to backfill placement and/or construction. All excavations should be observed by the geotechnical engineer prior to backfill placement.
- C. Stripped materials consisting of vegetation and organic materials should be wasted from the site or used to revegetate exposed slopes after completion of grading operations. If it is necessary to dispose of organic materials on-site, they should be placed in non-structural areas and in fill sections not exceeding 5' in height.
- D. All exposed areas which will receive fill, floor slabs and/or pavement, once properly cleared should be scarified to a minimum depth of 12", conditioned to near optimum moisture content and compacted.

3.03 GENERAL PROCEDURES

- A. Removal: Demolish and completely remove from the project site all existing underground utilities indicated to be removed. Coordinate with utility companies for discontinuance of services if lines are active.
- B. Protection of Persons and Property: Provide all necessary measures to protect workmen and passerby. Barricade open excavations occurring as part of the work, as required by municipal or other authorities having jurisdiction.
- C. Protect adjacent streets, roadways, and properties throughout the entire operation. Protect newly graded areas from destruction by weather or runoff. Protect structures, utilities, sidewalks, pavements, and other improvements from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

3.04 EXCAVATION

- A. Excavation is all considered unclassified and includes excavation to subgrade or over-excavation elevations indicated, regardless of character of materials and obstructions encountered.
- B. It is anticipated that excavations for the proposed construction can be accomplished with conventional earthmoving equipment.
- C. Depending upon depth of excavation and seasonal conditions, groundwater may be encountered in excavations on the site. Pumping from sumps may be utilized to control water within excavations.
- D. Use of lime, fly ash, kiln dust, cement or geotextiles could also be considered as a stabilization technique. Laboratory evaluation is recommended to determine the effect of chemical stabilization on subgrade soils prior to construction.

3.05 STABILITY OF EXCAVATIONS

- A. General: Comply with local codes, ordinances, and requirements of agencies having jurisdiction to include the latest revision to OSHA standards. Safety is the sole responsibility of the Contractor.
- B. Slope sides of excavations to comply with local codes, ordinances, and requirements of agencies having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated. Maintain sides and slopes of excavations in safe condition until completion of backfilling.
- C. Shoring and Bracing: Provide materials for shoring and bracing, such as sheet piling, uprights,

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stringers, and cross braces, in good serviceable condition. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Extend shoring and bracing as excavation progresses.

3.06 DEWATERING

- A. Prevent surface water and subsurface or ground water from flowing into excavations and from flooding project site and surrounding area.
 - 1. Do not allow water to accumulate in excavations. Remove water to sediment basin to prevent softening of foundation bottoms, undercutting footings, and soil changes detrimental to stability of subgrades and foundations. Provide and maintain pumps, well points, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations.
 - 2. Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey rain water and water removed from excavations to collection in sediment basins. Do not use trench excavations as temporary drainage ditches. Discharge directly to storm sewer prior to removal of sediment shall not be permitted.

3.07 STORAGE OF EXCAVATED MATERIALS

- A. Stockpile excavated materials acceptable for backfill and fill as indicated by Project Manager. Place, grade, and shape stockpiles for proper drainage.
 - 1. Locate and retain soil materials away from edge of excavations.
 - 2. Dispose of excess excavated soil material and materials not acceptable for use as backfill or fill as directed by Project Manager.

3.08 TRENCH EXCAVATION FOR PIPES AND CONDUIT

- A. Excavate trenches to uniform width, sufficiently wide to provide ample working room and a minimum of 6 to 9" of clearance on both sides of pipe or conduit.
- B. Excavate trenches and conduit to depth indicated or required to establish indicated slope and invert elevations and to support bottom of pipe or conduit on undisturbed soil. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.
 - 1. For pipes and equipment 6" or larger in nominal size, shape bottom of trench to fit bottom of pipe for 90 degrees (bottom 1/4 of the circumference). Fill depressions with tamped sand backfill. At each pipe joint, dig bell holes to relieve pipe bell of loads ensure continuous bearing of pipe barrel on bearing surface.

3.09 COLD WEATHER PROTECTION

- A. Protect excavation bottoms against freezing when atmospheric temperature is less than 35° F.
- B. Dust Control: Provide dust control as required to alleviate dust nuisance to the public, to adjacent properties and other work underway at the project site.
- C. Unanticipated Conditions: Notify the Project Manager immediately upon finding evidence of previous structures, filled materials which penetrate below designated excavation levels, or other conditions which are not shown or which cannot be reasonably assumed from existing surveys and geotechnical reports. Secure the Project Manager instruction 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 building and paved areas.

3.10 BACKFILL AND FILL

- A. General: Place soil material in layers to required subgrade elevations, for each area classification listed below, using materials specified in this Section.

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- B. Under grassed areas, use satisfactory excavated or borrow material, overlot fill.
- C. On-site granular and approved imported materials may be used as fill material for the following:
 - general site grading
 - foundation areas
 - floor slab areas
 - exterior slab areas
 - pavement areas
 - foundation backfill
- D. On-site existing clay and claystone are not recommended for use directly beneath proposed structures, unless a structural slab is used. However, these materials can be placed in pavement, non-structural areas and within deeper fill areas below the depths of removal and replacement as previously outlined.
- E. Frozen soils should not be used as fill or backfill.
- F. Imported soils (if required) should conform to the following or be approved by the Project Geotechnical Engineer:

<u>Gradation</u>	<u>Percent finer by weight (ASTM C136)</u>
6"100	
3"70-100	
No. 4 Sieve	50-80
No. 200 Sieve	35 (max)

- Liquid Limit..... 30 (max)
- Plasticity Index 15 (max)
- Maximum expansive potential (%)* 1.5

* Measured on a sample compacted to approximately 95% of the ASTM D698 maximum dry density at about 3% below optimum water content. The sample is confined under a 100 psf surcharge and submerged.

1. Do not backfill trenches until tests or inspections have been made and backfilling is authorized by Project Manager. Use care in backfilling to avoid damage or displacement of pipe systems.
- G. Backfill excavations as promptly as work permits, but not until completion of the following:
 1. Acceptance of construction below finish grade including, where applicable, waterproofing, and perimeter insulation.
 2. Inspection, testing, approval, and recording locations of underground utilities have been performed and recorded.
 3. Removal of concrete formwork.
 4. Removal of shoring and bracing, and backfilling of voids with satisfactory materials. Cut off temporary sheet piling driven below bottom of structures and remove in manner to prevent settlement of the structure or utilities, or leave in place if required.
 5. Removal of trash and debris from excavation.
 6. Permanent or temporary horizontal bracing is in place on horizontally supported walls.

3.11 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. Plow strip, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so that fill material will bond with existing surface.

1. When existing ground surface after compaction process has a density less than that specified under compaction requirements; for a particular area classification, break up ground surface. Scarify existing subgrade to depth of 6" prior to compacting and placing fill. Moisture condition

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between 2% below and 2% above optimum moisture content, and recompact to at least 95% of maximum Standard Proctor density (ASTM D698).

- B. Place backfill and fill materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers, each layer to be compacted to meet requirements herein.
- C. Compaction Requirements:
 - 1. The following general compaction specifications should be observed on this project.
 - a. Place and compact fill in horizontal lifts, using equipment and procedures that will produce recommended moisture contents and densities throughout the lift.
 - b. No fill should be placed over frozen ground.
 - c. Materials should be compacted to the following:

<u>Material</u>	<u>Minimum Percent (ASTM D698)</u>
Subgrade soils beneath fill areas.....	95
On-site soils or approved imported fill:	
Beneath foundations	98
Beneath slabs	95
Beneath pavements	95
Miscellaneous backfill	90

- d. Granular or imported soils should be compacted within a moisture content range of 3% below to 3% above optimum unless modified by the project geotechnical engineer.
 - e. Clay soils should be compacted within a moisture content range of optimum to 2% above optimum.
- D. 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.
- E. Place backfill and fill materials evenly adjacent to structures, piping, or conduit to required elevations. Prevent wedging action of backfill against structures or displacement of piping or conduit by carrying material uniformly around structure, piping, or conduit to approximately same elevation in each lift.
- F. Control soil and fill compaction, providing minimum percentage of density specified for each area classification indicated below. Correct improperly compacted areas or lifts as directed by testing agency if soil density tests indicate inadequate compaction.
 - 1. Moisture Control: Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade or layer of soil material. Apply water in minimum quantity as necessary to prevent free water from appearing on surface during or subsequent to compaction operations.
 - 2. Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density.
 - 3. Stockpile or spread soil material that has been removed because it is too wet to permit compaction. Assist drying by discing, harrowing, or pulverizing until moisture content is reduced to a satisfactory value.

3.12 SHRINKAGE

- A. Shrinkage: For balancing grading plans, estimated shrink or swell of soils and bedrock when used as compacted fill following recommendations in this report are as follows:

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<u>Material</u>	Estimated Shrink(-) Swell (+) <u>Based on ASTM D698</u>
On-site soils:	
Clays.....	-5 to -10%
Sands	-5 to -15%
On-site bedrock materials	
Claystone.....	+5 to +10%
Sandstone	-5 to -10%

3.13 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. Finish surfaces free from irregular surface changes and as follows:
 - 1. Lawn or Unpaved Areas: Finish areas to receive topsoil to within not more than 0.10 foot above or below required subgrade elevations.
 - 2. Walks: Shape surface of areas under walks to line, grade, and cross-section, with finish surface not more than 0.10 foot above or below required subgrade elevation.
 - 3. Pavements: Shape surface of areas under pavement to line, grade, and cross-section, with finish surface not more than 0.00 to 0.17 foot above required subgrade elevation.
- C. Grading Surface of Fill under Structural Slabs: Grade smooth and even, free of voids, compacted as specified, and to required elevation. Provide final grades within a tolerance of 0.05 foot when tested with a 10-foot straightedge.
- D. Compaction: After grading, compact subgrade surfaces to the depth and indicated percentage of maximum or relative density for each area classification.

3.14 EROSION CONTROL

- A. Provide erosion control methods in accordance with requirements of authorities having jurisdiction and erosion control plan submitted as part of the Construction Documents.

3.15 MAINTENANCE

- A. Protection of Graded Areas: Protect newly graded areas from traffic and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades in settled, eroded, and rutted areas to specified tolerances.
- C. 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.
- D. 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 to designated areas on property: Transport acceptable excess excavated material to designated soil storage areas on property.
- B. Removal from Property: Remove waste materials, including materials not allowed for fill, backfill or site grading as specified within, trash, and debris, and dispose of it off property at Contractor's

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expense.

END OF SECTION

SECTION 02270

TEMPORARY EROSION AND SEDIMENTATION CONTROL

PART 1 - GENERAL

1.1 RELATED WORK

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply if provided, to this Section.

1.2 SUMMARY

- A. Work Included. Furnish, install, maintain, and remove temporary erosion and sedimentation controls as shown on the drawings or specified herein, or as required to complete the work.
- B. Related Sections include the following:
 - 1. Division 2 Section "Site Clearing" site stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.
 - 2. Division 2 Section "Subdrainage Systems" for drainage of slabs-on-grade and landscaped areas.
 - 3. Division 2 Section "Earthwork" for soil materials, site excavating, filling and grading.
 - 4. Division 2 Section "Trenching" for excavating and backfilling of utilities.
- B. Permits and Fees: Obtain and pay for all permits and fees required for the work of this section, including erosion and sediment control and water quality permits required by the authority having jurisdiction and the Colorado Department of Public Health and Environment, Water Quality Control Division.
- C. Erosion Control: The Erosion and Sedimentation Control Drawings included in the Contract Documents is the minimum requirement to be implemented. Provide additional control as necessary to meet applicable local and State criteria.

1.3 DEFINITIONS

- A. Backfill: Soil material used to fill an excavation.
 - 1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
 - 2. Final Backfill: Backfill placed over initial backfill to fill a trench.
- B. Unclassified Excavation: Removal of all material of whatever character required for the work encountered above subgrade elevations and to lines and dimensions indicated, including boulders.
- C. Fill: Fill is all material placed to raise the grade of the site or to backfill excavation, upon which the Soils Engineer has made sufficient tests and observations to enable him to issue a written statement that, in his opinion, the fill has been placed and compacted in accordance with the requirements of these specifications.

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- D. **BMP: Best Management Practice.** Erosion and sediment control devices, which may consist of silt fence, crates, filter fabric, riprap, etc.
- E. **SWMP: Storm Water Management Plan.** Identifies BMPs, which are erosion and sediment control measures for the project.
- F. **Structures:** Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- G. **Subgrade:** Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.
- H. **Utilities:** Include on-site underground pipes, conduits, ducts, and cables, as well as underground services to buildings.

1.4 SUBMITTALS

- A. **Submittal Procedures:** All submittals are to be made to the Owner's Representative. If provided refer to Division 1 section "Submittals."
- B. **Product Data:** not required.

1.5 QUALITY ASSURANCE

- A. **Regulatory Requirements:** Comply with applicable local, State and Federal ordinances, rules and regulations concerning sedimentation control and storm water runoff.
- B. In case of conflict between the above codes, regulations, references and standards and these specifications, the more stringent requirements shall govern.
- C. **Preconstruction Conference:** Conduct conference at Project site as directed by Owner's Representative prior to start of construction. Contractor to comply with requirements, which may also be included in Division 1 Section "Project Management and Coordination."

1.6 PROJECT/SITE CONDITIONS

- A. **Existing Conditions:** Verify all existing conditions affecting the work of this section prior to submitting bids or proposals. Additional compensation will not be allowed for revisions or modification of work resulting from failure to verify existing conditions.

1.7 WARRANTY

- A. Temporary Erosion and Sediment Control measures shall be maintained until permanent measures are in place. All damaged, disturbed or devices filled with sediment, which may occur within the specified project warranty period, shall be corrected at no cost to the Owner. Any devices damaged by erosion or sediment shall be restored to their original condition by the Contractor, at no cost to the Owner.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Erosion and Sedimentation Control Materials: Provide one or more of the following materials, as shown on the plans or as applicable for site conditions:
 - 1. Sand bags.
 - 2. Clean, seed-free, certified, cereal hay or grain straw bales.
 - 3. Silt fences.
 - 4. Rock riprap.
 - 5. Biodegradable wood excelsior, straw, or coconut-fiber mat enclosed in a photodegradable plastic mesh.
 - 6. Biodegradable twisted jute or spun-coir mesh, 0.92 lb/sy minimum, with 50 to 65 percent open area.
 - 7. Drainage geotextile.
 - 8. Impervious fill.
 - 9. Other materials proposed for use on-site.

PART 3 - EXECUTION

3.1 PREPARATION

- A. General:
 - 1. Determine the existing ground elevations, drainage patterns, and changes to such patterns during excavation in order to satisfactorily plan and provide materials for adequate erosion and sediment control devices.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- A. Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and rights-of-way according to requirements of authorities having jurisdiction.
- B. Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
- C. Remove erosion and sedimentation controls, and restore and stabilize areas disturbed during removal.
- D. Secure grading permit from agency have jurisdiction prior to commencing grading operations, if required.

3.3 EXAMINATION

- A. Verification of Conditions: Examine areas and conditions under which the work of this section will be performed. Do not proceed with the work until unsatisfactory conditions have been corrected. Commencement of work implies acceptance of all areas and conditions.

3.4 INSTALLATION

- A. Erosion and Sedimentation Control Devices. Erosion and sedimentation control measures to be taken during construction include, but are not necessarily limited to the following:
1. Apply soil stabilization within 14 days to all disturbed areas that are to be dormant for a period longer than 30 calendar days after reaching grade. Stabilize soil with mulch anchored per criteria of authorities having jurisdiction. Temporarily revegetate areas that will remain in an interim condition for more than three months.
 2. Roads and parking areas indicated to be paved may be covered with an appropriate aggregate base course in lieu of mulch. Temporary mulching or aggregate base course is not required if final pavement construction will take place within 30 days after grading to final contours.
 3. Soils that will be stockpiled for more than 30 days must be mulched and seeded within 14 days after stockpile construction.
 4. Prevent sediment from leaving the project site by installing a silt fence or other BMPs as indicated on the plans. Protect existing storm inlets adjacent to the site by an approved gravel filter.
 5. Excavate the future detention/water quality pond and construct the outlet structure/storm sewer such that the pond may function as a temporary sediment basin during development of the site. Construct the sediment basin in accordance with authority having jurisdiction's criteria. Provide temporary swales to convey site runoff to the pond.
 6. Locate stone stabilization pads at all points of vehicular ingress and egress to the construction site.
 7. Provide temporary erosion controls consisting of berms at the top of slopes and interceptor ditches at ends of berms and at those locations which will eliminate or minimize erosion during construction, along with temporary seeding, temporary diversion, chutes, and down pipes and lining of water courses.
 8. Temporary sedimentation controls shall consist of silt dams, traps, silt fence, barriers, and appurtenances at the top of spoil and borrow area slopes and where runoff water exits the site.
 9. Maintain the available silt holding capacity of silt dams, fence traps and barriers until no longer needed. The sediment capacity of sediment retainage areas shall be at a minimum, the capacity shown on the plans in conformance with Urban Drainage Criteria Manual, Volume 3. Prior to removal, obtain concurrence of the Owner and Engineer.
 10. Remove accumulated sediment and debris from a BMP when the sediment level reaches one-half the height of the BMP, or at any time the sediment or debris adversely impacts the functioning of the BMP.
 11. Remove hay bales which have deteriorated and filter stone or cloth which has become dislodged. Place new hay bales and new filter and fence.
 12. The erosion/sediment control plan shows the minimum required for the project. If it becomes apparent that additional controls are necessary, the Engineer shall be notified and with approval of the Owner's Representative additional controls shall be installed.
- B. Chemicals and Pollutants:
1. Store construction materials and chemicals that could contribute pollutants to the runoff within an enclosure, container, or dike located around the perimeter of the storage area, to prevent discharge of these materials into runoff from the construction site.
 2. Locate areas used for collection and temporary storage of solid and liquid waste away from the storm drainage system. Provide covering or fencing as required to prevent windblown materials; construct perimeter dike to contain liquid runoff. These measures may not be necessary if materials are immediately placed in covered waste containers.
 3. Perform equipment maintenance in designated areas using measures such as drip pans to control petroleum products spillage.
 4. Immediately clean up and properly dispose of spills of construction related materials such as paints, solvents, or other chemicals.
- C. Final Stabilization and Long-Term Management

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1. Final stabilization shall be achieved through permanent vegetation and landscaping after construction of all buildings and paved surfaces.
 2. Temporary erosion and sediment control measures may be removed within 30 days after final site stabilization is achieved or after temporary measures are no longer needed.
- B. Inspection and Maintenance: Inspect erosion and sediment control measures weekly during construction. In addition, inspect all facilities immediately after any significant runoff or snowmelt which results in runoff. Repair or otherwise mitigate any damage to the erosion and sediment control facilities at no additional cost to the Owner.

3.5 CLEANING

- A. Removal of Controls: Remove controls upon completion of that portion of the work for which controls were furnished. Leave the site and work area in a clean condition.

END OF SECTION

SECTION 02317

TRENCHING, BACKFILLING, COMPACTING FOR UTILITIES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. This work shall consist of furnishing all labor, materials tools and equipment for trenching, bedding, backfill and compaction for all underground utilities as specified herein and shown on the accepted plans. The excavation shall be made to lines and grades shown on the accepted plans and as established by the Project Manager. Except where shown otherwise on the accepted plans and except where the Project Manager gives written permission to do otherwise, all trench excavation shall be made by open cut to the depth required to construct the pipelines as shown on the accepted plans. All excavation shall be unclassified.
2. Pavement removal and replacement as required.

B. Related Sections:

1. Earthwork: Section 02200.

C. Related Documents:

1. Geotechnical Engineering Report (not available)

1.02 QUALITY ASSURANCE:

- A. Regulatory Requirements: Perform excavation work in conformance to the requirements of authorities having jurisdiction. Supply, install, and remove all shoring as may be required to comply with all safety regulations and to maintain earth banks until backfill is placed.

- B. Testing and Inspection: Conform testing and inspection of backfill to the requirements of section 02200. Make in place density tests at intervals and locations as directed by the Project Manager.

1.03 PROJECT/SITE CONDITIONS;

- A. Protection: Protect existing utilities, and utility excavations, in accordance with the requirements of Section 02200.

B. Site Information:

1. Data on indicated subsurface conditions are not intended as representations or warranties of accuracy or continuity between soil borings. It is expressly understood that Project Manager will not be responsible for interpretations or conclusions drawn therefrom by Contractor. Data are made available for the convenience of the Contractor.
2. Soil investigation and test reports are available for examination as set forth in Information Available to Bidders.
3. Additional test borings and other exploratory operations may be made by the Contractor at no cost to the Project Manager.

PART 2 - PRODUCTS

2.01 SOIL MATERIALS

- A. Fill Materials: Excavated earth, loam, sandy clay, sand and gravel, soft shale, or other acceptable materials, approved by the Owner's Geotechnical Engineer free from organic matter, frozen material and large clods of earth or stone, and of a proper moisture content which will facilitate backfilling.
- B. Foundation Materials: In those areas where undisturbed ground is not considered to provide adequate support, foundation material conforming to Section 02200, 3.10 F.
- C. Select Backfill:
 - 1. Job excavated material may be used for select backfill when the job excavated material is finely divided and free from debris, tin cans, frozen earth, rubbish, stumps, organic material, cinders or other corrosive material, stones larger than 12" in greatest dimension or masses of moist, stiff clay.
 - 2. Graded gravels meeting the Specification for Class 6 Aggregate Base Course may be used as select backfill material.
- D. Granular Bedding Materials: Granular bedding material shall be crushed rock or pea gravel with not less than 95% by weight passing 1/2" (95% by weight passing 3/4" for 30" and larger pipe) and not less than 95% retained on a #4 sieve. The Project Manager may accept other gradations if requested in writing. Excavated materials may be used for the upper portion of the bedding if accepted by the Project Manager.
- E. Unsuitable Material: Highly organic soil; ASTM D2487 Group PT, topsoil, roots, vegetable matter, trash and debris.

PART 3 - EXECUTION

3.01 EXECUTION

- A. General:
 - 1. Slope sides of excavations to comply with local codes and ordinances having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated.
 - 2. When rock is encountered in trench bottom, trench shall be over-excavated to a depth of not less than 6" below pipe. The over-excavated material shall be replaced with acceptable bedding material.
 - 3. Maintain sides and slopes of excavations in a safe condition until completion of backfilling.
- B. Excavation Classifications:
 - 1. All excavation is to be considered as "unclassified", except where rock is encountered.
- C. Shoring and Bracing:
 - 1. Provide materials for shoring and bracing, such as sheet piling, up rights, stringers and cross-braces, in good serviceable condition. Provide shoring as required for safety and by governing authorities.
 - 2. Establish requirements for trench shoring and bracing to comply with local codes and authorities having jurisdiction.
 - 3. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Carry down shoring and bracing as excavation progresses. Arrange shoring and bracing so as not to place stress on completed work.
 - 4. Exercise care in removal of shoring and bracing to prevent collapse or caving of excavation faces.
- D. Dewatering:

SECTION 02317

1. Prevent surface water from flowing into excavations and from flooding project site and surrounding areas.
2. Do not allow water to accumulate in excavations. Remove water to prevent softening of trench bottoms, and soil changes detrimental to stability of subgrades and foundations.
3. Provide and maintain pumps, well points, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations.
4. Convey water removed from excavations and rain water to collecting or run off areas. Establish and maintain temporary drainage ditches and other diversions outside excavation limits for each structure.
5. Do not use pipe trench excavations as temporary drainage ditches.

