

SECTION 32 8400 - IRRIGATION

PART 1 - GENERAL

1.1 SUMMARY OF PROJECT

- A. The work covered by this section of the specifications consists of furnishing all labor, material, equipment and supplies in performing all operations in connection with the irrigation system and all site work in strict accordance with this section of specifications and applicable drawings.
- B. The purpose of this project is to provide the owner with a HydroPoint WeatherTRAK controlled irrigation system.
- C. Any material specified by name and/or model number in the specifications is deemed to be used for the purpose of identifying the materials and insuring the specific use of that material in the construction.
- D. Submit Contractor's construction schedule of anticipated work time to facilitate timely visits for review of work.
- E. Work to be done on Project shall:
 - 1. Include all labor, materials, equipment, tools and transportation.
 - 2. Perform all operations, in connection with and reasonably incidental to; the complete installation of the irrigation system.
- F. Items of work specifically included.
 - 1. Procurement of all applicable licenses and permits.
 - 2. Payment of any fees for connection to water source and power source.
 - 3. Coordinate of location of underground utilities, by contacting local services: 'Blue Stakes' or 'Call Before You Dig'.
 - 4. Sleeving necessary for irrigation pipe and wire.
 - 5. Provision for and connection of the electrical power supply to the irrigation control system.
 - 6. One year warranty of all irrigation components and all labor required to install.
 - 7. 90 day maintenance period of irrigation system and components.
- G. All disturbed areas shall receive irrigation unless specifically indicated on drawings.

1.2 DEFINITIONS

- A. CD's: Acronym for Construction Documents. Design /Build documents created and supplied by the Contractor for the purposes of building the irrigation system.
- B. Contract: For the purposes of the irrigation section of the specification, (Section 32 84 00) this term refers to the Contract, Sub-Contract, or portion of the Contract dealing only with the irrigation system.

- C. Contractor: For the purposes of the irrigation section of the specification this term refers to the specific contractor or sub-contractor responsible for installation of the irrigation system for this project.
- D. GPM: Acronym for Gallons per Minute.
- E. Isolation Valve: A manual valve located on the main line that when shut off, will remove constant pressure to a specific section of the main line and corresponding downstream irrigation components.
- F. Line Valve: A manual valve located on the main line that when shut off, restricts flow in the main line. More than one line valve must be shut off to isolate a section of main line and corresponding downstream irrigation components.
- G. Lateral Line Piping: Circuit piping downstream of remote control valve (RCV) providing water to sprinkler heads, bubblers, or drip components. Under pressure only when RCV activated and opened.
- H. Line Voltage Wiring: Wiring used to convey power to electrically operated equipment on the Project, such as 120 VAC, 240 VAC, or 480 3PH VAC.
- I. Low Voltage Wiring: Wiring used to convey power to irrigation system components, such as RCV's, master valve, flow meter, decoders, etc. An example would be: 14 AWG PE UL RCV control wire.
- J. Main Line Piping: Piping downstream of Point of Connection (POC). Provides water to RCV's, Quick Couplers, and hose bibs. Normally under constant pressure.
- K. OAR: Acronym for Owner's Approved Representative. This individual designated by Owner who is authorized to make decisions on behalf of the Owner. This individual is authorized by the Owner to direct actions of the Contractor. This individual shall have detailed involvement in the project and be on Project site at regular intervals.
- L. POC: Acronym for Point of Connection. The physical location of the water source for this Project, and the actual components installed connecting to the water source. May require Contractor to provide additional saddles, valves, nipples, fittings, spools etc. to provide water to the Project.
- M. RCV: Acronym for Remote Control Valve. An electrically operated 24 VAC valve.
- N. Static Pressure: Pressure measured at the POC, with no flow taking place within the system.
- O. Water Supply: Potable, and/or Non-Potable, and/or Effluent piping and components, furnished and installed by trades or contractors other than the irrigation contractor; to provide irrigation water to this Project upstream of (prior to) the POC.

1.3 ELIGIBILITY TO BID

- A. The minimum level of expectation for Experience and Qualifications required to be eligible to bid the irrigation system on this Project are listed below in this section.
 - 1. See Sections referring to 'Experience, Qualifications and Certifications' for more information and details.
 - 2. Contractor shall be in compliance with these requirements at the bid date.

- B. Contractor shall be prepared to submit documentation supporting their Experience and Qualifications to the General Contractor and the Owner's Approved Representative, (hereafter referred to as the OAR) within 48 hours of bid date.
- C. Failure to meet the minimum requirements for Experience and Qualifications may result in elimination of the Contractor's bid or his ability to work on this Project.
- D. Failure to provide supporting documents within 48 hours of bid may result in elimination of the Contractor's bid or his ability to work on this Project.
- E. Requirements for documentation of Certifications are also listed below in the same Section. Contractor shall not be required to submit documentation of Certification at Bid date, but at date indicated.

