

SECTION 02880
IRRIGATION SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Materials, equipment and services required to install the complete landscape irrigation system as indicated on Drawings.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 02300 – Earthwork
- B. Section 02324 - Trenching
- C. Section 02900 – Planting
- D. Section 16000 – Electrical

1.3 REFERENCES

- A. ASTM A 126 - Standard Specification for Gray Iron Castings For valves, Flanges and Fittings
- B. ASTM A 536 - Standard Specification for Ductile Iron Castings
- C. ASTM B 32 - Standard Specification for Solder Metal
- D. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings
- E. ASTM B88 - Standard Specification for Seamless Copper Water Tube
- F. ASTM B 302 - Standard Specification for Threadless Copper Pipe, Standard Sizes
- G. ASTM B 828 - Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings
- H. ASTM D 1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
- I. ASTM D 1785 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
- J. ASTM D 2464 - Standard Specification for Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
- K. ASTM D 2466 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40

- L. ASTM D 2564 - Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems
- M. ASTM D 3350 – Standard Specification for Polyethylene Plastic Pipe and Fittings Materials
- N. ASTM F 477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
- O. ASTM F 714 - Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
- P. NEMA 250 - Enclosures For Electrical Equipment

1.4 QUALITY ASSURANCE

- A. In accord with Section 01440 – Quality Assurance and Quality Control.
- B. Workman Qualifications:
 - 1. Contractor with no less than five (5) years experience installing irrigation systems, similar to the scope and complexity of this project, with documented completion of at least (5) successful installations of commercial, computer controlled irrigation systems.
 - 2. Installing personnel shall have completed central control system manufacturer's 'Installation Certification Program for Computer Controlled Irrigation Systems'.
 - 3. On-site field superintendent shall have no less than (5) years of continuous experience in the installation of commercial computer controlled irrigation systems. Supervisor shall remain on site during all specified work in progress.
- C. Tests and Inspections:
 - 1. Do not conceal any work until all required tests and inspections have been completed.
 - 2. Conduct the following tests, inspections and conference with Owner. Provide advanced notification of each according to the times indicated:
 - a. Pre-installation conference: 7 days
 - b. System layout: 24 hours
 - c. Hydrostatic testing of pressure main line and non-pressure lateral lines installed under paving: 24 hours
 - d. Coverage tests: 24 hours

- e. Final inspection: 48 hours
- 3. During final inspection, provide two-way radios and sufficient personnel to provide constant communication between inspection areas and the controller.
- 4. Hydrostatic tests:
 - a. Furnish force pump and all equipment required to perform hydrostatic testing.
 - b. Center load backfill over pipes, leaving all joints exposed until the installation has been inspected, tested, and approved by Owner.
 - c. Except for ball valves installed upstream of control valves, all testing shall be completed prior to the installation of all other valves and valve assemblies.
 - d. Perform hydrostatic tests in presence of Owner. Maintain 150 psi pressure in the lines for a period of not less than 4 hours. If leaks develop, remake joints and repeat tests until the entire system has proven watertight.
- 5. Coverage test:
 - a. Upon completion of the sprinkler system and prior to planting of shrubs, ground cover or turf, perform a coverage test in presence of Owner to determine that irrigation coverage for all planting areas is complete and adequate.
 - b. Furnish materials and perform work required to correct any inadequacies of coverage. Re-schedule and perform additional coverage test with Owner for approval.
- 6. Final Inspection:
 - a. Upon completion of the entire system, schedule and conduct a final inspection of all equipment and perform a coverage test of each valve station with the Project Manager as part of the Final Approval process.
 - b. During final inspection, provide two-way radio communication and sufficient personnel to provide constant communication between inspection areas and the controller.
- D. Final Acceptance:
 - 1. Prior to final approval of work, all of the following requirements shall be met:

- a. Landscape irrigation system completed and approved by Owner.
 - b. Coverage tests completed and approved by Owner.
 - c. Punch list items completed and approved by Owner.
 - d. As-built drawings completed and approved by Owner.
2. Maintain irrigation system and sufficient watering schedule until all conditions of approval have been completed.
3. Contracted irrigation maintenance period shall begin upon Owner's Final Acceptance.

1.5 PROJECT CONDITIONS

- A. Coordinate work with underground utilities and trades responsible for other underground improvements including the location and planting of specimen trees, and other planting as applicable. Verify locations with Owner of all planting requiring excavations 48 inches in diameter and larger prior to layout of main lines.
- B. Provide temporary irrigation at all times to properly maintain existing planting where required.

1.6 PRE-INSTALLATION CONFERENCE

- A. At least two (2) weeks prior to the commencement of work, conduct a pre-installation conference with the Owner. This meeting shall include all parties responsible for installation, scheduling and testing of the finish work under this section.
- B. Review methods and procedures related to the work of this Section, including, but not necessarily limited to the following:
 1. Products and system requirements
 2. Review of required submittals
 3. Review of required details
 4. Schedule and sequencing of work
 5. Coordination with other trades and existing site conditions
 6. Forecasted weather and procedures for coping with unfavorable conditions
 7. Required inspections, reviews and procedures for approvals
- C. Record discussions of conference including all decisions, directions and agreements reached. Furnish copies of record to all parties in attendance.