E. Cold Weather Protection:

1. Protect excavation bottoms against freezing when atmospheric temperature is less than 35°F.

F. Material Storage:

1. Stockpile satisfactory excavated materials on site or where directed, until required for backfill or fill. Place, grade and shape stockpiles for proper drainage.
2. Locate and retain soil materials away from edge of excavations a distance equal to the depth of the excavation or more.

G. Trenching:

1. Excavate trenches through all materials encountered to depths shown on Drawings. Dispose of excavated materials not suitable for backfill off site.
2. Excavate for manholes, vaults and other appurtenances with clearances between 12" and 24" on all sides.
3. Do not excavate below required levels unless necessary due to wet trench conditions, as determined by the Owner's Soils Engineer. Backfill unnecessary excavation below the required level with granular bedding material as directed by the Owner's Soils Engineer and thoroughly tamp.

H. Bedding:

1. Bed pipe as shown in the bedding details. Provide Class "C" bedding except irrigation pipe add athletic field under drain system which shall be bedded in accordance with the irrigation and underdrain pipe bedding detail.

3.02 CONTROLLED FILL

- A. After pipe bedding has been completed in accordance with applicable pipeline Sections, carefully backfill trenches using approved excavated materials. Carefully hand tamp around the pipe and up to 12" above the top of the pipe, in lifts not to exceed 6" loose thickness.
- B. Use care to place and tamp this course without disturbing joints, alignment, or grade of the piping. Fill remainder of trench in layers not exceeding 8" loose depth where pneumatic, vibratory or other tamping equipment is used.
- C. Where crane operated or hydraulic drop hammers are used to compact the remainder of the backfill, limit loose depth of each lift to 3'.
- D. Use care in backfilling and compacting operations to avoid disturbing pipe. Replace misaligned, crushed or otherwise disturbed main piping.
- E. Exercise extreme care in removing cribbing, shoring or sheeting so as not to disturb foundation, bedding and initial backfill. Where necessary to drive sheet piling or shoring below top of pipe, cut off sheet piling or shoring 12" above top of pipe and leave in place.
- F. Where groundwater or wet trench conditions occur, provide additional bedding below and over the pipe consisting of granular bedding material, as defined in pipe line sections, to a depth as required.

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If used, payment for the bedding materials shall be only for the additional amount in excess of the standard bedding requirements specified.

- G. Re-open trenches improperly backfilled or where settlement occurs, to the depth required for proper compacting, then refill and compact, restoring the surface to the required grade, compaction, and smoothness.
- H. Pooling or water flooding for consolidating the backfill will not be permitted, and the addition of water is limited to that needed for obtaining the desired moisture content specified.

3.03 PAVEMENT REMOVAL AND REPLACEMENT

- A. Saw cut to create clean break line. Remove and dispose of existing surface and aggregate base course. Leave 6" undisturbed subgrade lip on each side of trench. After trench has been backfilled and properly compacted, place aggregate base course in accordance with existing thickness. Compact aggregate base course to 95% AASHTO T180. Replace pavement in accordance with permit requirements or minimum thickness specified. Compact asphalt to 95% ASTM D1559.
- B. Replace sections (between joints) of concrete work. Remove and dispose of waste material. Compact and prepare subgrade for concrete in accordance with Section 02200.

3.04 QUALITY CONTROL

- A. Soil Compaction Tests:
 - 1. Determine maximum density and optimum moisture content of backfill material in accordance with ASTM D698.
 - 2. Moisture Content: Adjust and maintain moisture content of the soil within $\pm 2\%$ of optimum moisture content.
- B. Compaction Requirements:
 - 1. Compact backfill in utility trenches to not less than 95% maximum density from the top of the granular bedding to the top of the trench.
 - 2. Replace disturbed surface materials with material matching existing and adjacent materials.

END OF SECTION

SECTION 02521

CONCRETE CURBS, SIDEWALKS AND DRIVEWAYS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Concrete curb and gutter.
2. Concrete sidewalks.
3. Concrete plazas and drives.
4. Concrete grass/drain pans.
5. Concrete walls.
6. Concrete testing requirements

B. Related Sections:

1. Earthwork: Section 02200.
2. Asphaltic Pavement: Section 02510.
3. Concrete Formwork: Section 03100.
4. Concrete Reinforcement: Section 03200.
5. Cast-In-Place Concrete: Section 03300.

1.02 REFERENCES

A. Reference Standards:

1. Concrete Work: Follow recommendations of ACI 301.

1.03 SUBMITTALS.

A. Quality Control Submittals:

1. Mix Designs: Prior to pouring any concrete, submit concrete mixes for approval in accordance with Section 01300. Separate mix designs shall be submitted for each type of concrete to be used in the project. Submittals shall include all information used in designing the mixes. See Section 03300 for design procedures.
2. Test Reports: Reports of control tests, special tests or core tests specified under Section 01400 Quality Control shall be distributed by the testing laboratory.
3. Record of Work: A record shall be kept by the Contractor listing the time and date of placement of all concrete. Such record shall be kept until the completion of the project and shall be available to the Project Manager for examination at any time.

1.04 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Comply with design standards of applicable local codes and Ordinances.

1.05 DELIVERY, STORAGE AND HANDLING

A. Hauling Time: Discharge all concrete transmitted in a truck mixer, agitator or other transportation device within 1 1/2 hours after the mixing water has been added.

B. Extra Water:

1. Deliver concrete to the job in exact quantities required by the design mix.
2. If extra water is required before depositing concrete, the Contractor's superintendent shall have sole authority to authorize the addition of water.
3. Additional water added to the mix after leaving the batch plant shall be indicated on the truck ticket and signed by the person responsible.
4. When extra water is added to the concrete, mix thoroughly for 40 revolutions of the drum or 3-1/2 minutes at mixing speed, whichever is greater.

1.06 PROJECT CONDITIONS

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A. Environmental Requirements:

1. Cold Weather Placement: When depositing concrete after the first frost or when the mean daily temperatures are below 40° F. follow recommendations of ACI 306. Maintain concrete temperature at a minimum of 50° F. for not less than 72 hours after depositing. The concrete may not contain calcium chloride. Maintain forms in place for a minimum of 72 hours after depositing concrete, subject to approval of the Project Manager. Place no concrete without approval of the Project Manager on days when the temperature at 9:00 AM is below 30° F. until, in the opinion of the Project Manager, the Contractor has taken all necessary precautions and supplied all the necessary equipment to prevent the concrete from freezing.
2. Hot Weather Placement: When depositing concrete in hot weather, follow recommendations of ACI 605. The optimum temperature of concrete at time of placement shall not exceed 85° F. Protect to prevent rapid drying. Start finishing and curing as soon as possible. When the air temperatures are expected to exceed 90° F. the Contractor shall obtain approval from the Project Manager on the procedures to be used in protecting, depositing, finishing and curing of concrete. Pozzoloth Retarder, as manufactured by Master Builders Company, Cleveland, Ohio or approved equal, may be used upon approval of the Project Manager. The use of continuous fog sprays may be required by the Project Manager for 24 hours especially in times of low humidity.

PART 2 - PRODUCTS

2.01 CONCRETE MATERIALS

- A. General: Use ready mixed concrete conforming with ASTM C94-84. No on job mixed concrete will be allowed. See Section 03300 for materials.
- B. Cement:
 1. All cement used in concrete work shall be Portland Cement conforming to the requirements of ASTM C-150, Type I or Type II. In general, cement meeting the requirements of ASTM C-150 Type II cement shall be used in concrete which will be in contact with the soil, unless otherwise allowed or directed by the Project Manager. Cement, which for any reason has become partially set or which contains lumps of caked cement, shall be rejected.
 2. The Contractor will be responsible for the proper storage of all cement until it is used. When requested by the Project Manager, the Contractor will, at his own cost and expense, furnish the Project Manager with a certificate from the manufacturer or an acceptable testing laboratory for each carload of cement from which cement is taken for use in the work.
- C. Aggregate:
 1. Fine Aggregate: Will be composed of clean, hard, durable, uncoated particles of sand, free from injurious amounts of clay, dust, soft or flaky particles, loam, shale, alkali, organic matter, or other deleterious matter. Fine aggregate will be well graded from course to fine and when tested by means of laboratory sieves will meet the requirements of ASTM C 33.

Sieve Size	Percent Passing
3/8"	100
#4	95 - 100
#8	80 - 100
#16	50 - 85
#30	25 - 60
#50	10 - 30
#100	2 - 10

2. Coarse Aggregate: The coarse aggregate will consist of broken stone or gravel composed of clean, hard, tough and durable stone and will be free from soft, thin, elongated or laminated pieces, disintegrated stone, clay, loam, vegetable, or other deleterious matter.

Coarse aggregate will be well graded and when tested by means of laboratory sieves will meet the requirements of ASTM C 33

Sieve Size	Percent Passing
2"	100
1-1/2"	95 - 100
3/4"	35 - 70
3/8"	10 - 30
#4	0 - 5

- D. Air Entraining Agent: Conform to ASTM C260.
- E. Admixtures: The Contractor will use air-entraining admixtures for all surfaces of exposed concrete. Air-entraining admixtures shall meet ASTM C 260. All other chemical admixtures shall meet ASTM C 494.
- F. Fly Ash:
1. Fly ash may be utilized in the design mix when allowed by the Project Manager. Fly ash shall conform to the requirements of ASTM C 618 for Class C or Class F. The pozzolanic index shall be eighty-five (85) for Class C and Class F fly ash. Class C fly ash will not be permitted where sulfate resistant cement is required.
 2. The Contractor shall notify the Project Manager of the source of the fly ash for review prior to use in the project. The fly ash to be used on any project shall have been tested by the Contractor for compliance with these specifications. The results of this testing shall be submitted to the Project Manager prior to its use on the project.
 3. When required by the Project Manager, the Contractor shall provide the fly ash analysis performed by the fly ash supplier along with the concrete mix proportions.

2.02 MISCELLANEOUS MATERIALS

- A. Curing Compound - Vertical Surfaces: Conform to ASTM C309-81.
- B. Curing Compound - Horizontal Surfaces: Conform to ASTM C309-81.
- C. Reinforcing: See Section 03200 Concrete Reinforcement.

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2.03 CONCRETE

- A. All concrete shall conform to the following requirements:
 - 1. Design: 28 day compressive strength of 3,500 psi or as specified in drawings and details. Concrete shall be manufactured and delivered in accordance with ASTM C94, standard specification for ready-mixed concrete.
- B. Air Entrainment: All concrete work shall contain an air entraining agent.
 - 1. Concrete for walks, sidewalks, and curbs shall have an air content of 7% + 1%.
 - 2. The entrained air content of all other concrete shall be controlled at 6% + 2% for 3/4" aggregate concrete and 4-1/2% + 1-1/2% for 1-1/2" aggregate concrete.
- C. Admixtures: No admixtures will be allowed except as specified herein, unless authorized by the Project Manager. All requests for approval or substitution must be made by the Contractor and be accompanied by sufficient information and test data for evaluation.

2.04 MIXING

- A. Mixing:
 - 1. Add aggregate and approximately two-thirds of the required water to the mixer first and mix a minimum of seventy (70) revolutions at mixing speed to insure wetting of all the aggregate particles. Add cement, air entraining agent and remaining water and mix a minimum of thirty (30) revolutions at mixing speed. When the mean ambient temperatures are below 40° F. all concrete shall have a minimum temperature of 70° F. at time of depositing.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verification of Conditions: Forms and Reinforcement: Provide ample notice to the Project Manager to allow him to examine all forms and reinforcement just before concrete is deposited and to observe the placing of all concrete. Do not begin placement until approval of Project Manager is obtained.

3.02 PREPARATION

- A. Subgrade: Perform minor cut and fill required to bring the grade to the correct level to receive concrete work. Recompact to comply with Section 02200.
- B. Concrete Work Preparation: Comply with Section 03300.
- C. Existing Asphalt: Where new curb and gutter abuts existing asphalt paving, cut asphalt to a straight line and pour toe of gutter against asphalt to avoid necessity of patching asphalt. Cut existing concrete with a masonry saw.
- D. Protection: Comply with Section 03300.

3.03 SUBGRADE

- A. Work by Earthwork Contractor: Earthwork contractor will perform all cut and fill necessary to bring the subgrade to within $\pm 1/2$ " of bottom surface of sidewalks, curb and gutter and other concrete work under this Section.
- B. Work by Concrete Curbs, Sidewalks and Driveway Contractor: Cut or fill and finish grade as required to bottom of sidewalk or curb and gutter within a tolerance of 1/4". If fill is required use on-site material or Class 6 road base material compacted to at least 95% of Standard Proctor Density, ASTM D698.

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3.04 PLACEMENT

A. Placement:

1. Deposit concrete in approximately uniform horizontal layers not over 24" in height.
2. Piling up of the concrete in the forms or chuting in a manner that separates the aggregates will not be permitted.
3. Follow the recommendations of ACI 614 for depositing concrete into forms. No concrete shall be dropped over 5'-0".
4. Prevent accumulations of water on the surface of the concrete due to water gain, segregation, or other causes, during placement or compacting as far as possible by adjusting the mixture. Make provision for removal of such water as may accumulate so that under no circumstances will concrete be placed in such accumulation.

B. Compaction: Compact concrete during and immediately after depositing, by means of mechanical vibrators. Supplement by hand spading at corners and angles of the forms, around embedded fixtures and in other difficult areas.

3.05 SIDEWALKS, CURBS AND DRIVEWAYS

A. General: Construct sidewalks and curbs in accordance with details on the Drawings and in strict conformity with the ordinances of city governing such work.

B. Finish: Broom and belt finish as indicated. Final surface finish as directed by the Project Manager. Finish edges with a slightly rounded edging tool.

C. Thickness: Total thickness of all sidewalks shall be full 4" unless indicated otherwise.

D. Joints:

1. Joint materials will conform to AASHTO Specifications according to type as follows:

Concrete joint sealer, hot-poured elastic	M 173
Preformed expansion joint filler (Bituminous Type)	M 33
Preformed sponge rubber and cork expansion joint fillers	M 153
Preformed expansion joint fillers - non-extruding & resilient bitum.	M 213

2. Non-bituminous types shall be placed in widths shown on the accepted plans or three-eighths inch (3/8") when not specified. Bituminous type shall be used for concrete paving and structural construction where joint sealers are not called for.
3. Expansion joint material will be provided at the following locations and will be in place prior to the placing of concrete:
 - a. at each end of curb return;
 - b. at both edges of driveway;
 - c. between back of sidewalk and driveway slab or service walk;
 - d. between new concrete and existing masonry buildings;
 - e. as shown on the Drawings;
 - f. as directed by the Project Manager;
 - g. between new and existing concrete; and
 - h. every one hundred fifty feet (150') in sidewalk.
4. Transverse joints will be placed at maximum intervals of ten feet (10') to control random cracking; joints will be formed, sawed, or tooled to a minimum depth of one-third (1/3) of the total thickness (no less than 2"). If divider plates are used, the maximum depth of plates will not be greater than one-half (1/2) depth at the finished surface and will be no less than fifteen-sixteenths inch (15/16") thick.

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5. Tool joints will be spaced as follows:
 - a. not more than ten feet (10') nor less than five feet (5') apart in curb and gutter and combination curb-walk.
 - b. as shown on the Drawings

3.06 CURING

- A. General: Do not remove forms until such time as specified and remove carefully so as not to injure the concrete surface.
- B. Vertical Surfaces: Clean all surfaces of loose sand, mortar, debris and grout; spray lightly with water and coat with a clear or translucent curing compound as soon as possible after removing forms. Apply curing compound in all cases the same working day that the forms are removed.
- C. Horizontal Surfaces: As soon as possible after placing concrete, coat all exposed horizontal surfaces with curing compound as specified. Give special attention to obtaining adequate curing of slab edges.
- D. Exposed faces of curbs and sidewalks will be finished to true-line and grade as shown on the plans. Surface will be floated to a smooth but not slippery finish. Sidewalk and curb will be broomed or combed and edged, unless otherwise indicated by the Project Manager. After completion of brooming and before concrete has taken its initial set, all edges in contact with the forms will be tooled with an edger having a three-eighths inch (3/8") radius.
- E. No dusting or topping of the surface or sprinkling with water to facilitate finishing will be permitted.
- F. Immediately following the removal of the forms, all fins and irregular projections will be removed from all surfaces except from those which are not to be exposed or are not to be waterproofed. On all surfaces, the cavities produced by form ties, honeycomb spots, broken corners or edges, and other defects, shall be thoroughly cleaned, moistened with water and carefully pointed and trued with a mortar consisting of cement and fine aggregate. The surface will be left sound, smooth, even, and uniform in color. Mortar used in pointing will not be more than thirty (30) minutes old. All construction and expansion joints in the completed work will be left carefully tooled and free of all mortar and concrete. The joint filler will be left exposed for its full length with clean and true edges.
- G. Fresh concrete will be adequately protected from weather damage and mechanical injury during the curing periods. Curing processes described herein may be used at the option of the Project Manager. The selected curing process will be started as soon as it can be done without injury to the concrete surface. The use of a membrane curing compound is recommended. The following curing procedures may be used subject to the approval of the Project Manager:
 1. ponding (for slabs or footings)
 2. spraying
 3. wet burlap, earth, or cotton mats
 4. waterproof paper or polyethylene plastic cover
- H. Membrane curing compound will not be used when the concrete surface will be painted. The type of membrane curing compound chosen will not permanently discolor the concrete surface. Where membrane curing compound is not used, the curing process will be carefully adhered to as follows:
 1. Surfaces being wetted by ponding, spraying, or wetted material will be kept completely wetted, with an excess of free water on the surface, at all times for the first seventy-two (72) hours. After this period, but for the remaining four (4) days, a wetting schedule will be followed whereby the concrete is wetted on a schedule approved by the Project Manager.
 2. Surfaces being protected by waterproof paper or polyethylene plastic cover will receive special attention during the first seventy-two (72) hours to insure there is actually free moisture on the surface of the concrete under the waterproof surface. The Project Manager may require the removal of the cover and a wetting of the surface when, in his judgment, there is insufficient

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moisture for curing. After the first seventy-two (72) hours the cover will be kept tightly in place for the remainder of the curing period.

3.07 MISCELLANEOUS CONCRETE REQUIREMENTS

- A. Provide all other site concrete flatwork indicated on the Drawings even though not specifically mentioned herein to complete the work, including the following:
 - 1. Anchors and Sleeves: Install anchors, posts and sleeves furnished under other Sections in accordance with shop drawings.

3.08 BACKFILLING

- A. Backfilling: Backfill against all work following removal of forms. Fill level with surrounding area and compact as directed by the Project Manager. Final grade tolerance $\pm 1"$.

3.09 TESTING

- A. General:
 - 1. The requirements of this section will apply to testing services for all concrete curb and gutter, sidewalk, pavement, slope paving, retaining walls, structures, and for all miscellaneous concrete testing.
 - 2. Concrete materials and operations will be tested as directed by the Project Manager and as herein stipulated. The required testing services will be performed by a designated testing agency acceptable to the Project Manager and all testing agencies will meet the requirements of ASTM E329. Concrete testing shall be performed by the designated testing agency at the expense of the Contractor.
 - 3. A representative of the testing agency will inspect, sample, and test material and production of concrete as required by the Project Manager. When it appears that any material furnished or work performed by the Contractor fails to fulfill specification requirements, the testing agency will report such deficiency to the Project Manager and the Contractor.
 - 4. The testing agency will report all test and inspection results to the Project Manager and Contractor immediately after they are performed. All test reports will include the exact location of the work at which the batch represented by a test was deposited. The report of the strength test will include detailed information on storage and curing of specimen prior to testing, the project number, and the location of the concrete (curb, manhole, inlet, sidewalk, paving, etc.).
- B. Tests Provided by the Contractor:
 - 1. The following services shall be performed by the designated testing agency at the expense of the Contractor:
 - a. Conduct strength test of the concrete during construction in accordance with the following procedure: Secure composite samples in accordance with AASHTO T141; mold and cure specimens from each sample in accordance with AASHTO T23. The maximum time between sampling and casting the cylinders or beams shall be forty-five (45) minutes. If they cannot be returned to the laboratory and cast within the forth-five (45) minutes, they will be cast in the field and transported to the laboratory in twelve (12) to twenty-four (24) hours. One test series will be taken per fifty (50) cubic yards (or fraction thereof) of the concrete placed per day, or as directed by the Project Manager.
 - 1) Field cured test series: Four (4) cylinders: two (2) to be broken at seven (7) days; two (2) to be broken at fourteen (14) days or as directed by the Project Manager.
 - 2) Lab cured test series: Six (6) cylinders; Two (2) to be broken at seven (7) days; two (2) to be broken at twenty-eight (28) days*; two (2) to be broken at forty-five days.
 - * If the specified strength is not obtained at twenty-eight (28) days, two (2) cylinders are to be broken at forty-five (45) days.
 - b. Determine slump of the concrete sample of each strength test whenever consistency of concrete appears to vary, or when directed by the Project Manager, in accordance with AASHTO T119.

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- c. Determine air content of the concrete sample for each strength test in accordance with either AASHTO T152 (pressure method), T196 (volumetric method), or T121 (gravimetric method).
- d. Sample additional concrete at point of placement, and perform other testing or inspection service as required.
- e. When required by the Project Manager, the Contractor will provide concrete mix designs, the results of which will be immediately reported to the Project Manager. When pumped concrete is to be used, a separate mix design will be required. Mix designs will be in accordance with ACI 211 and 304, as applicable.
- f. Additional testing and inspection required because of changes in materials or proportions.
- g. When the work fails to pass inspection or previous tests fail to meet specifications, additional tests will be taken as directed by the Project Manager.
- h. Core samples will be obtained and tested when samples of fresh concrete were not obtained and tested. Obtaining and testing cores will be in accordance with ASTM C42. Concrete in the area represented by a core test will be considered adequate if the average strength of the cores is equal to at least eighty-five percent (85%) of the specified strength f_c , and if no single core is less than seventy-five percent (75%) of the specified strength. Core holes will be filled with low slump concrete or mortar. Cores may be tested in the dry condition in accordance with ACI 301.
- i. Failure of the Contractor to furnish testing as herein described will be sufficient cause for rejection of the work in question.

