

SECTION 19
LANDSCAPE IRRIGATION

19-1 GENERAL

19.1.1 Scope - Contractor shall furnish all labor, tools, equipment, materials, and perform all operations necessary for the proper execution and completion of all irrigation work in accordance with the Contract Plans and Special Provisions. The work shall include, but not necessarily be limited to, trenching and backfill, water and electrical service connection, backflow preventer, controllers, sleeves, conduits, main lines, lateral lines, remote control valves, pressure reducing valves, hose bibs, quick coupler valves, gate valves, risers, heads, emitter flush valves, emitters, emitter line and tubing, testing, adjustment of heads, maintenance and providing as-built drawings.

Contractor shall coordinate installation of irrigation system with layout and installation of the plant materials to insure that there will be complete and full irrigation coverage of planting in accordance with the Contract Plans, these specifications and the Special Provisions. The irrigation system shall be installed and tested prior to installation of plant material.

The "Model Water Efficient Landscape Ordinance" by the State Department of Water Resources shall apply.

19-1.2 Applicable Publications - The publications listed below comprise a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only. Unless specifically shown otherwise all publications shall be the latest edition. When there is a conflict between the applicable codes or standards and Project Specifications, the construction that conforms to the more stringent rules, results in a larger size, or achieve a higher quality shall govern. Any additional materials, equipment, or labor required to conform with the applicable codes and standards shall be considered to be incidental to the work, and no additional compensation shall be allowed therefor under the Contract.

Federal Specification (Fed. Spec.):

- | | |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------|
| WW-H-001220 | Head, Sprinkler, (Underground Connection) |
| WW-V-51F | Valve, Angle, Check and Globe, Bronze; 125-, 150-, and 200-pound, Threaded End, Flange Ends, Solder Ends, and Brazed End, for Land Use. |
| WW-V-54D | Valve, Gate, Bronze (125-, 150-, and 200 pound, Int Am 3 Screwed, Flanged, Solder End, for Land Use) |

American National Standards Institute (ANSI) Publications:

- | | |
|----------|------------------------------------------------------------------------------------------------------------------------------------|
| B2.1-68 | Pipe Threads (Except Dryseal) Specifications, Dimensions , Tapers and Straight Pipe Threads, Including Certain Special Application |
| B16.3-77 | Malleable Iron Threaded Fittings, Class 150 and 300. |

American Society for Testing and Materials (ASTM) Publications:

- | | |
|---------|------------------------------------------------|
| A53-81A | Pipe, Steel, Black and Hot-Dipped, Zinc-Coated |
|---------|------------------------------------------------|

Welded and Seamless

- | | |
|---------|-----------------------------------------------|
| A120-81 | Pipe, Steel, Black and Hot-Dipped Zinc-Coated |
|---------|-----------------------------------------------|

(Galvanized) Welded and Seamless for Ordinary Uses

- | | |
|----------|---------------------------------------------------------------------|
| B61-80 | Steam or Valve Bronze Castings |
| B62-80 | Composition Bronze or Ounce Metal Castings |
| D1785-76 | (Poly Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120 |
| D2241-80 | (Poly Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR) |
| D2287-81 | Non-rigid Vinyl Chloride Polymer and Copolymer |

Molding and Extrusion Compounds

- D2464-76 Threaded (Poly Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
D2466-78 (Poly Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
D2467-76A Socket-Type (Poly Vinyl Chloride) (PVC) Plastic

Pipe Fittings, Schedule 80

- D2564-80 Solvent Cements for (Poly Vinyl Chloride) (PVC)

Plastic Pipe and Fittings.

- D2774-72 Underground Installation of Thermoplastic (R1978) Pressure Piping
D2855-81 Making Solvent-Cemented Joints with (Poly Vinyl Chloride) (PVC) Pipe and Fittings.

American Society of Sanitary Engineering (ASSE) Publications

- 1013-80 Reduced Pressure Backflow Preventer
1003-1 Pressure Reducing Valve

American Water Works Association (AWWA) Publications:

- C506-78 Standard for Backflow Prevention Devices-Reduced

Pressure Principle and Double Check Valve Types

- C601-81 Standard for Disinfecting Water Mains
C800-66 Standard for Threads for Underground Service Line Fittings - with Appendix on Collected Standards for Service Line Materials.

Western Plumbing Officials Association

Uniform Plumbing Code

National Fire Protection Association (NFPA) Publications

- NFPA 24 Standard for Outside Protection
NFPA 70 National Electrical Code

National Sanitation Foundation (NSF) Publications

- STD No. 14-78 Plastic Piping System Components and Related Material

National Electric Code**Plastic Pipe Institute (PPI) Publication**

- PPI TN8 Making Threaded Joints with Thermoplastic Pipe and Fittings

19-1.3 Submittals - Submittals shall be in accordance with Section 5-6, "Shop Drawings," of these Technical Provisions and as provided for herein. The following items shall be submitted to the Engineer for review and approval or prior to final acceptance:

1. Materials list
2. Shop drawings
3. Manuals and cutsheets for all components used
4. As-built drawings (prior to final acceptance)
5. Controller charts (prior to final acceptance)

Controller Charts

1. As-built drawings shall be provided by the Contractor and approved by the Engineer before controller charts are prepared.
2. Provide one controller chart for each controller controlling each area.

3. The chart shall show the area controlled by the automatic controller and shall be the maximum size that will fit inside the controller door.
4. The chart is to be a reduced drawing of the actual as-built system. However, in the event the controller sequence is not legible when the drawing is reduced, the lettering shall be of a size that is readable when reduced to half scale.
5. The chart shall be a blackline or blueline ozalid print and a different color shall be used to indicate the area of coverage for each station.
6. When completed and approved, the chart shall be hermetically sealed between two pieces of plastic, each piece being a minimum of 10 mils.
7. These charts shall be completed and approved prior to final inspection of the irrigation system.

