914 - LAWN SPRINKLER SYSTEM

914.1 DESCRIPTION

Furnish all labor, materials, supplies, equipment, tools, and transportation, and perform all operations in connection with and reasonably incidental to the detailed design and complete installation of the irrigation system, and guarantee/warranty as shown on the drawings, the installation details, and as specified herein.

Procurement of all applicable licenses, permits, and fees.

Coordination of Utility Locates ("Call Before You Dig").

Detailed layout, hydraulic, and installation detail design of the irrigation system.

Provision and connection of backflow preventers, water tap, and connections necessary for irrigation system.

Connection of water supply to the irrigation system.

Maintenance period.

Sleeving for irrigation pipe and wire.

Provisions of electrical power supply to the irrigation system.

Contractor shall provide to the Engineer a “Plan of Action” for repairs to the existing irrigation systems. The “Plan of Action” shall include a time schedule when repairs will occur and a listing of materials required to make a fully operational irrigation system.

a. References:

American Society for Testing and Materials (ASTM):

(1) ASTM B62-96: Standard Specification for Composition Bronze or Ounce Metal Castings.

(2) ASTM D1785-96a: Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Schedule 40, 80, and 120.

(3) ASTM D2464-93: Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.

(4) ASTM D2467-96a: Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.

(5) ASTM D2564-93: Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.

(6) ASTM D2774-72 (1983): Standard Practice for Underground Installation of Thermoplastic Pressure Piping.

(7) ASTM F645-95: Standard Guide for Selection; Design, and Installation of Thermoplastic Water Pressure Piping Systems.

(8) ASTM F690-86: Standard Practice for Underground Installation of Thermoplastic Pressure Piping Irrigation Systems.

National Fire Protection Association (NFPA):

(9) NFPA 70, 1996 Edition: National Electrical Code.

b. Design Requirements:

(1) Consultant Design:

Intent: The intent of the irrigation design documents presented herein is to provide the Irrigation Contractor and Irrigation Consultant with a starting point for the preparation of detailed design and installation drawings. The documents set the desired level of excellence, flexibility, and efficiency expected of the irrigation system.

(2) Contractor Requirements:

General Requirements: Provide detailed irrigation system installation drawings for the sprinkler and drip irrigation systems including but not limited to sleeving and mainline pipe sizing; remote control valve locations and sizing; lateral pipe routing and sizing; sprinkler and drip irrigation layout; controller

size and stationing; control wire routing and sizing; and booster pump sizing. Coordinate provision of electrical power for the irrigation system.

In the areas which require repair to an existing irrigation system, the contractor shall provide all appurtenances necessary to make a fully operational system or as noted on the plans.

Irrigation Design Consultant Qualifications: the person or company completing the detailed design shall be a current professional member of the American Society of Irrigation Consultants or an IA (Irrigation Association) Certified Irrigation Designer and shall be normally engaged as an independent professional in the practice of irrigation consultation or irrigation engineering.

The irrigation consultant is expected to investigate the water supply and electrical supply and coordinate with the general contractor.

The irrigation consultant shall investigate all existing head types and spray patterns and provide equal replacement.

The irrigation consultant is expected to prepare drawings for a system that includes:

(a) Backflow prevention assembly.

(b) A central controller.

(c) Design details.

(3) Remote Control Valves:

Individual turf laterals must have a capacity for a maximum flow of 80 GPM to 120 GPM.

Individual drip zones must have a capacity for a maximum flow of 10 GPM.

1-inch remote control valves must have a flow capacity between 0 to 25 GPM.

1 ½-inch remote control valves must have a flow capacity between 25 to 60 GPM.

2-inch remote control valves must have a flow capacity between 60 to 120 GPM.

Spray sprinklers, rotary sprinklers, and drip emitters should be installed on separate laterals.

Areas with different exposures must be on separate remote control valves. For example, turf in a parking island should be on a separate lateral from turf in a pedestrian area.

(4) Pipe:

Mainline pipe velocities must not exceed 5 FPS. Lateral pipe velocities must not exceed 7.5 FPS.

Maximum allowable variation between the highest and lowest sprinkler operating pressures on an individual lateral must not exceed 10%.

Minimum mainline pipe size is 1 ¼-inch. Minimum sprinkler lateral pipe size is 1-inch. Minimum drip lateral pipe size is 3/4-inch.

(5) Sprinkler Layout Guidelines:

Use pop-up spray sprinklers on turf areas and annual planting beds. Use pop-up spray sprinklers in areas less than 30 feet in width or in areas, which are oddly shaped.