C. Responsibility and Duties of the Contractor.

1. The Contractor will provide the testing agency with the following:
 - a. Any labor necessary to assist the designated testing agency in obtaining and handling samples at the project or from other sources of material.
 - b. Provide and maintain for the sole use of the testing agency adequate facilities for safe storage and proper curing of concrete test specimens on the project site as required by AASHTO T23.
2. The use of testing services shall not relieve the Contractor of the responsibility to furnish material and construct in full compliance.

3.10 PROTECTION

- A. General: Protect all exposed surfaces of concrete from premature drying and frost. Protect freshly placed concrete against rain damage. Protect all concrete surfaces from staining, cracking, chipping and other damage during progress of work, and leave in good condition upon completion.
- B. Vandalism: Vandalized concrete is not acceptable and will be ordered removed and replaced at Contractor's expense.

END OF SECTION

SECTION 02810 – IRRIGATION SYSTEM

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Work in this Section generally includes provisions for the complete installation of an irrigation system, including but not limited to all labor, supplies, equipment, tools and transportation. Items of work specifically included are:
1. Procurement of all appropriate licenses, permits and fees.
 2. Coordination of all utility locates.
 3. Trenching, stockpiling excavation materials, refilling and compacting trenches.
 4. Complete irrigation system including but not limited to piping, backflow preventer assemblies, valves, fittings, heads, connection of electrical power supply to the control system and final adjustments to insure complete coverage.
 5. Water connections.
 6. Sleeving for irrigation pipe and control wire.
 7. Replacement of unsatisfactory materials.
 8. Clean-up, inspections, approval, testing and maintenance period.
- B. Related Sections:
1. Examine all Sections related to project work.

1.02 WORK NOT INCLUDED

- A. Items of work specifically excluded or covered under other sections are:
1. Provision of electrical power supply to the control system.
 2. Backflow Preventer

1.03 SUBMITTALS

- A. Manufacturer's Data: Prior to construction, Manufacturer's catalog cuts, specifications and operating instructions, for each type and piece of equipment specified herein.
- B. Shop Drawings: Prior to construction, submit shop drawings called for in the installation details. Show products required for proper installation, their relative locations and critical dimensions.
- C. Quality Control Submittals:
1. Design: Any deviations from the proposed irrigation design must be approved by the Architect prior to construction. Submit three (3) copies of any design deviations before commencing any work.
 - a. Design Criteria: Any deviation in design shall conform to the head and valve locations, pipe routing, zoning, and stationing indicated on the Drawings(s). Lateral piping is sized in accordance with recognized standards based on flow demands (GPM's) with velocities designed not to exceed five feet (5') per second. Lateral piping shall not be used less than one inch (1") I.D. Pipe shall be reduced no less than six inches (6") beyond the last tee of a larger pipe size.

1.04 RULES, REGULATIONS AND REFERENCES

- A. Ordinances and Regulations: Local, municipal and state laws and regulations governing or relating to any portion of this work (including but not limited to the latest edition of the

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National Electric Code and Uniform Plumbing Code) are hereby incorporated into and made a part of these specifications and their provisions shall be carried out by the Contractor. Anything contained in these Specifications shall not be construed to conflict with any of the aforementioned rules and regulations. However, when these Specifications and Drawings call for or describe materials, workmanship, or construction of a higher quality, standard or larger size than is required by the above rules and regulations, the provisions of these Specifications and Drawings shall take precedence.

- B. References: 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.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Packing and Shipping: Deliver all components in original containers and/or with original labels intact. Transport pipe only on vehicle or trailer long enough to allow pipe to lie flat to avoid undue bending. Repair dented pipe before installation. Replace damaged or discolored pipe immediately.
- B. Storage and Protection: Prevent damage to components during loading, transportation and unloading and store components in a clean dry location until they are installed.

1.06 SITE CONDITIONS

- A. Existing Conditions:
 1. Contractor is responsible for knowing the information contained in the Drawing(s) and Specifications for all earthwork and other related operations and verifying that the existing site conditions are as specified and indicated in those documents before beginning work under this Section.
 2. Preserve and protect all trees, plants, monuments, structures, and paved areas from damage due to work of this Section. In the event damage does occur, all damage to inanimate items shall be completely repaired or replaced to satisfaction of Owner and all injury to living plants shall be repaired by Owner. All costs of such repairs shall be charged to and paid by Contractor.
 3. Protect buildings, walks, walls and other property from damage. Flare and barricade open ditches. Damage caused to asphalt, concrete or other building material surfaces shall be repaired or replaced at no cost to Owner. Restore disturbed areas to original condition.
 4. Report unsatisfactory conditions in writing to the General Contractor and Architect.
 5. Beginning of installation means acceptance of existing conditions by this Contractor.
 6. Tolerances: Specified depths of mains and laterals and pitch of pipes are minimums. Settlement of trenches is cause for removal of finish grade treatment, refilling, compaction, and repair of finish grade treatment.
 7. Coordination with other contractors: Protect, maintain and coordinate work with work under other Sections.
 8. Damage to other improvements: Contractor shall replace or repair damage to grading, soil preparation, seeding, sodding, or planting done under other Sections during work associated with installation of irrigation system at no additional cost to Owner.

SECTION 02810 – IRRIGATION SYSTEM

1.07 GUARANTEE / WARRANTY AND REPLACEMENT

- A. For a period of one (1) year from commencement of the formal maintenance period, guarantee/warranty irrigation materials, equipment and workmanship against defects, unless stated otherwise in the General Conditions of the contract. Fill and repair settling of backfilled trenches or depressions. Restore landscape or structural features damaged by the settlement of irrigation trenches or excavations. Repair or replace damage to the area caused by a defective item.
- B. Contract documents govern replacements identically as with new work. Replacements shall be made with no additional costs to the Owner.
- C. Guarantee/warranty applies to originally installed materials and equipment and replacements made during the guarantee/warranty period.
- D. Expenses due to vandalism before Substantial Completion shall be borne by Contractor.
- E. Maintenance During Warranty Period:
 - 1. Make repairs and replacements needed due to defective workmanship and materials.
 - 2. Make repairs within three (3) days of notification. If Contractor fails to make repairs within three (3) days, Owner may make such repairs at Contractor's expense. If in Owner's judgment an emergency exists, Owner may make repairs at Contractor's expense.

1.08 TESTING AND FLUSHING

- A. General: Notify the Architect a minimum of five (5) days in advance of testing. Furnish clean, clear water, pumps, labor, fittings and equipment necessary to conduct tests or re-tests.
- B. Testing:
 - 1. Hydrostatic Pressure Test:
 - a. Hydrostatically test the mainline piping and electric control valves in place before backfilling. Electric control valves must be in place for test. Close tightly isolation valves on mainline for tests. Backfill to prevent pipe from moving under pressure.
 - b. Purge all air from pipeline before test.
 - c. Attach pressure gauge to pipeline in test section. After backfilling and installation of all control valves, fill mainline with water, and pressurize to forty (40) PSI over the designated static pressure or one-hundred twenty (120) PSI, whichever is greater, for a period of two (2) hours. Test each section of pipe between isolation gate valves on the mainline pipe separately.
 - d. Observe pressure loss on pressure gauge. If pressure loss is greater than two (2) PSI, identify reason for pressure loss.
 - e. Replace defective PVC pipe, fitting, joint, or valve with new part. No pipe splices will be accepted within sleeve pipe. No PVC pressure couplings or slip-fix repair couplings will be allowed. Cement or caulking to seal leaks is prohibited.
 - f. Retest the system until the pressure loss is equal to or less than two (2) PSI.

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- g. Before Final Acceptance, pressure supply line shall remain under pressure for a period of forty-eight (48) hours.
- 2. Operational Test:
 - a. After installation of sprinkler heads and quick coupling assemblies, test entire system for operation under normal operating pressure.
 - b. Test heads in each valve zone for ten (10) minutes (minimum).
 - c. Operate controller in sequence through two (2) complete cycles or each zone for two (2) minutes minimum. The Architect will observe operation, water application patterns and leakage.
 - d. Replace, adjust or move sprinkler heads to correct operational or coverage deficiencies. Repair leaks, defective pipe, fittings, joints, valves, or sprinklers and repeat test until each lateral passes all tests.
 - e. Test is acceptable if system operates in a satisfactory manner with uniform coverage of areas to be sprinkled and no leaks occur during any testing procedure.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Equipment must have performance characteristics to operate per the design conditions indicated. If any discrepancy or conflict exists between the quantities or types of equipment listed on the Drawings and Specifications, and no specific interpretation is issued prior to bidding, the decision regarding this interpretation will rest with the Architect. The Contractor is to act on this decision as directed.
- B. Explanation of Drawings: Due to the scale of the Drawings, it is not possible to indicate all offsets, fittings, sleeves, etc., which may be required. Carefully investigate the structural and finished conditions affecting all of this work and plan this work accordingly, furnishing such fittings, etc., as may be required to meet such conditions. The Drawings are generally diagrammatic and indicative of the work to be installed. The work shall be installed in such a manner as to avoid conflicts between irrigation systems, landscape plantings and site features.
- C. Substitutions: Acceptable equipment Manufacturer's are indicated on the Drawings. Substitute equipment must be approved by the Architect prior to bidding. Pipe sizes referenced on the Drawings are minimum sizes and may be increased at the option of the Contractor.

2.02 EQUIPMENT

- A. Pressure Supply Lines: Is that piping commencing at the water source/ tap, through the point of connection components to a below-grade transition to PVC main line.
 - 1. Type "K" rigid, seamless copper water tube, ASTM B88, for three inch (3") lines or smaller.
 - a. All joints: Silver soldered.
 - b. All fittings through the backflow preventer to be copper.
 - c. Provide brass union at the backflow preventer.
 - 2. Comply with applicable codes or supply/ service line installation standards.
- B. Pipe and Fittings:

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1. Pressure Main Line and Fittings: Is that piping commencing at the point of connection to the various automatic control valves (downstream of backflow prevention units).
 - a. Use rigid, PVC 1120 or 1220 NSF approved pipe conforming to ASTM D-2241 and ASTM D1784, cell classification 12454 –A or 12454-B, Type 1, Grade 1, with an integral belled end.
 - b. Use Class 200, SDR 21 pressure rated at 200 PSI at 73.4 degrees F., conforming to the dimensions and tolerances established by ASTM D-2241.
 - c. Use rubber-gasketed pipe equipped with factory installed reinforced gaskets for mainline pipe with a nominal diameter greater than or equal to three inches (3"). Gasketed pipe joints must conform to the Laboratory Qualifying Tests section of ASTM D-3139. Gasket material must conform to ASTM F-477. Use rubber-gasketed deep bell ductile fittings conforming to ASTM A-536 and ASTM F-477. Use lubricant approved by the pipe Manufacturer.
 - d. Use solvent weld pipe for mainline pipe with a nominal diameter less than three inches (3") or where a pipe connection occurs in a sleeve. Use Schedule 40, Type 1, PVC solvent weld fittings conforming to ASTM Standards D2466 and D1784. Use primer approved by the pipe Manufacturer. Solvent cement to conform to ASTM Standard D2564.
 2. Lateral Pipe and Fittings: Is that piping commencing at the various automatic control valves to the sprinkler heads.
 - a. Use rigid, PVC 1120 or 1220 NSF approved pipe conforming to ASTM D-2241 and ASTM D-1784, cell classification 12454 –A or 12454-B, Type 1, Grade 1, with an integral belled end suitable for solvent welding.
 - b. Use Class 200, SDR 21 pressure rated at 200 PSI at 73.4 degrees F., conforming to the dimensions and tolerances established by ASTM D-2241.
 - c. Use solvent weld pipe for mainline pipe. Use Schedule 40, Type 1, PVC solvent weld fittings conforming to ASTM Standards D2466 and D1784. Use primer approved by the pipe Manufacturer. Solvent cement to conform to ASTM Standard D2564.
 3. Drip Tubing: To be used for lateral lines on drip and micro-jet zones only. (Not allowed for lines greater than two inch (2") diameter.):
 - a. Drip Tubing: Hardie Dura-Pol EHD 1645, 3/4" with .050 inch wall thickness.
 - b. Emitter Tubing: As recommended by emitter manufacturer.
 4. Polyethylene lateral pipe is prohibited.
- C. Specialized Fittings:
1. Brass fittings: Medium brass, screwed 125 lb. class.
 2. Threaded Pipe Connections: ASTM D2464, PVC Schedule 80 nipples with molded threads and PVC Schedule 40 threaded fittings. Use only teflon tape on plastic threads.
- D. Risers:
1. Rotary Head or Quick Coupler Valve: Triple Swing Joints - components include three (3) Schedule 40 elbows, three (3) three inch (3") Schedule 80 nipples, one (1) twelve inches (12") Schedule 80 nipple, and Teflon tape. Factory pre-assembled swing joints are acceptable and recommended.

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- E. Backflow Preventer: Existing
- F. Valve Setter: not required.
- G. Hydrometer Enclosure: Existing
- H. Air Vacuum Relief Valve: As specified in drawings.
- I. Isolation Gate Valves: As specified in drawings.
 - 1. Gate Valves for 3/4" through 2-1/2" pipe: Brass construction; solid wedge, IPS threads, and non-rising stem with wheel operating handle.
 - 2. Gate Valves for three inch (3") and Larger Pipe: Iron body, brass or bronze mounted AWWA gate valves with a clear waterway equal to full nominal diameter of valve; rubber gasket or mechanical joint-type only. Valves shall be able to withstand a continuous working pressure of one-hundred fifty (150) PSI (minimum) and be equipped with a square operating nut at sleeves/valve boxes or wheel type handles at manholes or open areas, that opens counterclockwise. Install a separate valve box for each assembly.
- K. Electric Control Valves:
 - 1. Size and type shown on Drawings having manual flow adjustment (except drip valves) and manual bleed nut. Use wire connectors and waterproofing sealant to join control wires to solenoid valves. Install a separate valve box for each assembly.
 - 2. Cast brass body and bonnet, globe type. Install with plastic or brass ball valve in-line upstream. Valve shall be normally closed, mechanically molded, single-seat diaphragm-operated, two (2)-way, 24 volt solenoid activated with manual bleed plug and flow adjustment.
 - a. Atmosphere vented and three (3) - way solenoid valves are prohibited.
- L. Drip Irrigation Assembly:
 - 1. Drip Tubing: Manufactured of flexible vinyl chloride compound conforming to ASTM D-1248, Type 1, Class C, Category 4, P14 and ASTM D-3350 for PE 122111C.
 - 2. Fittings: Type and make recommended by tubing manufacturer.
 - 3. Drip Valve Assembly: Type and size shown on Drawings.
 - a. Wye Strainer: Plastic construction with 120 mesh nylon screen and one-half inch (1/2") blow-out assembly.
 - b. Control Valve: Two (2) -way, solenoid pilot operated type made of synthetic, non-corrosive material; diaphragm activated and slow closing. Include freely pivoted seat seal; retained (mounted) without attachment to diaphragm.
 - c. Pressure Reducing Valve: Plastic construction as detailed.
 - 4. Drip Emitters: Single port, pressure compensating, press on type by Rainbird.
 - a. Provide two (2) one gallon per hour emitters for each shrub and four (4) two gallon per hour emitters for each tree.
- M. Quick Coupling Valves: Cast brass two-piece body designed for working pressure of one-hundred fifty (150) PSI. Valve shall be equipped with a locking rubber cover. Key size and type as shown on Drawings.

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- N. Manual Valves: Bronze, angle type, two hundred pounds (200 lbs.) class with cross type operating handles.
- O. Valve Boxes:
 - 1. Isolation Gate Valves, Drip Line Blow-out Stubs, and Wire Stub Box: Carson #910-12, Brooks #1100.
 - 2. 3/4" through 2" Control Valves and Air-Relief Valves: Carson #1419-13B, Brooks #1419.
 - 3. Drip Valve Assemblies: Carson #1320-13B.
- P. Drainage Sump: Shall contain a minimum of three (3) cubic feet of three-quarters of an inch (3/4") crushed gravel wrapped in geo-textile at all manual drain valve locations.
- Q. Automatic Controller:
 - 1. Size and type shown on Drawings; installed as detailed and noted.
- R. Electrical Control Wiring:
 - 1. Low Voltage:
 - C. Electrical Control Wire: 2-wire system, provide **Provide one extra 2-Wire Cable the entire length of main.**
 - a.
 - b. Wire Colors: wire color shall be continuous over its entire length.
See Details for 2-Wire colors
 - c. If multiple controllers are utilized, and wire paths of different controllers cross each other, both common and control wires from each controller shall be different colors approved by the Architect.
 - d. Control wire connections or splices shall be made with 3M DBR/Y Splice Kits.
 - e. Multi strand wire is prohibited.
 - 3. High Voltage: Type required by local codes and ordinances of proper size to accommodate needs of equipment serviced.
 - 4. 2 WIRE
 - a. MAXI Wire, 12 or 14 AWG, dual conductor, double isolation, PVC insulation, outer jacket (PE), voltage 600 volts.
 - b. Decoders: FD-101 TURF
- S. LIGHTNING ARRESTORS
 - A. Lightning arrestors shall be installed per manufacturers recommendations for the Rain Bird ESP-LXD controller.
 - B. Lightning arrestors shall be a combination lightning rod and grounding plate meeting the minimum requirements for the specified controller.
 - C. Lightning arrestors shall be installed at each end unit of each leg of 2 wire cable, and along each wire path at a minimum of 600 feet.
 - D. Any branch of 2 wire that exceeds 50 feet in length shall have a lightning arrestor.
 - E. There shall be a lightning arrestor installed within 25 feet of the base controller.

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- F. Lighting arrestors shall be a combination of lighting rods and grounding plates meeting the minimum requirements per the manufacturers recommendations.

- T. Sprinkler Heads:
 - 1. Type and quantity as indicated on Drawings. Fabricated riser units in accordance with details on Drawings and specified herein, with riser nipples of same size as riser opening in sprinkler body.
 - 2. Gear Driven: Plastic body pop-up, with built in check valve, removable nozzle and rubber cover. Provide variable arc settings from to 360 degrees. Nozzles shall have matched precipitation rates. Sprinkler shall have a minimum pop-up height of 4".
 - 5. Pop-up Sprays: Plastic body pop-up, with built-in pressure regulator and check valve, and a removable spray nozzle. Provide pattern plastic nozzles, with matched precipitation rates. Minimum pop-up height shall be four inches (4"), see Drawings for pop-up height. Use appropriate variable arc nozzles in all locations where excessive over spray occurs with the fixed arc nozzles.

- U. Sleeving:
 - 1. Sleeving material beneath pedestrian pavements and vehicular drives and streets shall be PVC Class 200 pipe with solvent welded joints. Sleeving diameter is equal to twice that of pipe or wire bundle. Install separate sleeve beneath paved areas to route run of irrigation pipe or wiring bundle.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verification of Conditions:
 - 1. Verify existing site conditions per Article 1.06 this Section.
 - 2. Soil Conditions: Investigate the type of soil and conditions in which these lines are to be installed and allow for same in proposal. No extra will be allowed due to difficulty in trenching.
 - 3. Grading operations, with the exception of final grading, shall be completed and approved by Owner before staking or installation of any irrigation system begins.

3.02 PREPARATION

- A. Layout: Layout and stake system before beginning installation. Notify Architect forty-eight (48) hours in advance to inspect layout. Inspection does not relieve installer of coverage problems due to improper placement of heads after staking.

- B. Sleeving: Install sleeving under asphalt paving and concrete walks, prior to concreting and paving operations, to accommodate piping and wiring. Compact backfill around sleeves to ninety-five percent (95%) Modified Proctor Density within two percent (2%) of optimum moisture content in accordance with ASTM D1557.
 - 1. Main and Lateral Line Sleeving:
 - a. Install under all paved surfaces as indicated on the Drawings.
 - b. Minimum depth to top of pipe shall be determined by depth of mainline and lateral lines.
 - c. Lay sleeve to drain at minimum grade of 3"/100'. Cut squarely with tubing cutter, hand saw or hack saw and remove burrs.

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- d. Ends of Sleeves: Mark in manner to ensure easy location in future. Do not allow sleeves to become filled with soil or other undesirable material.
- e. Install valve control wire in separate sleeve inside of mainline sleeve.
- 2. Electrical Sleeving:
 - a. Controller: Provide sleeve from controller box or enclosure to nearest mainline pipe. Provide below grade sweeps or changes in direction of no less than twenty-four inch (24") radius bends.
 - b. Install sleeve at the mainline depth.
- C. Trenching: Trench excavation shall follow, as much as possible, 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.
 - 1. Trenching Under Limb Spread of Existing Trees: Accomplish by hand or other method that will not damage limbs or branches. Keep trenching at least six feet (6'-0") from trunk of existing trees and shrubs. Coordinate with landscape installation.
 - 2. Trenching Location: The Contractor shall be responsible for contacting the respective utility companies five (5) days in advance of excavation and verifying the exact locations of all utilities. The indication of the utilities on the Drawings does not relieve the Contractor of the responsibility for utility location. Trenches shall be routed to avoid existing utilities. Verify with the Architect any required relocation prior to installation.
 - 3. Clearances:
 - a. Piping 3" and Larger: Make trenches of sufficient width (14" minimum) to properly assemble and position pipe in trench. Minimum clearance of piping three inches (3") or larger shall be five inches (5") horizontally on both sides of the trench.
 - b. Piping Smaller than 3": Trenches shall have a minimum width of seven inches (7").
 - c. Line Clearance: Provide not less than six inches (6") of clearance between each line, and not less than twelve inches (12") of clearance between lines of other trades. Do not stack pipe in trench.
 - 4. Pipe and Wire Depth:
 - Pressure Supply Piping: 24" from top of pipe.
 - Non-pressure Piping (rotor): 16" from top of pipe.
 - Non-pressure Piping (pop-up): 10" from top of pipe.
 - Control Wiring: Side of pressure main.
 - Drip Tubing: 10" from top of pipe.
 - Emitter Tubing (Micro-tubing): under mulch..
 - 5. Boring will be permitted only where pipe must pass under obstruction(s) which cannot be removed. In backfilling bore, final density of backfill shall match that of surrounding soil. It is acceptable to use sleeves of suitable diameter installed first by jacking or boring, and pipe laid through sleeves. Observe same precautions as though pipe were installed in open trench.
 - 6. Vibratory Plow: Non-pressure piping may be installed through use of vibratory plow method if consultant determines soil conditions are satisfactory for this method installation. Vibratory plowing does not relieve installer of minimum pipe depths.
- D. Backfilling:

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1. Excavated trenching material will generally be considered satisfactory for backfill purposes. Backfill material shall be free from rubbish, vegetable matter, frozen materials, or stones larger than one inch (1") in maximum dimension. Do not mix subsoil with topsoil. Haul away any material not suitable for backfill. Contractor shall be responsible for providing suitable backfill if excavated material is unacceptable or not sufficient to meet backfill, compaction and final grade requirements.
2. Do not backfill in freezing weather except with written approval from the Architect.
3. Compact to existing densities.
4. Leave backfill in trenches slightly mounded to allow for settling.
5. Trenches shall be finished graded prior to walk-through of system with Architect and Owner.
6. Do not leave trenches open for more than forty-eight (48) hours. Open excavations shall be protected in accordance with OSHA regulations.
7. Compact backfill to ninety percent (90%) maximum density, determined in accordance with ASTM D155-7 utilizing the following methods:
 - a. Mechanical tamping.
 - b. Puddling or ponding: Puddling or ponding and/ or jetting is prohibited within twenty feet (20') of building or foundation walls.