19-1.4 Landscape and Irrigation Contract Plans - The Contractor's attention is directed to Section 4-1, "Intent of Contract Plans and Specifications," and Section 4-2, "Accuracy of Contract Plans and Specifications," of the General Provisions of the City Standard Specifications, and the specifications herein. All work called for on the Contract Plans by notes or details shall be furnished and installed whether or not specifically mentioned in these specifications, the Special Provisions, or Bid Proposal Form.

Due to the scale of the Contract Plans, it is not possible to indicate all offsets, fittings, sleeves, etc. which may be required. The Contractor shall carefully investigate the structural and finished conditions affecting all of this work and plan the work accordingly, furnishing such fittings, etc. as may be required to meet such conditions. Contract Plans 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 existing and the new irrigation systems, planting including existing trees and shrubs, architectural features, above and below grade utilities, hydrants, and drainage system.

The Contractor shall be responsible for modifications to the irrigation system to prevent blockage of sprinkler irrigation patterns; to prevent over spray and excessive runoff; and to provide full irrigation coverage to the planted areas.

Modifications shall be reviewed and approved by the Engineer prior to installation. All costs associated with modifications to the irrigation system and verification of utility and underground structure locations including pot-holing shall be considered as included in the Contract Prices paid for the various items of work and no additional compensation will be made therefor. Damage to utility lines, underground structures, etc., shall be repaired at the Contractor's expense to the satisfaction of the Engineer.

The Contractor shall not willfully install the irrigation system as shown on the Contract Plans when it is obvious in the field that obstructions, grade differences or discrepancies in area dimensions exist that might not have been considered in engineering or that will affect layout of the planting. Such obstructions or differences shall be brought to the attention of the Engineer. In the event this notification is not performed, the Contractor shall assume full responsibility for any revision necessary.

19-1.5 Equipment to be Furnished - The Contractor shall furnish to the Engineer, as a part of Contract, two (2) each of the following:

- 1) Any special tools required for removing, disassembling and adjusting each type of sprinkler and valve supplied on this project.
- 2) Keys for each automatic controller.
- 3) Keys for each controller enclosure.
- 4) Quick coupler keys and matching hose swivels for each type of quick coupling valve installed.
- 5) Keys for the hose bib.
- 6) The above equipment shall be turned over to the Engineer at the end of the designated maintenance period. Before final maintenance inspection is scheduled, the Contractor must show evidence that the City has received material.

19-1.6 Handling of PVC Pipe and Fittings - The Contractor is cautioned to exercise care in handling, loading, unloading, and storing of PVC pipe and fittings. All PVC pipe shall be transported in a vehicle which allows the length of pipe to lie flat so as not to subject it to undue bending or concentrated external load at any point. Any section of pipe that has been dented or damaged will be discarded and, if installed, shall be replaced with new piping. Pipes and fittings shall be protected from prolonged exposure to sunlight.

19-1.7 Verification of Site Conditions and Surveys - The Contractor shall, to the satisfaction of the Engineer, lay out the work from the Contract Plans and shall establish all bench marks, monuments, lines and levels necessary for the construction covered by this contract unless otherwise specified herein. All dimensions shall be checked against existing conditions and discrepancies reported immediately to the Engineer. Contractor shall be responsible for establishment of basic layout of entire area to the satisfaction of the Engineer prior to beginning any portion of construction. Any discrepancies arising from preliminary layout shall be resolved prior to construction

19-2 MATERIALS

19-2.1 General - The Contractor shall use only new materials of brands and types noted on the Contract Plans, specified herein, or approved equals.

Schedule 40 pipe shall be used for pipes installed on the discharge side of control valves and Schedule 80 pipe shall be used for continuously pressurized pipe installed on the supply side of control valves. Schedule 80 only, shall be supplied when threaded joints are specified or otherwise permitted by the Engineer.

19-2.2 Plastic Pipe for use with Solvent Weld Socket or Threaded Fittings - Plastic pipe for use with solvent welded socket or threaded fittings shall be rigid unplasticized polyvinyl chloride (PVC) 1120 (Type 1, Grade 2), manufactured in accordance with ASTM D 1785. Plastic pipe marked with product standard PS-21-70 conforms to this standard. The minimum pressure rating shall not be less than the working pressures indicated therein for the schedule and sizes listed.

Fittings and couplings for plastic pipe shall be threaded or slip-fitted tapered socket solvent weld type. Threaded adapters shall be provided with socket pipe for connections to threaded pipe. Plastic pipe fittings and couplings shall be PVC I or PVC I/II material supplied in the same schedule size specified for the pipe. The type of plastic material and schedule size shall be indicated on each fitting or coupling. Fittings and couplings shall comply with the following specifications:

Fitting Type	ASTM Designation
Socket Fittings	
Schedule 40	D 2466
Schedule 80	D 2467
Threaded Fittings	D 2464

19-2.3 Plastic Pipe for Use with Rubber Ring Gaskets - Plastic pipe for use with rubber ring gaskets shall be rigid unplasticized polyvinyl chloride PVC 1120 (Type 1, Grade 1), manufactured in accordance with ASTM D 2241. Plastic pipe marked with product standard PS-22-70 conforms to this standard.

Pipe shall be supplied with plain ends or with an integral thickened expanded bell with rubber ring groove. Couplings for plain end pipe shall be of the single rubber ring type with solvent weld socket on one end or shall be of the double ring type. Rubber ring gaskets shall be a synthetic rubber supplied in accordance with the requirements of ASTM D1869.

Pipe shall be furnished in the following Standard Dimension Ratios (SDR) and Pressure Ratings.

160 psi SDR 26
200 psi SDR 21

19-2.4 Solvent Cement and Primer Solvent cement and primer for PVC solvent-weld pipe and fittings shall be of type and installation methods prescribed by the manufacturer. Acceptable products include P-70 primer by Weld-On, and Weld-On 711 cement, or approved equal.

Pipe joint compound shall be non-hardening, non-toxic materials specifically designed for use on threaded connections in water-carrying pipes. Compound shall be Permatex No. 51, or approved equal.