1.7 SUBMITTALS

- A. In accord with Section 01300 – Submittal Procedures
- B. Documentation to substantiate required experience and workman qualifications.
 - 1. Provide copy of certificates for professional memberships, certifications and training.
 - 2. List project names, location, address, and telephone number of contact persons for information regarding completed work.
- C. List of materials:
 - 1. Submit a complete list of materials prior to commencing work. List of materials shall include the name of manufacturer, model number, and description of each item intended for use in the installation
 - 2. Irrigation submittal shall be specific and complete. All items shall be listed, including solvent, primer, wire, wire connectors, valve boxes, and all other items needed to complete work.
 - 3. Although manufacturer and other information may differ, the following is a guide to the proper format for submittal:

Item	Description	Manufacturer	Model No.
1.	Pop-up Sprinkler Bodies	Hunter	MP Rotary
2.	Controller	Rainbird	ESPLXME2-LXMM
3.	Manual Gate Valves	Nibco	T-113

- 4. Submit operating manuals and maintenance data of equipment.
 - a. No substitutions of materials or equipment will be allowed without prior written approval by Owner. Refer to Section 01630 - Substitution Procedures.
 - b. Any equipment or materials furnished without the prior approval of Owner may be rejected and required to be removed at Contractor's expense.

D. Project Record Documents:

1. Provide and keep up-to-date, a complete red-lined record set of drawings (blue-line Ozalid type prints) which shall be corrected daily. Prints for this purpose may be obtained from Owner at cost. Document every change from the original Drawings and the exact installed locations, sizes, and types of equipment. Final deliverable to client shall be reproducible hardcopy.
2. Red-lined drawings shall be kept on job site and shall be used only as a record set. The record drawings shall be available at all times for review by Owner. Formally submit copies of the red-lined record drawings for Owner's review on the first of each month.
3. Red-lined drawings shall serve as record for the progress of work completed and shall be used by the Owner as a basis for measurement and payment. Should record drawings not be available for review or not be up-to-date at the time of review, it will be assumed no work has been completed.
4. As-built locations shall be dimensioned from two permanent points of reference, such as building corners, curbs, hardscape edges, roadways, or similar elements. Offsets should be taken at 90 degree angles from reference points whenever possible.

Provide the GPS coordinate location of the following items and include on As-Built:

- a. Pressure main line routing. Include all changes in direction
- b. Point of connection to the existing water supply lines
- c. Sprinkler control valves
- d. Quick coupling valves and washdown valves
- e. Gate valves (manual and automatic)
- f. Communication and flow sensor cable routing
- g. Flow sensors
- h. Point of connection to electrical power service
- i. Diagrammatic routing of irrigation control wire
- j. Field satellite location
- k. Irrigation electrical pull box locations
- l. Other related equipment, as directed by Owner

E. Controller charts:

1. Provide two controller charts for each field satellite supplied.
2. Submit As-built drawings for review and approval by Owner prior to preparation of controller charts.
3. Controller charts shall be prepared in AutoCAD. Provide (2) hard copy prints of controller charts and AutoCAD electronic files on disk.
4. Controller chart to be a reduced scale drawing of the actual installed system depicting all valve stations from one field satellite. Each valve's area of coverage shall be uniquely identified by a contrasting color to the other adjacent valve stations.
5. The controller charts are to be completed and approved prior to final acceptance of the system.

1.8 PRODUCT HANDLING

- A. In accord with Section 01660 - Product Storage and Handling Requirements.
- B. Deliver and store products and equipment in manufacture's unopened packaging until ready for installation.

1.9 ADDITIONAL MATERIALS

- A. Furnish the following extra components prior to Final Approval.
 1. Two wrenches for each rotor type sprinkler head installed on project.
 2. One long-handled valve key each for square nut and hand wheel equipped gate valves.
 3. Two quick coupler key assemblies, for every five (5) washdown valves installed (or fraction there-of). Key assembly shall include; one Rainbird #44K key, one Nibco T-580 1 inch ball valve, one 1 inch x 2 inch brass nipple, and one Rain Bird SH-1 hose swivel.

1.10 WARRANTY

- A. Submit warranty documents in accord with Section 01770 – Contract Closeout.
- B. Warranty the entire landscape irrigation system to give satisfactory service, including all equipment and materials for a period of one (1) year from the date of Final Acceptance.
- C. Warranty the supplemental landscape irrigation system to give satisfactory service for a period of (6) months from the date of its acceptance by Owner.

- D. Should any problems develop within the warranty period due to inferior materials or faulty workmanship, correct problems to Owner's satisfaction at no additional cost.
- E. Any damages or re-work required of the landscape or hardscape due to repairs of the irrigation system shall be completed to Owner's satisfaction at no additional cost.
- F. Owner reserves the right to make temporary repairs, as necessary, to keep the landscape irrigation system in an operating condition. Exercising this right does not in any way relieve the contractor of any responsibilities under the terms of the warranty.
- G. Manufacturer's product warranties shall supplement but not relieve the Contractor of any liability from his contacted installation Warranty.