3.03 INSTALLATION

- A. PVC Piping: Snake pipe in trench as much as possible to allow for expansion and contraction. Do not install pipe when air temperature is below forty (40) degrees F. 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. PVC Pipe:
 1. Solvent Weld Pipe: Use primer and solvent cement. Lay pipe and make all plastic to plastic joints in accordance with Manufacturer's recommendations. Cure for 30 minutes (minimum) before handling and 24 hours before allowing water in pipe.
 2. Rubber Gasketed Pipe: Use pipe lubricant. Join pipe in the manner recommended by the Manufacturer and in accordance with accepted industry practices.
- C. Drip Tubing:
 1. Make all fitting connections as per Manufacturers recommendations.
 2. Use only Manufacturer provided or recommended hole punch when making penetrations in drip tubing for insert fittings. Use of any other hole punch shall be cause for immediate removal and replacement of all installed drip tubing.
 3. Install drip line blow-out stubs at all dead ends of drip tubing.
- D. Control Wiring:
 1. Low voltage wiring:
 - a. Bury control wiring between controller and electric valves in pressure supply line trenches, strung as close as possible to main pipe lines with such wires to be consistently located below and to one side of pipe, or in separate trenches.

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- b. Tape all twenty-four (24) volt wires at ten foot (10') intervals and lay with pressure supply line pipe to one side of the trench, consistently located below and to one side of the pipe.
 - c. Provide an expansion loop at every pressure pipe angle fitting, every electric control valve location (in valve box), and every one hundred feet (100'). Form expansion loop by wrapping wire at least eight (8) times around a three quarter inch (3/4") pipe and withdrawing pipe. Electrical connection at valve should have sufficient slack to allow ends to be pulled twelve inches (12") above ground for examination and cleaning.
 - d. Make all splices and E.C.V. connections using Rainbird Pentite connectors or similar dry splice method.
 - e. Install all control wire splices not occurring at control valve in a separate splice valve box.
 - f. Install one control wire for each control valve.
 - g. Run spare control wires and one (1) common wire from controller pedestal to the end of each and every leg of mainline. Label spare wires at controller and wire stub box. See Drawings for extra wire requirements.
 - h. Make connections in accordance with NEC.
 - i. Connect electric control valves to controller in numerical sequence as shown on the Drawings.
2. High voltage wiring for automatic controller:
 - a. Provide one-hundred twenty (120) volt power connection to automatic controller.
 - b. All electric work shall conform to local codes, ordinances, and authorities having jurisdiction. All high voltage electrical work shall be performed by licensed electrician.
- E. Automatic Controller:
1. Install controller in accordance with Manufacturer's published instructions.
 2. Final location of controller shall be approved by Architect and School District maintenance/grounds personnel, prior to installation.
 3. Controller shall have a dedicated separate ground wire and grounding rod as recommended by the Manufacturer.
 4. All above ground conduit shall be rigid galvanized with appropriate fittings. All below ground conduit shall be Schedule 40 PVC.
- F. Electric Control Valves:
1. Mount in-line with threaded connections. Flow control handle shall be a minimum of three inches (3") below finish grade where shown on the Drawings and as detailed.
 2. Install valves in separate valve boxes, a minimum of twelve inches (12") apart. Provide vertical separation to prevent contact with the mainline.
 3. When grouped together, allow at least twenty-four inches (24") minimum between valve box sides.
 4. Install Mirafi 104N or equal at bottom of electric control valve, valve box. Turn up fabric minimum four inches (4") around outside of valve box body prior to backfill. Stretch fabric taut at bottom of valve box. Install minimum four inches (4") gravel sump over fabric in bottom of each valve box.
 5. Install individual valve boxes flush with finish grade. Rectangular valve boxes to be set at parallel lines to adjacent site or architectural features. Multiple box locations shall all align uniformly.

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6. Each valve shall be identified by permanently affixing a brass tag to the flow control stem showing controller number.
 7. Brand controller letter and station number on lid of each valve box. Letter and number size shall be no smaller than one inch (1") and no greater in size than one and one-half inches (1½"). Depth of branding shall be no more than one-eighth inch (1/8") into valve box lid.
 8. Identify additional/spare wires on 'as-built' documents.
- G. Quick Coupling Valves:
1. Install quick couplers on swing-joint assemblies of Schedule 80 PVC pipe; plumb and flush to grade.
 2. Angled nipple relative to pressure supply line shall be no more than forty five (45) degrees and no less than twenty (20) degrees.
 3. Install quick coupling valves a detailed and in separate valve boxes.
- H. Drip Valve Assemblies:
1. Install drip valve assembly as detailed.
- I. Drip Emitters:
1. Stake all surface emitters as detailed and staked with acceptable tubing stakes as required.
 2. Provide two (2) one gallon per hour emitters for each shrub and four (4) two gallon per hour emitters for each tree.
- J. Manual Drain Valves:
1. Install manual drain valves at all low points in pressure supply line as detailed.
 2. Provide a three (3) cubic foot gravel drainage sump for each drain valve.
- K. Valve Boxes:
1. Install one (1) valve box for each type of valve installed as detailed.
 2. Valve box extensions are not acceptable except for master valves.
 3. Install gravel sump after compaction of all trenches.
 4. Place final portion of gravel inside valve box after valve box is backfilled and compacted.
- L. Isolation Gate Valves:
1. Compact subgrade to insure no settling occurs.
 2. Install concrete thrust blocks on either side of valves.
 3. Install in valve box with extensions to depth of valve.
 4. Install where shown on Drawings as detailed, and locate at least twelve inches (12") from and align with adjacent walls or edges of pavement.
- M. Sprinkler Heads:
1. Install where designated on the Drawings.
 2. Set heads plumb and one and one-half inches (1½") above finish earth grade in sod areas and flush with grade in seeded areas, except where part circles sprinklers are adjacent to curbs or paved surfaces where they should be set at the elevation of the

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- curb or paved surface. Install heads six inches (6") away from adjacent pavement and twelve inches (12") away from building.
3. Install heads on swing-joint risers of Schedule 40 PVC pipe. Angled nipple, relative to non-pressure line, shall be no more than forty-five (45) degrees or less than twenty (20) degrees.
 4. Spacing of heads shall not exceed the maximum indicated on the Drawing. In no case shall the spacing exceed maximum recommended by the Manufacturer.
 5. Adjust heads for proper coverage.
 6. No plant placement shall interfere with intended sprinkler head coverage, piping or other equipment.
 7. Architect may request nozzle changes or adjustments without additional cost to the Owner.
- N. Air Vacuum Relief Valve: Install in valve box per detail.
- O. Piping Under Paving:
1. Provide for a minimum cover of eighteen inches (18") between the top of the pipe and the bottom of the aggregate base for all pressure and non-pressure piping installed under asphaltic concrete or concrete paving.
 2. Piping located under areas where asphalt or concrete paving will be installed shall be bedded with sand (a layer six inches (6") below pipe and six inches (6") above pipe).
 3. Compact backfill material in six inch (6") lifts at ninety percent (90%) maximum density determined in accordance with ASTM D155-7 using manual or mechanical tamping devices.
 4. Set in place, cap, and pressure test all piping under paving, in presence of Architect prior to backfilling and paving operations.
 5. Piping under existing walks or concrete pavement shall be done by jacking, boring, or hydraulic driving, but where cutting or breaking of walks and/ or concrete is necessary, it shall be done and replaced at no cost to Owner. Obtain permission to cut or break walks and/ or concrete from Owner.
- P. Water Supply and Point of Connection: Water supply shall be extended as shown on the Drawing from water supply lines. Coordinate with civil drawings as necessary.
- 3.04 PRECISE EQUIPMENT LOCATION
- A. Edge of sprinkler equipment exposed at grade level shall be placed two inches (2") away from adjacent pavements and walls unless otherwise indicated. Locate other equipment as near as possible to the location indicated. Dimensioned pipe routing or equipment locations may not deviate from their indicated positions. Deviations must be accepted by the Architect prior to installation.
- 3.05 FLUSHING
- 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 furthest valves. Cap risers after flushing.

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- B. Nozzle Changes: Architect may require nozzle changes as deemed appropriate for coverage with no additional cost incurred to the Owner. Change out nozzles as directed accordingly.

3.06 ADJUSTING

- A. Upon completion of installation, "fine-tune" entire system by regulating valves adjusting patterns and break-up arms, 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 over spray onto walks, roadways, and buildings as much as possible. Heads of same type shall be operating at same pressure +/- 7%.
 1. If it is determined that irrigation adjustments will provide proper coverage, and improved water distribution as determined by the Architect, Contractor shall make such adjustments prior to Final Acceptance, as directed, at no additional cost to Owner. Adjustments may also include changes in nozzle sizes, degrees of arc and control valve throttling.
 2. All sprinkler heads shall be set perpendicular to finish grade unless otherwise designated.
 3. Areas which 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 Owner.

3.07 COMPLETION SERVICES

- A. Walk-through for Substantial Completion:
 1. Arrange for the Architect's presence forty-eight (48) hours in advance of walk-through.
 2. Entire system shall be completely installed and operational prior to scheduling of walk-through.
 3. Operate each zone in its entirety for the Architect at time of walk-through and additionally, open all valve boxes if directed.
 4. Generate a list of items to be corrected prior to Final Completion.
 5. Furnish all materials and perform all work required to correct all inadequacies of coverage due to deviations from Contract Documents.
 6. During walk-through, expose all drip emitters under operations for observation by the Architect to demonstrate that they are performing and installed as designed, prior to placing of all mulch material. Schedule separate walk-through if necessary.
- B. Walk-through for Final Completion:
 1. Arrange for the Architect's presence forty-eight (48) hours in advance of walk-through.
 2. Show evidence to the Architect that the Owner has received all accessories, charts, record drawings and equipment as required before final completion walk-through is scheduled.
 3. Operate each zone, in its entirety for the Architect at time of walk-through to insure correction of all incomplete items.
 4. Items deemed not acceptable by the Architect shall be reworked to complete satisfaction of the Architect.
 5. If after request to the Architect for walk-through for final completion of irrigation system, the Architect finds items during walk-through which have not been properly

SECTION 02810 – IRRIGATION SYSTEM

adjusted, reworked, or replaced as indicated on list of incomplete items from previous walk-through, Contractor shall be charged for all subsequent walk-thru's. Funds will be withheld from final payment and/ or retainage to Contractor, in amount equal to additional time and expenses required by the Architect to conduct and document further walk-thru's as deemed necessary to insure compliance with Contract Documents.

C. Project Record (As-built Drawings):

1. A contract set of Drawings for all phases of the work shall be maintained at the site, with all changes or deviations from the original Drawings marked thereon in contrasting color. This shall be a separate set of Drawings, not used for construction purposes, which will be kept up to date as the job progresses and be made available to the Architect for inspection at all times. The Contractor shall revise a tracing of the design Drawings to indicate all changes made during installation. Mylars or CAD data files compatible with AutoCAD software, will be available from the Architect. Using technical drafting pen or CAD, duplicate information contained on the contract set of drawings maintained on site. Label each sheet "Record Drawing". Dimensions, from two (2) permanent points of reference (building corners, sidewalk, road intersections or permanent structures), for the location of following items:
 - a. Connection to existing water lines.
 - b. Routing of sprinkler pressure lines (dimension maximum one-hundred feet (100') along routing).
 - c. Sprinkler control valves.
 - d. Quick coupling valves.
 - e. Drain valves.
 - f. Drip line blow-out stubs.
 - g. Control wire routing if not with pressure mainline.
 - h. All gate valves.
 - i. Other related equipment as directed.
2. Turn over the "Record Drawings" to the Architect. Completion of the Record Drawings will be a prerequisite for the Review at the completion of the irrigation system installation.
3. Operation and Maintenance Manual: Submit three (3) bound brochures including:
 - a. Written operating instructions including spring start-up and winterization procedures.
 - b. Controller programming schedule indicating length of time each zone is to be operated. Calculate turf zones at one and one half inches (1½") of water per week. Coordinate controller/ watering operations with Owner's maintenance personnel.
 - c. Controller Charts:
 - 1) Do not prepare charts until record (as-built) drawings have been reviewed by the Architect.
 - 2) Provide one (1) controller chart for each automatic controller installed.
 - a) Chart may be reproduction of record drawing, if scale permits fitting of controller door. If photo reduction prints are required, keep reduction to maximum size possible to retain full legibility.

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- b) Chart shall be blue-line print of actual "as-built" system, showing area covered by that controller.
 - 3) Identify area of coverage of each remote control valve, using a distinctly different color drawing over entire area of coverage.
 - 4) Following review of charts by Architect they shall be hermetically sealed between two (2) layers of twenty millimeter (20 mm) thick plastic sheet.
 - 5) Charts shall be completed and reviewed prior to final review of irrigation system.
4. EXTRA MATERIALS
- 1) In addition to installed system furnish the following items to Owner:
 - a. Ten (10) pop-up spray heads with nozzles of each type used.
 - b. Four (4) rotor heads of each type used.
 - c. Thirty (30) drip emitters of each type used.
 - 2) Furnish the following maintenance items to Owner prior to Final Acceptance:
 - a. Two (2) sets of special tools required for removing, disassembling, and adjusting each type of sprinkler head and valve supplied on this project.
 - b. Two (2) six foot (6') valve keys for operation of gate valves or stop and waste valves (if applicable).
 - c. Two (2) keys for each automatic controller and enclosure.
 - d. Four (4) quick coupler keys and two (2) matching hose swivels for each type of quick coupling valve installed.
 - e. Two (2) aluminum drain valve keys of sufficient length for operation of drain valves.
- 3.08 WINTERIZATION AND SPRING START-UP
- A. Winterization: At the end of the first irrigation season, within three (3) days of notification of the Owner, drain the system and connect an air compressor of sufficient size to discharge all water from low points of the system. Coordinate the winterization with the landscape maintenance personnel.
 - B. Spring Start-up: Recharge, operate and adjust system malfunctions at the start of the next irrigation season within three (3) days of notification by the Owner. Coordinate the start-up with the landscape maintenance personnel.
- 3.09 MAINTENANCE
- A. Upon completion of construction and review by the Architect, maintain the irrigation system for a duration of thirty (30) calendar days. Make periodic examinations and adjustments to the irrigation system components to achieve the most desirable application of water.
 - B. Following the completion of the Contractor's maintenance period, the Owner will be responsible for maintaining the system in working order during the remainder of the warranty/guarantee period, for performing necessary minor maintenance and for protecting against vandalism.

3.10 DEMONSTRATIONS

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- A. Demonstrations: Demonstrate system to the Owner's personnel. Include proper operation of system, adjusting of sprinkler heads, valves, controller and winterization procedures.
- 3.11 CLEANING
- A. Clean-up: Continuous operation throughout the duration of the work. Remove rubbish from site on daily basis. Deposit all excavated materials at least twenty-four inches (24") away from any trench side and promptly haul away any excess material leaving the backfilled trench with a neat and workmanlike appearance to the satisfaction of the Architect. Any material not removed may be removed by Owner at Contractor's expense with a minimum advance notice of five (5) working days.

END OF SECTION

**SECTION 02910
TOPSOIL, FINE GRADING AND SOIL PREPARATION**

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Salvaging Existing Topsoil for Re-distribution.
 - 2. Ripping/disking.
 - 3. Spreading stockpiled Topsoil.
 - 4. Soil Conditioner – Not Required.
 - 5. Fine Grading.

- B. Related Sections:
 - 1. Earthwork: Section 02300.
 - 2. Seeding: Section 02921.

1.02 SUBMITTALS

- A. Quality Control Submittals:
 - 1. Certificates: State, federal and other inspection certificates shall accompany invoice for materials showing source or origin. Submit to Architect prior to acceptance of material.

1.03 DELIVERY, STORAGE AND HANDLING

- A. General: Comply with Section 01600.

- B. Soil Amendments: Not Required

1.04 PROJECT/SITE CONDITIONS

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

- B. Vehicular accessibility on site shall be as required. Repair damage to prepared ground and surfaces caused by vehicular movement during work under this Section to original condition at no additional cost to Owner.

PART 2 - PRODUCTS

2.01 SOIL MATERIALS

- A. Topsoil:
 - 1. Existing Topsoil: This material is considered adequate for reuse as topsoil. Four (4) inches of existing topsoil shall be stripped and stockpiled for reuse and spreading.

- B. Soil Conditioner: Not required.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. General: Verify that existing site conditions are as specified and indicated before beginning work under this Section.

SECTION 02910

1. Grades: Inspect to verify rough grading is within +/- 1.25" of grades indicated and specified.
2. Damaged Earth: Inspect to verify that earth rendered unfit to receive planting due to concrete water, mortar, lime water or any other contaminant dumped on it has been removed and replaced with clean earth from a source approved by the Architect. All access roadways or compacted soil shall be ripped to loosen.

B. Unsatisfactory Conditions: Report in writing to General Contractor with copy to Architect.

C. Acceptance: Beginning of installation means acceptance of existing conditions by Contractor.

3.02 PREPARATION

A. Protection:

1. Locate sewer, water, irrigation, gas, electric, phone and other pipelines or conduits and equipment prior to commencing work.
2. Be responsible for proper repair to landscape, utilities, walls, pavements and other site improvements damaged by operations under this Section.
3. Pay for repairs made by Contractor(s) designated by Owner.

B. Weed Control: Remove annual weeds by tilling. Remove perennial weeds by applying herbicide one (1) week before soil preparation and as needed, but no sooner than three (3) months after emergence. Contractor to keep a log of all herbicide application rates throughout the duration of the project detailing its application and submit to Owner at the completion of project as required.

C. Surface Grade: Remove existing grass, weeds, debris and rocks larger than one-half inch (1/2") in all areas designated to receive new bluegrass sod or bluegrass seed. Verify that all rough grades have been established in accordance with specified earthwork grade tolerances and other provisions.

D. Runoff: Take measures and furnish equipment and labor necessary to control the flow, drainage, and accumulation of water to run off the grounds as is intended by the grades.

E. Erosion Control: Take measures and furnish equipment and labor necessary to control and prevent soil erosion (see Section 02921), blowing soil and accumulation of wind-deposited material on the site throughout duration of work.

3.03 INSTALLATION

A. Ripping and Tilling: Rip/till to minimum of eight inches (8"), with agricultural sub-soiler, in all areas to receive bluegrass sod with four (4) passes in at least two (2) directions. Rip/till to minimum of four inches (4"), with agricultural sub-soiler in native seed areas, with four (4) passes in at least two (2) directions. In areas where extremely stiff material or debris is encountered during ripping, re-adjust equipment to avoid bringing up chunks of un-tillable material.

B. Topsoil:

1. Apply four inches (4") deep (when compacted to eighty percent (80%) density with two percent (2%) at optimum moisture content) of stockpiled topsoil over entire disturbed area to receive landscaping.

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2. Imported topsoil not required unless existing is deemed to be unusable.
 - C. Soil Conditioner: Not required.
 - D. Fertilizer:
 1. See Part 2, C. of this Section.
 - E. Fine Grading in seeded areas:
 1. Do fine grading for areas prior to native seeding.
 2. For ground surface areas surrounding buildings, maintain required positive drainage away from buildings as required by Soils Engineer/Report.
 3. Noxious weeds or parts thereof shall not be present in the surface grade prior to seeding.
 4. Prior to acceptance of grades, hand rake to smooth, even surface free of debris, clods, rocks and vegetable matter greater than one-half inch (3/4").
- 3.04 NOTIFICATION AND INSPECTION
- A. Inspection: Provide notice to Landscape Architect requesting inspection at least seven (7) days prior to anticipated date of completion.
 - B. Deficiencies: Landscape Architect will specify deficiencies to Contractor who shall make satisfactory adjustments and shall again notify Architect for final inspection.
- 3.05 CLEANING
- A. General: Remove debris and excess materials from site. Clean out drainage inlet structures as required. Clean paved and finished surfaces soiled as a result of work under this Section, in accordance with direction given by Architect.
- 3.06 PROTECTION
- A. General: Provide and install barriers as required and as directed by Architect to protect completed areas against damage from pedestrian and vehicular traffic until acceptance by Owner. Contractor is responsible for malicious destruction caused by others.

END OF SECTION

**SECTION 02921
SEEDING**

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Native Seed Mix.
2. Hydromulch.
3. Erosion Control Matting.
4. Maintenance.

B. Related Sections:

1. Topsoil, Fine Grading and Soil Preparation: Section 02910.
2. Sodding: Section 02923.
3. Trees, Shrubs and Groundcover: Section 02930.

1.02 REFERENCES

- A. Reference Standards: Comply with U. S. Department of Agriculture Rules and Regulations under Federal Seed Act and be equal in quality to standards for Certified Seed.

1.03 SUBMITTALS

A. Quality Control Submittals:

1. Certificates: State, federal or other inspection certificates shall accompany the invoice for materials showing source or origin. Submit to Architect prior to acceptance of the material.
2. A sample of the soil retention blanket shall be submitted at least two (2) weeks in advance of its use on the project for approval by the Architect.

B. Contract Closeout Submittals:

1. Operating and Maintenance Data: At completion of work, submit three (3) copies. Include directions for irrigation, aeration, mowing, fertilizing and spraying as required for continued and proper maintenance through full growing season and dormant period.

- C. Warranty: At completion of work, furnish written warranty to Architect based upon requirements as specified.

1.04 QUALITY ASSURANCE

A. Source Quality Control:

1. Seed Materials: Subject to inspection and acceptance. Architect reserves the right to reject at any time or place prior to acceptance, any work and seed which in Architect's opinion fails to meet Specification requirements.
2. Inspection: Primarily for quality, however, other requirements are not waived even though visual inspection results in acceptance.
3. Inspection can be made periodically during seeding, at completion and at end of warranty period by Architect.

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

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1.05 DELIVERY, STORAGE AND HANDLING

- A. Seed: Deliver seed in sealed standard containers stating correct name and composition on the outside of the container. Seed damaged in transit or storage will not be accepted.
- B. Notification: Verify material arrivals at project site with Architect. Immediately remove unacceptable material from job site.