19-2.5 PVC Pipe Markings All PVC pipe must bear the following markings:

- 1) Manufacturer's name

- 2) Nominal pipe size
- 3) Schedule of class
- 4) Pressure rating in psi
- 5) NSF (National Sanitation Foundation) approval
- 6) Date of extrusion

19-2.6 Hose Bibs - Hose bibs shall be brass construction with removable key handle as indicated on the Contract Plans.

19-2.7 Valves -

19-2.7.1 General - Gate valves shall conform to the specifications of the American Water Works Association and as specified herein. Gate valves shall be installed in accordance with the Contract Plans, Special Provisions and as specified herein.

Valves shall be capable of satisfactory performance at a working pressure of 200 psi. Valves shall be designed to permit easy disassembly for service or repair, without removal of the valve from the irrigation system.

19-2.7.2 Gate Valves 2" and Smaller - Shall:

- 1) Be all bronze double disc wedge type with integral taper seats and non-rising stem, equipped with operating wheel;
- 2) Be installed in nine (9)-inch diameter plastic valve box unless otherwise shown on the Plans;
- 3) Be manufactured by Stockham Valve Co., or approved equal.

19-2.7.3 Gate Valves 2½" and Larger - Shall have the same requirements as Section 19-2.7.2 above, and shall:

- 1) Be iron body, bronze Trimmed, double discs, parallel seats with pin disc spreader mechanism;
- 2) Have a square operating nut, with arrow cast in metal indicating direction of opening;
- 3) Have ends compatible with pipe in which they are being installed;
- 4) Be manufactured by Kennedy Valve Mfg. Co., or approved equal.

19-2.7.4 Manual Control Valves - Manual control valves shall be brass or bronze, and shall be straight or angle pattern globe valves, full opening, key operated with replaceable compression disc and ground joint union on the discharge side.

19-2.7.5 Remote Control Valves - The Contractor shall furnish and install remote control valves as indicated on the Contract Plans, and as further specified herein. Electrical control valves shall:

- 1) Be as listed on the Contract Plans.
- 2) Have a manual flow adjustment.
- 3) Have one control valve box for each electric control valve.
- 4) Be equipped with an approved lock and locking assembly.
- 5) Have each line wire at the valve marked.

See Section 19-4, "Installation," of these Technical Provisions for additional information and requirements.

19-2.7.6 Quick Coupling Valves - Quick coupling valves shall have a brass, or bronze two piece body, designed for working pressure of 150 P.S.I. operable with quick coupler. Key size and type shall be as shown on the Contract Plans. Valves shall have a built in flow control and self-closing valve and supplied in 3/4" size unless shown otherwise on the Contract Plans or required. The valve shall consist of the valve, quick coupler connection and hose swivel. Contractor shall provide three (3) key and swivel hose ells for each quick coupling valve.

Quick coupling valves shall be installed at a distance of 6" to 12" from the nearest adjacent paved area.

19-2.8 Control Wiring - Connections between the automatic controllers and the electrical control valves shall be made with single strand, UL-approved for direct burial in ground, solid copper wire AWG-U.F., 600 volt, conforming to applicable provisions of ASTM D 2219 and 2220. Contractor shall install wires in accordance with the valve manufacturer's specifications and wire chart. In no case shall wire size be less than #14 gauge.

Wires: Control wires shall have an insulating jacket with a color other than white that is unique for each controller. The common wire shall have a white insulating jacket with a stripe of color to match the control wire it serves. The spare wire shall have an insulating jacket with a color that is different from all control or common wires. A separate ground wire shall be provided for each controller.

Wiring shall occupy the same trench and shall be installed along the same route as pressure supply or lateral lines wherever possible. Electrical service wiring shall be run inside a conduit conforming to Section 19-2.

An expansion curl shall be provided within three (3) feet of each wire connection and at least every 100 feet in length. Wrapping at least five turns of wire around a one-inch diameter pipe, then withdrawing pipe shall form expansion curls. Expansion curl shall be of sufficient length at each splice connection at each electric control valve, so that in case of repair, the valve bonnet may be brought to the surface without disconnection of the control wires.

Splices: Splices shall be made in a valve or splice box with 3M-DBY wire splice Scotchlok seal pack, DS-400 Dri-Splice Wire, or approved equal. Use one splice per connector sealing pack. Field splices between the automatic controller and electrical control valves shall not be allowed without prior approval of the Engineer.

19-2.9 Automatic Controllers - Automatic controllers shall be of size and type shown on the Contract Plans, and shall be Rainbird, or approved equal. The Engineer shall approve the final location of automatic controllers.

Power: Unless otherwise noted on the Contract Plans, the 120 volt electrical power to the automatic controller location is to be furnished by a licensed electrical subcontractor and not by the irrigation subcontractor. The final electrical hook-up shall be the responsibility of the irrigation contractor.

Labels: Each new control line wire shall be labeled at controller. See Section 19-4, "Installation," of these Technical Provisions.

Rain Sensing Override: All controllers shall be equipped with an approved rain sensing override device.

19-2.10 Valve Boxes - Unless shown otherwise on the Contract Plans control valve boxes shall be as specified herein.

Gate Valves and Quick Coupling Valves - A 10" round valve box with extension and bolt down cover, Carson Industries 910-12B or approved equal shall be used unless shown otherwise on the Contract Plans, or a larger size is required to accommodate the valve. The valve box shall be bolt lockable.

Electrical Control Valves - Contractor shall install a 12" x 17" x 11-3/4" " rectangular box and bolt down cover for each single electrical control valve. Boxes shall be Carson Industries 1419-12B or approved equal. Boxes shall be bolt lockable. Lids shall be marked "Irrigation Control Valve." Boxes to contain multiple valves shall be sized accordingly, with review and approval by the Engineer as part of Contract Submittals as stipulated in Section 19-1.3 of these Technical Provisions.

19-2.11 Sprinkler Heads - Unless shown otherwise on the Contract Plans, all sprinkler heads shall be Champion, approved equal, and as specified herein.