Use pop-up rotary sprinkles in turf areas. Use pop-up rotary sprinklers in areas greater than 30 feet in width.

Use a sprinkler nozzle and spacing combination such that the scheduling coefficient for every sprinkler lateral is between 1.15 and 1.2. If a maximum scheduling coefficient of 1.2 can not be achieved, use a sprinkler nozzle and spacing combination to achieve the minimum scheduling coefficient possible and present data supporting the choice.

Trim out all hardscape areas. Layout sprinklers to minimize overspray onto sidewalks, buildings, and attractions.

Spray sprinklers on an individual lateral must have matched precipitation rate nozzles.

Nozzles for rotary sprinklers on an individual lateral must approximate a uniform precipitation rate.

(6) Drip Layout

Drip irrigate trees, shrubs, and groundcover in planting beds and trees in tree wells.

Use single outlet emitters on trees, shrubs and groundcover in planting beds. Use multi-outlet emitters on trees in tree wells.

Trees in planting beds to be controlled on separate laterals from trees in tree wells.

Controller Stationing/Sequencing

Assign only one remote control valve per controller station. Simultaneous operation of remote control valves may be needed to optimize the available flow. Simultaneous operation of remote control valves on a single controller should occur via use of the central control system, not by hardwiring multiple valves to a single station.

Assign station numbers in a logical manner to allow maintenance personnel to easily inspect the operation of the system on a regular basis.

c. Submittals:

Shop drawings shall be submitted in accordance with the Shop Drawings section in the General Conditions.

(1) Materials List: Include pipe, fittings, mainline components, water emission components, and control system components. Quantities of materials need not be included.

(2) Manufacturers' Data: Submit 7 copies of manufacturers' catalog cuts, specifications, and operating instructions for equipment shown on the materials list.

(3) Detailed Irrigation Layout Drawings/Shop Drawings:

Complete detailed irrigation layout drawings using CAD techniques.

Submit copies of layout drawings showing remote control valve locations and sizing, lateral pipe routing and sizing, sprinkler layout, emitter layout, controller sizes, and controller stationing.

Submit copies of hydraulic calculations for each point of connection showing friction loss calculations from the point of connection to the most remote water emission device for the worst case spray sprinkler, rotary sprinkler, bubbler, and drip emitter laterals. List the highest and lowest sprinkler operating pressures on the lateral.

Submit copies of uniformity evaluation charts for each sprinkler/nozzle/spacing combination showing the scheduling coefficient for the critical 1%, 5%, 10% window size.

Submit copies of control wire diagrams including sizing and calculations verifying that the control wire size is in accordance with valve manufacturer’s printed recommendations.

Submit copies of detailed controller enclosure drawings to show all dimensions of control equipment inside the cabinet.

d. Rules and Regulations:

Work and materials shall be in accordance with the latest edition of the National Electric Code, the Uniform Plumbing Code as published by the Western Plumbing Officials Association, and applicable laws and regulations of the governing authorities.

When the contract documents call for materials or construction of a better quality or larger size than required by the above-mentioned rules and regulations, provide the quality and size required by the contract documents.

If quantities are provided either in these specifications or on the drawings, these quantities are provided <u>for information only</u>. It is the Contractor's responsibility to determine the actual quantities of all material, equipment, and supplies required by the project and to complete an independent estimate of quantities and wastage.

e. Testing:

Notify the Engineer three days in advance of testing.

Pipelines jointed with rubber gaskets or threaded connections may be subjected to a pressure test at any time after partial completion of backfill. Pipelines jointed with solvent-welded PVC joints shall be allowed to cure at least 24 hours before testing.

Subsections of mainline pipe may be tested independently, subject to the review of the Engineer.

Furnish clean, clear water, pumps, labor, fittings, and equipment necessary to conduct tests or retest.

(1) Hydrostatic Pressure Test:

Subject mainline pipe to a hydrostatic pressure equal to the anticipated operating pressure for two hours. Test with mainline components installed.

Subject lateral pipe to a hydrostatic pressure equal to the anticipated operating pressure.

Backfill to prevent pipe from moving under pressure. Expose couplings and fittings.

Leakage will be detected by visual inspection. Replace defective pipe, fitting, joint, valve, or appurtenance. Repeat the test until the pipe passes test.

Cement or caulking to seal leaks is prohibited.

(2) Hydrostatic Pressure Test (Gasketed Pipe):

Close tightly isolation gate valves and sprinkler lateral isolation gate valves on mainline for tests. Backfill to prevent pipe from moving under pressure.

Test each section of pipe between isolation gates valves on the mainline pipe separately.