1.06 PROJECT/SITE CONDITIONS

- A. Existing Conditions:
 - 1. Vehicular accessibility onsite shall be as directed by Architect. Repair damage to prepared ground and surfaces caused by vehicular movement during work under this Section to original condition at no additional cost to Owner.
- B. Environmental Conditions: Do not drill or sow seed during windy weather or when ground is frozen or otherwise un-tillable.

1.07 WARRANTY

- A. Warranty for 'Native Grass Seed Areas: Warrant areas in seed to be in a healthy, vigorous growing condition and for consistency of coverage for a period of one (1) year from date of acceptance. After time of seed germination, re-seed any spots where seed has not germinated within the total seeding area. Continue this procedure until a successful stand of grass is growing and accepted by the Architect and Owner.

1.08 MAINTENANCE

- A. General: The maintenance period shall begin immediately after each area is seeded and continue until final acceptance of entire project. During this time, be responsible for all work as necessary to ensure that seeded areas are in a vigorous growing condition. Provide all supervision, labor, material and equipment to maintain seeded areas.
- B. Materials: Conform to Specifications or otherwise be acceptable to the Architect.
- C. Watering: Not required for native seed areas.
- D. Weed Control: As required, using selective herbicides approved by Architect and adhering to local environmental laws.
- E. Insect and Disease Control: As required, apply insecticide and fungicide approved by Architect and adhering to local environmental laws.
- F. Reseeding: In areas larger than two (2) sq. ft. in which no stand of grass is established. Reseed and water until stand of grass is successfully established.
- G. Mowing and Trimming:
 - 1. Mow non-irrigated, native grasses only as required. Cut back to six inches (6"). This shall occur no more than three (3) times only during the first year. Remove clippings from adjacent gravel, pavement or irrigated turf areas.
- H. Fertilization:
 - 1. 'Native Seed Mix' - None required.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Seed Mixtures:

1. Seed Mixture for Seeding Areas as Indicated:

Sow the following seed mixture(s) for pure live seed at the following rate(s):

- a. 'Low Grow' Seed Mix – Use mix on plans if seeded between February-May 1st. If seeding is done outside this window consult the Landscape Architect for Alternate Mixes such as Annual Rye Grass.

- B. Water: Free of substances harmful to plant growth. Owner is responsible for watering seeded areas for one (1) full year from date of seeding.

- C. Fertilizer: Apply in accordance with Section 02910 – Topsoil, Fine Grading and Soil Preparation.

D. Mulch:

1. Seeded Areas: Hydromulch with Conweb 200/Matfiber and Tackifier or accepted substitute.

- a. Wood cellulose fiber: Must be thermally produced, air dried and conforming to the following:

Percent Moisture Content: 12.0% ± 3.0%.
Percent Organic Matter: 99.3% minimum.
Percent Ash: 0.8% ± 0.2%.
pH Range: 4.8% ± 0.5%.
Percent Water Holding Capacity: 100 gms. H2O/100 gms. Fiber.
Water Soluble Dye: Green.

- b. Mulch Material: Supply in packages having gross weight not over one-hundred pounds (100 lbs.) and marked by Manufacturer to show air dry weight content.
- c. Tackifier: Hydromulch fiber may contain tackifier or tackifier may be added at time of mulching.
- d. Suppliers: Certify that laboratory and field testing of product has been accomplished and that it meets all of foregoing requirements for wood cellulose fiber mulch. Inorganic tackifier and asphaltic material will not be permitted. The organic tackifier shall be a free-flowing, non-corrosive powder produced from natural plant gum of Plantago Insulares (Indian Wheat) and applied at a minimum rate of one-hundred pounds (100 lbs.) per acre.

- E. Erosion Control: Shall be a machine produced mat consisting of seventy percent (70%) agricultural straw and thirty percent (30%) coconut fiber. The blanket shall be of consistent thickness with the straw evenly distributed over the entire area of the mat. The blanket shall be covered on the top side with polypropylene netting having an approximate 16 mm x 16 mm mesh and on the bottom with polypropylene netting with

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an approximate 6 mm x 6 mm to 13 mm x 13 mm mesh. The blanket shall be sown together with cotton, biodegradable or photodegradable thread.

- F. Staples: No. 11 gauge steel wire formed into a "U" shape six inch (6") long.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that existing site conditions are as specified and indicated before beginning work under this Section.
1. Layout: Verify layout of seeding areas as indicated prior to starting seeding operations.
 2. Grades: Verify intent of Drainage Channels and relationship of adjacent grades, modified grades and desired clean-up and drainage results.
- B. Acceptance: Beginning of installation means acceptance of existing conditions by Contractor.

3.02 PREPARATION

- A. Protection:
1. Be responsible for proper repair to landscape, utilities, walls, pavements and other site improvements damaged by operations under this Section.
 2. Pay for repairs made by Contractor(s) designated by Architect.
 3. Identify prepared seeding areas requiring protection and erect barriers for proper protection and traffic control maintained throughout germination/development period.
- B. Erosion Control: Take measures and furnish equipment and labor necessary to control and prevent soil erosion, blowing soil and accumulation of wind-deposited materials on the site throughout the duration of work. Erosion damage is the Contractor's responsibility once site disruption begins.
- C. Drainage Channels: Entire channel flow lines, banks and adjacent terrain within fifteen feet (15') of channel center lines are to be cleared and re-vegetated with seed.
- D. Seeded Areas: Remove weeds, debris and rocks larger than one half inch (3/4") which may hinder seeding or subsequent operations. Dispose of accumulated debris at direction of Architect.
- E. Fine Grading: Perform as required to maintain positive drainage, prevent ponding while directing run-off into catch basins, drainage structures, etc. and as required to provide smooth uniform, well-contoured surface prior to proceeding. Tolerance: \pm one half inch (1/2").

3.03 SEEDING

- A. General: Seed in manner such that after surface is raked and rolled, seed shall have one-quarter inch (1/4") of cover.

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- B. Hydraulic Seeding/Mulching Equipment: Include pump capable of being operated at one-hundred (100) gallons per minute and at one-hundred pounds (100 lbs.) per square inch pressure, unless otherwise directed.
 - 1. Equipment: Nozzle adaptable to hydraulic seeding requirements.
 - 2. Storage Tanks: Means of estimating volume used or remaining in tank.
 - C. Drainage Channels: Seed all drainage channels and other areas of potentially high flows at two (2) times the specified rate.
- 3.04 MULCHING
- A. Hydromulching:
 - 1. Mixing: Add cellulose fiber mulch after proportionate quantities of water and other accepted material have been placed in slurry tank. Mix ingredients to form homogeneous slurry.
 - 2. Spraying: Spray apply slurry mulch uniformly over designated seed areas using color of mulch as metering agent.
 - a. Apply at rate of two thousand pounds (2,000 lbs.) per acre plus tackifier at rate of one-hundred pounds (100 lbs.) per acre.
 - 3. Hydromulching: Do not apply in presence of free surface water resulting from rain, melting snow or other causes.
 - B. Timing: Mulch seeded areas within twenty four (24) hours after seeding. Areas not mulched within twenty four (24) hours after seeding shall be re-seeded with the specified seed mix prior to mulching.
 - C. Hay Mulching: Not required.
 - D. Quality Control: Repair and re-mulch areas improperly mulched or damaged by Contractor's negligence, in specified manner. Mulch removed by circumstances beyond the Contractor's control shall be repaired and re-mulched as ordered with payment for this corrective work, when ordered, at the contract prices.
- 3.05 EROSION CONTROL **(to be utilized on all slopes 4:1 or steeper)**
- A. Soil Retention Blankets: The area to be covered with Soil Retention Blanket shall be properly prepared and seeded before the blanket is placed. When the blanket is unrolled, the heavyweight polypropylene netting shall be on top and the lightweight polypropylene netting shall be in contact with the soil. In ditches and on slopes, blankets shall be unrolled in the direction of the flow of water. Installation shall be in accordance with the Manufacturer's recommendations. A representative of the Manufacturer can be present to give instruction during the installation of the soil retention blanket.
 - 1. The blanket shall be placed smoothly but loosely on the soil surface without stretching.
 - 2. The upslope end shall be buried in a trench six inches (6") wide by six inches (6") deep beyond the crest of the slope to avoid undercutting. For slope applications, there shall be a six inches (6") overlap wherever one (1) roll of blanket ends and another begins with the uphill blanket placed on top of the blanket on the downhill side.
 - 3. There shall be a four inch (4") overlap whenever two (2) widths of blanket are applied side to side.

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4. Insert staples in a pattern according to the Manufacturer's recommendation at approximately two (2) staples per square meter.
5. At terminal ends and every twenty-five feet (25'). Soil Retention Blanket placed in ditches shall be buried in a trench approximately 6" deep by 6" wide. Before backfilling, staples shall be placed across the width of the trench spaced at 6" on center in a zigzag pattern. The trench shall then be backfilled to grade and compacted by foot tamping.

B. Drainage Channels:

1. Grade and smooth channel. Apply seed prior to installing blankets.
2. Anchor blankets at top of channel. Backfill with check slot material. For culvert outfalls, place blanket at least twelve inches (12") upstream from pipe opening.
3. Install a blanket in the center of the channel, in the direction of water flow. Additional blankets are installed at the edges of this center blanket.
4. Construct check slots with soil, gravel, or stone, in the middle and end of each blanket.
5. Overlap side channel blanket edges a minimum of three inches (3") over the center channel blanket and staple. Overlap end and beginning blanket edges a minimum of six inches (6") and staple.
6. Anchor the top edge of side channel blankets.
7. Anchor the terminal ends of blankets in a check slot.

C. Stapling: Staple overlaps which run parallel to direction of flow in channel bottoms on two foot (2') intervals. Staple outside edges, centers and overlaps on banks on two foot (2') intervals.

1. Each Width of Cloth: Install row of staples down center as well as along each side.
2. Staple check slots and junctions of new rolls across channel on six inch (6") intervals.
3. On soft or sandy soil or in windy areas, apply staples in alternate slanting position and space at eighteen inch (18") intervals.
4. For extra hard soil or shale areas, use sharp hardened steel three inch (3") fence type staples.

3.06 NOTIFICATION AND INSPECTION

- A. Inspection: Provide notice to Architect requesting inspection at least seven (7) days prior to anticipated date of completion. All planting must be alive and healthy in order to be considered complete.
- B. Deficiencies: Architect will specify deficiencies to Contractor who shall make satisfactory adjustments and shall again notify Architect for final inspection.

3.07 CLEANING

- A. Remove debris and excess materials from site. Clean paved and finished areas soiled as a result of work under this Section, in accordance with direction given by Architect. Clean out drainage inlet structures as required.
- B. Remove mulch immediately from trees, shrubs and sod to prevent damage to same.

3.08 PROTECTION

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- A. Provide and install barriers as required and as directed by Architect to protect seeded areas from damage from pedestrian and vehicular traffic. Contractor is responsible for malicious destruction of seeding caused by others.

END OF SECTION

**SECTION 02923
SODDING**

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Fertilizing.
 - 2. Bluegrass Sodding.
 - 3. Maintenance.

- B. Related Sections:
 - 1. Irrigation System: Section 02810.
 - 2. Topsoil, Fine Grading and Soil Preparation: Section 02910.
 - 3. Seeding: Section 02921.
 - 4. Trees, Shrubs, and Groundcover: Section 02930.

1.02 REFERENCES

- A. Reference Standards: U.S. Department of Agriculture Rules and Regulations under Federal Seed Act and equal in quality to standards for Certified Seed.

1.03 SUBMITTALS

- A. Quality Control Submittals:
 - 1. Certificates: State, federal and other inspection certificates shall accompany the invoice for materials showing source or origin. Submit to Architect prior to acceptance of material.

- B. Contract Closeout Submittals:
 - 1. Operating and Maintenance Data: At completion of work, submit three (3) copies in accordance with Section 01770. Include directions for irrigation, fertilizing, aeration, mowing, and spraying as required for continued and proper maintenance through a full growing season and dormant period.
 - 2. Warranty: At completion of work, furnish written warranty to Architect based upon requirements as specified.

1.04 QUALITY ASSURANCE

- A. Source Quality Control:
 - 1. Sod Materials: Subject to inspection and acceptance. Architect reserves the right to reject at any time or place prior to acceptance, any work and sod which in the Architect's opinion fails to meet these Specification requirements.
 - 2. Inspection: Primarily for quality; however, other requirements are not waived even though visual inspection results in acceptance. Notify Architect of intended sod farm prior to cutting for possible inspection. Inspection at growth site shall not preclude the right of rejection at project site.
 - 3. Promptly remove rejected sod from site.
 - 4. Inspection can be made periodically during sodding, at completion or at end of warranty period by Architect.

- B. Sod Standards:
 - 1. General: Healthy, thick turf having undergone a program of regular fertilization, mowing and weed control; free of objectionable weeds; uniform in green color, leaf

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texture and density; healthy, vigorous root system; inspected and found free of disease, nematodes, pests and pest larvae by the entomologist of the State Department of Agriculture.

2. Each piece of Sod: Sandy-loam soil base that will not break, crumble or tear during sod installation.
3. Thickness: one inch (1") thick, including top growth and thatch.
4. Thatch: Not to exceed one-half inch (5/8") compressed.
5. Size: Big Roll size is recommended.

1.05 DELIVERY, STORAGE AND HANDLING

- A. General: Comply with Section 01600.
- B. Sod: Deliver Big Roll sod, properly loaded on vehicles and with root system protected from exposure to sun, wind, and heat in accordance with standard practice and labeled with botanical and common name of each grass species in accordance with Federal Seed Act.
 1. Protect from dehydration, contamination and heating at all times. Keep stored sod moist and under shade or covered with moistened burlap.
 2. Do not drop sod rolls from carts, trucks or pallets.
 3. Do not deliver more sod than can be installed within twenty-four (24) hours.
- C. Fertilizer: Deliver inorganic or chemical fertilizer(s) to site in original unopened container bearing Manufacturer's guaranteed chemical analysis, name, trade name, trademark, warranty and conformance to state law.
 1. Material shall be inspected upon arrival at job site.
 2. Immediately remove unacceptable material from job site.

1.06 PROJECT/SITE CONDITIONS

- A. Existing Conditions:
 1. Import and place any fill material required to adjust the fine grade to meet drainage requirements or to match adjacent surface fine grade.
 2. Vehicular accessibility on site shall be as required. Repair damage to prepared grounds and surfaces caused by vehicular movement during work under this Section to original condition at no additional cost to Architect.
- B. Environmental Requirements:
 1. Install sod between spring and fall: March 1 - November 1.
 2. Do not install sod on saturated or frozen soil.

1.07 WARRANTY

- A. Sod: Warrant sod for a period of one (1) year from date of acceptance.
 1. During the original warranty period, replace at once, sod areas that die due to natural causes, etc. or which in Architect's opinion are unhealthy.
 2. Replacement will not be required in any season definitely unfavorable for sodding.
 3. Install replacements as originally specified and warranted.

1.08 MAINTENANCE

- A. General: The maintenance period shall begin immediately after each area is sodded and continue until final acceptance of entire project. During this time, be responsible for watering, mowing, fertilizing, spraying, weeding, aerating, and all related work as

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necessary to ensure that sodded areas are in a vigorous growing condition. Furnish all supervision, labor, material and equipment to maintain turf areas.

- B. Materials: Conform to Specification or otherwise be acceptable to Architect.
- C. Watering: Initially water sod upon completion of convenient work areas until installation is complete and the irrigation system can be operated under full control. Water sod sufficiently to moisten subsoil at least six inches (6") deep in a manner not to cause erosion or damage to adjacent finished surfaces. Water shall be free of substances harmful to plant growth. Contractor shall be responsible for furnishing water from irrigation system, quick couplers or other source.
- D. Fertilizing: If work has not received final acceptance within thirty (30) days after fertilizer application to sodded areas, repeat fertilizer application to maintain optimal sod vigor.
- E. Mowing and Trimming: Mow and trim around trees and shrubbery (keeping mulch in saucers and beds), walls, fences, etc. maintaining turf at 2.5 - 2.75" height. Do not remove more than thirty-three percent (33%) of grass leaf in single mowing. Remove grass clippings from pavement areas. Only turf type mowers will be used for this operation.
- F. Re-sodding: Re-sod spots larger than one (1) sq. ft. not having a healthy, uniform stand of grass and re-sod sod joints which separate one-half inch (1/2") or more.
- G. Weed Control: As required, using selective herbicides approved by Architect, and adhering to local environmental laws.
- H. Insect and Disease Control: As required, using insecticides and fungicides approved by Architect, and adhering to local environmental laws.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Sod:
 - 1. Colorado Grown - 100% Texas Hybrid Bluegrass blend having a healthy, vigorous root system. Blend shall contain a minimum of three (3) improved varieties.
- B. Size: Sod shall be harvested by the "Big Roll" sod method in a one inch (1") thickness, 3/8" of earth thickness and 5/8" thickness of thatch after being freshly cut. "Big Roll" size is recommended to eliminate as many sod joints as possible.
- C. Water: Free of substances harmful to plant growth. Contractor is responsible for furnishing water from irrigation system, quick couplers or other source.
- D. Fertilizer: See Section 3.03A.

PART 3 - EXECUTION

3.01 EXAMINATION

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- A. General: Verify that existing site conditions are as specified and indicated before beginning work under this Section.
 - 1. Layout: Verify layout of sodded areas as indicated prior to starting operations.
 - 2. Grades: Verify that grades are within one-half inch (1/2") of grades indicated and specified.
 - 3. Patching: Verify all turf areas on site which require patching. Any area equal or greater than aged or barren turf shall be patched.
- B. Unsatisfactory Conditions: Report in writing to General Contractor with copy to Architect.
- C. Beginning of installation means acceptance of existing conditions by this Contractor.

3.02 PREPARATION

- A. Protection:
 - 1. Be responsible for proper repair to landscape, utilities, fences, walls, pavements and other site improvements damaged by operations under this Section.
 - 2. Pay for repairs made by construction operations as designated by Owner.
 - 3. Identify new sod areas requiring protection and erect barriers for proper protection and traffic control.
- B. Sodding Areas: Remove weeds, debris and rocks larger than three-quarters of an inch (3/4") which may hinder sodding. Dispose of accumulated debris offsite.
- C. Repair and Patchwork: Re-establish grade and uniform conditions to damaged sod areas prior to placing sod. Cut existing turf areas and remove old sod to conform to new sod roll placement.
- D. Adjustment: Adjust irrigation heads to proper watering height according to depth of sod material but lower than compacted blade height to enable lawn mowers to cut grass freely without damage to the irrigation system.
- E. Fine grading: Perform as required to maintain positive drainage, prevent ponding and direct run-off into catch basins, drainage structures, etc. and as required to provide smooth well-contoured surface prior to proceeding. Tolerance: +/- one-half inch (1/2").
- F. Inspection: Do not lay sod until base preparation and planted depth of trees and shrubs has been inspected and accepted by Architect.

3.03 FERTILIZING

- A. First Application: See Section 02910.
- B. Second and Subsequent Applications: See Section 02910.

3.04 SODDING

- A. Sodding:
 - 1. Soil on which sod is laid: Slightly moist.
 - 2. Lay with longest dimension parallel to contours and in continuous rows.

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3. Tightly butt ends and sides of sod together. Stagger sod rows by twenty four inch (24") minimum and compact vertical joints between sod strips by rolling so sod will be incorporated with the ground surface, insuring tight joints between adjacent pieces. Sod shrinkage is grounds for rejection.
 4. Cut rows terminating on the designated property lines to a straight line.
 5. Use a sod cutter to provide a clean edge on existing sod if required. New to existing sod edge must match smoothly.
- B. Rolling: When soil and sod are moist, roll sod lightly as soon as possible after it is laid. Delay rolling until just before the second watering. Re-roll sod as necessary prior to acceptance.
- C. Topsoil: Add along exposed edges to match adjacent grade. Feather topsoil out approximately twelve inches (12") from edge of sod.
- D. Drainage: Assure finished areas of sod are such that positive drainage of storm and irrigation water will occur and ponding of water will be minimized.
- 3.05 NOTIFICATION AND INSPECTION
- A. Notification: Give notice requesting inspection by Architect at least seven (7) days prior to the anticipated date of completion. All new sod must be alive and healthy in order to be considered complete.
 - B. Deficiencies: If deficiencies exist, Architect shall specify such deficiencies to the Contractor who shall make satisfactory adjustments and will again notify the Architect for final inspection.
- 3.06 CLEANING
- A. Cleaning: Remove pallets, unused sod, and other debris from site. Clean paved and finished surfaces soiled as a result of work under this Section. Clean out drainage inlet structures as required.
- 3.07 PROTECTION
- A. General: Provide and install barriers as required and as directed by Architect to protect sodded areas against damage from pedestrian and vehicular traffic until acceptance by Architect. Contractor is responsible for malicious destruction of sodding caused by others.

END OF SECTION

**SECTION 02930
TREES, SHRUBS AND GROWDCOVERS**

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Plant Materials
 - 2. Backfill Materials.
 - 3. Mulching.
 - 4. Staking and Guying.
 - 5. Edging.

- B. Related Sections:
 - 1. Irrigation System: Section 02810.
 - 2. Topsoil, Fine Grading and Soil Preparation: Section 02910.
 - 3. Seeding: Section 02921.
 - 4. Sodding: Section 02923.

1.02 REFERENCES

- A. Reference Standards: American Joint Committee on Horticulture (AJCH), American Standard for Nursery Stock (American National Standard Institute ANSI Z60.1 - 1980), and Colorado Nursery Act of 1971.

1.03 SUBMITTALS

- A. Quality Control Submittals:
 - 1. Certificates: State, federal or other inspection certificates shall accompany invoice for material showing source and/or origin. Architect prior to acceptance of material.

- B. Samples: Submit the following samples to Architect three (3) weeks prior to delivery to site in accordance with Section 01330:
 - 1. Broken Twig Brush Mulch.
 - 2. Cotton/Nylon Webbing strap.
 - 3. Steel Tee Post.
 - 4. Steel Edger.
 - 5. Rock Mulch

- C. Contract Closeout Submittals:
 - 1. Maintenance Data: Provide data in accordance with Section 01770. At completion of work, and prior to acceptance of project by Owner, furnish three (3) copies of written maintenance instructions to the Owner for maintenance and care of installed individual plant types through their full growing season and dormant period. Include directions for irrigation, fertilization, pruning and spraying, etc., as required for continuance and proper maintenance.
 - 2. Warranty: At completion of work, furnish written warranty to Owner based upon requirements as specified.

