SECTION 328400
IRRIGATION SYSTEM

PART 1 - GENERAL

1.01 SUMMARY:

A. This section covers the furnishings of all materials and performing all operations to provide a complete operable landscape irrigation system as shown on the drawings including the following:

1. Trenching, stockpiling excavated materials and refilling trenches.

2. Irrigation system components including but not limited to: piping, backflow prevention devices and enclosures, valves, fittings, rotors, spray heads, central control system controllers, wiring and final adjustments as determined by the architect to insure efficient and uniform distribution.

3. Pipe connections to irrigation pump stations, water meters and backflow prevention devices.

4. Testing and inspection of irrigation system.

5. Clean-up and maintenance

B. The conditions of the Contract and Division 1 apply to this section as fully as if repeated herein.

1.02 GENERAL REQUIREMENTS:

A. Code Requirements shall be those of State and Municipal Codes and Regulations locally governing this work, providing that any requirements of the Drawings and Specifications, not conflicting therewith but exceeding the Code Requirements shall govern, unless written permission to the contrary is granted by the Architect.

B. Conform to the requirements of the reference information listed below except where more stringent requirements are shown or specified in the most current set of construction documents:

1. American Society for Testing Material (ASTM), for test methods specifically referenced in this section.

2. Underwriter's Laboratories (UL), for UL wires and cables.

C. Work involving substantial plumbing for installation of brass piping, backflow prevention devices and other related work shall be executed by a licensed and bonded plumbing contractor. Any necessary permits shall be obtained prior to beginning work.

D. Specified depths of pressure supply lines, laterals and pitch of pipes as stated in this section are minimums. Settlement of trenches lower than grades specified on the final grading plans is cause for removal of finish grade treatment, refilling trenches, recompacting and repairing of finish grade treatment.

E. Follow current printed manufacturer's specifications and drawings for items or information not specified or graphically indicated in the most current set of construction drawings.

F. Scaled dimensions are approximate and at times it is not possible to indicate offsets, fittings and other related equipment graphically on the construction drawings. Contractor shall be responsible for minor changes caused by actual site conditions. Before proceeding with any work, the Contractor shall carefully check and verify all dimensions of related architectural elements, utilities and landscaping and furnish and install required fittings.

G. Do not install the irrigation system as shown on the construction drawings when it is obvious that actual field conditions such as physical obstructions, grading discrepancies and field dimensions vary from those recorded on the construction drawings. Immediately bring any such discrepancies to the attention of the architect prior to proceeding with work. If immediate notification is not given and such discrepancies exist, the contractor shall assume full responsibility for necessary revisions, as determined by the architect.

H. All central control system telephone communication and/or radio communication shall be tested and certified in writing by the appropriate manufacturer's representative and shall also be tested on line with the central computer system prior to requesting a walk through for substantial completion.

1.03 EXISTING FIELD CONDITIONS:

A. Preserve and protect all existing trees, plants, monuments, structures, hardscape and architectural elements from damage due to work in this section. In the event that damage does occur to inanimate object and structures, the contractor will repair or replace such damage to the satisfaction of the owner or owner's representative. Damage or injury to living plant material will be replaced by the contractor at the contractor’s expense.

B. Trenching or other work required in this section under the limb spread of existing trees shall be done by hand or by other methods so as to prevent damage or harm to limbs, branches and roots.

C. Trenching in areas where root diameter exceeds 2 inches shall be done by hand. Exposed roots of this size shall be heavily wrapped with moistened burlap to avoid scarring or excessive drying. Where a trenching machine is operated in proximity to roots that are less than 2 inches, the wall of the trench shall be hand trimmed , making clean cuts through roots.

D. Trenches adjacent to or under existing trees shall be closed within 24 hours , and when this is not possible, the side of trench closest to the tree or trees affected shall be covered with moistened burlap.

E. Protect, maintain and coordinate work with other contracts, specifications, trades, and utilities. Extreme care shall be exercised in excavating and working in the area due to existing utilities. Contractor shall be responsible for damages caused by their operations. In the event that damage does occur, the costs of such repairs shall be paid by the contractor unless other arrangements have been made with the owner.

F. Use caution where trenches and piping cross existing roadways, sidewalks, hardscape, paths or curbs. In the event that damage does occur, the contractor will repair such damage at the contractor's expense.

1.04 REQUIRED DOCUMENTS:

A. Submittals

1. Submit (6) six sets of all irrigation equipment to be used, manufacturer's brochures, service manuals, guarantees, and operating instructions for approval to the architect prior to beginning work. Submittals should be in a bound form complete with table of contents. The contractor shall not proceed with work in the field until this submittal is approved in its entirety by the architect.

B. Service Manuals

1. The Contractor shall furnish (4) four service manuals to the owner prior to scheduling a walk through for substantial completion. Manuals shall be submitted in a bound form complete with a table of contents, and workmanship form on company letterhead copy of contractor's warranty, copy of the letter of certification for the central control system on the central control system manufacturer’s letterhead and shall contain complete enlarged drawings of all equipment installed showing component warranties and catalog numbers together with the manufacturer's name and address. Manuals shall include operation instructions. Manuals shall be subject to approval by the owner or owner's representative as to completeness.

C. Record Drawings/As-builts

1. Prior to beginning work in the field the contractor shall secure a complete set of irrigation plans at the original scale complete with details and specifications. The contractor shall be responsible for making a set of blueline prints for every week on the project. At the end of each working day, the contractor shall record all work accomplished for that day on the set of blueline prints in red ink. These record drawings shall be brought up to date at the end of each work week by a qualified draftsperson. The drawings should indicate the following:

a. Any zoning changes.

b. Dimension from two permanent points of reference (building corners, fixed hardscape corners, road intersections, permanent existing utilities) the location of the following items:

.1 Water meters.
.2 Pump stations.
.3 Connection to existing water lines.
.4 Routing of pressure supply lines at every 100' along routing.
.5 Backflow Prevention Devices
.6 Flow Sensors
.7 Master Valves
.8 Isolation Ball Valves
.9 Quick Coupling Valves
.10 Air Release Valves
.11 Electric Control Valves
.12 Drip Valve Assemblies
.13 Flush Valve Assemblies
.14 Swing Check Valves
.15 Central Control System Controllers
.16 Grounding rods.
.17 Control wire routing (if routed separately from pressure supply line).
.18 Control wire splices that are outside of the controller.
.19 Weather Station Equipment
.20 Communication Equipment for Central Control System
.21 Other equipment as directed by the architect.

2. Prior to scheduling a walk through for substantial completion, provide a record set of field as-built drawings as described above to the architect for review. After review, the architect will return the as-built set to the field foreman requesting further information or will notify the owner that the record set of field as-builts drawings are complete. After approval from the owner, a walk through for substantial completion may be scheduled.

3. Prior to scheduling the final walk through, the final set of irrigation as-built drawings shall be professionally drafted in auto-cadd by the architect.

4. The architect and the contractor shall verify the final as-builts at the time of the final walk through and once successful the architect shall deliver the final set of as-built drawings to the owner or owner's representative prior to initiating the maintenance period for the contractor.

D. Controller Charts

1. Prior to scheduling a walk through for substantial completion, provide a record set of field controller charts which have color coded each station within each controller to the architect for review. After review, the architect will return the controller charts to the field foreman requesting further information or will notify the owner that the record set of controller charts are complete. After approval from the owner, a walk through for substantial completion may be scheduled.

2. Prior to scheduling a final walk through, one set of controller charts shall be professionally drafted in auto-cadd by the architect for each controller unit installed on the project. The controller drawings shall be an actual auto-cadd reduction of the area covered by that controller unit and shall be at the maximum allowable scale that will fit inside the controller door without folding the drawing.

3. The architect and the contractor shall verify each controller chart at the time of the final walk through and once successful the architect shall deliver the final set of controller charts to the owner or owner's representative prior to initiating the maintenance period for the contractor. The controller chart sent to the owner shall be hermetically sealed between two (2) pieces of minimum 20 mils thick plastic.

4. The architect shall then deliver one controller chart to the contractor who will permanently fix the controller chart to the inside of the applicable controller.