Spray Heads: Spray heads shall have a manual screw flow adjustment.

Riser Units: Riser units shall be fabricated in accordance with the details shown on the Contract Plans.

Riser Nipples: Riser nipples for all sprinkler heads shall be the same size as the riser opening in the sprinkler body.

Sprinkler Heads: Sprinkler heads shall be brass, and the same type shall be by the same manufacturer.

19-2.12 Sleeves - Even if not shown on the Contract Plans, all water lines installed across streets, sidewalks, walkways and similar features shall be installed in Class 200 PVC pipe. Unless shown otherwise on the Contract Plans the size of the sleeve as a minimum shall be equal to the sum of outside diameters of the pipes being installed plus 1" plus twice the thickness of the coupler.

Sleeves shall extend 12" beyond edges of pavement. Removable non-decaying plugs shall be installed at sleeve ends to prevent the intrusion of dirt and debris. There shall be no ringtite couplings inside of sleeves. Where length of sleeve exceeds 15' in length and where ringtite pipe is designated to be installed at sleeve location, substitute class 315 solvent weld pipe and Schedule 40 solvent weld fittings inside sleeve.

The Contractor shall be responsible for coordinating sleeve and pipe locations with other trench work and paving installations prior to installation.

19-2.13 Conduit for Electrical Wiring - All low voltage electrical wire shall be installed in schedule 40 PVC gray conduit. Unless specified otherwise on the Contract Plans the minimum conduit size shall be equal to the total thickness of all wires to be contained in the conduit plus 1".

Conduit shall extend into splice boxes, or other enclosures. Where splice box is located in paved area, provide capped stub-out conduit piece extending out from box at least 12" into planting bed area.

Splice boxes, which must be installed in paved areas, are to be concrete valve boxes approved by the Engineer. Boxes shall not be installed in streets, driveways, or in locations where there is vehicular traffic. The Contractor shall be responsible for coordinating conduit locations with other trench work and paving installations prior to installation.

The conduit installed to a utility company electrical service location shall be minimum two (2) inches in diameter. Ends of conduits in a pull boxes shall have a bell bushing and be at minimum four (4) inches above the rock base and six (6) inches below the top of box.

19-2.14 Backflow Prevention Devices - Backflow prevention devices shall be installed in accordance with the Contract Plans, Special Provisions and as specified herein.

19-2.14.1 Reduced Pressure Type Backflow Preventer - ASSE 1013, backflow preventer shall be of the reduced pressure principle type conforming to the applicable requirements of AWWA C506. A certificate of Full Approval or a current Certificate of Approval shall be furnished for each design, size, and make of backflow preventer being provided for the project. The certificate shall be from the Foundation for Cross-Connection Control and Hydraulic Research, University of Southern California, and shall attest that this design, size and make of backflow preventer has satisfactorily passed the complete sequence of performance testing and evaluation for the respective level of approval. A Certificate of Provisional Approval will not be acceptable in lieu of the above.

Reduced pressure type backflow preventer shall be Febco 825Y, Wilkins Model 575R, or approved.

The backflow preventer shall be installed in an enclosure as detailed on the Contract Plans. If an enclosure is not shown on the Contract Plans the Contractor shall furnish and install an enclosure as approved by the Engineer.

19-2.14.2 Double Check Valve Assembly - Double check valve assembly where required shall be a Febco No. 805, Hershey No. 1 or approved equal. The check valve shall be installed in a concrete box with lockable reinforced concrete lid, as approved by the Engineer.

19-2.15 Flushing End Plugs - The Contractor shall furnish and install one flushing end plug at the end of each lateral in any drip irrigation system installed under the contract. The flushing end plug shall be housed in Carson Box No. 910-12B, or approved equal.

19-2.16 Pressure Reducing Valves - Unless shown otherwise on the Contract Plans, pressure reducing valves shall be Wilkins Model 90 - $\frac{3}{4}$ ", or approved equal. The discharge pressure shall be set at 30 PSI.

19-2.17 Filters - Unless shown otherwise on the Contract Plans, filters where required shall be installed on emitter manifold and shall be Irri-Delco $\frac{3}{4}$ "-39-0 filter with 155 mesh stainless steel screen and flush valve, or approved equal. Emitter manifold assembly shall be installed in a lockable box.

19-2.18 Emitters

Risers - Unless shown otherwise on the Contract Plans, emitter riser, where required, shall be $\frac{1}{2}$ " IPS Flexible Hose (.840 O.D.) Only IPS Weld-on #795 solvent weld cement shall be used.

Emitter Assembly - Unless shown otherwise on the Contract Plans emitter assemblies, where required, shall be as provided for herein.

Single Outlet Emitter: Emitter assembly shall consist of a $\frac{1}{2}$ " schedule 80 PVC Male adapter (gray), a Salco RA 125T Adapter or approved equal, and a Salco emitter or approved equal.

Multiple Outlet Emitter: Emitter assembly shall consist of a ½" schedule 40 PVC Male Adapter, a RA 125T, ½" adapter, a Salco PC6-1 Multi-Outlet Emitter, Salco Distribution Tubing #CT-125 PVC, Salco EOCV Emitter Outlet Check Valves on Tips of Distribution Tubing and a Salco DAS-8 Emitter Access Sleeve, all products as specified or approved equal.

19-2.19 Backflow Preventer Enclosure - Backflow preventer shall be housed in an expanded metal enclosure as specified herein.

Size - As shown on the Contract Drawings or specified in the Special Provisions. The minimum size shall be no less than the overall dimension of the backflow preventer plus 6-inches clearance on all sides.

Materials - Frame shall be 10-gage cold rolled, formed steel angle. Cage shall be diamond pattern, 1-1/2" number 9, flattened, expanded metal, allowing full view of the backflow preventer.