1.04 QUALITY ASSURANCE

- A. Source Quality Control:
 - 1. Plants: First class representatives of specified species or variety or cultivar, in healthy condition with normal well developed branch and root systems, free of all

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objectionable features, and in conformance with the requirements of AJCH (plant names shall meet standards of AJCH), American Standard for Nursery Stock and Colorado State Nursery Act. Where standards may conflict, use standard which requires the highest quality of performance.

- a. Trees: Fully branched in proportion to width and height. Minimum acceptable sizes of plants measured before pruning with branches in normal position, shall conform to measurements as specified in plant list furnished.
 - b. Larger plants than specified may be used, if accepted, at no additional cost to Owner.
 - c. All plants must be a minimum of two (2) years old.
2. Source: Plants grown in Hardiness Zones 2, 3, 4, and 5 only will be accepted. Plants shall be nursery grown. The term "nursery grown" includes native plants and imported plants that have been growing in a nursery for a minimum of one (1) growing season. Trees and shrubs shall have been root-pruned during their growing period in the nursery in accordance with standard nursery practice.
 - a. Hardiness Zones: Defined in U.S. Department of Agriculture publications.
 - b. Grower's Certificates: Required when doubt exists as to origin of plant material.
 3. Insects, Pests and Plant Diseases:
 - a. Trees and Shrubs: Healthy, free of diseases, insects, eggs, larvae or parasites of objectionable or damaging nature.
 - b. Coniferous Trees: Spray at time of installation and periodically as required to exclude infestation until final acceptance.
 4. Inspection: Subject to inspection and acceptance. Architect reserves right to reject at any time or place prior to final project acceptance, any and all materials and plants which in the Architect's opinion fail to meet these Specification requirements. Inspection is primarily for quality; however, other requirements are not waived even though visual inspection results in acceptance. Plants may be inspected where growing, but inspection at growth site shall not preclude right of rejection at site.
 5. Promptly remove rejected plants and other materials from site.

1.05 DELIVERY, STORAGE AND HANDLING

A. General: Comply with Section 01600.

B. Delivery

1. Packaged Materials: Deliver to site in original unopened containers bearing Manufacturer's information (chemical analysis, name, trade name, trademark and conformance to state law).
2. Plants: Containerized or balled and burlapped (B&B), with limbs bound, properly pruned and prepared for shipping in accordance with recognized standard practice. Keep root systems moist and protect plants from adverse conditions due to climate and transportation between time they are dug and actual planting. Spray broad leafed trees planted in full leaf with Protec 400W Antitranspirant, or approved substitute, prior to delivery to site. Apply according to Manufacturer's directions.
3. Identification: Grower's label affixed to plant which contains data necessary to indicate conformance to Specifications. Use durable waterproof labels with water resistant ink which will remain legible for at least sixty (60) days.
4. Remove unacceptable plant material immediately from project site.

SECTION 02930

- C. Storage: Deliver plants direct from nursery and heel-in immediately if not to be planted within four (4) hours. Protect roots of plant material from drying out. Store plants in shade and protect from severe weather.
- D. Handling:
 - 1. Do not drop plants. Do not lift plants by trunk, stems or foliage.
 - a. Ball of Plant: Natural, not made. Handle plant by ball at all times. Plants will not be accepted if ball is broken or trunk is loose in ball.
 - 2. Protect plants from drying out or other injury.
 - a. Prune minor broken and damaged roots before planting. Treat minor wounds immediately to prevent disease and insect infestation.
 - b. Major damage will be cause for rejection as determined by Architect.

1.06 PROJECT CONDITIONS

- A. Existing Conditions:
 - 1. Vehicular accessibility on site shall be as directed by Architect. Repair damage to prepared grounds and surfaces caused by vehicular movement during work under this Section to original condition at no additional cost to Owner.
- B. Environmental:
 - 1. Do not perform work when climate and existing site conditions will not provide satisfactory results.

1.07 SEQUENCING AND SCHEDULING

- A. Construction Sequencing:
 - 1. Schedule plant installation work just ahead of sodding operations, where possible, to allow irrigation system or other watering coverage coincidental with grass watering. However, make whatever interim watering provisions are necessary to maintain plants until such time as irrigation system is completely operational and plant material has been accepted as installed.

1.08 WARRANTY

- A. Plant Guarantee and Replacement:
 - 1. For a period of one (1) years from date of Substantial Completion, and at no additional cost to the Owner, replace any plants that are dead or that are, in opinion of Architect, in unhealthy or unsightly condition, or that have lost their natural shape due to dead branches or excessive pruning of dead branches.
 - a. Inadequate or improper maintenance by Owner shall not be cause for replacement, provided that Contractor shall have submitted throughout guarantee period a monthly letter reporting to Owner any improper or inadequate maintenance practices with observation dates.
 - b. If permanent changes in maintenance schedule are desired by Owner, written approval of changes must be obtained by Owner from Contractor.
 - 2. Execute replacement plantings within ten (10) days of notice to replace such plants.
 - 3. Replacement Planting: In accordance with original Specifications. Fully restore areas damaged by replacement operations to their original condition.

1.09 MAINTENANCE

SECTION 02930

- A. General: Maintain trees, shrubs and groundcover in a healthy vigorous state until final acceptance of entire project. Provide all supervision, labor, material, equipment and transportation required to maintain plants under this Section.
- B.
- C. Materials: Conform to Specifications or otherwise be acceptable to Owner.
- D. Replacement: Replace and replant plants damaged by Contractor's operations and negligence, and according to WARRANTY, 1.08, of this Section.
- E. Watering: Water deeply eight to ten inches (8-10") when soil moisture is below optimum level for best plant growth. Water woody plants in any winter month that snow or rain does not provide at least one-inch (1") of precipitation.
- F. Wrapping: No tree trunk shall be wrapped after May 21 nor before November 1. All deciduous trees shall be wrapped by November 15. Wrappings shall be removed by May 31.
- G. Staking and Guying: Inspect at least two (2) times per year (spring and fall) and assure conformance with the following:
 - 1. Webbing strap in good condition.
 - 2. Trunks and branches not girdled by webbing strap.
 - 3. Guy wires secure but not taut.
 - 4. Stakes secure.
 - 5. Trees plumb.
- H. Pruning: Prune only damaged or dead branches in accordance with Specifications in this Section.
- I. Mulching: Supplement mulch around shrubs and throughout planters and tree rings in accordance with Specifications in this Section.
- J. Weed Control: As required, using selective herbicides approved by Owner.
- K. Insect and Disease Control: As required, using insecticides and fungicides approved by Owner.

PART 2 - PRODUCTS

2.01 PLANT MATERIALS

- A. Plants Required: Species (scientific name), size, manner in which to be furnished and quantity required to complete the planting, are listed and indicated by symbol on the Drawings.
 - 1. In the event discrepancies occur between the quantities of plants indicated in schedule and indicated by symbol on Drawings, plant quantities indicated by symbol on the Drawing shall govern.
- B. Procurement: The entering of a proposal and execution of a contract will be construed as evidence that the Contractor has made successful procurement arrangements for plant materials as specified.

SECTION 02930

- C. Substitutions: Substitutions will not be accepted without written permission of Architect.

2.02 PLANT BACKFILL MATERIAL

- A. Planting Pit Backfill Mix: Use one (1) part acceptable topsoil, one (1) part sphagnum peat moss or compost, and two (2) parts onsite soil, thoroughly blended to consistent mixture.
 1. Topsoil: Imported friable sandy clay loam topsoil, free from lumps, pests, excessive salts, toxic substances, sticks, debris, vegetation, and stones over one inch (1") in maximum dimension. Acceptable pH - 6.0 to 7.5. Maximum acceptable salt level: 2.0 mmhos/cm.
 2. Soil Conditioner: Canadian Sphagnum peat in commercial bales of 5 to 7-1/2 cubic feet of compressed peat. Sphagnum peat shall contain at least 95% organic matter determined on an oven dry basis and shall have a pH factor of less than five (5).
 3. Onsite Soil: Native site soil excavated from planting pits with all stones larger than one inch (1") removed.

2.03 MULCHING BEDS AND EDGING

- A. Mulch:
 1. Tree Planting Pits in Grass Areas: four inches (4") deep, western red cedar mulch.
 2. Shrub Beds: four inches (4") deep throughout, western red cedar (gorilla hair) and 6"-10" cobbles as directed on plan.
- B. Steel Edger: 3/16" thick x 4" deep x 16'-0" long, green, Ryerson Steel Edger or accepted substitute.
 1. Provide punched holes in edger for drainage in all locations where edger is adjacent the building.
 2. Provide steel stakes, as recommended by the Manufacturer, for supports.
- C. Geo-textile Fabric: Mirafi 140N or approved substitute.

2.04 PLANT INSTALLATION ACCESSORIES AND MATERIALS

- A. Guying and Staking Material:
 1. Stakes for Evergreen Tree Support: Two (2) green, steel tee posts, two and one-half inches (2-1/2") wide by length required to drive stake eighteen inches (18") below six foot (6') and two foot (2') on trees above six foot (6'). Drive stakes into ground and extend above midpoint of trunk.
 2. Guying Wire: twelve (12) gauge galvanized steel wire.
 3. Cotton/ Nylon Webbing Straps with Grommets or accepted substitute.
 - a. Size for trees up to three and one-half inches (3-1/2") caliper: sixteen inches (16") long x three inches (3") wide.
 - b. Straps: Tensile strength of one-thousand pounds (1,000 lbs.) and heat sealed on ends.
 - c. Strap Color: Brown or tan.
 - d. Grommets: Securely attached and minimum one-quarter inch (1/4") from end of strap.
 4. Tree Wrap: Provide standard crinkled tree wrapping paper in strips three inches (3") wide.
 - a. Wrap all trees on the plant list.

SECTION 02930

- b. Start at ground and cover trunk to height of second branch and securely attach with tape or cord at approximately twenty-four inch (24") intervals along the trunk.
- c. Before wrapping, inspect tree trunks for injury, improper pruning and insect infestation and take the appropriate corrective measures.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that existing conditions are as specified and indicated before beginning work under this Contract.
 1. Grades: Verify acceptance of final grades prior to beginning planting operations. Bring areas to be planted to lines and grade designated.
 2. Percolation: Final earth placement conditions onsite require pre-installation planting pit drainage testing. Contractor is to excavate planting pits per plant locations, filling and observing water retention in each pit. If water does not evacuate hole by natural percolation within two (2) hours, Contractor is to contact Architect to discuss the addition of a pit subdrainage system. Failure to conduct this test and merely planting means Contractor accepts full responsibility for plant fatalities, due to poor sub-base drainage.
- B. Unsatisfactory Conditions: Report in writing to the Architect for transmittal to the Owner.
- C. Acceptance: Beginning of installation means acceptance of existing conditions by Contractor.

3.02 PREPARATION

- A. Layout: Stake plant locations and obtain acceptance by Architect, if required, before planting holes are prepared. Place plant material according to planting plans or as directed by Architect.
- B. Interference:
 1. Plant Placement: Do not interfere with sprinkler irrigation coverage, with piping or other equipment. Locate planting as indicated except when obstructions above or below ground are encountered or where changes have been made in construction.
 2. If plant relocation is necessary due to interference with utility boxes or pits, underground piping or wiring, or sprinkler head coverage, etc., relocate at direction of Architect.
- C. Plants: Do not begin planting until deficiencies are corrected or plants replaced.
- D. Protection:
 1. Be responsible for proper repair of underground pipe, electric wiring, or other subsurface improvements damaged by operations under this Section.
 2. Be responsible for proper repair to walls, pavements and any other structural surfaces damaged by operations under this Section.
 3. Pay for repairs made by Contractors designated by Owner.
 4. Be responsible for replacement of vandalized materials not yet installed. Report all cases of vandalism promptly to the Architect.

SECTION 02930

3.03 EXCAVATION FOR PLANTING

A. Pits and Trenches:

1. Shape:
 - a. Hand-dug Plant Pits: Circular, vertical sides and flat bottom.
 - b. Backhoe Dug Pits: Orient in opposite direction to tree stake alignment, vertical sides where stakes occur and flat bottom. Backfill and compact over excavation ends to match existing fill.
 2. Size for Trees:
 - a. Depth:
 - b. Minimum Width or Diameter:
 3. Size for Shrubs:
 - a. Depth: Depth of root ball.
 - b. Minimum Width or Diameter: Twelve inches (12") greater than diameter of ball or container.
 4. Preparation:
 - a. Scarify "glazed" planting pit walls and scarify bottom of pit to minimum two inch (2") depth.
 - b. Remove rocks greater than two inch (2") which occur at bottom of pit.
 5. Backfill planting pits with sufficient planting pit backfill mix to raise bottom surface grade of pit two inch (2") when compacted. Compact to ninety percent (90%) Standard Proctor Density within two percent (2%) optimum moisture.
- B. Disposal of Excess Soil: Dispose of unacceptable or unused excess soils or rock as required.

3.04 PLANTING

A. General:

1. Center plant in pit.
 2. Face for best effect.
 3. Set plant plumb and hold rigidly in position until soil has been lightly tamped around ball or container roots.
 4. Use only plant backfill mix for backfill.
 5. Backfill pit with planting mixture, until two-thirds full and water thoroughly to settle soil.
 6. After soil settles, fill pit with planting backfill, water and shape surface so that it slopes to drain from trunk and matches the ground at the edge of planting pit.
 7. Do not compact backfill mix by tamping.
 8. Watering Basin:
 - a. Construct a topsoil berm three inch (3") above finish grade, forming a watering basin around each plant.
 - b. Size: Twenty-four inch (24") greater than diameter of ball or container roots.
- B. Balled and Burlapped Plants (B&B):
1. Place in pit on firmly compacted soil.
 2. Place with burlap intact so location of ground line at top of ball is two inch (2") higher than finish grade.
 3. Cut and remove burlap or cloth, ropes, wires and other wrapping materials from top two-thirds of ball. Cut wire as near to base of ball as possible.
 4. Do not pull wrapping from under ball.
 5. Do not plant if ball is cracked or broken before or during planting process.

SECTION 02930

C. Container-Grown Plants

1. Can Removal:
 - a. Knockout Cans: Do not cut sides. Tap can and gently remove plant.
 - b. Straight-Side Cans: Cut cans on two (2) sides with acceptable can cutter. Do not cut with spade or ax.
2. Carefully remove plants without injury or damage to root ball. After removing plant, vertically score root ball using a sharp knife, about one-quarter inch (1/4") deep and every two inches (2") to three inches (3") in circumference.
3. Biodegradable container installations must be accepted prior to planting.
4. Dig planting holes as specified.
5. Hand place plants on firmly compacted soil.
6. Hand backfill and hand tamp leaving slight depression around outer circumference of planting area.

3.05 MULCHING AND EDGING

A. Mulching:

1. General: Mulch within two (2) days after planting.
2. Tree Pits and Shrub Pits: Mulch to completely cover planting area to the outside edge of ball/ watering basin.
3. Shrub Beds: Mulch areas indicated throughout and compact to four inch (4") depth, unless otherwise indicated.

B. Shrub Bed Edging:

1. Install at depth so top of edger matches top of curbs, sidewalks and mowed turf areas.
2. When edger abuts these concrete surfaces, cut so end is straight and rests against these surfaces.
3. Stake steel edger at Manufacturer's recommended intervals.

3.06 GUYING AND STAKING OF TREES

A. Stake all trees on Plant List.

1. General:
 - a. Stake installation as indicated with irregular ridge facing away from tree center.
 - b. Drive stakes into undisturbed soil just beyond backfill and slightly out of plumb away from tree center. Pull stakes into final plumb when attaching guying wire.
 - c. Binder twine is not permitted for tying trees to stakes.
2. Staking Evergreen Trees:
 - a. Stake on two (2) sides of trees four feet (4'-0") tall, and on three (3) sides for trees six foot (6'-0") and taller. (Do not stake trees under four feet (4'-0"). Verify size range at nursery prior to bidding.
 - b. Secure to tree with strap and galvanized wire at approximate midpoint of trunk, carefully avoiding damage to needles and branches.
3. Staking Deciduous Trees:
 - a. Stake on two (2) sides for trees three inches (3") caliper or less and on three (3) sides for trees greater than three inches 3" caliper.
 - b. Stakes: Project five foot (5') (minimum) above the finish grade and secured to tree as detailed.
 - c. Do not puncture root ball.

SECTION 02930

4. Tying and Cross-Bracing: Tie trees with double strand of guy wire run through grommets of appropriate length of cotton/ nylon webbing strap placed at approximate midpoint of trunk on evergreen trees.

3.07 PRUNING

- A. Trees: Licensed tree surgeon shall prune trees as necessary immediately following installation.
- B. New Plant Material: Prune minimum necessary to remove injured twigs and branches, deadwood, and suckers and as required to insure healthy plant representative of species and in keeping with accepted horticulture practice.
 1. Prune any damaged or dead roots or branches back to and slightly above, nearest healthy side bud, but at angle from remaining portion not exceeding forty-five (45) degrees.
 2. Evergreen: Trim only damaged or dead foliage and/or branches.
 3. Do not prune leaders. On cuts over one inch (1") diameter, trace injury back to living tissue, smooth and treat with accepted tree wound dressing.

3.08 NOTIFICATION AND INSPECTION

- A. Inspection: Provide notice to Architect requesting inspection at least seven (7) days prior to anticipated date of completion. All planting must be alive and healthy in order to be considered complete.
- B. Deficiencies: Architect will specify deficiencies to Contractor, who shall make satisfactory adjustments, and shall again notify Architect for final inspection.

3.09 CLEANING

- A. General: Remove debris and excess materials from site. Clean paved and finished surfaces soiled by work of this Section. After final acceptance, remove plant tags from plants.

3.10 PROTECTION

- A. Plant Materials: Contractor is not responsible for malicious destruction of planting after installation, until final acceptance. Report cases of vandalism promptly to Owner. Inform Owner in writing if special plant protection must be installed to secure planting from damage after Owner assumes responsibility for maintenance.

END OF SECTION

**SECTION 03100
CONCRETE FORMWORK**

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Formwork for Cast-In-Place Concrete.
2. Formwork Accessories.

B. General: Whenever necessary, forms will be used to confine the concrete and shape it to the required lines. Forms will have sufficient strength to withstand, without deformation, the pressure resulting from placement and vibration of the concrete. Forms will be constructed so that the finished concrete will conform to the shapes, lines, grades and dimensions indicated on the accepted plans. Any form which is not clean and has had the surface prepared with a commercial form oil that will effectively prevent bonding and that will not stain or soften concrete surfaces will not be used.

C. Related Sections:

1. Concrete Curbs, Sidewalks and Driveways: Section 02521.
3. Concrete Reinforcement: Section 03200.
4. Fibrous Reinforcement: Section 03240.
5. Cast-In-Place Concrete: Section 03300.

1.02 REFERENCES

A. Reference Standards: See Section 01091. Comply with the following:

1. ACI 301-89 Specifications for Structural Concrete for Buildings.
2. ACI 347-78 Recommended Practice for Concrete Formwork.

B. Comply with listed reference standards except as modified by supplemental requirements on the Drawings or by these Specifications.

1.03 QUALITY ASSURANCE

A. Design Criteria:

1. Safety: Assume responsibility for safety of formwork and provide necessary design, construction, materials and maintenance to produce required concrete work safety.

PART 2 - PRODUCTS

2.01 FORMWORK AND ACCESSORIES

A. Plywood forms, plastic coated plywood forms, or steel forms will be used for all surfaces requiring forming which are exposed to view, whether inside or outside any structure. Surfaces against backfilled earth, interior surfaces of covered channels, or other places permanently obscured from view, may be formed with forms having sub-standard surfaces.

B. Form Ties: Adjustable in length to permit tightening of forms and of type to leave no metal closer than 1" of surface nor holes or depressions larger than 7/8" in diameter.

C. Clamps, Brackets, Braces, Washers, Wedges, Walers, Etc.: Contractor's option.

D. Chamfer Strips: 3/4" 45° job cut wood or 3/4" 45° PVC for unexposed surfaces. Use PVC for exposed surfaces.

E. Shoring System: Contractor's option.

SECTION 03100

2.02 MISCELLANEOUS MATERIALS

- A. Form Oil: Non-staining. Contractor's option.
- B. Expansion Joint Filler: Bituminous fiber type complying with ASTM D1751-83. Sizes as indicated.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Foundation Bearing Surfaces: Inspected and approved by Owner's Geotechnical Engineer prior to start of formwork.
- B. Formwork: Provide ample notice to Project Manager to allow for review of formwork surfaces that will provide finish surface of exposed concrete.

3.02 PREPARATION

- A. Underslab Surfaces: Fine grade to smooth, level surface prior to installation of slab forms.

3.03 ERECTION

- A. General: Maintain formwork tolerances complying with ACI 301.
- B. Footings:
 - 1. Use of earth as form not allowed.
 - 2. Lap forming with dressed lumber or plywood not allowed.
 - 3. Butt form material end to end conforming to shape, lines and dimensions indicated on Drawings.
 - 4. Properly brace or tie to maintain position. Install forms sufficiently tight to prevent excess leakage of mortar.
- C. Construction Joints:
 - 1. Use construction joints at temporary stopping of concrete placement or as indicated on Drawings.
 - 2. Submit locations of joints desired for construction to Project Manager for acceptance.
 - 3. Leave joints in reinforced structural members rough and provide longitudinal or vertical keys at least 1-1/2" deep.
- D. Slabs on Grade:
 - 1. Where concrete slabs are deposited on earth, take care to obtain smooth level surface so slabs will be of uniform thickness as required throughout.

3.04 FORM COATING

- A. Coating:
 - 1. Coat surface of formwork prior to each pour.
 - 2. Apply in accordance with Manufacturer's recommendations.
 - 3. Apply coating prior to placing of reinforcement.
 - 4. Promptly remove excess coating material.
 - 5. Remove coatings of dust from contact surfaces of forms prior to depositing concrete.

3.05 REMOVAL

- A. Forms will not be disturbed until the concrete has hardened sufficiently to permit their removal without damaging the concrete or until the forms are not required to protect the concrete from mechanical damage. Minimum time before removal of forms after placing concrete will be one (1) day for footings and Class "B" concrete and two (2) days for all other concrete except in curbs, gutters, and sidewalks.

3.06 REUSE

SECTION 03100

- A. Forms: Clean form material suitable for reuse before erection.

END OF SECTION

**SECTION 03200
CONCRETE REINFORCEMENT**

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Reinforcing Bars for Cast-In-Place Concrete.

- B. Related Section:
 - 1. Concrete Curbs, Sidewalks and Driveways: Section 02521.
 - 2. Concrete Formwork: Section 03100.
 - 3. Fibrous Reinforcement: Section 03240.
 - 4. Cast-In-Place Concrete: Section 03300.

1.02 REFERENCES

- A. Reference Standards: See Section 01091. Comply with the following:
 - 1. ACI 301-89 - Specifications for Structural Concrete for Buildings.
 - 2. ACI 315-88 (SP-66) - ACI Detailing Manual.
 - 3. ACI 318-89 - Building Code requirements for Reinforced Concrete.