PART 2 - PRODUCTS

2.01 PIPING

A. General Piping:

1. Pipe sizes shown are nominal inside diameter unless otherwise noted.

2. Pipe shall be identified with the following indelible markings:

a. Manufacturer's name.
b. Nominal pipe size.
c. Schedule or class.
d. Pressure rating.
e. NSF (National Sanitation Foundation) seal of approval.
f. Date of extrusion.

B. Solvent Weld Pressure Supply Line:

1. Solvent Weld Pressure Supply Line: (downstream of Backflow prevention device) PVC CL315BE (1" - 3")

   a. Manufactured from virgin polyvinyl chloride (PVC) compound in accordance with ASTM D2241 and ASTM D1784; cell classification 12454-B.
   b. Type 1, Grade 1.

2. Fittings: Standard weight, Schedule 40, injection molded PVC, complying with ASTM D1784 and D2466, cell classification 12454-B.

   a. Threads- Injection molded type (where required)
   b. Tees and Ells- side gated

3. Threaded Nipples: ASTM D2464, Schedule 80 with molded threads.

4. Joint Cement and Primer: Type as recommended by manufacturer of pipe and fittings.

C. Gasket-End Pressure Supply Line:

1. Gasket-End Pressure Supply Line: (downstream of Backflow prevention device) PVC Class 200 (4" and larger).

   a. Manufactured from virgin polyvinyl chloride (PVC) compound in accordance with ASTM D2241 and ASTM D1784; cell classification 12454-B,
   b. Type 1, Grade 1.

2. Fittings: Cast Iron or Epoxy coated steel; complying with ASTM D1784 and D2466, cell classification 12454-B.

3. Gaskets: Factory installed in pipe and fittings, having a metal or plastic support within the gasket or a plastic retainer ring for gasket.

4. Lubricant: As recommended by manufacturer of pipe fittings.

D. Non-Pressure Lines Below Grade:

1. Non-Pressure Lines: (downstream of electric remote control valve) PVC SCH 40.

2. Fittings: Standard weight, Schedule 40, injection molded PVC, complying with ASTM D1784 and D2466, cell classification 12454-B.

   a. Threads- Injection molded type (where required)
   b. Tees and Ells- side gated
   c. Threaded Nipples: ASTM D2464, Schedule 80 with molded threads.

3. Joint Cement and Primer: Type as recommended by manufacturer of pipe and fittings.

E. Non-Pressure Lines Above Grade:

1. Non-Pressure Lines: (downstream of electric remote control valve) Ultraviolet Resistant PVC SCH 40, conforming to ASTM D1785-83.

2. Fittings: Standard weight, Schedule 40, injection molded PVC, complying with ASTM D1784 and D2466, cell classification 12454-B.

   a. Threads- Injection molded type (where required)
   b. Tees and Ells- side gated
   c. Threaded Nipples: ASTM D2464, Schedule 80 with molded threads.

3. Joint Cement and Primer: Type as recommended by manufacturer of pipe and fittings.

4. On-Grade Pipe Stabilizer Bars: 5/16" hot rolled "J" Hook with protective vinyl tubing, welded to #4 rebar stake.

F. Sleeving and Conduit:

1. All PVC sleeving for pressure supply line and non- pressure supply line shall be twice the nominal size of the pipe within and used for sleeves below grade as indicated in the following sleeve and conduit schedule:

2. Sleeving and Conduit Material Under Hardscape:

   a. PVC SCH 40 for 1"-2 1/2" pressure supply line.
   b. PVC SCH40 for 3" and larger pressure supply line.
   c. PVC SCH 40 for non- pressure lines.
   d. (1) one ¾" PVC SCH. 40 conduit for up to 5 wires.
   e. (1) one 1" PVC SCH. 40 conduit for up to 8 wires.
   f. (1) one 1 ¼" PVC SCH. 40 conduit for up to 15 wires.
   g. (1) one 1 ½" PVC SCH. 40 conduit for up to 20 wires
   h. (1) one 2" PVC SCH 40 conduit for up to 30 wires.
   i. (1) one 2 ½"" PVC SCH 40 conduit for up to 35 wires.
   j. (1) one 3/4" PVC SCH 40 wire conduit for flow sensing cable.
   k. (1) one 3/4" PVC SCH 40 wire conduit for master valve wire.

3. Flow sensing cable and master valve wires shall be installed each in their own conduit separate and apart from all other wires.

4. Sleeving and Conduit Material Over Concrete V-Ditches:

a. Galvanized SCH. 40 for 1"-2 1/2" pressure supply line.
b. Galvanized SCH.40 for 3" and larger pressure supply line.
c. Galvanized SCH. 40 for non- pressure lines.
d. (1) one ¾" Galvanized SCH. 40 conduit for up to 5 wires.
e. (1) one 1" Galvanized SCH. 40 conduit for up to 8 wires.
f. (1) one 1 ¼" Galvanized SCH. 40 conduit for up to 15 wires.
g. (1) one 1 ½" Galvanized SCH. 40 conduit for up to 20 wires
h. (1) one 2" Galvanized SCH. 40 conduit for up to 30 wires.
i. (1) one 2 ½"" Galvanized SCH. 40 conduit for up to 35 wires.
j. (1) one 3/4" Galvanized SCH. 40 wire conduit for flow sensing cable.
k. (1) one 3/4" Galvanized SCH. 40 wire conduit for master valve wire.

5. On-Grade Pipe Stabilizer Bars: 5/16" hot rolled "J" Hook with protective vinyl tubing, welded to #4 rebar stake.

G. Brass Pipe and Fittings:

1. Pressure Supply line (from point of connection through Backflow Prevention Device) Brass pipe shall be regular weight, 85% red brass, ANSI Schedule 40 screwed pipe.

2. Fittings: Medium brass, screwed at 125 pound class.

2.02 BACKFLOW PREVENTION DEVICE 2" AND SMALLER

A. Backflow Prevention Device: Reduced pressure principal Backflow assembly shall consist of an approved brass or bronze body, brass check valves, hydraulically actuated relief valve, inlet and discharge shutoffs and field test cocks, as specified on drawings.

B. Backflow prevention units shall be approved by the Foundation for Cross-Connection Control and Hydraulic Research.

C. Backflow device enclosure shall be constructed of stainless steel tube and wire construction and have a smooth surface to protect against handling industry. Enclosure shall have a full release locaking mechanism and provide easy access for service and repairs.

2.03 BACKFLOW PREVENTION DEVICE 2 ½" AND LARGER

A. Backflow Prevention Device: Double check assembly shall consist of an approved ductile iron grade 65-45-12 with fusion epoxy coated (interior and exterior) body and NRS resilient wedge gate valves with stainless steel springs and flanged fittings.

2.04 ATMOSPHERIC VACUUM BREAKER

A. Atmospheric vacuum breaker shall consist of and approved brass or bronze body with non spilling type bronze bonnet rated to 150 PSI.

2.05 BOOSTER PUMP

A. Booster pump shall be single stage end suction close coupled centrifugal, cast iron bronze fitted construction, equipped with mechanical shaft seal, back pullout design. Impeller shall be keyed and locked to the shaft with a hex head impeller nut and washer. Pump shaft shall be high strength S.A.E. 1045 carbon steel protected in the stuffing box area by a replaceable bronze shaft sleeve. Pump shall be directly coupled to a C-face electric motor.

B. Electric motor shall be of the squirrel cage induction type suitable for full voltage starting. Motor shall be ODP to aid in cooling. Electric motor shall be rated for continuous service. The motor shall have horsepower ratings such that the motor will carry the maximum possible load to be developed under the designed pumping conditions and not overload the motor beyond the nameplate rating of the motor. Motor shall have a 1.15 service factor. The motor shall conform to the latest NEMA Standards for motor design and construction.

C. Pump Control Panel shall have a NEMA 4X plain front non-metallic enclosure with padlock latches. This Includes power and control re-settable thermal circuit breakers, heavy duty magnetic starter with adjustable overload protection, Hand-Off-Auto switch to select mode of operation, and heavy duty numbered terminal strips for power and control wiring lead terminations.