PART 2 - PRODUCTS

2.1 PLASTIC PIPE AND FITTINGS

- A. Non-potable pipe shall be lavender colored with "Do Not Drink" warning, marked with Manufacturer's name, nominal pipe size, schedule or class, pressure rating in PSI, and date of extrusion.
 - 1. Non-pressure 'lateral line' pipe: Class 200, PVC plastic, ASTM D1785, Type I, Grade I with solvent welded joints. Use Schedule 40, PVC for all pipe installed under paving.
 - 2. Pressure main line pipe, sizes 2½ inches and smaller: Schedule 40, PVC plastic, ASTM D 1785, Type I, Grade I, with solvent welded joints, with Christy's detectable marking tape, green color with irrigation line below warning.
 - 3. Pressure main line pipe, sizes 3 inches and larger: Class 200, PVC plastic, ASTM D 1785, Type I, Grade I with rubber gasketed bell and spigot connections, with Christy's detectable marking tape, green color with irrigation line below warning. Insertion marks shall be visible to show proper depth into spigot.
- B. Potable Pipe shall be marked with Manufacturer's name, nominal pipe size, schedule or class, pressure rating in PSI, and date of extrusion.
 - 1. Non-pressure 'lateral line' pipe: Class 200, PVC plastic, ASTM D1785, Type I, Grade I with solvent welded joints. Use Schedule 40, PVC for all pipe installed under paving.
 - 2. Pressure main line pipe, sizes 2½ inches and smaller: Schedule 40, PVC plastic, ASTM D 1785, Type I, Grade I, with solvent welded joints, and Christy's detectable marking tape, green color with irrigation line below warning.

3. Pressure main line pipe, sizes 3 inches and larger: Class 200, PVC plastic, ASTM D 1785, Type I, Grade I with rubber gasketed bell and spigot connections, with Christy's detectable marking tape, green color with irrigation line below warning. Insertion marks shall be visible to show proper depth into spigot.
- C. Fittings shall bear manufacturer's name or trademark, material designation, size, and applicable I.P.S. schedule.
1. Glued socket type, for pipe sizes 2½ inches and smaller; Schedule 40, PVC plastic; Grade I, ASTM D 2466, Type I.
 - a. Solvent cement: ASTM D2546, for PVC pipe and fittings.
 2. Threaded type, for pipe sizes 2½ inches and smaller; Schedule 80, PVC plastic; Grade I, ASTM D 2464, and ASTM F 437.
 3. Bell-end, sizes 3 inches and larger; Ductile iron, grade 70-55-05 in accord with ASTM A 536, having deep bell push-on joints with gaskets meeting ASTM F477.
 - a. Harco 'Deep Bell' by the Harrington Corp. of Lynchburg, VA., (804) 845-7094; or Owner-approved equivalent.

2.2 COPPER PIPE AND FITTINGS

- A. Type K, hard tempered pipe, ASTM B 88.
- B. Solder joint type wrought copper fittings, ASTM B 828.
- C. 95/5 solder, ASTM B 32.

2.3 HDPE PIPE AND FITTINGS

- A. Pipe shall be manufactured from a pipe resin which meets ASTM D 3350-05 with a minimum cell classification of 445474C. Pipe shall be manufactured to the dimensions of ASTM F-714. The service factor to determine the pressure rating shall be 0.63. Pipe shall be have a minimum pressure ratings of:

DR 9	240 psi
DR 11	200 psi
DR 13.5	160 psi
DR 15.5	138 psi
DR 17	125 psi
DR 21	100 psi
DR 26	80 psi

The pipe shall contain no recycled compounds except that generated in the manufacturer's own plant from resin of the same specification from the same raw material.

- B. Butt Fusion Fittings - Fittings shall be made from HDPE pipe resin meeting ASTM D 3350-05 with a minimum cell classification of 445474C. Molded Butt Fusion Fittings shall have a manufacturing standard of ASTM D-3261. Molded & fabricated fittings shall have the same pressure rating as the pipe unless otherwise specified on the plans. Fabricated fittings must have the same pressure rating as the pipe; a DR less than the pipe shall be used. Fabricated fittings are to be manufactured using a Data Logger to record temperature, fusion pressure, and a graphic representation of the fusion cycle shall be part of the Quality Control records.
- C. Electrofusion Fittings - Fittings shall be made from resin or pipe meeting ASTM D 3350-05 with a minimum cell classification of 445474C. Electrofusion Fittings shall meet the manufacturing standard of ASTM F-1055. Fittings shall have the same pressure rating as the pipe or higher unless otherwise specified on the plans.
- D. Flanged and Mechanical Joint Adapters - Flanged and Mechanical Joint Adapters shall be made from materials containing resin that meets ASTM D 3350-05 with a minimum cell classification of 445474C.

2.4 FLEXIBLE TUBING

- A. Rain Bird Swing Pipe, Toro 850-01, or equal thick wall flexible pipe.

2.5 CONDUIT

- A. Gray PVC Schedule 80 conduit with solvent weld fittings.
- B. Use separate conduits for each type of wire or cable run.
- C. Size conduits as indicated on Drawings or as required to accommodate anticipated number of wires without binding or damaging wire insulation.

2.6 SLEEVES

- A. Schedule 40 PVC for applications requiring 3 inches and smaller diameter.
- B. Class 200 PVC for applications 4 inches and larger.
- C. All sleeves shall be 2 pipe sizes larger than the diameter of the protected pipe run for pipes under 6 inches diameter and 2 pipe sizes larger for runs 6 inches and larger.

2.7 CONTROL WIRE

A. Control Wire:

1. UL-approved direct burial copper wire AWG-U.F. 600V.
2. No. 14 for control wires and No. 12 for common wires.
 - a. Provide separate control wires and a single common wire for operation of each automatic gate valve.
 - b. Color of all common wire shall be white. Multiple common wires in the same trench shall be white with a different colored stripe on each. Provide separate common wire for each field satellite or controller installed.