Purge all air from the pipeline before test. Attach pressure gauge to pipeline in test section. Attaching pressure gauge immediately downstream of one sprinkler lateral isolation gate in the test section is acceptable.

Subject mainline pipe to the anticipated operating pressure for two hours. Observe pressure loss on pressure gauge. If pressure loss is greater than 2 PSI, identify reason for pressure loss. Replace defective pipe, fitting, joint, valve, or appurtenance. Repeat the test until the pressure loss is equal to or less than 2 PSI.

Cement or caulking to seal leaks is prohibited.

(3) Operational Test:

Activate each remote control valve in sequence from controller. The Engineer and Property Owner will visually observe operation, water application patterns, and leakage.

Replace defective remote control valve, solenoid, wiring, or appurtenance to correct operational deficiencies.

Replace, adjust, or move water emission devices to correct operational or coverage deficiencies.

Replace defective pipe, fitting, joint, valve, sprinkler, or appurtenance to correct leakage problems. Cement or caulking to seal leaks is prohibited.

Repeat test(s) until each lateral passes all tests. Repeat tests, replace components, and correct deficiencies at no additional cost to the City.

f. Construction Review:

The purpose of on-site reviews by the Engineer is to periodically observe the work in progress, the Contractor's interpretation of the construction documents, and to address questions with regard to the installation.

Scheduled reviews such as those for irrigation system layout or testing must be scheduled with the Engineer as required by these specifications.

Impromptu reviews may occur at any time during the project.

A review will occur at the completion of the irrigation system installation and Project Record (As-Built) Drawing submittal.

g. Guarantee/Warranty and Replacement:

The purpose of this guarantee/warranty is to insure that the City receives irrigation materials of prime quality, installed and maintained in a thorough and careful manner.

For a period of two (2) years from commencement of the formal maintenance period, guarantee/warranty irrigation materials, equipment, and workmanship against defects. Fill and repair depressions. Restore landscape or structural features damaged by the settlement of irrigation trenches or excavations. Repair damage to the premises caused by a defective item. Make repairs within seven days of notification from the Engineer.

Contract documents govern replacements identically as with new work. Make replacements at no additional cost to the contract price.

Guarantee/warranty applies to originally installed materials and equipment and replacements made during the guarantee/warranty period.

914.2 MATERIALS

a. Quality:

Use materials, which are new and without flaws or defects of any type, and which are the best of their class and kind.

b. Substitutions:

Acceptable equipment manufacturer is Toro, Rain Bird, Hunter or approved equal.

Any pipe sizes referenced in the construction documents are minimum sizes, and may be increased at the option of the Contractor or increased in consideration of the finalized hydraulic requirements of the system.

c. Sleeving:

The sleeving shall be installed per the following specifications and shall be field located and installed subsidiary to the irrigation system lump sum pay item.

(1) Sleeving beneath streets, ramps and through walls shall be Class 200, SDR-21 pipe in accordance to ASTM D2241.

(2) Sleeving diameter: sleeve sizes shall be 2 times the size of mainline or lateral pipe or as shown on the irrigation plans.

(3) Additional sleeving, if required, shall be pushed by mechanical methods beneath existing paved areas.

d. Irrigation Tap and Water Meter:

The Contractor will be responsible for all materials, labor and connection fees necessary as required to make utility connections for water to the Irrigation System. This work will not be paid for directly but will be subsidiary to the Bid Item “Lawn Sprinkler System”.

e. Pipe and Fittings:

(1) Mainline Pipe and Fittings:

Use rigid, unplasticized polyvinyl chloride (PVC) 1120, 1220 National Sanitation Foundation (NSF) approved pipe, extruded from material meeting the requirements of Cell Classification 12454-A or 12454-B, ASTM Standard D1784, with an integral belled end.

Use Class 200, SDR-21, rated at 200 PSI, conforming to the dimensions and tolerances established by ASTM Standard D2241. Use PVC pipe rated at higher pressures than Class 200 in the case of small nominal diameters, which are not manufactured in Class 200.

Use rubber-gasketed pipe equipped with factory installed reinforced gaskets for mainline pipe with a nominal diameter greater than or equal to 3-inches. Gasketed pipe joints must conform to the “Laboratory Qualifying Tests” section of ASTM D3139. Gasket material must conform to ASTM F477. Use rubber-gasketed deep bell ductile iron fittings conforming to ASTM A-536 and ASTM F-477. Use lubricant approved by the pipe manufacturer.