D. Metal oxide varistor protected pump start relay(s) incorporated in panel to start pump with signal from each irrigation controller.

E. All system piping shall be type “L” copper. All fittings shall be copper or brass, with unions or flanges to allow for system disassembly or major component removal. System shall incorporate an integral full pipe size bypass line with isolation valve to allow for pump removal and repair without disrupting water supply to system.

F. Isolation valves shall be all brass quarter turn ball valves with hard chrome ball on lines 2” and less. Isolation valves shall be lug style butterfly valves with Buna-N elastomeric seats, ductile iron nickel coated disc, and stainless steel stem with handle and 10 position galvanized memory plate on lines 2½” and greater.

G. Gauges shall be 2½” diameter face, glycerin filled with stainless casing and brass internals.

H. Flow activated paddle style magnetically coupled flow switch, sensitive to flows as low as 1 fps, mounted on piping and interconnected to time delay relay to shut down pump on no-flow conditions, time delay relay adjustable from 0 to 5 minutes.

I. Pump system shall be mounted on a structural aluminum skid with mounting flanges on front and back to allow for mounting of skid to concrete pad. Skid equipped with pipe support on suction and discharge piping. All nuts and bolts and washers to be heavy zinc coated steel on skid and piping. Skid shall include mounting hardware for integral aluminum enclosure.

J. The system enclosure shall be vandal and weather resistant, marine grade aluminum alloy 5052-H32 construction with rectangular punch-outs for viewing and heat dissipation. The enclosure shall be low profile hinged top design with padlock provision. The cover shall be secured to the concrete pad with stainless steel hardware.

K. Pump Assembly shall include the following option(s):

(ATT) Where specified by the System Design Parameters, Sound Attenuation foam shall be installed on interior of enclosure with baffles on venting to reduce sound emanating from the booster system.

(VFD) Where specified by the System Design Parameters, a Variable Frequency Drive system to convert incoming 1 phase power to 3 phase power for the motor. VFD system to receive feedback signal from system mounted stainless steel pressure transducer, and in conjunction with internal software driven PID control loop maintain customer adjustable constant system discharge pressure by varying the speed of the pump in response to varying system load.

(FSW) Where specified by the System Design Parameters, Flow activated non-adjustable pivoting vane style magnetically coupled Flow Switch, with 300 series stainless vane, brass body and weatherproof enclosure. Flow switch sensitive to flows as low as 1 fps, with electrical contact ratings of 5 Amps at 125/250 VAC, pressure rated to 250 PSI, mounted on piping and interconnected to time delay relay to shut down pump on no-flow conditions, time delay relay adjustable from 0 to 5 minutes. (Option: Flow switch to provide on-off control of pumping unit)

L. The services of a factory representative or trained service professional shall be made available on the job site to check installation and perform the startup and instruct the operating personnel. A startup report containing voltage and amperage readings, suction and discharge pressure readings, estimated flow conditions, and general operating characteristics shall be submitted to the Owner.

M. Four sets of operating and maintenance manuals shall be provided to the owner after startup and shall include parts manuals for major components, performance curve for pump, general sequence of operation, and electrical schematic for control panel.

2.06 BASKET STRAINER

A. Basket strainer shall be manufactured with a steel powder coat or stainless steel body with an 80-mesh filtration element and stainless steel basket.

B. Specify basket strainer at P.O.C. directly down stream of the backflow device. Install per filter detail.

2.07 WYE STRAINER

A. Wye strainer shall be bronze construction with a stainless steel screen element. Wye strainer shall have a standard filtration size of 80 mesh.

2.08 PRESSURE REGULATING VALVE

A. Pressure reducing valves shall be of bronze and stainless steel construction and be adjusted from 25 P.S.I. to 125 P.S.I.

2.09 MASTER VALVES

A. The master valve shall be normally closed, pressure reducing, surge protecting, supplying constant downsream pressure when opened. Operating voltage of 16-40 VAC. Regulating and surge anticipation control piolot frange from 5 125 psi with accuracy within =/1 5 percent of setting. Capable of operating within a range of .01 to 400 GPM. Copper encased solenoids that area corrosion resistant and provide heat dissipation for prolonged coil life, cast iron, epoxy coated body and bronse trim fully guided, 600 psi rated diaphragm assembly, with manual on-off capability.

2.10 FLOW SENSORS

A. The flow meter shall use two #14 AWG; one red, and one black in 1"PVC conduit to connect to the irrigation controller. The maximum wire run between flow meter and controller shall be 2000 ft. The flow meter shall send low voltage digital pulses back to the controller and therefore all electrical connections must be waterproof and shall resist any moisture entry.

B. It is intended that all wire runs between the controller and flow meter shall be direct pulls and shall have no splices. If wire splices are unavoidable, they shall be installed in a valve box with water proof connectors and properly labeled valve boxes.

C. Each flow meter shall have the following characteristics:
1. Housing to be a Sch 80 polyvinyl chloride tee or bronze tee
2. Have a pulsing output that operates at 9V DC and a pulse rate that is proportionate to the GPM
3. Fully compatible with the internal interface at each field controller
4. Powered by the controller
5. Replaceable metering insert shall feature a six-bladed design with a proprietary, non-magnetic sensing mechanism
6. Supplied by the same manufacturer as the irrigation controller.

D. Irrigation zones must be sized so that the specified flow meter is capable of reading the minimum and maximum gallons per minute for all proposed zones.

E. Install down stream of master valve.

2.11 ISOLATION VALVES

A. Isolation Ball PVC Valves: Industrial grade sealed unit socket weld schedule 80 PVC ball valve (Use for mainline pipe 1-1/2" and smaller) as manufactured by Spears model 2122 or approved equal.

B. Isolation Gate Valve: Bronze, screw-in-bonnet, non-rising stem, cross handle, solid wedge, threaded valve (Use on mainline pipe 2" and 2-1/2 " in size) as manufactured by Nibco model T-113-K, or approved equal.

C. Isolation Gate Valve: Iron bolted bonnet with 2" square operating nut, non-rising stem, resilient wedge type, soft seat, flanged end epoxy coated, bronze trimmed iron body. (Use on pipe 3" and greater) as manufactured by Nibco model F-619-RW flanged, or approved equal.

2.12 QUICK COUPLING VALVES

A. Quick coupler valves shall have a body constructed of red brass with a wall thickness guaranteed to withstand normal working pressure of 150 P.S.I. without leakage with female threads (penning at base). Quick coupler valve shall have a hinge cover constructed of red brass with leather like vinyl cover bonded to it on such a manner that it becomes permanent type of cover. Quick couplers used with potable water shall have vinyl covers yellow in color. Quick coupler valves used for reclaimed water shall have vinyl covers purple in color with the appropriate reclaimed water warnings in English and Spanish as well as the international "Do Not Drink" symbol.

B. All quick coupler valves must have a schedule 80 ball valve to isolate mainline from quick coupler valve. Mainline shall be the size of quick coupler valve from mainline tee to quick coupler.

2.13 HOSE BIB

A. Hose bib shall be a one-piece body with ¾" FIPT inlet and ¾" hose thread non-kink, angled outlet.

B. Hose bib shall have optional recessed locking nut.

2.14 AIR RELIEF VALVES FOR PRESSURE SUPPLY LINE

A. Air relief valve shall be composed of schedule 80 PVC material and be continuous acting in type. Air relief valve shall have a minimum inlet size of 1" MIPT.

2.15 ELECTRIC CONTROL VALVES

A. Electric Remote Control Valves: Electric control valves with pressure regulating feature two way solenoid, pilot operated made of synthetics, non corrosive material; diaphragm activated and slow closing. Include freely pivoted seat seal, retained (mounted) without attachment to diaphragm.

B. Isolation Ball Valve at Manifold and/or Electric Control Valve:

1. Ball Valve: PVC threaded true union ball valve, with heavy bodied PVC construction, buttress threaded double union nuts, safe-t-block seal carrier, PTFE ball seat, high impact polypropylene handlesafe-t-shear stem, full schedule 80 bore, 235PSI rating, NSF listed.