B. Color code all control wires as follows:

Common (1) – White	Common (3) – White with Black stripe
Common (2) – White with Red stripe	Common (4) – White with Blue stripe
Spare – Red	
Station No. 1 – Black	Station No. 2 – Orange
Station No. 3 – Brown	Station No. 4 – Blue
Station No. 5 – Lt. Blue	Station No. 6 – Tan
Station No. 7 – Purple	Station No. 8 – Blue with White stripe
Station No. 9 – Pink	Station No. 10 – Gray
Station No. 11 – Yellow	Station No. 12 – Red
Station No. 13 – Black with Red stripe	Station No. 14 – Orange with Red stripe
Station No. 15 – Brown with Red stripe	Station No. 16 – Blue with Red stripe
Station No. 17 – Lt. Blue with Red stripe	Station No. 18 – Tan with Red stripe
Station No. 19 – Purple with White stripe	Station No. 20 – Blue with Yellow stripe
Station No. 21 – Pink with White stripe	Station No. 22 – Gray with Red stripe
Station No. 23 – Yellow with Red stripe	Station No. 24 – Red with White stripe

C. Wire Connectors: DBY-6 and DBR-6 direct bury splice kits by 3M with 'Scotchlok'™ connectors.

D. Communication Cable and Sensor Wire:

1. Central System Communications Cable:
 - a. PE-89, rodent resistant, six pair, 19 gauge telephone cable, Model No.P-7073D as manufactured by the Paige Electric Co

- b. All communication cable runs are to be installed in 2 inch PVC Schedule 40 conduit and are direct pulls without buried splices. For interior installations, conduit is not required.
 - c. All connections are to be made at a terminal strip inside controller enclosure. The maximum length of one communications chain is 5,000 feet.
- 2. Unavoidable wire splices below grade are to be made with Re-enterable Splice Kit No. 8006039 by Ranger Serviceal. All below grade splices shall be installed in a PVC valve box unless within 3 feet of a traffic area which shall require a concrete box with road rated cast iron lid.

2.8 BACKFLOW DEVICE

- A. Backflow Device: As indicated on Drawings.

2.9 FLOW SENSOR AND FLOW METER

- A. Flow sensor as manufactured by Hunter Industries.
 - 1. Model No. FCT-150; brass, tee mounted flow sensor for 1 inch, 1-1/4 inch, & 1-1/2 inch sizes.
 - 2. Model No. FCT-150; brass, tee mounted flow sensor for 2 inches size.
 - 3. Model No. IR-220-SS; insert style, stainless steel flow sensor for sizes 2-1/2 inches and larger.

2.10 VALVES

- A. Gate Valves:
 - 1. Manual Gate Valves 2-1/2 inches and smaller:
 - a. Nibco T-113 or Owner-approved equivalent that includes the following options; 200 lb. saturated steam rated brass body, ASTM B62, with threaded joints, non-rising stem, screwed bonnet and bronze hand wheel.
 - 2. Manual Gate Valves 3 inches and larger:
 - a. Nibco F-619 or Owner-approved equivalent that shall include the following options; 200 lb. W.O.G. epoxy coated iron body, ASTM A126 Class B, with flanged joints, non-rising stem and double disk, and bolted bonnet with 2 inch square operating nut.
- B. Ball Valves:

1. Spears No. 2121 series industrial grade PVC ball valve with threaded ends or Owner-approved equivalent that includes the following options;
 - a. Heavy bodied PVC construction with 236 psi min. pressure rating.
 - b. PTFE ball seats.
 - c. EPDM high grade abrasion resistant O-rings.
 - d. NSF listed for potable water.
- C. Electric Control Valves: Type and size as indicated on Drawings.
- D. Quick Coupler Valves: Type and size as indicated on Drawings.

2.11 CONTROLLERS

- A. Central Computer Control system:
 1. ESPLXME2-LXMM by Rain Bird computerized landscape irrigation central control system, or as indicated on Drawings.
 2. Incidental parts which may not be specified or indicated on Drawings, but are required to complete or modify the existing system shall be furnished and installed without additional cost.
 3. Coordinate with Owner for connections to the existing service and/or installation of conduit, cable, telephone service, jacks or modems.
- B. Controller Cabinet:
 1. Strong Box SB-18SS, as manufactured by V.I.T. Products, Inc., PH: (800) 729-1314, or approved equal.
 2. NEMA Type 3R rating with thermostatically controlled fan and louvered-vent filters.
 3. Include a minimum of two (2) GFCI receptacles within controller enclosure.

2.12 SPRINKLER HEADS

- A. Sprinkler Heads: As specified on Drawings.
- B. Rotor Heads: As specified on Drawings.