Use solvent weld pipe for mainline pipe with a nominal diameter less than 3-inches or where a pipe connection occurs in a sleeve. Use Schedule 40, Type 1, PVC solvent weld fittings conforming to ASTM Standards D2466 and D1784. Use primer approved by the pipe manufacturer. Solvent cement to conform to ASTM Standard D2564.

(2) Lateral Pipe and Fittings:

Use rigid, unplasticized polyvinyl chloride (PVC) 1120, 1220 National Sanitation Foundation (NSF) approved pipe, extruded from material meeting the requirements of Cell Classification 12454-A or 12454-B, ASTM Standard D1784, with an integral belled end suitable for solvent welding.

Use Class 160, SDR-26, rated at 160 PSI, conforming to the dimensions and tolerances established by ASTM Standard D2241. Use solvent weld pipe for lateral pipe. Use Schedule 40, Type 1, PVC solvent weld fittings conforming to ASTM Standards D2466 and D1784 for PVC pipe. Use primer approved by the pipe manufacturer. Solvent cement to conform to ASTM Standard D2564, of a type approved by the pipe manufacturer.

For drip irrigation laterals, use UV radiation resistant polyethylene pipe manufactured from Prime Union Carbide G-resin 7510 Natural 7 manufactured by Union Carbide or a Union Carbide Licensee with a minimum of 2% carbon black. Use PVC/compression line fittings compatible with the drip lateral pipe. Use tubing stakes or landscape fabric staples to hold above-ground pipe in place.

(3) Specialized Pipe and Fittings:

Copper pipe: Use Type "K" rigid conforming to ASTM Standard B88. Use wrought copper or cast bronze fittings, soldered or threaded per the installation details. Use 95% tin and 5% antimony solder.

Ductile iron pipe: Use Class 50 conforming to ANSI A21.51 (AWWA C151). Use a minimum of Class 53 thickness pipe for flanged piping. Use mechanical joints conforming to ANSI A 21.10 (AWWA C110) and ANSI A21.11 (AWWA C111) or flanged fittings conforming to ANSI/AWWA C110 and ANSI B16.1 (125#).

Use a dielectric union wherever a copper-based metal (copper, brass, and bronze) is joined to an iron-based metal (iron, galvanized steel, and stainless steel).

Low Density Polyethylene Hose:

Use pipe specifically intended for use as a flexible swing joint.

Inside diameter: 0.490±0.010 inch.

Wall thickness: 0.100±0.010 inch.

Color: Black.

Use spiral barb fittings supplied by the same manufacturer as the hose.

Assemblies calling for threaded pipe connections shall utilize PVC Schedule 80 nipples and PVC Schedule 40 threaded fittings.

Joint sealant: Use only teflon-type tape or teflon based paste pipe joint sealant on plastic threads. Use nonhardening, nontoxic pipe joint sealant formulated for use on water-carrying pipes on metal threaded connections.

(4) Thrust Blocks:

Use thrust blocks for fittings on pipe greater than or equal to 3-inch diameter or any diameter rubber gasketed pipe.

Use 3,000 PSI concrete.

Use 2 mil plastic.

Use No. 4 Rebar wrapped or painted with asphalt tar based mastic coating.

(5) Joint Restraint Harness:

Use a joint restraint harness wherever joints are not positively restrained by flanged fittings, threaded fittings, and/or thrust blocks.

Use a joint restraint harness with transition fittings between metal and PVC pipe, where weak trench banks do not allow the use of thrust blocks, or where extra support is required to retain a fitting or joint.

Use bolts, nuts, retaining clamps, all-thread, or other joint restraint harness materials, which are zinc plated or galvanized.

Use on pipe greater than or equal to 3-inch diameter or any diameter rubber gasketed pipe.

f. Mainline Components:

(1) Winterization Assembly

Install a 3/4-inch quick-couple valve downstream of the Backflow Prevention Assembly for the injection of compressed air into the mainline.

(2) Backflow Prevention Assembly

Acceptable manufacturer for the backflow prevention device is Febco or approved equal. Acceptable manufacturer for the backflow enclosure is Strongbox.

(3) Isolation Gate Valve Assembly

Install a separate valve box over a 3-inch depth of 3/4-inch gravel for each assembly. Acceptable manufacturers for gate valves less that 3-inch are A. Y. McDonald, Nibco, of Watts. Acceptable manufacturers for gate valves 3-inch and larger are Clow, Kennedy, Matco, Mueller, or Waterous. Acceptable manufacturer for valve box is Ametek or Carson-Brooks.