Hardware - The enclosure shall be equipped with the following

- 1) Locking tabs or 3/8" U-Bolt for padlock security
- 2) Easy lift handles
- 3) Hinged at one end of the base for service and testing

Powder Coating - All metal shall be powdered coated with a high performance polymer alloy. The coating shall be black unless specified otherwise in the Special Provisions, or shown otherwise on the Contract Plans.

Foundation Base - The enclosure shall be mounted on a four-inch thick concrete pad. Unless shown otherwise on the Contract Plans, the concrete pad shall be constructed in accordance with Section 17-7, "Minor Concrete Structures," of these Technical Provisions.

Shop Drawings - The Engineer shall approve shop drawings of the enclosure prior to its manufacture.

19-3 PREPARATION

19-3.1 Physical Layout- Prior to installation, the Contractor shall stake out all pressure supply lines, routing and location of sprinkler heads. The Contractor shall coordinate drip, bubbler and spray system with approved plant layout prior to installation of any irrigation piping. The Engineer shall approve the layout prior to installation.

19-3.2 Water Supply - The irrigation system shall be connected by the Contractor to the water supply as indicated on the Contract Plans, as approved by the Engineer.

19-3.3 Electrical Source - The electrical connections for automatic controller wiring shall be made by the Contractor to electrical service points as indicated on the Contract Plans. Contractor is responsible for minor changes required to adapt to site conditions.

19-4 INSTALLATION

19-4.1 General - The Contractor is responsible for coordinating work with paving installations and/or removal and repair of all asphalt and/or concrete paving necessary to install the irrigation system as shown on the Contract Plans

19-4.2 Trenching - Trenching shall be in accordance with Section 18-1, "Trenching," of these Technical Provisions, Section 6-11, "General Safety," of the General Provisions, and as specified herein.

Trenches shall be dug straight and shall support pipe continuously along the bottom of the trench. Pipe shall be laid to an even grade. Trenching excavation shall follow layout indicated on Contract Plans or the Contractor's layout approved by the Engineer. Contractor shall lay out pipe runs so as to minimize the number of bends requiring elbows and connection fittings. Where possible, pipelines and control wirings may be installed in common trenches.

Where it is necessary to excavate adjacent to existing trees, the Contractor shall exercise care to avoid injury to trees and tree roots. Excavation in areas where two (2) inch and larger roots occur shall be done by hand. All roots two (2) inches and larger in diameter, except directly in the space occupied by the pipe, shall be tunneled under and wrapped with

burlap and kept damp, to prevent scarring or excessive drying. Damaged or cut roots greater than two (2) shall be well painted with an approved sealer.

To protect existing trees the Engineer may require the Contractor to use smaller equipment, including hand operated tools. Existing trees within the limits of construction not to be removed shall be protected and treated in accordance with Section 22-3, "Tree and Plant Protection" of these Technical Provisions.

Trenches within the spring line of trees, which are not backfilled within twenty-four (24) hours, shall be covered with damp burlap or canvas. The burlap or canvass shall be kept moist until the trench is backfilled.

When trenching near a location equipped with a traffic signal, Contractor shall identify locations of existing traffic signal loop detectors and wires. Contractor shall hand-dig all trenches crossing said loops and wires to avoid damage to them. Contractor shall notify the Engineer of any damages resulting from his operation. Contractor shall perform the necessary repairs within twenty-four (24) hours at his sole expense.

Subgrade of all trenches shall be flush with the adjoining subgrade. The Contractor shall set in place, cap, and pressure test all piping to be under pavement prior to the paving work.

Where shown on the Contact Plans, or provided for by the Bid Proposal, piping under existing sidewalks and pavement shall be installed without removal or damage to the existing sidewalk or pavement. Where cutting or breaking of pavement or sidewalks is allowed or required, pavement or sidewalk shall be removed and replaced by the Contractor as part of the Contract lump sum price or unit prices paid for Irrigation and no additional compensation shall be allowed therefor. Removal and replacement of asphalt pavement or concrete shall be in accordance with other applicable provisions of the Standard Specifications.

When soils are to be amended, the trenching for installation of irrigation pipes and facilities shall be performed after the soils have been properly amended, tested, and approved by the Engineer. When irrigation pipes and facilities will be placed in an area to receive imported topsoil, any trenching shall be performed after imported topsoil has been placed to a depth of no less than 12 inches above the proposed pipes.

Minimum Cover Requirements ⁽¹⁾			
Irrigation Component	Cover Required Under		
	Vehicle Area	Paved Walk	Landscape Area
Control Wiring	36 inches	24 inches	18 inches
Pipe	36 inches	24 inches	18 inches
Pipe Connecting to Emitters	36 inches	24 inches	12 inches
Sleeves	36 inches	24 inches	N/A

(1) Cover of 36 inches is required in all cases using directional drilling method.

Directional Drilling - No hydraulic driving will be permitted under concrete pavement or sidewalk. At Contractor's option, conduits and sleeves may be installed by directional drilling (or boring) per Section 24, "Directional Drilling" of these Technical Provisions, at no additional cost to City. The minimum depth of pipe shall be 36 inches below surface grade except where entering or exiting a pull box or cabinet. Placement of the directional drilling equipment and alignment of the bore shall be approved by the Engineer prior to boring operation. Pavement shall not be disturbed without permission from the Engineer. In the event obstructions are encountered, upon approval from the Engineer, small holes may be cut in the pavement to locate and remove the obstruction. Excessive use of water, such that pavement might be undermined or subgrade softened, shall not be permitted

19-4.3 Assemblies - All assemblies shall be installed in accordance with the details in the Contract Plans and Special Provisions and as specified herein. In absence of details or specifications pertaining to specific items required to complete work, the performance such work shall be in accordance with best standard practice and as approved by the Engineer.

Routing of sprinkler irrigation lines as indicated on the Contract Plans is diagrammatic the actual layout shall be as approved by the Engineer in the field

Multiple assemblies shall not be installed from mainlines. Each assembly shall have an outlet.

On PVC to metal connections, the Contractor shall work the metal connections first.