- B. Comply with listed reference standards except as modified by supplemental requirements on the Drawings or by these Specifications.

1.03 SUBMITTALS

- A. Shop Drawings: Submit in accordance with Section 01300.
 - 1. Contractor will submit to the Project Manager shop drawings of the reinforcement for his review and acceptance. The Project Manager's acceptance of shop drawings and bar schedules will not relieve the Contractor of fulfilling his responsibilities as outlined in the plans and specifications of the contract.
 - 2. Indicate size, configuration, pertinent dimensions, number, exact position, and spacing of reinforcement and exact location of openings, framing, and special conditions affecting work.
 - 3. All shop drawings shall be original drawings produced by the subcontractor or supplier and shall not be reproductions of the contract documents.

1.04 DELIVERY, STORAGE AND HANDLING

- A. General: Comply with Section 01600.
 - 1. Unload and store reinforcing bars to keep clean. Store on timber skids while awaiting use.

PART 2 - PRODUCTS

2.01 GENERAL

- A. The placing, fastening, splicing and supporting of reinforcing steel and wire mesh or bar mat reinforcement shall be in accordance with the plans and the latest edition of "CRSI Recommended Practice for Placing Reinforcing Bars". Before being positioned, all reinforcing steel will be thoroughly cleaned of mill and rust scale and of coatings that will destroy or reduce the bond. Where there is delay in depositing concrete, reinforcement will be reinspected and, if necessary, cleaned.

2.02 MATERIALS

- A. Reinforcing Bars: ASTM A615-87, Grade 60 unless otherwise indicated.

- B. Bar supports and Spacers: Contractor's option.

- C. Tie Wire: No. 14 or No. 16 gage, black, soft iron wire.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Reinforcement: Provide ample notice to Project Manager to allow for review of completed concrete reinforcement before placing concrete.

3.02 PLACEMENT

- A. Reinforcement will be carefully formed to the dimensions indicated on the accepted plans by the cold bending method. Cold bends will be made so that the inside diameter of the bend measured on the inside of the bar shall be as follows:

Bar Size	Grade 60
#3 through #8	6 bar dia.
#9, #10, and #11	8 bar dia.
#14 and #18	10 bar dia.

The inside diameter of bend for stirrups and ties shall not be less than four (4) bar diameters for sizes #5 and smaller, and five (5) bar diameters for #6 and #8 inclusive. Reinforcement shall not be bent or straightened in a manner that will injure the material. Bars with kinks or bends not shown on the plans will not be used. Heating of reinforcement will not be permitted.

- B. Reinforcing steel will be accurately placed and secured against displacement by using annealed iron wire of not less than No. 18 gauge, or by suitable clips at intersections. Where necessary, reinforcing steel will be supported by metal chairs or spacers, precast mortar blocks, or metal hangers. Splicing of bars, except where shown on the plans, will not be permitted without approval of the Project Manager.
- C. Welded wire fabric for concrete reinforcement will be of the gauge, spacing, dimensions, and form specified on the plans or detailed drawings and will comply with "Specifications for Welded Steel Wire Fabric for Concrete Reinforcement" (ASTM A-185) or "Specification for Welded Deformed Steel Wire Fabric for Concrete Reinforcement" (ASTM A-497).
- D. Unless otherwise shown on the plans, the minimum clear cover for reinforcing steel will be the following, which is specified in ACI 301, Sec. 5.5:

Bottom bars on soil bearing foundations & slabs	3 inches
Bars adjacent to surfaces exposed to weather on earth backfill:	
For bars more than ¾" in diameter	2 inches
For bars ¾" or less in diameter	1-½ inches
Interior Surfaces: slabs, wall, joints with 1-3/8" diameter or smaller	¾ inches

3.03 CLEANING

- A. Reinforcement: Clean prior to placing concrete to remove scale, oil, ice or other coatings that will destroy or reduce bond, including mortar from previous concrete pours.

END OF SECTION

**SECTION 03240
FIBROUS REINFORCING**

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Incorporation of synthetic fibrous concrete reinforcement in site flatwork.

B. Related Sections:

1. Concrete Curbs, Sidewalks and Driveways: Section 02521.
2. Concrete Formwork: Section 03100.
3. Concrete Reinforcement: Section 03200.
4. Cast-In-Place Concrete: Section 03300.

1.02 QUALITY ASSURANCE

- A. Record of Work: Comply with requirements of Section 03300. Batch trip tickets shall show, in addition to the information specified in Section 03300, the amount of fibrous concrete reinforcement material added to the batch.

- B. Comply with requirements of Section 03300 Cast-In-Place Concrete as supplemented herein.

- C. The fibrous concrete reinforcement supplier shall provide the services of a qualified technical representative to instruct the concrete supplier and Contractor in proper batching, mixing, testing, placing and finishing of materials to be provided under this Section.

- D. Work provided under this Section shall produce concrete conforming to the requirements for each type and class of concrete specified when tested in accordance with specified methods.

1.03 DELIVERY, STORAGE AND HANDLING

- A. Comply with applicable requirements of Section 03300.

PART 2 - PRODUCTS

2.01 GENERAL

- A. When shown on the accepted plans or approved by the Project Manager fibrous reinforcing may be utilized. Fibrous concrete reinforcement shall be one hundred percent (100%) virgin polypropylene fibrillated fibers specifically manufactured for use as concrete reinforcement, containing no reprocessed olefin materials. The fibers shall have the following physical characteristics:

1. Specific gravity - 0.91.
2. Tensile strength - 70,000 to 110,000 psi.
3. Fiber length - per Manufacturer's recommendation for specific use ($\frac{3}{4}$ " for sidewalks).

2.02 MANUFACTURERS

A. Acceptable Products:

1. Fibermesh; Fibermesh, Inc.
2. Forta-CFP; Forta Corp.
3. Approved Substitute.

- B. Material: Virgin polypropylene collated, fibrillated fibers containing no reprocessed olefin materials and have tensile strength of not less than 70,000 psi.

PART 3 - EXECUTION

3.01 GENERAL

SECTION 03240

- A. Comply with applicable provisions of Section 03300 for which fibrous concrete reinforcement will be supplied.

3.02 BATCHING AND MIXING

- A. Add fibrous concrete reinforcement to concrete materials at the time the concrete is batched in the amounts recommended by the Manufacturer (1.5 lb./s.y. for sidewalks) or as indicated on the accepted plans.
- B. Concrete shall be mixed in strict accordance with fibrous concrete reinforcement Manufacturer's instructions and recommendations to assure uniform and complete dispersion.

3.03 PLACING AND FINISHING

- A. Place and finish concrete in accordance with the fibrous concrete reinforcement Manufacturer's instructions.
- B. Quality and tolerance of finish for fiber reinforced concrete shall comply with the requirements of Section 03300.

END OF SECTION

**SECTION 03300
CAST-IN-PLACE CONCRETE**

PART 1 - GENERAL

- A. Section Includes:
 - 1. Formed Cast-In-Place Concrete.
 - 2. Concrete Curbs and Flatwork.
 - 3. Miscellaneous Concrete.

- B. Related Requirements:
 - 1. Testing: Section 01400.
 - 2. Quality Control: Section 01400.

- C. Related Sections:
 - 1. Concrete Curbs, Sidewalks and Driveway: Section 02521.
 - 2. Concrete Formwork: Section 03100.
 - 3. Concrete Reinforcement: Section 03200.
 - 4. Fibrous Reinforcement: Section 03240.

1.02 REFERENCES

- A. Reference Standards: Comply with following except as modified by supplementary requirements of this project Specification.
 - 1. ACI 117-90: Standard Specifications for Tolerances for Concrete Construction and Materials.
 - 2. ACI 301-89: Specifications for Structural Concrete for Buildings.
 - 3. ACI 305R-91: Hot Weather Concreting.
 - 4. ACI 309R-87: Guide for Consolidation of Concrete.
 - 5. ACI 318-89 (Revised 1992): Building Code Requirements for Reinforced Concrete, Parts 2 and 3.
 - 6. ACI 503.2-92: Standard Specification for Bonding Plastic Concrete to Hardened Concrete with a Multi-Component Epoxy Adhesive.
 - 7. ASTM C94-90b: Standard Specification for Ready-Mixed Concrete.
 - 8. ASTM C494-86: Standard Specification for Chemical Admixtures for Concrete.
 - 9. ACI 306.1-90: Standard Specifications for Cold Weather Concreting.
 - 10. ACI 308-92: Standard Practice for Curing Concrete.

- B. Field References: Keep at least one (1) copy of ACI 301 on site at all times. Other reference standards listed above shall be kept on site when directed by Project Manager.

1.03 SUBMITTALS:

- A. Mix Designs: Not less than two (2) weeks prior to placing any concrete. Submit mixes for acceptance in accordance with Product Data provisions of Section 01300.
 - 1. Submit Manufacturer's data and/or certifications verifying conformance of mix materials including admixtures with specified requirements.
 - 2. Submit separate mix design for each concrete mix type to be used in project. Include following:
 - a. Mix identification designation.
 - b. Statement of intended use for mix.
 - c. Mix proportions, including admixtures.
 - d. Wet and dry unit weight.
 - e. Entrained air content.
 - f. Design slump.
 - g. Design compressive strength.
 - h. Strength qualification data.
 - i. Water/cementitious materials ratio.
 - 3. Strength Qualification Data:

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- a. Submit required average strength qualification data and documentation per ACI 301 3.9.1, 3.9.2 and 3.9.3.
- b. If trial batches are used to qualify average strength, mix design shall be prepared by an independent testing laboratory and shall achieve average compression strength a minimum of 1200 psi greater than specified strength with slump within 1" of maximum permitted and air content within 0.5% of maximum allowable.
- c. If field test data is used to qualify average strength, submit separate qualification data for each production facility which will supply concrete to project, including copies of concrete testing agency's reports from which data was compiled.

- B. Test Reports: Reports of control tests, special tests and core tests specified under Field Quality Control in Part 3 shall be distributed by independent testing laboratory in accordance with Section 01400 if required.

1.04 QUALITY ASSURANCE

- A. Testing Agency: All testing will be conducted by approved testing laboratory. See Field Quality Control - Part 3 and Section 01400.
- B. Source Quality Control: Project Manager shall be offered uninterrupted access to ready-mix batching plant while work is in progress.
- C. Record of Work: Keep record listing time, location and date of placement of concrete for structure. Keep such record until completion of project and make available to Project Manager for examination at any time.

1.05 DELIVERY, STORAGE AND HANDLING

- A. General: Materials handling and batching shall conform to applicable provisions of ASTM C94.
- B. Hauling Time: Discharge concrete transmitted in truck mixer, agitator or other transportation device within 1-1/2 hours after mixing water has been added.
- C. 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 water/cement ratio of accepted mix design has not been exceeded, General Contractor's superintendent shall have sole authority to authorize addition of water. 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 50 revolutions of drum before depositing.
 4. Water may be added at the site only once for each batch.

1.06 PROJECT CONDITIONS

- A. Environmental Requirements:
 1. Cold Weather Placement:
 - a. When for three (3) successive days prior to concrete placement the average daily outdoor temperature drops below 40° F or when the average outdoor temperature is expected to drop below 40° F on the day of concrete placement, preparation, protection and curing of concrete shall comply with ACI 306.1.
 - b. Minimum temperature of concrete upon delivery shall conform to ACI 301 Table 7.6.1.1. Concrete temperature at placement shall conform to minimum values of ACI 306.1 Table 3.2.1, and shall not exceed minimum values by more than 20° F.
 - c. Subject to acceptance of Project Manager, an accelerating admixture may be used. Admixtures shall meet requirements of Part 2. Calcium Chloride and other chloride-type accelerating admixtures will not be allowed.
 - d. Subject to acceptance of Project Manager, Contractor may substitute cement for equal weight of fly ash in design mix.

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- e. Comply with concrete protection temperature requirements of ACI 306.1. Record concrete temperatures during specified protection period at intervals not to exceed sixteen (16) hours and no less than twice during any 24 hour period.
 - f. Submittal of detailed procedures, means, and methods for production, transportation, placement, protection, curing, and temperature monitoring of concrete during cold weather is not required.
2. Hot Weather Placement:
- a. When depositing concrete in hot weather, follow recommendations of ACI 305R.
 - b. Temperature of concrete at time of placement shall not exceed 85° F.
 - c. When air temperatures on day of placement are expected to exceed 90° F, mix ingredients shall be cooled before mixing. Flake ice or well-crushed ice of a size that will melt completely during placement.
 - d. Approved substitute in accordance with Section 01600. Calcium chloride and admixtures containing more than 0.10 percent chloride ions or sodium thiocyanates not allowed.
3. Water-Reducing, Retarding Admixture:
- a. ASTM C494, Type D:
 - 1. Cormix PSI-R Plus.
 - 2. Euclid Eucon Retarder 75.
 - 3. W.R. Grace Daratard-17.
 - 4. Sika Plastocrete 161R.
 - 5. Approved substitute in accordance with Section 01600.
- B. Miscellaneous Materials:
- 1. Curing Compound - Vertical Surfaces: ASTM C309-81.
 - 2. Curing and Sealing Compound - Exterior Concrete: Minimum 30% solids content, maximum moisture loss of 0.030 grams per square centimeter (300 square feet per gallon coverage):
 - a. Euclid Super Rex Seal or Super Pliocure.
 - b. Master Builders Masterseal.
 - c. Approved substitute in accordance with Section 01600. Comply with requirements of floor finish manufacturers.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Concrete will be composed of Portland Cement, aggregate, and water, and shall be reinforced with steel bars or steel wire fabric where required. Admixtures other than air-entraining agents require written permission of the Project Manager.
- B. ACI 301: Provide materials in accordance with ACI 301, paragraphs as listed, unless amended or superseded by requirements of this Section or general notes on Drawings.
- C. Concrete Materials (ACI 301 Chapter 2):
- 1. General: Ready-mixed Concrete: ASTM C94-90b. On-site mixed concrete not allowed.
 - 2. Cement:
 - a. All cement used in concrete work shall be Portland Cement conforming to the requirements of ASTM C-150, Type I or Type II. In general, cement meeting the requirements of ASTM C 150 Type II cement shall be used in concrete which will be in contact with the soil, unless otherwise allowed or directed by the Project Manager. Cement, which for any reason has become partially set or which contains lumps of caked cement, shall be rejected.
 - b. The Contractor will be responsible for the proper storage of all cement until it is used. When requested by the Project Manager, the Contractor will, at his own cost and expense, furnish the Project Manager with a certificate from the Manufacturer or an acceptable testing laboratory for each carload of cement from which cement is taken for use in the work.
 - 3. Fly Ash:

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- a. Fly ash may be utilized in the design mix when allowed by the Project Manager. Fly ash shall conform to the requirements of ASTM C 618 for Class C or Class F. The pozzolanic index shall be eighty-five (85) for Class C and Class F fly ash. Class C fly ash will not be permitted where sulfate resistant cement is required.
 - b. The Contractor shall notify the Project Manager of the source of the fly ash for review prior to use in the project. The fly ash to be used on any project shall have been tested by the Contractor for compliance with these Specifications. The results of this testing shall be submitted to the Project Manager prior to its use on the project.
 - c. When required by the Project Manager, the Contractor shall provide the fly ash analysis performed by the fly ash supplier along with the concrete mix proportions.
4. Aggregate: ASTM C33-86, obtained from same source throughout project:
- a. Fine Aggregate: Fine aggregate will be composed of clean, hard, durable, uncoated particles of sand, free from injurious amounts of clay, dust, soft or flaky particles, loam, shale, alkali, organic matter, or other deleterious matter. Fine aggregate will be well graded from course to fine and when tested by means of laboratory sieves will meet the requirements of ASTM C33.

<u>Sieve Size</u>	<u>Percent Passing</u>
3/8"	100
#4	95 - 100
#8	80 - 100
#16	50 - 85
#30	25 - 60
#50	10 - 30
#100	2 - 10

- b. Coarse Aggregate: The coarse aggregate will consist of broken stone or gravel composed of clean, hard, tough and durable stone and will be free from soft, thin, elongated or laminated pieces, disintegrated stone, clay, loam, vegetable, or other deleterious matter. Coarse aggregate will be well graded and when tested by means of laboratory sieves will meet the requirements of ASTM C33.

<u>Sieve Size</u>	<u>Percent Passing</u>
2"	100
1-1/2"	95 - 100
3/4"	35 - 70
3/8"	10 - 30
#4	0 - 5

- 5. Non-Corrosive. Non-Chloride Accelerator: ASTM C494-86. Type C or E, containing not more chloride ions than present in municipal drinking water and with long term test data from independent testing laboratory providing non-corrosive effect on reinforcing steel:
 - a. Euclid Accelguard 80.
 - b. W.R. Grace Daraset.
 - c. Sika Plastocrete 161 FL.
 - d. Master Builders Pozzutec 20.
 - e. Gilco Accelerator.
 - f. Approved substitute in accordance with Section 01600.
- 6. Water-Reducing, Retarding Admixture: ASTM C494, Type D:
 - a. Cormix PSI-R Plus.
 - b. Euclid Eucon Retarder 75.
 - c. W.R. Grace Daratard-17.
 - d. Master Builders Pozzolith R.
 - e. Prokrete Industries Protard.

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- f. Sika Plastiment.
- g. Approved substitute in accordance with Section 01600.

D. Miscellaneous Materials:

- 1. Curing Compound - Vertical Surfaces: ASTM C309-81.
- 2. Curing and Sealing Compound - Exterior Concrete: Minimum 30% solids content, maximum moisture loss of 0.030 grams per square centimeter (300 sq. ft. per gallon coverage):
 - a. Euclid Super Rex Seal or Super Pliocure.
 - b. Master Builders Masterseal.
 - c. Approved substitute in accordance with Section 01600. Comply with requirements of floor finish manufacturers.

2.02 ADHESIVES AND BONDING COMPOUNDS

- A. Epoxy Adhesives for Use in All Structural Repairs: Two component. 100% solids, 100% reactive compound suitable for use on dry or damp surfaces and comply with ASTM C881.
 - 1. Euclid Euco Epoxy 452 or 620.
 - 2. Sika Sidatur Hi-Mod.
 - 3. Approved substitute in accordance with Section 01600. Where epoxy injection procedures are used, use low viscosity epoxy made by one of the above manufacturers.
- B. Epoxy Joint Filler: Three component. 100% solids compound with minimum shore D hardness of 50:
 - 1. Euclid Euco Epoxy 600 or 700.
 - 2. Sika Sikadur 51.
 - 3. Approved substitute in accordance with Section 01600.

2.03 PROPORTIONING AND DESIGN OF MIXES

- A. Reference Standard: ACI 301 Chapter 3.
- B. Design: Conform to general notes on the Drawings. Proportion ingredients for mixes in accordance with ACI 301 3.9.
 - 1. Should Contractor require special mix due to structural requirements, weather or materials, submit samples of cement and aggregate to be used to approved testing laboratory. Testing laboratory will make analysis of materials and design proper mix to be used.
- C. Durability: Conform to ACI 301 3.4 as modified herein.
 - 1. Concrete Exposed to weather or Freeze-Thaw Including Paving, Site Work and Exterior Slabs: Meet requirements of ACI 301 3.4.1 except that concrete shall have a water-cement ratio not exceeding 0.45.
- D. Slump: Design water-cementitious material ratio to provide slumps indicated under mix type.
 - 1. Concrete Containing High Range Water Reducing Admixture (Superplasticizer): Slump of 2-3" upon arrival at site, maximum slump of 8" after addition of superplasticizer.
 - 2. Other Concrete: Maximum 4".
 - 3. Design slump of fiber reinforced concrete shall be the slump prior to addition of fibers.
- E. Water/Cementitious Material Ratio: Provide concrete with following water/cementitious material ratios:
 - 1. Concrete Subject to Freezing/Thawing: Maximum 0.50.
 - 2. Fiber Reinforced Concrete: Maximum 0.55. Water includes free surface moisture on aggregates and liquid admixture.
- F. Selection of Proportions:
 - 1. Mix Design: Cost of concrete mix design by concrete contractor.
 - 2. Selection of Proportions: Use method of ACI 301 3.9. Proportioning based on method of ACI 301 3.10 not allowed.

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- a. Field test records used for documentation of the average strength produced by a proposed mix in accordance with ACI 301 3.9.3.2 shall, in addition to the requirements there listed, comply with the following:
 - 1. The test record shall represent production concrete from a single design mix, produced during the past year, and may be composed of thirty (30) or more consecutive tests.
 - 2. The test record shall represent concrete made with identical materials and proportions (including admixtures) to the proposed mix.
 - 3. The test record shall represent concrete proportioned to produce the maximum slump allowed by these Specifications and for air entrained concrete within $\pm 0.5\%$ of the maximum air content allowed.
- b. Mixes proportioned on the basis of trial mixtures shall meet the provisions of ACI 301 3.9.3.3.

G. Admixtures:

- 1. General: No admixtures will be allowed except as specified herein unless authorized by the Project Manager. All requests for approval or substitution must be made by the General Contractor and be accompanied by sufficient information and test data for evaluation. All admixtures shall be chemically compatible with cementitious materials and all other admixtures used in the mix. All admixtures shall be chloride free. No calcium chloride shall be added to concrete.
- 2. The Contractor will use air-entraining admixtures for all surfaces of exposed concrete. Air entraining admixtures shall meet ASTM C 260. All other chemical admixtures shall meet ASTM C 494.

H. Chloride Ions: Maximum water soluble chloride ion concentration in concrete mix shall not exceed following percentages by weight of cementitious materials.

- a. All Concrete: 0.15%.

I. Mixing: All concrete will be thoroughly mixed in a batch mixer of an approved type and capacity for a period of not less than two (2) minutes after all the materials, including the water, have been placed in the drum. During the period of mixing, the drum will be operated at the speed specified by the Manufacturer of the equipment. The entire contents of the mixer will be discharged before recharge, and the mixer will be cleaned frequently. The concrete will be mixed only in such quantities that are required for immediate use. No retempering of concrete will be permitted. Hand-mixed concrete will not be permitted except by written approval of the Project Manager, and then in only very small quantities or in case of an emergency.

2.04 CONCRETE MIX TYPES

A. General: Concrete mix information shall be prepared and submitted in accordance with ACI 301 Section 4.2. Proportions shall be submitted to the Project Manager, along with at least two (2) sets of certified twenty-eight (28) day test results, for review and acceptance. No concrete will be incorporated into the work until the proportions have been accepted by the Project Manager.