2.13 JOINT RESTRAINT FITTINGS

- A. Lateral Isolation Valve Specifications: Lateral Isolation Valves shall be 200 psi rated angle globe valves with integrally restrained ends. Ends shall be male swivel or integrally restrained push on gasketed joint as required. Components shall be Ductile Iron, 316 Stainless Steel, and Low Zinc Bronze complying with ASTM A536, ASTM A276, ASTM B62-C83600 respectively or equivalent. Ductile Iron shall be fusion bond epoxy coated. Gasketed joints shall be SBR Rubber and comply with ASTM F477. Internal seals shall be EPDM rubber. Lateral Isolation Valves shall be as manufactured by HARCO (Harrington Corporation) of Lynchburg, VA.
- B. Fittings: Fittings shall be manufactured of ductile iron, Grade 65-45-12 in accordance with ASTM A-536. Fittings shall have deep bell push-on joints with gaskets meeting ASTM F-477. Fittings shall be DEEP BELL as manufactured by HARCO (Harrington Corporation) of Lynchburg, VA. Transition gaskets are not allowed.
- C. Fitting to Pipe Joint Restraint: Joint Restraint shall be knuckle type as manufactured by HARCO (Harrington Corporation) of Lynchburg, Virginia. The grip ring shall be one piece residing within a ductile iron housing having machined serrations and shall be activated by one bolt. Housing and grip ring shall be of ductile iron to ASTM A536. Bolt and nut shall be Type 304 stainless steel.
- D. Fitting to Pipe Joint Restraint: Fitting to Pipe Restraints shall meet the requirements of UNI-B-13-94. Grip ring serrations shall be machined. As cast serrations are not permitted. Restraint rods, bolts and nuts shall be of ductile iron to ASTM A563 or low alloy steel to AWWA/ANSI C111/A21.11. Fitting to Pipe Restraint shall be supplied by HARCO (Harrington Corporation), Lynchburg, VA.
- E. Pipe to Pipe Restraints: Pipe to Pipe Restraints shall meet the requirements of UNI-B-13-94. Grip ring serrations shall be machined. As cast serrations are not permitted. Restraint rods, bolts and nuts shall be of low alloy steel to AWWA/ANSI C111/A21.11. Pipe to Pipe Restraints shall be supplied by HARCO (Harrington Corporation) of Lynchburg, VA.
- F. Gate Valve to Pipe Restraint: Valve to Pipe Restraint shall consist of ductile iron (ASTM A536) grip rings with machined serrations and ductile iron restraint rods. The ring that grips the pipe shall meet the requirements of Uni-B-13-94. The restraint rod nuts shall be made from low alloy steel to AWWA/ANSI C111/A21.1 or ductile iron to ASTM A536. All valve restraint is to be supplied by HARCO (Harrington Corporation) of Lynchburg, Virginia.

2.14 VALVE BOXES

- A. All subgrade valves and valve assemblies located within planting areas are to be installed in green plastic boxes with matching green lids. Armor™ brand (formerly Amatek) as manufactured by Underhill International.

1. For manual gate valves; 10 inch x 10-1/4 inch round box with bolt-down cover. Extension sleeve shall be PVC with minimum depth of 6 inches.
 2. For Electric Control Valves; 11-3/4 inch x 17 inch x 12 inch rectangular box with bolt-down cover.
 3. For Control Valves with wye strainer assembly; 16 inch x 25-1/2 inch x 12 inch jumbo rectangular box with bolt-down cover.
 4. Communication cable and flow sensor wire pull boxes; 12 inch x 18 inch rectangular box, with green bolt-down cover.
 5. For quick coupler valves; 10 inch x 10-1/4 inch round box with bolt-down cover.
- B. Gate Valves located in hardscape and traffic areas;
1. Rectangle shape concrete boxes with cast iron lids, Brooks brand concrete body with cast iron frame and cast iron non-locking cover, or Owner-approved equivalent.

2.15 VALVE IDENTIFICATION TAGS

- A. Christy brand, Maxi Tag™, manufactured from Behr polyurethane Desopan 2, hot-stamped with black letters on yellow background. Attach one tag to each electric control valve providing ACC, field satellite and station numbers.
- B. All valves, regardless of type, shall have 'Reclaimed Water' ID tags attached. Tags shall be Christy brand Maxi Tag™, hot-stamped with black letters on purple background. Tags shall read "Warning - Reclaimed Water - Do Not Drink." Tag shall be printed in English and Spanish.
- C. Special order tags from T. Christy Enterprises, 403 West Brenna Lane, Orange, CA 92667. Ph: (714) 771-4142, Fax: (714) 771-3029.

2.16 LIGHTING PROTECTION

- A. Grounding Rods to be 5/8 inch diameter x 10 foot copper clad; No. 182007 by Paige Electric, (800) 327-2443, or approved equal.
- B. Grounding plates to be 4 inch x 96 inch x 0.064 inch solid copper with integral wire connection of 25 feet long #6 AWG bare, solid copper wire, UL Listed and conforming to the minimum requirements of Section 250 of the National Electric code; No. 182199L by Paige Electric, (800) 327-2443.
- C. Grounding connections to utilize exothermic welding process; UL Listed Cadweld connectors.
- D. Grounding wire shall be #6 AWG, solid, bare copper wire.

- E. Ground enhancement material shall be Powerset as manufactured by Loresco in 50 pound bags.

2.17 MISCELLANEOUS EQUIPMENT

- A. Surge Arresters:
 - 1. For 120V power wiring: Surge-arresting duplex outlet by Leviton, Model No. 528-I.
- B. Flex Risers: King Brothers, Global Water System, or Excaliber
- C. Stakes: #4 rebar – length as noted.
- D. Clamps: Stainless steel screw clamps
- E. Swing Joints: Dura, Spears, Rain Bird maximum, or Lasco

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

- A. Layout of irrigation pipe and equipment indicated on Drawings is diagrammatic. Actual locations are contingent upon actual site conditions and integration with other underground utilities.
- B. Verify dimensions, grades and points of connection in field prior to commencement of work.
- C. Do not proceed with installation when it is apparent that obstructions, grade differences or conflicts in the Drawings exist. Bring all such conflicts or discrepancies are to the immediate attention of Owner for clarification.
- D. Obtain and pay all plumbing permits and inspections required by governing agencies.