2.16 DRIP VALVE ASSEMBLIES:

A. Electric Remote Control Valves: Electric control valves with pressure regulating feature two way solenoid, pilot operated made of synthetics, non corrosive material; diaphragm activated and slow closing. Include freely pivoted seat seal, retained (mounted) without attachment to diaphragm.

B. Wye Strainer: 150 mesh screen for point to point drip and sub surface

C. Isolation Ball Valve: Ball Socket Ball Valve with thermoplastic molded one piece construction and teflon seat with EDPM cushions.

2.17 HARD PIPED POINT TO POINT DRIP IRRIGATION:

A. Riser Assembly For Hard Piped Point to Point Drip Irrigation:

1. 12” Long, ½” IPS flexible PVC tubing with factory attached ½” schedule 40 PVC MIPT adapters on both ends.

B. Emitters For Hard Piped Point to Point Drip Irrigation:

1. Pressure compensating single outlet emitter with ½” FIPT base and 20 mesh screen. ½ GPH, 1 GPH or 2GPH. Mulch Camo Brown in color.

2.18 MULTI OUTLET POINT TO POINT DRIP IRRIGATION:

A. Drip Tubing For Point to Point Drip Irrigation with Multi-Port Adapter:

1. DuraPolyHose 1/4”, manufactured of flexible vinyl chloride conforming to ASTM D2855M, D380 and D1599.

B. 6 Outlet Manifold for Point to Point Drip Irrigation

1. Emission Device with ½” FPT inlet thread for ½” MIPT threaded riser, providing a manifold with six free-flowing ¼” barb outlets. Each barb outlet shall be sealed with a durable, removable, plastic cap that can be removed for additional emission devices.

C. Emitters For Point to Point Drip Irrigation with Multi-Port Adapter:

1. ¼” barbed pressure compensating emitter with a high quality diaphragm for improved pressure compensation and uniformity over a wide range of pressure.

Emitter shall have a take apart feature for inspection and cleaning as well as an outlet baffle to deter entry of insects.

Emitters shall be installed according to the following schedule:
1 Gallon Shrub – (2) .5 GPH Emitters
5 Gallon Shrub – (2) .5 GPH Emitters
15 Gallon Shrub/Tree – (3) 1 GPH Emitters
24" Box Tree – (4) 1 GPH Emitters
36" Box Tree – (6) 1 GPH Emitters
48" Box Tree – (8) 1 GPH Emitters

D. Tubing Stakes For Point to Point Drip Irrigation with Multi-Port Adapter:

1. 6" galvanized, 9 gauge, pvc coated tubing stake.

2.19 SUB SURFACE DRIP IRRIGATION:

A. Drip Tubing For Subsurface Drip Tubing:

1. The drip tubing shall be a pre-bonded emitter type. The tubing shall have emitters spaced at 12 or 18 inches and in flow rates of .53 or 1.0 gallons per hour.

   Water distribution shall be via an integrated turbulent flow path emitter with dual discharge ports on opposing sides of the tubing. The tubing shall consist of nominal-sized, linear low-density 5/8" (15,8mm) polyethylene with an outside diameter (O.D.) of approximately .710" (18mm) and an inside diameter (I.D.) of approximately .620" (16mm). The emitters shall be molded from virgin polyethylene. The tubing shall be available in pressure-compensating version that shall incorporate a circular silicon rubber disk designed to flush at startup, shutdown and during the irrigation cycle to inhibit debris collection.

B. Pressure Regulator Valves For Subsurface Drip Tubing:

1. The pressure regulator valve(s) shall be a spring-operated piston type with an externally accessible regulation unit that can be serviced without removing the valve from the system. The valve shall be constructed from molded black plastic with six different colored tops with interchangable springs denoting different pressure regulation and flow ranges. The regulator shall have a built-in indicator that shows when the proper outlet pressure is reached. Operating ranges for the valves shall be from 15-50 PSI in 5-PSI increments. Inlet and outlet ports of the valve shall be a combination of male/female threads.

C. Air /Vacuum Relief Valves for Subsurface Drip Tubing:

1. Air / vacuum relief valves shall be constructed of grey and/or black plastic with an internal sliding poppet valve that is capable of venting air or preventing vacuum.. The main body shall have a ½" male pipe thread (MPT). Operating pressure range for the air/vacuum relief valve shall be 7 PSI minimum to 140 PSI maximum.

2.20 CHECK VALVES:

A. Swing Check Valves: PVC, Slip x Slip check valves, for non-pressure lateral line applications on slopes.

B. Spring Check Valves: for pop-up sprayheads and sprayheads on risers and ¾" for pop-up rotors and rotors on risers.

2.21 FLUSH VALVE ASSEMBLIES:

A. Schedule 80 Ball Valve, threaded schedule 80 nipples and fittings with polyethylene tubing for flush hose.

2.22 VALVE BOXES:

A. Jumbo rectangular valve boxes shall be 14-7/8 inch wide by 21-3/8 inch long and 12 inch high. Rectangular valve boxes shall be 11-3/4 inch wide by 17 inch long and 12 inch high. Round valve boxes shall be 10-inch diameter and 10 1/2 inch high. All valve boxes shall be constructed of rigid polyolefin.

B. Valve boxes shall have locking covers secure with a 3/8-inch stainless steel bolt and washer.

C. Jumbo rectangular valve boxes shall be used for master control valves.

D. Rectangle valve boxes shall be used for control valves, pressure regulators, flow sensors, wye strainers, filtration devices, ball valves and pull boxes.

E. Round valve boxes shall be used for gate valves quick coupler valves, flush valve assemblies and spare wires.

F. All valve boxes to be green in color unless otherwise specified for use of reclaimed water.

G. Heat brand all box lids with the appropriate two-inch high identification letters and/or numbers.

H. All valve boxes shall receive landscape fabric. Landscape fabric shall be constructed of 5.0 oz. weight proven polypropylene weed barrier with burst strength of 225 P.S.I. and capable of 12 gallons per minute of water flow and puncture strength of 60 lbs. Dewitt Pro, Mirify or approved equal.

I. All valve boxes shall receive 2 cubic feet of 3/4-inch gravel.

J. Valve Tag: Manufactured from UV stabilized plastic with 180lbs pull out resistance and hot stamped for maximum visibility. Top hole shall be designed to pass a 16 gauge or smaller solenoid pigtail or attach with a nylon tie.

2.23 IRRIGATION HEADS (GENERAL):

A. All irrigation heads shall be the size, type, and provide the same rate of precipitation with the same radius of spray, pressure and discharge in G.P.M. as listed on drawings

B. All spray head sprinklers shall have stainless steel screw adjustment for radius of spray.

C. All irrigation heads shall have a factory installed check valve or have an after market check valve installed.

D. All other requirements for non-pressure lateral line pipe to be as specified in fitting specification section.

E. In no case shall the irrigation head spacing exceed the maximum manufacturer's recommendation.

F. Irrigation heads along walks, curbs, paving, etc. shall be positioned 1 inch above finish grade. Irrigation in turf areas shall be positioned 2 inches above finish grade.

G. All sprinkler heads shall be set perpendicular to finish grades.

H. All sprinklers in turf areas shall have a minimum pop-up height of six (6) inches.

I. All sprinklers in planter/slope areas shall have a minimum pop-up height of twelve (12) inches.

2.24 BUBBLERS:

A. Bubblers shall be constructed of heavy duty plastic and be pressure compensation full circle. The bubbler shall have a 20 mesh screen to protect it from clogging.

B. Bubblers shall be from .25 - 1.0 GPM and operate between 20-90 PSI.

2.25 POP UP SPRAY HEADS:

A. The spray head body, nozzle, stem and screen shall be molded out of heavy duty plastic.

B. Pop-up height shall be as listed in drawings and in no case shorter than 4 inches.

C. The spray head shall have an adjustment screw used for regulating flow and radius with matched precipitation rate (MPR) nozzle.

D. The spray head shall have a removable screen to protect it from clogging.

E. The spray head shall have a stainless steel spring for proper pop down.

F. The spray head shall be equipped with a factory installed check valve identified on the cap and capable of holding water up to 10 feet of elevation change.