(4) Quick Coupling Valve Assembly

Double swing joint arrangement. Acceptable manufacturer and model is Toro Model 474-03. Acceptable manufacturer for valve box is Ametek or Carson-Brooks.

g. Sprinkler Irrigation Components:

(1) Remote Control Valve (RCV) Assembly for Sprinkler Laterals

Use wire connectors and waterproofing sealant to join control wires to solenoid valves. Use standard Christy I.D. tags with hot-stamped black letters on a yellow background. Install a separate valve box over a 3-inch depth of 3/4-inch gravel for each assembly. Acceptable manufacturer for remote control valve is Toro or Rain Bird. Rated working pressure for all remote control valves is to be 200 PSI. Acceptable manufacturer for valve box is Ametek or Carson-Brooks.

(2) Sprinkler Assembly

Acceptable manufacturer and model for pop-up spray sprinklers is Toro Model 570Z, Rain Bird 1800, or Hunter Model SRS. Acceptable manufacturer and models for pop-up rotary sprinklers are Toro Model S700C or S2001, Rain Bird 3500 or 5000+, or Hunter 1-25 or 1-40. All rotor sprinklers are to have a manufacturer installed rubber cover.

h. Drip Irrigation Components:

(1) Remote Control Valve (RCV) Assembly for Drip Laterals:

Use wire connectors and waterproofing sealant to join control wires to solenoid valves. Use standard Christy I.D. tags with hot-stamped black letters on a yellow background. Install a separate valve box over a 3-inch depth of 3/4-inch gravel for each assembly. Acceptable manufacturer and model for remote control valve is Toro Model 252 or Rain Bird Model DVX. Acceptable manufacturer for fixed pressure regulator is Agricultural Products or Senniger. Acceptable manufacturer for filter is Amiad, Irritrol Systems, Netafim, or Rain Bird. Acceptable manufacturer for valve box is Ametek or Carson-Brooks.

(2) Drip Emitter Assembly:

Landscape drip line, pressure compensating inline device. Acceptable manufacturer is Rain Bird.

Install emitter types and quantities on the following schedule:

Ground cover plant: 1 single outlet emitter each or 1 single outlet emitter per square foot of planting area, whichever is less

Shrub: 2 single outlet emitters each

Tree: 4 emitters each in shrub beds and tree wells.

(3) Flush Cap Assembly:

Locate at the end of each drip irrigation lateral pipe. Install a separate valve box over a 3-inch depth of 3/4-inch gravel for each assembly. Acceptable manufacturer is Agricultural Products. Acceptable manufacturer for valve box is Ametek or Carson-Brooks.

(4) Control System Components:

Control Enclosure: Weatherproof with lockable cover with 2 keys, complying with NFPA 70 and NEMA 250 Type 4.

Material: Plastic or stainless steel.

Mounting: Surface mounted on wall.

Transformer: Internal, suitable for converting 120 volt alternating current power to 24 volt alternating power.

Controller Stations for Automatic Control Valves: Each station is variable from approximately 5 to 60 minutes.

Include switch for manual or automatic operation of each station.

Timing Device: Adjustable, 24-hour, 14-day clock with automatic operations to skip operation any day in timer period, to operate every other day, or to operate two or more times daily.

Manual or semiautomatic operation: Allow this mode without disturbing preset automatic operation.

Nickel cadmium battery and trickle charger: Automatically power timing device during power outages.

(5) Instrumentation:

As presented in the installation details.

Rain Sensor: Use Hunter Mini-Clik II or Rain Bird Rain Check.

(6) Control Wire:

Use American Wire Gauge (AWG) No. 14 solid copper, Type UF or PE cable, UL approved for direct underground burial from the automatic control system to each remote control valve.

Color: Use white for common ground wire. Use easily distinguished colors for other control wires. Spare control wires shall be of a color different from that of the active control wire. Wire color shall be continuous over its entire length.

Splices: Use 3M DBY splices

Warning tape: Inert plastic film highly resistant to alkalis, acids, or other destructive chemical components likely to be encountered in soils. Three inches wide colored yellow and imprinted with "CAUTION: BURIED ELECTRIC LINE BELOW."

i. Other Components:

(1) Tools and Spare Parts:

Provide the following operating keys, servicing tools, and spare parts.

Two (2) operating keys for each type of manually operated valve.

Five (5) of each servicing wrench or tool needed for complete access, adjustment and repair of all rotary sprinklers.

Five (5) quick coupling keys, each with attached hose swivel ell for operation of the quick coupling valves.

Five (5) of each type of spray sprinkler used.

Five (5) of every spray sprinkler nozzle used.

Five (5) of each type of rotary sprinkler used complete with nozzle.

Two (2) of each size of remote control valve used.