3.2 SUPPLEMENTAL IRRIGATION

- A. Provide a supplemental drip irrigation system for all palm trees and all boxed trees 24 inches and larger installed under this contract. This system is to ensure that installed trees will be automatically irrigated during the plant establishment period.
- B. The supplemental system shall be designed by a qualified irrigation design professional that is experienced with drip and low flow irrigation systems.
 - 1. Submit for Owner approval, prior to commencing with work, schematic drawings showing intended drip irrigation design with all pertinent information for temporary water connections, equipment and installation.

- C. System to be installed and operational prior to tree planting, regardless of the availability of a permanent water connection. If permanent irrigation water is not available at the time the system is installed, provide a temporary water connection until a permanent connection can be made.
- D. Pipe and/or tubing, not in a hazardous area, to be installed on-grade. Pipe installed as a part of temporary irrigation shall not be re-used as any part of the permanent landscape irrigation system.
- E. All pipe and/or tubing shall be buried and sleeved under construction or access roads at a proper depth to prevent damage.
- F. Protect temporary system during entire planting process. Repair any damage to landscape caused by leaking or broken lines.
- G. The system should be designed at 90% capacity to allow for additional plant material or emitters as required. Ten percent (10%) additional emitters to be included in contract and installed at Owners discretion.
- H. Use the following table to determine the required quantity of emitters or spray stakes;
 - 1. 1 spray stake/emitter for all rootballs up to 2 feet measured in the largest dimension.
 - 2. 2 spray stakes/emitters for all rootballs up to 4 feet measured in the largest dimension.
 - 3. 3 spray stakes/emitters for all rootballs up to 6 feet measured in the largest dimension.
 - 4. 4 spray stakes/emitters for all rootballs up to 8 feet measured in the largest dimension.
- I. Flow rates should be calculated using 0.25 GPM per emitter.
- J. Upon completion of the permanent irrigation system, remove the supplemental system without damaging landscape. Battery operated controllers and valves to be turned over to Owner. Remainder of supplemental materials to be salvaged or properly disposed of off-site.

3.3 POINT OF CONNECTION

- A. Connections to water source shall be at approximate location indicated on Drawings. Make any minor changes caused by actual site conditions without additional cost to Owner.

3.4 FLOW METER AND FLOW SENSOR

- A. Install in accord with manufacturer's instructions and as indicated on Drawings.

- B. Provide separate flow sensor cable from each flow sensor to its respective pulse decoder. Run all cables in PVC Schedule 40 conduit.
 - 1. Maximum of two (2) cables from the same point of connection may be installed within the same conduit. Cables from different points of connection are not permitted within the same conduit.
 - 2. Control and common wires for automatic gate valve, upstream of flow sensor, shall be installed within flow sensor cable conduit.

3.5 TRENCHING

- A. Lay-out system using an approved staking method.
- B. Coordinate routing of mainline piping and trenching with underground utilities and specimen tree locations.
 - 1. Planting locations shall take precedence over sprinkler and piping locations where possible
 - 2. Maintain minimum clearance between pipes as required by code.
 - 3. Notify and coordinate with Owner of any major deviations from original layout.
- C. Excavate trenches with straight and vertical sides. Provide continuous support for pipe on bottom of trenches. Lay pipe to uniform grade.
 - 1. Maintain 1 inch minimum clearance between lines which cross at 45 degree to 90 degree angles.
 - 2. Maintain 6 inches minimum clearance between sprinkler lines and between lines of other trades. Do not install sprinkler lines directly above any other pipes or utilities.
- D. Where irrigation lines occur within landscaping, trench depths shall be:
 - 1. Provide minimum cover of 24 inches over all pressure main lines 6 inches and larger. Maximum cover shall be 48 inches unless otherwise approved by Owner.
 - 2. Provide minimum cover of 18 inches over all pressure supply main lines 4 inches and larger. Maximum cover shall be 48 inches unless otherwise approved by Owner.
 - 3. Provide minimum cover of 10 inches over non-pressure lateral lines. Maximum cover shall be 18 inches unless otherwise approved by Owner.
- E. Where irrigation lines occur under paving, depth of coverage shall be measured from the bottom of paving material. Trench depths shall be:

1. Provide minimum cover of 36 inches over all sleeves or direct-bury pressure main lines 6 inches and larger. Maximum cover shall be 48 inches unless otherwise approved by Owner.
 2. Provide minimum cover of 24 inches over all sleeves or direct-bury pressure supply main lines 4 inches and larger. Maximum cover shall be 48 inches unless otherwise approved by Owner.
 3. Provide minimum cover of 12 inches over all sleeves or direct-bury non-pressure lateral lines. Maximum cover shall be 18 inches unless otherwise approved by Owner.
- F. Install, under mainline, one continuous No. 14 AWG UF tracer wire in all locations where control wires are not installed in same trench as mainline. Tracer wire shall be black with a white stripe.

3.6 BACKFILLING

- A. Backfill and compaction: In accord with Section 02320, Excavation & Backfilling for Utilities.
- B. Initial backfill over all pipe shall be clean, fine granular material.
- C. Backfill only when pipe is cool. During hot weather, pipe can be cooled by operating the system for a short time prior to backfilling.
- D. Provide marking tape, as specified in Section 02505 – Underground Utility Marking, over all pressure supply main lines.
- E. Properly compact backfill in trenches to dry density equal to the adjacent undisturbed soil, and conform to adjacent grades without dips, sunken areas, humps, or other irregularities.
- F. Restore grades and repair any damage where settlement may occur.