Pipe Joint Compound: Permatex 51 pipe joint compound or approved equal, shall be used on all threaded PVC to PVC, and on all threaded PVC to metal joints. Where threaded PVC connections are required, use threaded PVC adapters into which the pipe may be welded. Pipe joint compound shall not be used on threaded connections at sprinkler inlets.

19-4.4 Line Clearance - All lines shall have a minimum clearance of six (6) inches from each other and all other underground lines, except sanitary sewer clearance shall be a minimum of 12" at perpendicular crossings and 2 feet minimum where lines are parallel. Parallel lines shall not be installed directly over one another.

19-4.5 PVC Pipe - All PVC irrigation pipe shall be installed in accordance with the details in the Contract Plans and Special Provisions and as specified herein.

Solvent Weld Joints - Pipe shall be cut with a fine tooth hacksaw or approved PVC cutting tool and any burrs shall be removed. The outside surface of the pipe and the inside surface of the fittings shall be wiped with a clean cloth saturated with methyl isobutyl ketone (MIBK) to remove all dirt and moisture and primed before the cement solution is applied. Insert pipe dry into fitting to check for mis-sizing. Pipe shall enter into fitting by 1/3 to 2/3 of depth of socket. Coat the inside socket surface of the fitting and the male end of the pipe primer. Then without delay, apply cement liberally to the male end of the pipe and lightly to the inside of the socket. At this time, apply a second coat of cement to the pipe end. The cement solution shall be applied to the pipe and fitting socket with a brush having a width approximately three-quarters the depth of the socket. The cement solution shall be applied freely with a light wiping action to spread the cement uniformly over the surfaces. The pipe surface of fitting socket shall not be rubbed with a brush any more than is necessary to spread the cement. If the cement thickens, it shall be discarded.

Immediately after the cement has been applied to the surface to be joined, the pipe shall be inserted into the fitting with a twisting motion to the full depth of the fitting socket. Immediately after joining is completed, any excess cement shall be thoroughly wiped from the pipe and fitting. The joined members shall be aligned without strain to either and shall be allowed to cure for at least fifteen (15) minutes before they are handled. In cold or damp weather, the curing period shall be increased due to slower evaporation of the solvent. An additional fitting or pipe section may be added to the completed joint within five (5) minutes if care is exercised in handling so that a strain is not placed on the previous joint. Joints shall be cured for six (6) hours before allowing water into the pipe.

Threaded Joints – Field threading is not permitted. Only factory-formed threads shall be allowed. Only factory-made nipples shall be used. Only the male pipe threads of all threaded connections on PVC plastic pipe shall be coated with an approved pipe joint compound for use with plastic pipe. A joint shall be taken up no more than one full turn beyond hand tight.

Opening in pipelines shall be plugged or capped to prevent intrusion of dirt and debris. Remove caps and plugs only when necessary to complete assembly. Except as shown on the Contract Plans, PVC plastic pipe placed in a trench shall be laid on level, undisturbed, or well-compacted earth and solvent-weld pipe shall be snaked from side to side in the trench at intervals of approximately 50 feet. Pipe shall be held down between joints with small mounds of earth to prevent movement. After completing the pressure tests on the pipelines and before any backfill is placed, water shall be run through the entire line until the pipe has been cooled to the supply water temperature. The trench shall be immediately backfilled, covering the pipe with soft earth to prevent damage to the pipe. See **Section 19-4.14.3 for backfill specifications.**

19-4.6 Thrust Blocks - Thrust blocks pipe shall be installed in accordance with the details in the Contract Plans and Special Provisions and as specified herein. If thrust blocks are not specifically detailed on the Contract Plans the Contractor shall still be responsible for providing thrust blocks where necessary to resist system pressure on ring-tite gasket pipe and fittings and where directed by the Engineer. Blocks shall be concrete and the size shall be based on an average safe bearing load of soil of 2,000 lbs./sf.

Thrust blocks shall be formed in such a manner that concrete comes in contact only with the fitting, and shall be between solid undisturbed soil and the fitting.

19-4.7 Remote Control Valves - Valves shall be installed in accordance with the details on the Contract Plans, the Special Provisions, the manufacturer's specifications and as specified herein

The mainline shall be thoroughly flushed before installing valves. Valves shall be installed in ground cover or shrub areas no further than twelve (12) inches from the main line whenever possible. When grouped together, valves shall be a minimum of six (6) inches apart (clear distance). There shall be only one remote control valve per box.

Remote control valves shall be adjusted so the sprinkler heads operate at the pressure recommended by the head manufacturer and so a uniform distribution of water is applied by the sprinkler heads to the planting area for each individual valve system.

Each control line wire shall be labeled at each valve with a 2¼" x 2¾" polyurethane or stamped metal I.D. tag, indicating identification number of valve (controller and station number). The label shall be attached to the control wire.

19-4.8 Hose Bib - Hose bids where required, shall be installed in accordance with the details on the Contract Plans, the Special Provisions, the manufacturer's specifications and as specified herein.

19-4.9 Valve Boxes - Contractor's attention is also directed to Section 19-2.10 of these Technical Provisions regarding physical requirements for valve boxes. Valve boxes shall be installed for all valves in accordance with the details on the Contract Plans, the Special Provisions, the manufacturer's specifications and as specified herein.

All valve boxes shall be set to finish grade in lawn areas and 2 inches above finish grade in ground cover areas.

Valve boxes located near walks, curbs, and header boards, shall be installed in such a way as to align with or perpendicular to those items, and with top surface matching plane as items listed above.

Valves boxes shall be installed 12" away from and perpendicular to adjacent improvements. At multiple valve box groups, install boxes 6" apart, measured at finish grade surface. Short side of box shall be parallel to adjacent improvement.

19-4.10 Flushing of System - After all new sprinkler pipe lines and risers are in place and connected, all necessary diversion work completed, and prior to installation of sprinkler heads, the control valves shall be opened and a full head of water used to flush out the system.