(2) Other Materials:

Provide other materials or equipment shown on the drawings or installation details which are part of the irrigation system, even though such items may not have been referenced in these specifications.

914.3 –CONSTRUCTION REQUIREMENTS

a. Inspections and Reviews:

(1) Site Inspections:

Verify construction site conditions and note irregularities affecting work of this section. Report irregularities to the Engineer prior to beginning work.

Beginning work of this section implies acceptance of existing conditions.

(2) Utility Locates ("Call Before You Dig"):

Arrange for and coordinate with local authorities the location of all underground utilities.

Repair any underground utilities damaged during construction. Make repairs at no additional cost to the contract price.

(3) Irrigation System Layout Review

Irrigation system layout review will occur after the staking has been completed. Notify the Engineer one week in advance of review. The Engineer and Property Owner at this review will identify modifications.

b. Layout of Work:

Stake out the irrigation system. Items staked include: mainline pipe, remote control valves, isolation valves, quick coupling valves, and sprinklers.

Install all mainline pipe and mainline components inside of project property lines.

c. Excavation, Trenching, and Backfilling:

Excavate to permit the pipes to be laid at the intended elevations and to permit work space for installing connections and fittings.

Minimum cover (distance from top of pipe or control wire to finish grade):

(a) 24-inch over mainline pipe equal to and smaller than 4-inch.
(b) 30-inch over mainline pipe equal to and larger than 6-inch.
(c) 18-inch over mainline pipe less than 3-inch.
(d) 18-inch over control wire.
(e) 12-inch over lateral pipe to pop-up spray sprinklers.
(f) 18-inch over lateral pipe to rotary sprinklers.
(g) 8-inch over drip lateral pipe in turf or paved areas.
(h) 3-inch minimum mulch cover over drip lateral pipe in planting beds.
(i) PVC UV radiation resistant lateral pipe shall be installed directly on the soil surface.

Maintain at least 15-feet clearance from the mainline and laterals to the centerline of any tree.

PVC lateral pipes may be pulled into the soil utilizing a vibratory plow device specifically manufactured for pipe pulling. Minimum burial depths equals minimum cover listed above.

Backfill only after lines have been reviewed and tested.

Excavated material is generally satisfactory for backfill. Backfill shall be free from rubbish, vegetable matter, frozen materials**,** and stones larger than 2-inches in maximum dimension. Remove material not suitable for backfill. Backfill placed next to pipe shall be free of sharp objects, which may damage the pipe.

Backfill un-sleeved pipe in either of the following manners:

(a) Backfill and puddle the lower half of the trench. Allow to dry 24 hours. Backfill the remainder of the trench in 6-inch layers. Compact to density of surrounding soil.

(b) Backfill the trench by depositing the backfill material equally on both sides of the pipe in 6-inch layers and compacting to the density of surrounding soil.

Enclose pipe and wiring beneath roadways, walks, curbs, etc., in sleeves. Minimum compaction of backfill for sleeves shall be 95% Standard Proctor Density, ASTM D698-78. Use of water for compaction around sleeves, "puddling", will not be permitted.

Dress backfilled areas to original grade.

Where utilities conflict with irrigation trenching and pipe work, contact the Engineer for trench depth adjustments.

d. Sleeving:

Install sleeving at a depth, which permits the encased pipe, or wiring to remain at the specified burial depth with a minimum cover of 24 inches.

Extend sleeve ends 36 inches beyond the edge of curbs or paved surfaces.

Cover pipe ends and mark with stakes. Mark concrete with a chiseled “x” at sleeve end locations.

Enclose pipe and wiring beneath roadways, walks, curbs, etc., in sleeves. Minimum compaction of backfill for sleeves shall be 95% Standard Proctor Density, ASTM D698-78.

e. Irrigation Tap and Water Meter

Provide all labor and materials for installation of Water Meters, pit and all required connections. Comply with Water District No. 1 Standard Specifications.

Water District No. 1 will tap the existing water main as shown on the plans.

The Contractor is responsible for all tap-related fees, labor and materials, acquisition of required water and electrical permit(s).

f. Assembling Pipe and Fittings:

(1) General:

Keep pipe free from dirt and pipe scale. Cut pipe ends square and debur. Clean pipe ends.

Keep ends of assembled pipe capped. Remove caps only when necessary to continue assembly.

Trenches may be curved to change direction or avoid obstructions within the limits of the curvature of the pipe. Minimum radius of curvature and offset per 20 foot length of pipe by pipe size are shown in the following table. All curvature results from the bending of the pipe lengths. No deflection will be allowed at a pipe joint.