G. The spray head shall be equipped with a factory installed pressure-regulating device constructed of stainless steel and heavy-duty plastic capable of maintaining a pressure of 35-70 P.S.I. to 30 P.S.I. for operation of the sprinkler.

H. All spray head bodies shall have universal male thread risers to accept universal female threaded nozzles.

2.26 SPRAY HEADS ON RISER:

A. The spray head adapter body, nozzle, stem and screen shall be molded out of heavy duty plastic.

B. Spray head adapter and nozzle shall be mounted on an Schedule 80 riser a minimum height of 6" from finish grade.

C. The spray head shall have an adjustment screw used for regulating flow and radius with matched precipitation rate (MPR) nozzle.

D. The spray head shall have a removable screen to protect it from clogging.

E. The spray head shall be equipped with an external check valve capable of holding water up to 10 feet of elevation change.

2.27 POP UP ROTOR:

A. All pop-up rotors shall have a rubber cover and be constructed of heavy duty plastic except for wiper seal, bearing spring and bearing washers. The riser shall be constructed of plastic or of plastic encased in a stainless steel sleeve. All rotors to have a reinforced rib design with flange encasement.

B. Pop-up height shall be as listed in drawings and in no case be shorted than 3-1/2 inches.

C. The rotor shall have a diffuser pin for regulating flow and radius.

D. The rotor shall have a screen to protect it from clogging and have a minimum inlet of 3/4 inch.

F. Medium Range rotors shall be capable of covering 16-55 feet radius at 20-60 PSI with a rate of .5 - 9.2 GPM. and be adjustable from 1-360 degrees. Long range rotor shall be capable of covering 16-55 feet radius at 40-74 PSI with a rate of 3.8 - 27.5 GPM. and be adjustable from 1-360 degrees.

2.28 ROTOR ON RISER

A. All rotors mounted on risers shall have a rubber cover and be constructed of heavy duty plastic except for wiper seal, bearing spring and bearing washers. The rotor riser shall be constructed of plastic.

B. Rotor shall be mounted on an ultraviolet resistant riser a minimum height of 12" from finish grade supported by a rebar stabilizer stake and sprinkler ties.

C. The rotor shall have a diffuser pin for regulating flow and radius.

D. The rotor shall have a screen to protect it from clogging and have a minimum inlet of 3/4 inch.

E. Medium Range rotors shall be capable of covering 16-55 feet radius at 20-60 PSI with a rate of .5 - 9.2 GPM. and be adjustable from 1-360 degrees. Long range rotor shall be capable of covering 16-55 feet radius at 40-74 PSI with a rate of 3.8 - 27.5 GPM. and be adjustable from 1-360 degrees.

2.29 CENTRAL CONTROL SYSTEM CONTROLLER AND COMMUNICATION HUB MANUFACTURED BY CALSENSE

All controllers/hubs shall the most current Calsense version and model and shall have the following specifications and capabilities:

A. Shall be capable of fully automatic, semi-automatic, and manual operation using a keypad that is an integrated part of the controller. Each controller shall be capable of storing irrigation schedules, monitor and manage flow all without the Central Computer (i.e. if the Central Computer is turned off, removed, or if communication from/to the Central Computer fails, the field controllers will continue to perform weather and flow management functions).

B. Backlit display shall have a minimum of sixteen (16) lines by forty (40) characters so that scrolling through menus is minimized. The display shall allow the user to easily move from screen to screen through an intuitive, self-prompting display so that it is easier for the user to program, read and understand the controller. The controller shall display an area description for each station including the station's location, the type of plant material irrigated and type of irrigation equipment used.

C. The controller shall have the built-in capacity for sensing flow via a flow meter input and utilizing a master valve without the addition of sensor boards, decoders, or other pieces of equipment.

D. There shall be a minimum of seven (7) regular irrigation programs with individual station cycle and soak watering, plus two additional syringe/propagation programs each with minimum of six (6) start times, adjustable station run times and with automatic programming capability up to a specific data. When the date is reached the controller shall automatically cease irrigating the manual program.

E. The controller shall have a water budget feature that provides monthly water volume allotments proportionate to historical evapo-transpiration (ET) which is interactive with all programs, and able to alert the user (via on screen alarms) when the controllers' water usage is more than the user set water budget.

F. A full year master schedule to allow twelve (12) month programming shall be a standard feature of the controller.

G. Programming shall be based on a seven (7), fourteen (14), twenty-one (21) or twenty-eight (28) day scheduling and shall be able to irrigate in minutes and as a % of ETo.

H. The controller shall be able to receive real-time weather data directly from an ET gage and tipping rain bucket, and as a stand-alone controller automatically use the data to calculate appropriate run times for each station without use of a central control system.

I. The controller shall be able to irrigate with the use of soil moisture sensing whereas the soil moisture sensor overrides programmed irrigation minutes, or minutes calculated when using real-time weather data. The soil moisture sensor used with the irrigation control system shall be by the same manufacturer.

J. The controller shall have flow management capability as a standard feature whereas the controller shall learn each station's expected GPM flow rate automatically at night over several irrigations, and use the mainline GPM capacity programmed, to operate up to four (4) valves at the same time plus the master valve to shorten the water window.

K. Alerts shall be able to be processed and responded to at both the field controller location and at the Central Computer location.

L. When an alert, such as High Flow is indicated on the controller, the station with the High Flow shall still attempt to come on each watering cycle and then shut off, rather than having the alert keep the station off until someone clears the alert from the central computer or at the field controller.

M. The controller shall have built-in amperage meter to accurately measure and diagnose valve solenoid electrical problems such as "no current", "station short", "under current", "over current", etc.

N. The controller shall have an irrigation test program or "walk-thru" program that has a delay time to allow a user to walk to a certain area before valves come on. The controller shall then manually water a sequence of predetermined stations for set program times. The programmable delay time shall be an integral part of the irrigation test program. The controller shall be capable of operating a test program without affecting the controller's normal program station times or without terminating a regular watering schedule.

O. The system shall be capable of allowing the user to make changes to the irrigation program via either at the Central Computer or at the field controller without requiring the user to go back to the Central Computer to accept the change.

P. The controller shall allow for operator-set water window, which prevents irrigation from continuing beyond a set end time. Remaining run-times shall be carried in a hold-over table and shall be applied at the next scheduled irrigation with the system prioritizing which valve to operate based on accumulated ET and the hold-over time.

Q. The system shall provide a multi-level access control up to four (4) levels for controlling who programs what at each controller. The controller shall have the ability to track and report on when an access code or "individual" user logged into the

controller, what keys were pushed while there, and when an access code logged out of the controller. These shall be date and time stamped.

R. The controller shall be able to display for the user a detailed water usage report categorizing for each month the usage during scheduled irrigation, test and manual key operation, and for non-controller usage such as bleeding valves on manually, using quick couplers or hose bibs.

S. Optional Radio Remote receiver board, (model–RRe) shall be built-in the controller and a hand-held radio remote transmitter (model RRe-TRAN) will be supplied so that the end user can trouble shoot valves remotely without having to go the controller itself. The hand-held transmitter shall display operational information such as valve on, gallon per minute flow rate and electrical draw in amps.

T. The field controller(s) shall be capable of utilizing a single mode or a combination of communication modes such as hardwire cable, standard telephone, Ethernet, WiFi, point-to-point spread spectrum radio, local radio in the 450-470 MHz range, fiber optic modems, or GPRS wireless modem application as communication links to the central computer. The field controllers shall be capable of directly receiving, storing, and operating commands downloaded from the central computer.

U. The controller shall operate on a minimum of 120 volts A.C. power input and shall be capable of operating up to four 5.5 VAC 24 volt A.C. remote control valves at once. The controller shall have a reset circuit breaker to protect the controller from overloading.

V. Install one extra 1-1/2" inch conduit to controller for future use.

2.30 CENTRAL CONTROL SYSTEM CONTROLLER ENCLOSURE MANUFACTURED BY CALSENSE

A. The enclosure shall be of a vandal and weather resistant nature manufactured entirely of 304-grade stainless steel, and the top shall be 12 gauge and the body 14 gauge. The main housing shall be louvered upper and lower body to allow for cross flow ventilation. A stainless steel backboard shall be provided for the purpose of mounting electronic and various other types of equipment. The stainless steel backboard shall be mounted on four stainless steel bolts that will allow for easy removal of the backboard.