Sprinkler heads shall be installed only after flushing of the system has been accomplished to the complete satisfaction of the Engineer.

19-4.11 Sprinkler Heads - Sprinkler heads shall be installed as shown on the Contract Plans. Spacing of heads shall not exceed the maximum indicated on the Contract Plans. In no case shall the spacing exceed the maximum recommended by the manufacturer.

Nozzles on stationary sprinklers shall be tightened after installation and sprinklers having an adjustment stem shall be adjusted on a lateral line for the proper radius, diameter and flow rate. They shall be set perpendicular to finish grade.

Adjacent to existing utility company boxes and other obstructions the spray pattern shall be adjusted as necessary to avoid over-spray on such facilities.

19-4.12 Automatic Controller - Remote control valves shall be installed in accordance with the details on the Contract Plans, the Special Provisions, and the manufacturer's specifications and as specified herein.

Remote control valves shall be connected to controller in numerical sequence as shown on the Contract Plans.

Each control line wire shall have a label attached at the controller. The label shall be permanent non-fading and shall indicate the station number of each valve being controlled.

Low Voltage Control Wiring - A single common wire as previously described in these specifications shall be installed from the controller to the control valves in series.

For each control valve, a separate control wire shall be installed, as previously described herein, from the Controller to each control valve serviced by the controller. Each control line wire shall be labeled at the controller with a permanent

non-fading ink indicating the station number of the valve controlled. Contractor shall tie wires in bundles with pipe wrapping tape at ten (10)-foot intervals and allow sufficient slack for contraction between strappings. This shall be not be done when wires run inside conduits. At each valve box three (3) feet of slack of all wires shall be provided. Connections shall be made by crimping wires with brass connectors and sealing with watertight resin sealer packs.

A single spare wire, as previously described herein, shall be installed from the controller and stubbed into each valve box in series. The spare wire is not to be connected to any equipment at the time of installation.

Splicing shall not be allowed, except where runs exceed 2,500 feet, in which case splices are allowed within valve boxes.

High Voltage Wiring for Automatic Controller - the Contractor shall provide A 120-volt power source and service switch for the automatic controller. The Contractor shall install the wires from the 120-volt power service switch to the controller.

The Contractor shall provide and install the service unit and meter socket and make the connection between the power source and the controller.

Adequate coverage and protection of the 24-volt service wire leading from the controller shall be maintained from the bottom of the controller.

19-4.13 Testing -.

19-4.13.1 General - After the entire irrigation system has been completely installed, a complete test of the entire installation shall be made by the Contractor in the presence of the Engineer, prior to installation of landscaping. Contractor shall request the presence of the Engineer seventy-two (72) hours in advance of performing testing.

19-4.13.2 Testing of Service Lines - Prior to backfilled, each section of the pipe to be tested shall be slowly filled with water and all air shall be expelled from the pipe. The valves controlling the admission of water into the section of pipe to be tested should be opened wide before shutting hydrants or blowoff. After the system has been filled with water and all air expelled, all valves controlling the section to be tested shall be closed and the line be allowed to set for a period of not less than 24 hours.

The pipe shall then be refilled, if necessary, and subjected to a pressure of not less than 125 lbs. per square inch or the service pressure plus 50 pounds, whichever is greater for a period of six (6) hours. Service line is considered to pass test if the test pressure is maintained during the duration of the test period and the leakage is no greater than that specified below.

All exposed pipe, fittings, valves, and joints shall be carefully examined during the pressure test. Any cracked or defective pipe, fittings, or valves discovered during the test shall be removed and replaced with sound material and the test repeated until the system is proved satisfactory by the Engineer.

For a hydrostatic test, the allowable leakage in gallons is equal to diameter (inches) x length (feet) x 0.00158. The test water shall be left in the mains until backfilling operations are completed.

After backfilling is completed, and before pavement sections are installed, the test shall be run again and no section shall be allowed a leakage greater than that of the hydrostatic test.

19-4.13.3 Testing of System

After all new sprinkler piping and risers are in place and connected, and all necessary division work has been completed and prior to the installation of sprinkler heads, control valves shall be opened and a full head of water used to flush out the system. After the system is thoroughly flushed, risers shall be capped off and the system pressure tested. At drip system, cap tees before flexible riser is installed. Request the presence of the Engineer in writing at least seventy-two (72) hours in advance of testing. All testing shall be done in the presence of the Engineer or the Engineer's authorized representative.

A continuous static water pressure of 120 psi shall be applied to all main lines and 60-psi to all lateral lines. Welded plastic joints shall have cured at least 24 hours, and all risers capped prior to pressure testing. The duration of testing shall be as follows:

- 1) Test main lines and sub-mains for 4 hours.
- 2) Test lateral lines for 2 hours.

Pressure readings shall remain constant during the duration of the test. Any leak shall be repair as approved by the Engineer and the line re-tested. Pressure testing shall continue until no leakage or loss of pressure is shown over the entire prescribed test period.

At successfully passing the pressure test, the heads, flexible risers, and emitters shall be installed and tested for operation in accordance with design requirements under normal operating pressure.

19-4.13.4 Electrical System - Prior to acceptance of the work, the Contractor shall cause the following tests to be made:

- 1) For continuity of each circuit.
- 2) For grounds in each circuit.
- 3) A megger test on each circuit.
- 4) A functional test in which it is demonstrated that each and every part of the system functions as specified or intended.

19-4.14 Backfilling

19-4.14.1 General - Backfill of trenches shall conform to Section 18-2, "Bedding," and 18-7, "Backfill," of these Technical Provisions, and as specified herein. Notwithstanding any Project Specifications, Contractor shall ensure that backfill adjacent to plastic pipes do not contain sharp objects that may damage pipes.

Trenches shall not be backfilled until all required tests have been performed and passed. If settlement occurs and subsequent adjustments and/or repairs in pipe, valves, sprinkler heads, lawn or planting, or other construction are necessary, the Contractor shall make all required adjustments and repairs at the Contractors expense.