SIZE	RADIUS	OFFSET PER 20' LENGTH
1 ½"	25'	7'-8"
2"	25'	7'8"
2 ½"	100'	1'-11"
3"	100'	1'-11"
4"	100'	1'-11"
6"	150'	1'-4"

(2) Mainline Pipe and Fittings:

Use only strap-type friction wrenches for threaded plastic pipe.

PVC Rubber-Gasketed Pipe:

Use pipe lubricant. Join pipe in the manner recommended by manufacturer and in accordance with accepted industry practices.

Ductile iron fittings shall not be struck with a metallic tool. Cushion blows with a wood block or similar shock absorber.

PVC Solvent Weld Pipe:

Use primer and solvent cement. Join pipe in a manner recommended by the manufacturer and in accordance with accepted industry practices.

Cure for 30 minutes before handling and 24 hours before allowing water in pipe.

Snake pipe from side to side within the trench.

Fittings: The use of cross type fittings is not permitted.

(3) Lateral Pipe and Fittings:

Use only strap-type friction wrenches for threaded plastic pipe.

PVC Solvent Weld Pipe:

Use primer and solvent cement. Join pipe in the manner recommended by the manufacturer and in accordance with accepted industry practices.

Cure for 30 minutes before handling and 24 hours before allowing water in the pipe.

Snake pipe from side to side within the trench.

UV Radiation Resistant Polyethylene Pipe:

Join pipe in the manner recommended by manufacturer and in accordance with accepted industry practices.

Snake pipe from side to side on the soil surface, and hold in place with tubing stakes or landscape fabric staples spaced every five feet. Pipe is not to be compressed or crimped by the stake or staple or other construction activity.

Fittings: The use of cross type fittings is not permitted.

(4) Specialized Pipe and Fittings:

Copper Pipe:

Buff surfaces to be joined to a bright finish. Coat with solder flux.

Solder so that a continuous bead shows around the joint circumference.

Ductile Iron Pipe:

Join pipe in the manner recommended by manufacturer and in accordance with accepted industry practices.

Insert a dielectric union wherever a copper-based metal (copper, brass, bronze) and an iron-based metal (iron, galvanized steel, and stainless steel) are joined.

Low Density Polyethylene Hose: Install per manufacturer's recommendations.

PVC Threaded Connections:

Use only factory-formed threads. Field-cut threads are not permitted.

Use only Teflon-type tape or teflon based paste.

When connection is plastic-to-metal, the plastic component shall have male threads and the metal component shall have female threads.

Make metal-to-metal, threaded connections with Teflon-type tape or pipe joint compound applied to the male threads only.

(5) Thrust Blocks:

Use cast-in-place concrete bearing against undisturbed soil.

Size, orientation and placement shall be as shown on the installation details.

Wrap fitting with plastic to protect bolts, joint, and fitting from concrete.

Install rebar with mastic coating as shown on the installation details.

(6) Joint Restraint Harness:

Install harness in the manner recommended by the manufacturer and in accordance with accepted industry practices.

g. Installation of Mainline Components:

(1) Winterization Assembly

Install at each point-of-connection.

(2) Backflow Prevention Assembly

Install at each point of connection. Install assembly so that its elevation, orientation, access, and drainage conform to the manufacturer's recommendations and applicable health codes.

(3) Isolation Gate Valve Assembly

Install at tee fittings on the mainline, before hardscape crossings, and at a maximum of 500 foot intervals on straight runs of pipe.

Locate at least 12-inches from and align with adjacent walls or edges of paved areas.

(4) Quick Coupling Valve Assembly

Install one quick coupling valve immediately downstream of each Backflow Prevention Assembly for winterization of the irrigation system.

Install adjacent to shrub beds for miscellaneous watering needs and adjacent to sidewalks for washing. Maximum spacing between quick coupling valves is 150 feet.

Locate at least 12-inches from and align with adjacent walls or edges of paved areas.

h. Installation of Sprinkler Irrigation Components:

(1) Remote Control Valve (RCV) Assembly for Sprinkler Laterals:

Flush mainline before installation of RCV assembly.

Wire connectors and waterproof sealant shall be used to connect control wires to remote control valve wires. Install connectors and sealant per the manufacturer's recommendations.

Install only one RCV to a valve box. Locate valve box at least 12-inches from and align with nearby walls or edges of paved areas. Group RCV assemblies together where practical. Arrange grouped valve boxes in rectangular patterns. Allow at least 12-inches between valve boxes.

Adjust RCV to regulate the downstream operating pressure.

Attach ID tag with controller station number to control wiring.