B. The 38-inch height with flip top shall provide easy access for programming from a standing position under normal installations.

C. The pre-assembled vandal resistant enclosure by Calsense shall come complete with lightning and surge protection and all terminals shall be factory labeled. The pre-assembled enclosure shall come provided with an On/Off switch to isolate the controller along with a GFI receptacle. An optional radio antenna shall be pre-mounted and connected on SSE-R enclosure. The enclosure shall include 2-7/8”, 1-1/2” thick, 6-pin cylinder, die-cast steel padlock with unique shackles design.

D. Factory pre-assembled enclosure with controller shall carry a full UL listing.

E. The enclosure and Controller installed equipment within shall carry a five (5) year warranty.

2.31 ET GAGE FOR CENTRAL CONTROL SYSTEM MANUFACTURED BY CALSENSE

A. The Central Control system shall include a remote connected ET gage where shown on the plans and specifications. The ET measuring device shall be powered by the selected field controller. ET is measured directly in 0.01" increments and pulses from the gage shall be sent directly to the field controller. The daily, on-site ET data shall be stored in a 28-day table in the controller.

B. Cable shall be installed in conduit and shall be run from the location of the ET gage back to the controller. Maximum length of cable shall be 1,000 feet. Wire runs shall be direct pulls without underground splices.

C. The top surface of the gage shall be 3'4" above grade. The location shall be representative of the area to be irrigated, free of any obstructions to sunlight and wind. The location of the gage shall be located in an area where water from sprinkler heads does not hit the top surface of the gage. Calsense shall be called at 800-572-8608 for assistance in correct placement of the ET Gage.

D. A vandal-resistant stainless-steel enclosure shall be used to protect the ET gage. The ET gage shall be mounted on a poured concrete base 18"x18"x 6" with the enclosure metal base and stake embedded into the slab. The horizontal plate shall be one inch (1") below the poured concrete, and the finish grade shall be two inches (2") below top of the concrete base.

2.32 RAIN BUCKET AND WIND SENSOR FOR CENTRAL CONTROL SYSTEM MANUFACTURED BY CALSENSE

A. The Central Control system shall include a remote connected Tipping Rain Bucket where shown on the plans and specifications. The rain-measuring device shall be wired using the 60' of 2-conductor cable supplied with the Tipping Rain Bucket to the selected field controller. The cable should be installed in conduit and the connections are to be made at a terminal strip inside the enclosure. Maximum length of cable run shall be 200 feet.

B. The Rain Bucket shall accurately measure rainfall in 0.01" increments by means of a tipping and emptying device mounted below the center of the collection dish.

C. The controller shall provide the following programming parameters for rain:
Stop Irrigation after x.xx inches
Maximum Rain in One Hour is x.xx inches
Maximum Rain in 24 Hours is x.xx inches
Let Rain only build up to x.xx inches

2.33 ELECTRIC CONTROL VALVE WIRE

A. Low Voltage:

1. AWG UF UL approved No. 14 direct burial copper wire for all control wires and No. 14 direct burial copper wire for all common wires.

2. Wire Colors:

   a. Control Wires- As specified on drawings
   b. Common Wires- As specified on drawings.
   c. Master Valve Wires- Blue.
   d. Spare Wires- Green (labeled at termination)

3. Wire Splice Connectors: 3M DBY Direct Bury Splice Kits.

B. High Voltage:

1. Type required by local codes and ordinances, of proper size to accommodate needs of equipment serviced.

2.34 PIPE JOINT RESTRAINTS

A. All pressure line fittings 4 inch and larger shall be iron ductile deep bell type constructed of grade 65-45-12 and shall be in accordance with ASTM A536. Rubber for gaskets in fittings shall be in accordance with ASTM-477. All iron ductile fittings shall have stainless steel exterior lugs to secure a joint restraint system.

2.35 SAND BEDDING

A. Sand bedding shall be construction grade.

PART 3 - EXECUTION

3.01 PREPARATION

A. Examine field conditions prior to beginning work described in this section. Grading operations shall be completed and approved prior to beginning work.

B. Verify all sleeve locations below future hardscape and/or across concrete v-ditches prior to beginning work in this section. Flag all existing sleeves and conduits installed by other trades. Report any conflicts and discrepancies to the architect immediately.

C. Irrigation system shall be constructed to the sizes and grades at the locations shown on the drawings. Mark with powdered lime or marking paint routing of pressure supply line and stake the location of each sprayhead, rotor, electric control valve and other related equipment for the first three zones. Architect shall review staking and direct any necessary changes with the contractor prior to proceeding to other zones. This review does not in any way alleviate the contractor from the responsibilities associated with proper uniformity and distribution of head placement after staking.

D. Install sleeves, to accommodate pipes and wires, under paving, hardscape areas, sidewalks, and paths prior to asphalt and concrete operations. Compact backfill around

sleeves to 95% Modified Proctor Density within 2% of optimum moisture content in accordance with ASTM D1557.

3.02 EXCAVATION AND BACKFILLING OF TRENCHES

A. Trench excavation shall as much as possible follow the layout shown on the drawings. Trenches shall be straight in alignment and support pipe continuously on bottom of trench. Remove rocks and debris greater than 1" in diameter. Over excavate as required for bedding material.

B. Depth of Trench (in landscape areas):

Pressure Supply Line (3” and smaller): 18" from top of pipe to finish grade.
Non-Pressure Line (12” pop-up Rotors): 18" from top of pipe to finish grade.
Non-Pressure Line (6” and smaller pop-up Rotors): 12" from top of pipe to finish grade.
Non-Pressure Line (12” pop-up Spray Heads): 18" from top of pipe to finish grade.
Non-Pressure Line (6” and smaller pop-up Spray Heads): 12" from top of pipe to finish grade
Control Wiring: directly at side and bottom of pressure supply line.
Pressure Supply line Locator Tape: 6" above top of pipe.

C. Depth of Trench (under asphalt paving or concrete):

Pressure Supply Line (3” and smaller): 24" from top of pipe to aggregate base.
Non-Pressure Line: 24" from top of pipe to aggregate base.
Control Wiring: directly at side and bottom of pressure supply line.
Pressure Supply line Locator Tape: 6" above top of pipe.

1. Piping located under asphalt paving or concrete shall be installed with the appropriate sized sleeve and backfilled with sand bedding (6" below pipe and 6" above pipe).

2. Compact backfill material in 6" lifts at 90% maximum density determined in accordance with ASTM D1557 using manual or mechanical tamping device.

3. Set in place, cap, and pressure test piping in the presence of the owner or owner's representative prior to backfilling.

D. Width of Trench:

Pipe Greater than 3": 14" minimum.
Pipe Less than 3": 7" minimum.

E. Width between Trenches:

Irrigation Trench to Irrigation Trench: 6" minimum.
Irrigation Trench and other Trade Trenches: 12" minimum.

F. Boring: Boring will only be permitted where pipe must pass under an obstruction that cannot be avoided or removed. Backfill shall match surrounding soil density and grain.

Boring under existing paving, sidewalks, or hardscape may be permitted at contractor's own risk. Contractor is responsible for any repairs or damage to such items at their own expense.

G. Backfilling: Backfilling of trenches may not be done until all required testing for the irrigation system has been completed.

1. Material: Excavated material is generally considered to be adequate for backfilling operations. Before beginning the backfilling operation, insure that backfill material is free from debris and rocks greater than 1" in diameter, and is not mixed with topsoil. These materials after separated from backfill, shall be legally disposed of at contractor's expense.

2. Bedding: Bed pressure supply line with construction grade sand 6" above and 6" below pipe as shown on details. Remaining backfill may be as described above.

3. Bed all electrical control wire trenched separate from pressure supply line, with construction grade sand 6" above and 6" below wires.