19-4.14.2 Paved Streets and Walkway Areas - Backfilling of trenches within paved streets or walks shall be performed in accordance with to Section 18-2, "Bedding," and 18-6, "Backfill," of these Technical Provisions.

19-4.14.3 Non-Street or Walkway Areas -

Initial Backfill - Initial backfill includes pipe bedding and the section of trench 6 inches above the pipe. A layer of approved fine granular material shall be carefully placed and compacted around and above the pipe. No foreign matter larger than one-half ½" in size will be permitted in the initial backfill. The initial compaction shall be to 85% relative compaction.

Intermediate Backfill - After completion of the initial backfill the section of trench above the initial backfill to within 6 inches of finish grade shall be carefully backfilled with soils as approved by the Engineer. Soils for intermediate backfill shall consist of clean earth, loam, sandy clay and/or sand. Backfill shall be free from large clods, stones, or deleterious materials.

Backfill shall be compacted to 90% relative compaction. The finish grade shall conform to adjacent grades without dips, sunken areas, humps or other surface irregularities.

Final Backfill - The final six inches of trench shall be backfilled with approved topsoil to 85% relative compaction.

19-4.15 Adjustment of the System - The Contractor shall flush and adjust all sprinkler heads for optimum performance and to prevent over-spray as much as possible.

If it is determined that adjustments in the irrigation equipment will provide proper and more adequate coverage, the Contractor shall make such adjustments after approval by the Engineer, prior to planting. Adjustments may also include changes in nozzle or screen sizes and degrees of arc as required. Contractor is responsible for providing full coverage of all planted areas, with no flooding or dry spots.

Lowering raised sprinkler heads by the Contractor shall be accomplished within ten (10) days after notification by the Engineer.

The irrigation system shall also be tested at the time of final inspection for planting. If in the opinion of the Engineer, any portion of the irrigation system is found to be defective or damaged the Contractor shall make all required repairs or replacement to meet the requirements of the irrigation specifications at the Contractor's expense. The Contractor shall make repairs within two weeks after final inspection of the planting.

19-5 MAINTENANCE - The irrigation system shall be maintained, repaired and adjusted by the Contractor during the required landscape maintenance period as set forth by Section 20-8, "Maintenance," of these Technical Provisions, and as specified herein.

Soil moisture at the plant root balls in each watering zone shall be checked prior to watering. The Contractor shall be responsible for adjusting watering cycles so that plants receive sufficient water to ensure vigorous growth without allowing soil to become over saturated with water.

If the Contractor is not, in the opinion of the Engineer, properly maintaining the irrigation system the City may have any required work performed and deducted any such costs thereof, plus 20 percent markup for administration, from monies due or to become due to the Contractor.

19-6 FINAL MAINTENANCE INSPECTION - At the time of the performance of the final maintenance inspection of the landscaping in accordance with Section 20-8.6, "Final Maintenance Inspection," of these Technical Provisions the complete irrigation system shall also be inspected and tested.

19-7 ACCEPTANCE - After successful completion of the required maintenance period the irrigation system will be accepted by the Engineer. Prior to acceptance, Contractor shall provide training to the Engineer in the complete operation of the irrigation system. Submittal of operating manuals does not constitute training. A minimum of three (3) training sessions of (4) hours each shall be provided. Upon written acceptance of the landscaping by the Engineer, the Contractor shall be relieved from any further maintenance.

Relief from maintenance shall not be construed as releasing the Contractor from the provisions of any applicable warranties.

Acceptance of the irrigation system by the City will be separate from the project as a whole and will be contingent upon proper maintenance and performance of the system. Any portion thereof which does not perform as specified, or as required to adequately irrigate the landscaping for which it is intended to serve, will be subject to continued maintenance and correction at the Contractor's expense.

If project improvements, corrective work, and maintenance have not been performed as specified, and to the satisfaction of the Engineer, maintenance shall continue at the Contractor's expense until the work has been successfully completed and accepted by the City.

19-8 GUARANTEE - All components of the irrigation system shall be guaranteed for a period of one year after final acceptance of the project by the City Council for the purpose of filing a Notice of Completion, or thirty (30) calendar days following acceptance of the irrigation system by the City at the conclusion of the required maintenance period, which ever is later.

During the guarantee period, within 15 calendar days of notification by the Engineer, the Contractor shall, at Contractor's own expense, remove and replace any defective or damaged component of the irrigation system.

Replacements shall be made to same specifications as required for original components and shall carry the same guarantee and such guarantee shall commence from the time they are replaced.

19-9 MEASUREMENT - The irrigation system shall be measured as a lump sum or by contract units as provided for in the "Bid Proposal". Maintenance shall be measured as a lump sum item in combination with the Bid price for "Landscape Maintenance". There shall be no separate measurement for required guarantees.

19-10 PAYMENT

19-10.1 General - The Contract lump sum bid price, or unit prices paid, shall be considered as full compensation for furnishing all labor, materials, tools, equipment, incidentals and for doing all work required to construct the irrigation system, including but not necessarily limited to; layout, trenching, backfilling, and testing, as shown on the Contract Plans and as specified, and no additional compensation shall be allowed therefor.

When there are no separate contract items for materials necessary to complete the irrigation system, such materials shall be furnished and installed. Full compensation for this work and materials shall be considered as included in the prices paid for the various bid items, or lump sum price paid, for the irrigation system, and no additional payment will be made therefore.

The provisions of Section 9, "Measurement and Payments," of the General Provisions of the City Standard Specifications, are hereby modified as necessary to comply with these provisions.

19-10.2 Guarantee - There shall be no separate payment for guarantees required or provided under the Contract. Full compensation for furnishing and compliance to guarantee requirements shall be considered as included in various contract items of work and no separate compensation shall be allowed therefor.

19-10.3 Maintenance - The contract price for performing Landscape Maintenance as specified in Section 20-11.3 of these Technical Provisions shall include full compensation for maintenance and repair of the irrigation system during the specified maintenance period.