(2) Sprinkler Assembly:

Flush lateral pipe before installing sprinkler assembly.

Install per the installation details.

Locate rotary sprinklers 6-inches from adjacent walls, fences, or edges of paved areas.

Locate spray sprinklers 3-inches from adjacent walls, fences, or edges of paved areas.

Install sprinklers perpendicular to the finish grade.

Supply appropriate nozzle or adjust arc of coverage of each sprinkler for best performance.

Adjust the radius of throw of each sprinkler for best performance.

i. Installation of Drip Irrigation Components:

(1) Remote Control Valve (RCV) Assembly for Drip Laterals:

Flush mainline pipe before installing RCV assembly.

Wire connectors and waterproof sealant shall be used to connect control wires to remote control valve wires. Connectors and sealant shall be installed as per the manufacturer's recommendations.

Install only one RCV to valve box. Locate at least 12-inches from and align with nearby walls or edges of paved areas. Group RCV assemblies together where practical.

Arrange grouped valve boxes in rectangular patterns. Set RCV assembly discharge pressure to 30 PSI.

(2) Drip Emitter Assembly:

Locate as shown on the installation details.

Flush lateral pipe before installing emitter assembly.

Cut emitter outlet distribution tubing square.

Install an access sleeve as part of each multiple-outlet emitter assembly.

Use tools and techniques recommended by the manufacturer. Make openings for barb-mounted emitters with the emitter manufacturer's hole-punching tool.

(3) Flush Cap Assembly

Install at the end of each drip irrigation lateral pipe as shown on the installation details.

(4) Pressure Adjustment Procedure:

Fully open all zone control valves and energize the RCV assembly.

Determine which emitter has the least outlet pressure; this is the critical emitter.

Set discharge pressure of RCV such that the critical pressure compensating emitter has a pressure of 25 PSI $\pm$ 5 PSI. Measure with pressure gauge attached to critical emitter.

j. Installation of Other Components:

(1) Tools and Spare Parts:

Prior to completion of construction, supply to the Engineer all operating keys, servicing tools, spare parts, and any other items indicated in these specifications.

(2) Other Materials

Install other materials or equipment shown on the drawings or installation details which are part of the irrigation system, even though such items may not have been referenced in these specifications.

k. Project Record (As-Built) Drawings:

Submit Record Drawings. The Contractor is responsible for documenting changes to the design. Maintain on-site and separate from documents used for construction, one complete set of contract documents as Project Documents. Keep documents current. Do not permanently cover work until as-built information is recorded.

Record pipe and wiring network alterations. Record work, which is installed differently than shown on the construction drawings. Record accurate reference dimensions, measured from at least two permanent reference points, of each irrigation system valve, each backflow prevention device, each satellite controller, each sleeve end, and other irrigation components enclosed within a valve box.

Prior to construction completion, transfer the information contained on the project drawings maintained on site onto the design drawings. Label each sheet "Record Drawing".

Turn over the hard copy “Record Drawings” and electronic CAD files to the Engineer. Electronic files to be provided on a media suitable to the Engineer’s requirements. Completion of the Record Drawings will be a prerequisite for the Review at the completion of the irrigation system installation.

l. Winterization and Spring Start-Up:

Winterize the irrigation system the first fall following construction and start-up the irrigation system the following spring. Repair any damage caused in improper winterization at no additional cost to the City. Coordinate the winterization and start-up with the Owner’s landscape maintenance personnel.

m. Maintenance:

Upon completion of construction and Review by the Engineer, maintain irrigation system for a duration of two (2) years. If system is shut down for winterization during maintenance period, duration will continue once system is turned back on. Make periodic examinations and adjustments to irrigation system components so as to achieve the most desirable application of water.

n. Irrigation System Adjustment:

Installation of irrigation components will allow for raising or lowering to accommodate planting of trees and sod.

Flag all sprinklers, valve boxes and other irrigation system components prior to fine grading, sodding, planting, and installation of roadway sign bases to avoid damage to irrigation equipment.

Adjust all sprinklers to ensure they are flush with finish grade. Valve boxes shall be adjusted to extend 25-mm minimum above finished grade.

o. Cleanup:

Upon completion of work, remove from the site all machinery, tools, excess materials, and rubbish.

914.4 MEASUREMENT AND PAYMENT

The Engineer will measure the lawn sprinkler system by the lump sum.

Payment for “Lawn Sprinkler System” at the contract lump sum price bid is full compensation for the specified work, all excavation, compaction, piping, sprinkler heads, wiring, sensors, and other appurtenances necessary to make a fully operational sprinkler system.