4. When backfilling, slightly mound filled trenches for settlement after backfilling is compacted. Compact backfill to a 90% maximum density in accordance with ASTM D1557 with a mechanical tamper. Do not leave trenches open for a period greater than 48 hours. Open trenches shall be protected in accordance with current OSHA regulations.

5. Smooth trenches to finish grade prior to requesting a walk through for substantial completion with the architect.

3.03 POINT OF CONNECTION(S)

A. Point of connection shall be approximately as shown on drawings. Connect new underground piping and valves and provide all flanges, adapters, or other necessary fittings.

3.04 INSTALLATION OF SOLVENT WELD POLYVINYL CHLORIDE PIPE (PVC)

A. Polyvinyl chloride pipe shall be cut with an approved PVC pipe cutter designed only for that purpose.

B. All plastic-to-plastic solvent weld joints shall use only the solvent recommended by the pipe manufacturer. Do not install solvent weld pipe when temperature is below 40° F.

C. Pipe ends and fittings shall be wiped with MEK, or approved equal, before welding solvent is applied. Welded joints shall be given a minimum of 15 minutes to set before moving or handling.

D. Pipe shall be snaked from side-to-side on trench bottom to allow for expansion and contractions.

E. All changes of direction over 15 degrees shall be made with appropriate fittings.

F. When pipe laying is not in progress at the end of each working day, close pipe ends with tight plug or cap.

G. Install pressure supply line locating tape along the entire length of pressure supply line.

H. Coordinate pressure supply line with sand bedding operations.

I. No water shall be permitted in the pipe until inspections have been completed and a period of at least 24 hours has elapsed for solvent weld setting and curing.

J. Center load pipe with small amount of backfill to prevent arching and slipping under pressure. Leave joints exposed for inspection during testing.

3.05 INSTALLATION OF GASKET-END POLYVINYL CHLORIDE PIPE

A. Lay pipe and make pipe to fitting or pipe to pipe joints following OR70 recommendations (Johns- Manville Guide for Installation of Ring-Tite Pipe), or pipe manufacturer's recommendations.

B. Pipe shall be snaked from side-to-side of trench bottom to allow for expansion and contractions.

C. All changes of direction over 15 degrees shall be made with fittings.

D. Install pipe joint restraints on all gasket end fittings as specified above and as shown on details.

E. When pipe laying is not in progress and at the end of each working day, close pipe ends with tight plug or cap.

F. Install pressure supply line locating tape along the entire length of pressure supply line.

G. Center load pipe with small amount of backfill to prevent arching and slipping under pressure. Leave joints exposed for inspection during testing.

H. Coordinate pressure supply line with sand bedding operations.

I. No water shall be permitted in the pipe until inspections have been completed and a period of at least 24 hours has elapsed for solvent weld setting and curing.

3.06 INSTALLATION OF BRASS PIPE:

A. Brass piping shall be cut by a power hacksaw, a circular cutting machine using an abrasive wheel, or by means of a hand hacksaw. All pipe shall be reamed and rough edges or burrs removed so that a smooth and unobstructed flow is obtained.

B. Eccentric reducing fittings shall be used where any change in pipe size occurs. Bushings shall not be used unless specifically authorized by the architect.

C. Joint compound shall be carefully and smoothly placed on the male thread only. All screwed joints must be tightened with tongs or wrenches. Caulking of any kind will not be permitted.

D. All exposed piping under structural slabs shall be stenciled with "Irrigation Main" or "Irrigation Lateral" as required, at ten foot (10') intervals in black lettering, 3/4" minimum high.

3.07 BACKFLOW PREVENTION DEVICE

A. Install Backflow prevention device, enclosure and associated equipment at the location as specified on drawings.

B. Coordinate installation with local governing codes and ordinances.

3.08 FLOW SENSORS

A. Install flow sensors as specified on drawings and per manufacturer's specifications.

B. Install flow sensing cable in a separate conduit and connect to terminal strip at controller.

3.09 MASTER VALVES

A. Install master valves as specified on drawings and per manufacturer's specifications.

B. Install master valve wire in a separate conduit and connect to terminal strip at controller.

3.10 ISOLATION BALL VALVES

A. Install isolation ball valves in separate valve boxes as specified on the drawings.

3.11 QUICK COUPLING VALVES

A. Install quick coupling valves in separate valve box as specified on the detail drawings.

B. Angled nipple relative to pressure supply line shall be no greater than 45° and no less than 10°.

3.12 AIR RELIEF VALVES

A. Install air release valves in separate valve boxes as specified on the drawings.

3.13 ELECTRIC CONTROL VALVES

A. Install each electric control valve in a separate valve box so that cross handle is 3" min. below valve box cover as specified on the detail drawings.

B. Group electric control valves together as specified on the drawings allowing a maximum of 12 " between each valve box. Install valve boxes in the same direction and parallel with one another and perpendicular to paving, hardscape, sidewalks and paths.

C. Install electric control valves on slopes within two feet from toe of slope. Use same trench as toe of slope non-pressure lateral line for pressure supply line and wire routing see section 3.02 B and C for pipe and wire depths.

3.14 CHECK VALVES

A. Install swing check valves as specified on drawings.

B. Install spring check valves as specified on drawings.

3.15 VALVE BOXES

A. Install valve boxes with each type of irrigation equipment so that top of valve box is above finish grade as specified on the detail drawings. Valve box extensions are not acceptable.

B. Place gravel sump below and around each valve box prior to installing valve box as specified on the drawings. Place remaining portion of gravel inside valve box allowing full access in and around all fittings. Valve box shall be fully supported by gravel sump. No brick or wood supports are allowed.

C. Brand valve box lid of associated equipment as follows:

Electric control valve box lid with "Controller Letter and Station Number".
Quick coupling valve box lid with the letters "QC".
Isolation ball valve box lid with the letters "BV".
Air relief valve box lid with the letters "AR".
Spare Wire box lids with the letters “SW”
Wire Splice box lid with the letters "WS".

Letter and number size of brand shall be no less than 1" and no greater than 1 1/2" in height and shall be 1/8" maximum in depth. Provide sample branding to the owner or owner's representative prior to commencement of work.

D. Walk through for substantial completion will not be allowed until all branding is complete.

3.16 SPRAY HEADS AND ROTORS

A. Install spray heads and rotors as specified on drawings allowing minimum distance between paving, hardscape, sidewalks, and paths.

B. Spray heads and rotors shall not exceed the maximum head and row spacing specified on the drawings or staked in the field by the architect. In no case may spray heads or rotors be installed at a distance between heads that exceeds the manufacturer's recommended distance.

C. Angled nipples on swing joints below spray heads and rotors shall not exceed 45° nor be less than 10°.

D. After installation adjust nozzle sizes, arcs and radius of throw to allow head to head uniform distribution. Adjust all spray heads and rotors to correct height above sod as detailed. Adjust all shrub nozzles on risers and rotors on riser's perpendicular to finish grade and as specified on the drawings. No over spray will be allowed on paving, hardscape, sidewalks, and paths.

E. Adjust adjacent plant material so that it does not interfere with uniform distribution of each spray head or rotor.

F. Architect may request nozzle changes and/or adjustments without additional cost to the owner.

3.17 AUTOMATIC CONTROLLER UNIT

A. Verify electrical power at location of automatic controller unit prior to installation of automatic controller unit. Notify architect immediately if power source is not available.

B. Hardwire controller to the on/off switch and existing power source. Controller shall not be plugged into socket provided for other equipment.

C. Install automatic controller unit where shown on drawings per manufacturer's specifications. Controller shall be tested with complete electrical connections. The Contractor shall be responsible for temporary power to the Controller for operation and testing purposes.

D. Connect electric control valve wiring to controller unit in the same numerical sequence as indicated on the drawings and label within 1" of the terminal strip. Label all spare wires as "spare".

E. Connect flow sensing and master valve wiring to controller unit and label within 1" of the terminal strip.

F. Install a separate ground rod and wire for each controller unit as specified on the drawings and per manufacturer's specifications.

G. Above ground conduit shall be rigid galvanized pipe with the appropriate fittings. Below ground conduit shall be PVC SCH 40 pipe with appropriate fittings.