B. Concrete will be made in two (2) classes, "A" and "B", conforming to the following:

	<u>Class A</u>	<u>Class B</u>
Minimum compressive strength - 28 days *	4000 psi	3,000 psi
Minimum cement - sacks/cubic yard	6	5
Maximum water/cement ratio - by weight	0.50	0.63
Slump - inches	1-4	2-4
Air entrainment - % by volume	4-8	4-8

* When tested in accordance with ASTM C-31.

C. The fine aggregate in both classes of concrete shall be between thirty-four percent (34%) and thirty-eight percent (38%) by volume of the total aggregates.

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- D. Admixtures:
 - 1. Non-Corrosive, Non-Chloride Accelerator: Use at all concrete slabs placed at air temperature below 50° F.
 - 2. Air Entraining Agent: Use at all concrete required to be air entrained.
 - 3. Superplasticizer: Contractor's option at:
 - a. All pumped concrete.
 - b. Concrete with water/cement ratio below 0.50.
- E. Mix Designs: Identified by mix identification letter. Submit new mix designs indicating slump, air content and admixtures for all mixes designated to receive fibrous reinforcing.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Project Manager's Review: Provide minimum of twenty-four (24) hour notice to Project Manager to allow him to review forms and reinforcement just before concrete is placed and to observe placing of concrete.
- B. Contractor's Review: Contractor shall inspect forms and reinforcing prior to concrete placement to assure accurate placement of embedded items.

3.02 GENERAL

- A. Install concrete work in accordance with ACI 301, paragraphs as listed unless amended or superseded by this Section or notes on the Drawings.
- B. The use of ready-mixed concrete will in no way relieve the Contractor of the responsibility for proportion, mix, delivery, or placement of concrete; all concrete must conform to all requirements ASTM C-94. The information included on the delivery system should be in accordance with ASTM C-94 section 16.
- C. Concrete will be continuously mixed or agitated from the time the water is added until the time of use and will be completely discharged from the truck mixer or truck agitator within one and one-half (1½) hours after it comes in contact with the mixing water or with the aggregates. Retempered concrete will not be allowed.
- D. The Project Manager will have free access to the mixing plant at all times. The organization supplying the concrete will have sufficient plant and transportation facilities to assure continuous delivery of the concrete at the required rate. (The Contractor will collect delivery, or batch, tickets from the driver for all concrete used on the project and deliver them to the Project Manager.) Batch tickets will provide the following information in accordance with ASTM C-94:
 - 1. Name of ready-mix batch plant.
 - 2. Serial number of ticket.
 - 3. Date.
 - 4. Truck number.
 - 5. Name of purchaser.
 - 6. Specific designation of job (name and location).
 - 7. Specific class or designation of the concrete in conformance with that employed in job specifications.
 - 8. Amount of concrete in cubic yards.
 - 9. Time loaded or of first mixing of cement and aggregates.
 - 10. Water added by receiver of concrete and his initials.
 - 11. Weights of fine and coarse aggregates.
 - 12. Type, brand, and amount of cement.
 - 13. Type, brand and amount of admixtures.
 - 14. Weight (in gallons) of water including surface water on aggregates.

3.03 PREPARATION

- A. Do not begin concrete work until operations are complete enough to allow placement to be carried on as continuous operation for entire section that is to be placed. Clean equipment for mixing and transporting concrete.
 - 1. Forms: Cleaned of debris and ice, wetted (except in freezing weather), and coated as specified under Section 03100.
 - 2. If water accumulates in forms, pump out before concrete is deposited.
 - 3. Clearly mark finish top surface of vertical members on form walls.
- B. Protection: Cover masonry walls, glazing, and other finish materials with polyethylene or otherwise protect from damage due to placing of slabs, sidewalks or floors above.

3.04 PLACEMENT

- A. General: Comply with ACI 301, Chapter 8.
- B. Placement: Before depositing concrete, debris will be removed from the space to be occupied by the concrete and the forms, including any existing concrete surfaces, will be thoroughly wetted. Concrete will not be placed until all forms and reinforcing steel have been inspected and accepted by the Project Manager. Concrete will be handled from the mixer to the place of final deposit as rapidly as possible by methods which prevent separation or loss of ingredients. The concrete will be deposited in the forms as nearly as practicable in its final position to avoid rehandling. It will be deposited in continuous layers, the thickness of which generally will not exceed twelve inches (12"). Concrete will be placed in a manner that will avoid segregation and will not be dropped freely more than five feet (5'). If segregation occurs, the Project Manager may require the concrete to be removed and replaced at the Contractor's expense. Concrete will be placed in one (1) continuous operation, except where keyed construction joints are shown on the plans or as approved by the Project Manager. Delays in excess of thirty (30) minutes may require removal and replacement of that pour, as determined by the Project Manager.
- C. Water: Prevent accumulations of water on surface of concrete due to water gain, segregation, or other causes, during placement or compacting. Make provision for removal of water as may accumulate so that concrete not be placed in such accumulation.
- D. Consolidation: Consolidate concrete during and immediately after depositing by means of mechanical vibrators. Supplement by hand spading at corners and angles of forms, around embedded fixtures and in other difficult areas.
 - 1. Mechanical Vibrator: Concrete will be thoroughly compacted or vibrated. All concrete will be compacted by internal vibration using mechanical vibrating equipment, except that concrete in floor slabs, sidewalks, or curb and gutter, not poured against form linings, will be either tamped or vibrated. Care will be taken in vibrating the concrete to vibrate only long enough to bring a continuous film of mortar to the surface. Vibration will stop before any segregation of the concrete occurs. Mechanical vibrators will be an approved type as specified in ACI Publication 309, Chapter 5. Vibrators will not be used to move or spread the concrete.
 - 2. Any evidence of lack of consolidation or overconsolidation will be regarded as sufficient reason to require the removal of the section involved and its replacement with new concrete at the Contractor's expense. The Contractor will be responsible for any defects in the quality and appearance of the completed work.
 - 3. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than visible effectiveness of machine. Place vibrators to rapidly penetrate placed layer and at least 6" into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix.

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- E. The consistency of concrete will be kept uniform for each class of work and will be checked by means of slump tests or Kelly ball tests. The workability of the concrete will be varied as directed by the Project Manager. At all times concrete will have a consistency such that it can be worked into corners and angles of the forms and around joints, dowels and tie-bars by the construction methods which are being used without excessive spading, segregation or undue accumulation of water or laitance on the surface. If, through accident, intention, or error in mixing, any concrete fails to conform to the proportions of the approved mix design, such concrete will not be incorporated in the work but will be discarded off the project site as waste material at the Contractor's expense. NO WATER MAY BE ADDED AT THE JOB SITE WITHOUT PERMISSION OF THE PROJECT MANAGER. If approval is obtained and water is added at the job site, slump tests will be run and test cylinders cast following the addition of the water. Any expense incurred in excess of ordinary tests will be borne by the Contractor.
- F. Finishing:
1. Where tops of cast-in-place concrete walls will form finished surface, immediately finish concrete in form by skilled cement finisher. Walls or surfaces not finished to level subject to removal and replacement.
 2. No dusting or topping of the surface or sprinkling with water to facilitate finishing will be permitted.
- G. Immediately following the removal of the forms, all fins and irregular projections will be removed from all surfaces except from those which are not to be exposed or are not to be waterproofed. On all surfaces, the cavities produced by form ties, honeycomb spots, broken corners or edges, and other defects, shall be thoroughly cleaned, moistened with water and carefully pointed and trued with a mortar consisting of cement and fine aggregate. The surface will be left sound, smooth, even, and uniform in color. Mortar used in pointing will not be more than thirty (30) minutes old. All construction and expansion joints in the completed work will be left carefully tooled and free of all mortar and concrete. The joint filler will be left exposed for its full length with clean and true edges.

3.05 CONSTRUCTION JOINTS OF STRUCTURAL MEMBERS

- A. Not required.

3.06 REPAIR OF SURFACE DEFECTS

- A. Reference Standard: ACI 301 9.1.

- B. Inspection: Allow Project Manager to inspect concrete surfaces immediately upon removal of forms.

- C. Repair:

1. Modify or replace concrete not conforming to required lines, details, and elevations.
2. Repair or replace concrete not properly placed resulting in excessive honeycombing and other defects. Do not patch, repair or replace exposed architectural finished concrete except upon express direction of Project Manager.
3. Patch holes and defects.

3.07 TREATMENT OF FORMED SURFACES

- A. Reference Standard: ACI 301 Chapter 10.

- B. Form Removal: Finish and cure concrete surfaces covered by formwork immediately after forms have been removed. Do not expose more surface area than can be finished and cured in one working day.

- C. Patching:

1. Patch voids, honeycombs or damaged areas in accordance with repair of surface defects above.

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2. Add white cement to patching grout as required to match color of existing concrete where patches are exposed to view.
 3. Patch all tie holes.
 4. Use specified bonding compound and epoxy adhesive.
- D. Laitance: Remove deposits of laitance occurring on top of concrete surfaces as soon as concrete has hardened sufficiently to prevent injury to concrete. Repair areas where laitance is removed as specified for patching.
- E. Unexposed Concrete Surfaces: Treat surfaces of concrete wall, slabs, beams, and columns, which are to be covered by subsequent work, as specified under Patching.
- F. Unpainted Exposed Concrete Surfaces:
1. Carefully protect from damage and soiling concrete surfaces, both interior and exterior, to remain exposed but unpainted.
 2. Patch where required as specified under Patching. Upon completion of work, reclean damaged or soiled surface as required to make clean, smooth and finished in every respect.
- ### 3.08 CURING AND PROTECTION
- A. Reference Standard: ACI Chapter 12.
- B. Finishing: Exposed faces of curbs and sidewalks will be finished to true-line and grade as shown on the plans. Surface will be floated to a smooth but not slippery finish. Sidewalk and curb will be broomed or combed and edged, unless otherwise indicated by the Project Manager. After completion of brooming and before concrete has taken its initial set, all edges in contact with the forms will be tooled with an edger having a three-eighths inch (3/8") radius.
- C. Protection: Protect exposed surfaces of concrete from premature drying and frost. Protect freshly placed concrete from rain damage. Protect finished slabs from mortar leakage from pouring of slabs above.
- D. Form Removal: Do not remove forms until times as specified. Remove carefully to not injure concrete surface. Protect edges and corners to prevent cracking, chipping or other damage and premature drying.
- E. Vertical Surfaces: Clean surfaces of loose sand, mortar, debris and grout; spray lightly with water and coat with clear or translucent curing compound as soon as possible after removing forms. Apply curing compound same working day that forms are removed.
- F. Horizontal Surfaces:
1. As soon as possible after placing concrete, coat exposed horizontal surfaces with curing compound in accordance with Manufacturer's recommendations and cover with white polyethylene sheeting of minimum of six (6) mil nominal thickness. Give special attention to providing adequate curing of slab edges.
 2. Provide polyethylene sheeting as wide as practical, edges lapped minimum of six inches (6"), weighted to prevent blowing, and sealed to prevent loss of moisture. Keep sheeting in place a minimum of seven (7) days.
- G. Protection/Completion: Protect concrete surfaces from staining, cracking, chipping, and other damage during progress of the work, and leave in good condition upon completion. The exposed surfaces of the concrete will be thoroughly cleaned upon completion of the work.
- H. Fresh concrete will be adequately protected from weather damage and mechanical injury during the curing periods. Curing processes described herein may be used at the option of the Project Manager. The selected curing process will be started as soon as it can be done without injury to the

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concrete surface. The use of a membrane curing compound is recommended. The following curing procedures may be used subject to the approval of the Project Manager.

1. Ponding (for slabs or footings).
 2. Spraying.
 3. Wet burlap, earth, or cotton mats.
 4. Waterproof paper or polyethylene plastic cover.
- I. Membrane curing compound will not be used when the concrete surface will be painted. The type of membrane curing compound chosen will not permanently discolor the concrete surface. Where membrane curing compound is not used, the curing process will be carefully adhered to as follows:
1. Surfaces being wetted by ponding, spraying, or wetted material will be kept completely wetted, with an excess of free water on the surface, at all times for the first seventy-two (72) hours. After this period, but for the remaining four (4) days, a wetting schedule will be followed whereby the concrete is wetted on a schedule approved by the Project Manager.
 2. Surfaces being protected by waterproof paper or polyethylene plastic cover will receive special attention during the first seventy-two (72) hours to insure there is actually free moisture on the surface of the concrete under the waterproof surface. The Project Manager may require the removal of the cover and a wetting of the surface when, in his judgment, there is insufficient moisture for curing. After the first seventy-two (72) hours the cover will be kept tightly in place for the remainder of the curing period.

3.09 BACKFILLING

- A. When side forms are removed and the concrete has gained sufficient strength, the space adjoining the concrete will be promptly backfilled with suitable material, properly compacted, and brought flush with the surface of the concrete and adjoining ground surface. In embankments, the backfill will be level with the top of the concrete for at least two feet (2') and then sloped as shown on the accepted plans or as directed by the Project Manager. Existing pavement which is damaged during construction will be repaired by the Contractor at his expense. The first two feet (2') of patching to match existing asphalt or concrete will be the Contractor's responsibility.

3.10 FIELD QUALITY CONTROL

- A. Reference Standard: ACI Chapters 16 and 17.
- B. General: Testing will be conducted by a designated testing agency. See Section 01400. The requirements of this section will apply to testing services for all concrete curb and gutter, sidewalk, pavement, slope paving, retaining walls, structures, and for all miscellaneous concrete testing.
- C. Test Priority: Control tests shall be used to determine concrete quality throughout project; however, special tests shall have precedence over control tests, and core tests shall have precedence over all previous tests.
- D. Tests: Cooperate fully with those making tests. Following tests and procedures are subject to change during construction at discretion of Project Manager:
1. Concrete materials and operations will be tested as directed by the Project Manager and as herein stipulated. The required testing services will be performed by a designated testing agency acceptable to the Project Manager and all testing agencies will meet the requirements of ASTM E329.
 2. A representative of the testing agency will inspect, sample, and test material and production of concrete as required by the Project Manager. When it appears that any material furnished or work performed by the Contractor fails to fulfill specification requirements, the testing agency will report such deficiency to the Project Manager and the Contractor.
 3. The testing agency will report all test and inspection results to the Project Manager and Contractor immediately after they are performed. All test reports will include the exact location of the work at which the batch represented by a test was deposited. The report of the strength test will include detailed information on storage and curing of specimen prior to testing, the project number, and the location of the concrete (curb, manhole, inlet, sidewalk, paving, etc.).

4. The testing agency or its representative is not authorized to revoke, alter, relax, enlarge or release any requirements set forth in these specifications.

E. Tests Provided by the Contractor:

1. The following services shall be performed by the designated testing agency at the expense of the Contractor:
 - a. Conduct strength test of the concrete during construction in accordance with the following procedure: Secure composite samples in accordance with AASHTO T141; mold and cure specimens from each sample in accordance with AASHTO T23. The maximum time between sampling and casting the cylinders or beams shall be forty-five (45) minutes. If they cannot be returned to the laboratory and cast within the forty-five (45) minutes, they will be cast in the field and transported to the laboratory in twelve (12) to twenty-four (24) hours. One test series will be taken per fifty (50) cubic yards (or fraction thereof) of the concrete placed per day, or as directed by the Project Manager.
 1. Field cured test series: Four (4) cylinders; two (2) to be broken at seven (7) days; two (2) to be broken at fourteen (14) days or as directed by the Project Manager.
 2. Lab cured test series: Six (6) cylinders; two (2) to be broken at seven (7) days; two (2) to be broken at twenty-eight (28) days; two (2) to be broken at forty-five (45) days.

* If the specified strength is not obtained at twenty-eight (28) days, two (2) cylinders are to be broken at forty-five (45) days.

- b. Determine slump of the concrete sample of each strength test whenever consistency of concrete appears to vary, or when directed by the Project Manager, in accordance with AASHTO T119.
- c. Determine air content of the concrete sample for each strength test in accordance with either AASHTO T152 (pressure method), T196 (volumetric method), or T121 (gravimetric method).
- d. Sample additional concrete at point of placement, and perform other testing or inspection service as required.
- e. When required by the Project Manager, the Contractor will provide concrete mix designs, the results of which will be immediately reported to the Project Manager. When pumped concrete is to be used, a separate mix design will be required. Mix designs will be in accordance with ACI 211 and 304, as applicable.
- f. Additional testing and inspection required because of changes in materials or proportions.
- g. When the work fails to pass inspection or previous tests fail to meet Specifications, additional tests will be taken as directed by the Project Manager.
- h. Core samples will be obtained and tested when samples of fresh concrete were not obtained and tested in accordance with the provisions set forth in these specifications. Obtaining and testing cores will be in accordance with ASTM C42. Concrete in the area represented by a core test will be considered adequate if the average strength of the cores is equal to at least eighty-five percent (85%) of the specified strength f_c , and if no single core is less than seventy-five percent (75%) of the specified strength. Core holes will be filled with low slump concrete or mortar. Cores may be tested in the dry condition in accordance with ACI 301.
- i. Failure of the Contractor to furnish testing as herein described will be sufficient cause for rejection of the work in question.

F. Responsibility and Duties of the Contractor:

1. The Contractor will provide the testing agency with the following:
 - a. Any labor necessary to assist the designated testing agency in obtaining and handling samples at the project or from other sources of material.
 - b. Provide and maintain for the sole use of the testing agency adequate facilities for safe storage and proper curing of concrete test specimens on the project site as required by AASHTO T23.

SECTION 02062

2. The use of testing services shall not relieve the Contractor of the responsibility to furnish material and construct in full compliance with the standards set forth in these specifications.

END OF SECTION

**SECTION 07900
JOINT SEALERS**

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Providing all caulking and sealant indicated on Drawings, specified herein, and not specified under other sections. In general, seal all openings indicated on Drawings and at other locations requiring sealant to seal visually and against infiltration from air and water, including but not limited to following:
 - 1. Expansion joints in concrete slabs.
 - 2. Isolation joints, between structure and other elements.

1.02 QUALITY ASSURANCE

- A. Installer: Company specializing in sealant application.
 - 1. Experience: Continuously installed sealants in State of Colorado for five (5) years.

1.03 PROJECT CONDITIONS

- A. Environmental Conditions: Do not apply exterior sealants during wet weather or when outside temperature is below 40° F or apply interior sealants when inside temperature is below 60° F.

PART 2 - PRODUCTS

2.01 JOINT BACKING MATERIAL

- A. General: Size joint backing material for minimum 30% compression when inserted in joint.
Material: Round rod or semi-circular type.
- B. Manufacturers:
 - 1. Dow Chemical Company, Ethafoam.
 - 2. Sonneborn, Sonofoam.
 - 3. Accepted Substitute in accordance with Section 01600.

2.02 SEALANT MATERIAL

- A. Acceptable Materials:
 - 1. Interior and Under Thresholds: Not required.
 - 2. Exterior: Two (2) component polyurethane, FS TT-S-00227E, Type II, Class A, non-sag.
 - 3. Primer: As recommended by sealant manufacturer.
 - 4. Sealant at Concrete Pads: Two (2) component self-leveling polyurethane, FS TT-S-00227E, Type I, Class A, pourable type.
 - 5. Colors: As selected by Project Manager from standard colors.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verification of Conditions: Comply with Section 01600:
 - 1. Inspect joints to be sealed to application of any work under this section.
 - 2. Notification: Notify General Contractor of any joints which cannot be put into proper condition to receive sealants in writing with copy to Project Manager.
- B. Acceptance: Beginning of work means acceptance of existing conditions by installer.

3.02 PREPARATION

A. Preparation of Surfaces:

1. Clean surfaces in accordance with manufacturer's recommendations.
2. Mask edges, if required, to protect adjoining surfaces and produce a straight finish line.
3. Clean joint surfaces immediately before installation of sealant. Remove dirt, insecure coatings, moisture and other substances which would interfere with bond of sealant.

B. Joint Backing:

1. Joints: Depth necessary to provide for specified allowable thickness of sealant and also required backing where and as specified. Provide backing of extent and type as specified and required to provide for allowable depth of sealant.
2. Back-up Materials for Sealants: Non-staining, compatible with sealant and primer, resilient nature, and as recommended by manufacturer of sealant.
 - a. Size and Shape: As required by width of joint and specified.
 - b. Do not use materials impregnated with oil, solvents or bituminous materials.
3. Compress backing material minimum of 30% when inserted in joint. Backing material for upper portion of joints shall be round rod or semi-circular in cross-section where in contact with sealant.

3.03 APPLICATION

A. Exterior Thresholds: Not required.

B. Seal Joints:

1. Apply sealants in continuous beads without open joints, voids or air pockets, using ratchet hand gun or mechanical powered gun.
2. Confine sealants to joint areas with masking tapes or other precautions. Apply compounds in concealed compression joints accurately so that excess compound will not extrude from joints.
3. Remove excess compound or sealant promptly as work progresses, and clean adjoining surfaces.
4. In rough surfaces or joints of uneven widths, install sealant well back into joint. Recess equal to width of joint, or 3/8" minimum at masonry.
5. Use anti-tack agent where necessary to protect freshly applied sealant from public traffic and dirt.
6. Comply with manufacturer's specifications and recommendations.

C. Workmanship: Employ only proven installation techniques, which will ensure that sealants will be deposited in uniform, continuous ribbons without gaps or air pockets, with complete "wetting" of joint bond surfaces equally on opposite sides.

1. Except as otherwise indicated, fill sealant rabbet to slightly concave surface, slightly below adjoining surfaces.
2. Where horizontal joints are between horizontal surface and vertical surface, fill joint to form slight cove, so that joint will not trap moisture and dirt.

D. Joint Sizes: Install sealants to depths as indicated or, as recommended by sealant manufacturer but within following general limitations:

1. For normal moving joints sealed with elastomeric sealants but not subject to traffic, fill joints to depth equal to 50% of joint width, but not more than 1/2" deep or less than 1/4" deep.
2. For joints sealed with non-elastomeric sealants and caulking compounds, fill joints to depth in range of 75% to 125% of joint width.

- E. Spillage:
 - 1. Do not allow sealants or compounds to overflow or spill onto adjoining surfaces, or to migrate into voids of adjoining surfaces. Use masking tape or other precautionary devices to prevent staining of adjoining surfaces, by either primer/sealer or sealant.
 - 2. Remove excess and spillage of compounds promptly as work progresses. Clean adjoining surfaces by whatever means may be necessary to eliminate evidence of spillage. Do not damage adjoining surfaces or finishes.

- 3.04 CURING, PROTECTION AND CLEANING
 - A. Curing: Cure sealants and caulking compounds in compliance with manufacturer's instructions and recommendations, to obtain high early bond strength, internal cohesive strength and surface durability.

 - B. Protection:
 - 1. Advise General Contractor of procedures required for protection of sealants during construction period, so that they will be without deterioration or damage (other than normal weathering) at time of acceptance.
 - 2. Protect surfaces from damage. Clean soiled surfaces immediately. Replace any damaged material which cannot be cleaned with new material.

END OF SECTION