3.7 PLASTIC PIPE AND FITTINGS

- A. Install and connect plastic pipe in accord with manufacturer's recommendations.
- B. Prepare all welded joints with approved cleaner prior to applying primer and solvent.
 1. Allow welded joints at least 15 minutes set-up and curing time before moving or handling.
 2. Partially center load pipe in trenches to prevent movement or shifting when water pressure is applied.
 3. Do not permit water in pipe for a minimum of 4 hours after applying solvent welds.

4. When the temperature is above 80°F, allow solvent weld joints at least 24 hours curing time before water is introduced under pressure.
- C. Installing pipe under existing pavement:
1. Piping under existing pavement may be installed by jacking, boring, or hydraulic driving. Hydraulic driving will not be permitted under asphalt paving.
 2. Secure permission from Owner prior to cutting or breaking any existing pavement. Repairs or replacement to existing paving shall be approved and completed to the satisfaction of the Owner and shall be installed at no additional cost.
- D. Marking Tape: Install continuous identifying warning tape 12 inches above all pressure and washdown mainline piping.
- E. Flushing System:
1. After all sprinkler pipe and risers are in place, open control valve and thoroughly flush system clean prior to installing sprinkler heads.
 2. Contractor shall be responsible for repair of clogged nozzles for a period of thirty days after notice of substantial completion.

3.8 HDPE PIPE

- A. During loading, transportation and unloading, every precaution shall be taken to prevent injury to the pipe. No pipe shall be dropped from cars or trucks, or allowed to roll down slides without proper retaining ropes. During transportation each pipe shall rest on suitable pads, strips, skids or blocks securely wedged or tied in place. Any pipe damaged shall be replaced.
- B. Sections of polyethylene pipe should be joined into continuous lengths on the jobsite above ground. The joining method shall be the butt fusion method and shall be performed in strict accordance with the pipe supplier's recommendations. The butt fusion equipment used in the joining procedures should be capable of meeting all conditions recommended by the pipe supplier. The butt fusion joining will produce a joint weld strength equal to or greater than the tensile strength of the pipe itself. All field welds shall be made with fusion equipment equipped with a Data Logger. Temperature, fusion pressure and a graphic representation of the fusion cycle shall be part of the Quality Control records.
- C. Mechanical joining will be used where the butt fusion method can not be used. Mechanical joining will be accomplished by either using a HDPE flange adapter with a Ductile Iron back-up ring.
- D. Hot gas fusion, threading, solvents, and epoxies will not be used to join HDPE pipe.

3.9 CONDUITS

- A. Install conduit where control wires pass through or under walks, walls and paving. Conduits shall be of adequate size to accommodate retrieval of wires for repair and shall extend 18 inches beyond edges of walls and pavement.
- B. Install continuous conduit for all flow sensor and communication cables.

3.10 SLEEVES

- A. Install sleeves for all pipes and conduits passing through or under walks, walls and paving as indicated on Drawings. Sleeving shall be of adequate size to accommodate retrieval of wiring or piping for repair and shall extend 18 inches beyond edges of paving or other construction.
- B. Field verify location, size and depth of existing sleeves where noted on the Drawings. Notify owner of any discrepancies prior to the start of installation.

3.11 CONTROL WIRE

- A. Control wire shall be run in same trench adjacent to mainline pipe whenever possible. Multiple wires in run to be bundled and taped together at 12 foot intervals.
- B. Install control wire in PVC Schedule 40 gray conduit when not run with mainline.
- C. Use only continuous wire between controller and remote control valves. Do not use wire splices without prior approval by Owner.
- D. Make underground wire connections to electric remote control valves with UL-listed 3M DBR/Y6 connectors (depending on wire size).
- E. An expansion curl shall be provided at each wire connection. Expansion curl shall be of sufficient length at each control valve, so that the valve bonnet may be brought to the surface for maintenance without disconnecting the wires.

3.12 VALVE ASSEMBLIES

- A. Install and connect all assemblies in accord with Drawings.
- B. Do not install multiple assemblies on individual service tees. Provide each assembly with its own outlet. When used, the pressure relief valve shall be the last assembly.
- C. All threaded fittings shall be assembled using Teflon tape applied to the male threads.
- D. When specified, install backflow assemblies in shrub areas at the minimum height required by local codes.

- E. Locations for all equipment, as indicated on Drawings, such as point of connection, ACC's, field satellites and valves are approximate.
 - 1. Minor modifications to layout and location of equipment shall be provided at no additional costs to Owner.
 - 2. Stake out all equipment locations for Owner's review and obtain approval prior to installation. Failure to obtain Owner's approval prior to installation may require Contractor to relocate or re-work installation at no additional costs to Owner.

3.13 GATE VALVES

- A. Install in accord with Drawings.
- B. Check and tighten valve bonnet packing before backfill.

3.14 ELECTRIC CONTROL VALVES

- A. Install in accord with Drawings.
- B. Install at sufficient depth to provide not more than 6 inches and not less than 4 inches cover from top of valve to finish grade.
- C. Install valves in a plumb position with 24 inches minimum maintenance clearance from other equipment.
- D. Electric control valves shall be connected to field satellites in numerical sequence as indicated on Drawings.