H. Label each automatic controller unit with the letter or number designated on the drawings. Letter or number shall be located in a visible location on the inside panel cover with 3" high vinyl letters.

I. Each automatic controller unit shall be completely operable prior to scheduling a walk through for substantial completion.

3.18 ELECTRICAL WIRE

A. Low Voltage Wiring:

1. Bury control wiring in same trench as pressure supply line as specified.

2. Bundle all 24 volt wires at 20' intervals with electrical tape.

3. Provide expansion loops at every pressure supply line angle fitting and at 250' length intervals along routing. Form expansion loop by wrapping wire a minimum of 10 times around a 3/4" pipe and withdrawing pipe as specified on the drawings.

4. Limit splicing of electrical wiring. Provide each splice made at intervals or in electric control valve and drip valve assembly valve boxes with 3M DBY Direct Bury Splice Kits.

5. Wire splices occurring at intervals outside electric control valve boxes shall be installed in a separate valve box.

6. Provide (1) one electrical control wire for every electric control valve. Piggy backing like zones on the same electrical control wire is not allowed.

7. Install (2) two spare #14-1 electrical control wires from the automatic controller unit pedestal to the last electric control valve on each leg of pressure supply line. Locate the spare wires in their own valve box as specified on the drawings. In addition to these spare wires, check the drawings for any additional wires that may be required and locate them in the same valve box as the spare wires.

B. High Voltage Wiring:

1. Install 120 volt power from power source to automatic controller unit following local governing codes and ordinances.

3.19 QUALITY CONTROL

A. Preconstruction Meeting: The contractor is responsible for contacting the architect prior to beginning construction and/or ordering materials to establish a meeting to review and discuss project objectives, concerns and to review the construction documents to insure a complete understanding of required installation procedures.

B. General Observation: The architect will visit the construction site at interim times during the construction process to access construction progress regarding installation of irrigation equipment to be in compliance with the drawings, details, specifications and site conditions. The architect will prepare a site report after each visit noting progress of installation, verbal communication with the contractor and identifying any field adjustments necessary which require modifications to the designed irrigation system. A copy of this site report will be delivered to both the owner and the contractor. The

contractor is responsible to immediately address each item on the site report before proceeding with further construction.

C. Pressure Testing the Pressure Supply Line: After backfilling, flushing, and prior to the installation of each electric control valve, isolation ball valve and quick coupling valve the irrigation system shall be pressure tested.

1. Pressure testing shall be performed in the presence of the architect and owner or owner's representative utilizing the following procedure:

a. Pressurize the irrigation system to 40 psi greater than the designated static pressure or 150 psi whichever is greater for a period of no less than 2 hours. The pressure gauge used for the pressure test shall not exceed readings greater than 300psi. Pressure pump and other equipment necessary for the test shall be furnished by the contractor.
b. Test is acceptable if no leakage occurs within the system for the duration of the testing period.
c. If leaks occur, repair said leaks and begin pressure test again. Repeat this operation until no leaks occur in the irrigation system.
d. Before requesting a walk through for substantial completion, the entire irrigation system shall remain under pressure for a period of no less than 48 hours.

2. The contractor is responsible for notifying the architect one day in advance of the pressure test.

D. Flushing: Center load all piping prior to flushing. After all new irrigation piping and risers are in place and connected and all necessary diversion work has been completed and prior to the installation of sprinkler heads, rotors and quick coupling valves, thoroughly flush piping system under full head of pressure. After the furthermost riser from the point of connection begins to flush, continue flushing for a duration of five minutes. After the system is thoroughly flushed, cap all risers.

E. Walk Through For Substantial Completion:

1. Before requesting a walk through for substantial completion the following requirements must be entirely satisfied:

a. The entire irrigation system is completely installed, flushed and satisfactorily pressure tested. If the contractor failed to notify the architect for the pressure test and flushing procedures stated above than the contractor assumes full responsibility for any design modifications directed by the architect during the walk through for substantial completion regarding pressure and flushing issues.
b. All valve boxes have been branded.
c. All automatic controllers are fully operable and communication has been certified in writing and checked at central control system by the central control system manufacturer on their letter head.
d. Record as-built drawings have been submitted to the architect for review as to completeness.

e. (4) Four Services manuals have been delivered to the owner or owner's representative.

2. Once the above requirements have been met a walk through for substantial completion may be requested. The following procedures will be used during the walk through:

a. Contractor must have (2) two personnel available with radio communication for the entire length of the walk through.
b. All valve box lids shall be removed from valve boxes and placed face up adjacent to the valve box prior to beginning the walk through.
c. The walk through will be divided into (2) two sections and proceed as follows:

.1 Visual Walk Through: This will consist of walking through the entire irrigation system and examining all components of the system without turning on zones. A punch list will be established of deficiencies in the construction and workmanship of the irrigation system as compared to the construction drawings, details, and specifications.

.2 Operational Walk Through: This will consist of walking through the entire irrigation system observing each zone in a fully operable condition. Valves must be activated from the automatic controller unit (Manual bleeding of individual electric control valves will not be acceptable). A punch list will be established of deficiencies in the operation of each zone in the irrigation system evaluating but not limited to head spacing, row spacing, nozzle sizing, correct radius of throw, correct stationing, as compared to the construction drawings, details, and specifications.

3. Once the Walk Through for Substantial Completion has been completed the architect will provide a copy of all punch list items to the owner for review and distribution to the contractor. It is the contractor's responsibility to repair, replace, and adjust all items on the punch prior to requesting a final walk through.

F. Final Walk Through:

1. Before commencement of a final walk through is requested, the following requirements must be entirely satisfied:

a. Each item on the walk through for substantial completion has been thoroughly addressed and resolved by the contractor.
b. All final record as-built drawings and controller charts have been produced by the architect for review by the architect and contractor at the final walk through.

2. Once the above requirements have been met a final walk through may be requested. The following procedures will be used:

   a. Contractor must have (2) two personnel available with radio communication for the entire length of the walk through.
   b. Only those valve box lids shall be removed from valve boxes as indicated on the walk through for substantial completion punch list. The valve box lids shall be placed faced up adjacent to the valve box prior to beginning the final walk through.
   c. The final walk through will be divided into (2) two sections and proceed as follows:

      .1 Visual Walk Through: This will consist of walking through the punch list items created at the time of the walk through for substantial completion, examining all components of the system without turning on zones. Any remaining deficiencies in the construction and workmanship of the irrigation system as compared to the punch list generated at the time of the walk through for substantial completion, construction drawings, details and specifications will be noted.

      .2 Operational Walk Through: This will consist of walking through the punch list items created at the time of the walk through for substantial completion and observing each zone in a fully operable condition. Valves must be activated from the automatic controller unit (Manual bleeding of individual electric control valves will not be acceptable). Any remaining deficiencies in the operation of each zone in the irrigation system including but not limited to head spacing, row spacing, nozzle sizing, correct radius of throw, correct stationing as compared to the punch list generated at the time of the walk through for substantial completion construction drawings, details, and specifications.

3. Once the Final Walk Through is completed and all items created on the final punch list have been addressed the maintenance period may begin. Any additional walk throughs required due to contractors' inability to address all issues on the punch lists described above will be provided at the contractor's expense.

3.21 MAINTENANCE PERIOD

A. The Maintenance Period shall be for ninety (90) days after notification from the architect of a successful final walk through and will begin once all items on the final walk through punch list have been satisfactorily addressed by a written statement indicating such from the architect to the owner.

   1. The contractor is responsible for obtaining and following any maintenance manuals created specifically for the project from the owner at the beginning of the maintenance period.

2. At the end of the maintenance period and prior to turning the project over to the owner, the contractor shall deliver the following to the owner:

   a. Five (5) pop-up spray heads with nozzles of each type used, for every 100 pop-up spray heads installed on the project.

   b. Five (5) rotor heads with nozzles of each type used, for every 100 rotors installed on the project.

3. Once the contractor has fulfilled all maintenance agreement obligations an has provided the above items to the owner, the maintenance period will end see section 320533 Landscape Maintenance, for maintenance responsibilities.

END OF SECTION 328400