3.15 QUICK COUPLER VALVES

- A. Install in accord with Drawings.

3.16 CONTROLLERS

- A. Field Controller Assemblies:
 - 1. Coordinate with Owner for connections to central computer control system.
 - 2. Secure the following services from the approved equipment supplier:
 - a. On-site meeting to review system operation and ensure that all personnel understand system installation techniques.
 - b. On-site technical assistance during installation period when requested by Contractor or Owner.
 - c. Testing of grounding system.
 - d. Hook-up of communication and sensor wires within assemblies.

- e. Continuity and resistance tests on communication wires.
 - f. Address satellites and decoders.
 - g. Verify system flow range and calibrate pulse transmitter.
 - h. Test system components for proper operation.
 - i. Certification that equipment conforms to and is installed in accord with Drawings, Specifications, and manufacturers' recommendations.
- B. High voltage wiring for field satellite:
- 1. 120V power connection to field satellites to be provided under Division 16 of Specifications.
 - 2. All electrical work shall conform to local codes, ordinances, and authorities having jurisdiction.
- C. Central Computer Control Interconnect Circuitry:
- 1. Warranty tests shall be performed by the approved supplier on all electrical circuits. Provide Owner with written approval from the equipment supplier prior to start of maintenance period.
 - a. Wire loop resistance (continuity): Test each circuit for maximum loop resistance of 200 ohms.
 - b. Ground fault: Test each circuit with an ohm meter, after each interconnect circuit has been installed and connections have been made. Minimum ground resistance to be 700,000 ohms. After test has been completed, remove splices and leave exposed in pull box for future access.
 - c. Record results of circuitry tests and submit to Owner prior to acceptance of work.
 - d. Functional test: Perform test to demonstrate each and every part of the system functions as specified and intended.
 - (1) The functional test for each new or modified electrical system shall consist of not less than (5) days of continuous, satisfactory operation. If unsatisfactory performance of the system develops, correct the condition and repeat test until (5) days of continuous satisfactory operation has been obtained.

- (2) Functional tests and turn-on shall not be started on a Friday, or on a day preceding a legal holiday. Shutdown caused by factors beyond Contractor's control shall not constitute discontinuance of the functional test.

D. Interconnect Conductors:

1. Irrigation interconnect conductors shall be pulled by hand, leave 2 feet of coiled slack at each field controller and at each pull box.
2. Irrigation interconnect wire shall be continuous from satellite to satellite. Splices shall occur within satellite enclosure, unless specifically authorized otherwise by Owner.

Make splices by approved connectors only. Splices shall be capable of satisfactory operation under continuous submersion in water.

3.17 GROUNDING

- A. Multiple controller locations shall have separate grounding for each controller or group of controllers. Lightning protection grids shall be installed in an irrigated area.
- B. Install ground rods a minimum of 12 feet from the controller and connect via a Cadwell connection to #6 solid, bare copper wire. Additional rods shall be spaced at 20 foot intervals. The copper wire is to be installed in as straight a line as possible, and where necessary to make a turn or bend, it shall be done in a sweeping curve with a minimum radius of 9 inches and a minimum included angle of 90 degrees. There shall be no splices in the bare copper wire.
- C. Top of each grounding rod shall be driven into the ground to below finish grade and covered with a standard 10 inch round plastic valve box with lid.
- D. Grounding plates to be installed horizontally at 36 inches below grade with 100 lbs of 'Powerset'™ ground enhancement material spread evenly above and below each plate in accordance with manufacturer's directions.
- E. Install a minimum of 6 inches of 4 inch perforated polyethylene pipe over each plate and cap with a flat PVC drain grate for periodic inspection. Plates shall also be covered with a 4 inch grated cover as specified, set a minimum of 1 inch below grade, to facilitate drainage onto the plate. Cover shall be installed on a minimum of 36 inches of 4 inch ADS corrugated polyethylene, perforated drainage pipe.

3.18 SPRINKLER HEADS

- A. Install in a plumb position, perpendicular to finish grade, at intervals not to exceed maximum spacing indicated on drawings.
- B. Install heads 1/2 inch above finish grade along curbs, walks, paving, and similar areas.

- C. Lay out sprinkler heads and make all minor adjustments required due to differences between site conditions and Drawings. All such deviations in layout shall be within the intent of the original Drawings, and without additional cost to Owner. Routing and layout of all piping shall be approved by Owner prior to installation.
- D. After all permanent sprinkler pipe lines and risers are in place and prior to installation of sprinkler nozzles, open control valves and flush out the system with a full head of water.
- E. Install nozzles of the required size and pattern for the area of coverage. Install pressure compensating screens per manufacturer's recommendations.

3.19 FINAL ADJUSTMENTS

- A. Adjust sprinkler heights and vertical alignment as required to maintain proper relationship to established grades and planting. Re-grade and replant around sprinkler heads as necessary.
- B. Fill-in all depressions that may arise from possible settlement over trenching or other excavations, with proper soil mix. Compact lightly, and replant as needed to maintain planting design.
- C. Adjust nozzles to provide optimum coverage with no overspray to hardscape or building walls.
- D. Replace nozzles where required to provide full and complete coverage.
- E. Adjust or relocate moisture sensing equipment, as required, for proper operation.
- F. Adjust irrigation schedule and run times to provide adequate water to maintain landscaping.

END OF SECTION