1.4 PROJECT CONDITIONS

- A. Contractor shall accept Project site in 'as-is' condition.
- B. Emergency Interruption of water service.
 - 1. In the event irrigation installation requires emergency shut-down of the municipal water system, Project site or development water system, or Project's irrigation system. Contractor shall be responsible to notify OAR and governing agency immediately. Contractor shall make every effort to restore service in a timely manner.
- C. Planned Interruption of water service
 - 1. In the event irrigation installation require shut-down of municipal water system(s), Contractor shall be responsible to coordinate with and receive approval from the OAR and local governing agency. Contractor shall be responsible for notification of any affected properties as directed by the local governing agency. In no case shall notification be less than 48 hours in advance of shut down, nor shall the shut-down extend beyond 8 hours.
- D. Contractor shall be responsible for continuous provision of irrigation water maintaining all existing or new plant material on Project in a healthy condition during term of this project.
- E. Contractor shall maintain Project work area in a safe condition, and provide flagging, taping, barricades, trench covering, shoring and or fencing necessary to maintain safety.

1.5 PERFORMANCE REQUIREMENTS

- A. Minimum pressure and minimum flow required:

1. Performance Specifications expect that the Contractor access or provide a POC that has available a minimum static pressure and a minimum flow capable to safely and efficiently operate irrigation system.
2. Contractor shall perform static/working pressure and volume test within 48 hours of commencement of work, and provide written results to OAR.

B. Responsibility for coverage:

1. Performance Specification design intends that the Contractor shall provide 100% coverage of sprinklers (also known as double coverage or head-to-head coverage.)
2. Contractor shall have authority to make minor adjustments to actual placement of sprinkler heads or irrigation components vs. locations shown on plan, in order to best achieve full coverage indicated above, without significant overspray on hardscapes, buildings or other project features.
3. Contractor shall notify OAR in writing of: potential discrepancies or weaknesses due to field conditions in implementing irrigation design.

C. Layout of Components

1. During layout and staking, consult with OAR to verify proper placement of major irrigation components.
2. Contractor shall not proceed with implementation of irrigation plans without OAR's approval.
3. Contractor shall have authority to make minor adjustments to pipe routing or equipment locations due to conflicts with site utilities or other obstructions.

1.6 SEQUENCING

- A. Contractor shall contact local utility locator service at least 48 hours prior to commencement of work on the Project, and as often as needed during progress of the Project to maintain Project safety and protection of site utilities.
- B. Contractor shall familiarize himself with site utilities and hazards prior to commencement of work.
- C. Contractor shall coordinate this work with other work by other trades on Project as well as other landscape tasks on Project.
- D. Install sleeving prior to installation of concrete flat work, paving or other permanent site elements as needed.
- E. Irrigation system Point of Connection components, backflow prevention shall be installed and operational prior to all downstream components.

- F. All main lines shall be thoroughly flushed of all debris prior to installation of Remote Control Valves.
- G. All lateral lines shall be thoroughly flushed of all debris prior to installation of any sprinkler heads.

1.7 REFERENCE / RELATED DOCUMENTS

- A. The Specification General and Supplementary General Conditions of the Specifications shall apply to all work under this section.
- B. Separation of these specifications into sections is for convenience only and is not intended to establish limits of work.
- C. Work under this section shall include coordination with all other sections of these specifications.
- D. The following references apply to this project, the Contractor shall be responsible to be familiar with, refer to, and implement these references in completion of this project:
 - 1. ASTM – American Society for Testing and Materials.
 - 2. Irrigation Association: Turf and Landscape Irrigation Best Management Practices (BMPs).
 - 3. American Society of Irrigation Consultants (ASIC) ‘ASIC Guideline 100-2002 (January 2, 2002) For Earth Grounding Electronic Equipment in Irrigation Systems.
 - 4. Utah Irrigation Professionals document: Minimum Standards for Landscape Design and Construction.
 - 5. Any local governing agency codes, ordinances and/or any standards, details and specifications for irrigation applicable agency may have.
 - 6. Applicable industry codes, ordinances or standards such as (but not limited to) UBC or NEC.

1.8 SUBMITTALS

- A. Contractor shall follow format and requirements as set forth in Submittals section of this specification document for materials submittals.
- B. Contractor shall provide submittal for irrigation equipment and materials prior to ordering or taking delivery of any products.
- C. Equipment or materials purchased or installed prior to receiving written submittal approval is at risk of rejection by OAR. Use of materials other than those approved in writing is at risk of

rejection by OAR. Contractor shall be liable for removal or replacement of any or all non-approved products at his own expense.

D. Contractor shall provide OAR with 2 copies of Operations and Maintenance manual, containing:

1. Copy of approved submittal products
2. Detailed written instruction for Spring Start-up and Winterization.
3. Site map showing Controller zones, each zone distinguished by a different color.
4. Table showing typical Controller program schedule for worst case day.
5. Copy of control system certification if required for this Project.
6. Copy of water audit results if audit is required for this Project.
 - a. Copy of water audit certification when Project has met required criteria.

1.9 EXPERIENCE

A. Contractor shall provide an Experience resume or document; in pdf format, indicating:

1. That Contractor is licensed to perform landscape and irrigation construction in the State where this Project resides.
2. That Contractor is bondable and insured for the work to be performed.
3. That Contractor has been installing sprinkler systems on commercial projects for the last five consecutive years.
4. References of five projects of similar scope and size completed within the last five years. Three of the projects listed shall be local.

1.10 QUALIFICATIONS

A. Contractor shall provide a Qualifications resume or document; in pdf format indicating:

1. That Contractor currently employs both skilled and unskilled workers in sufficient quantities to complete project within time limits indicated by Contract.
2. A list of employees to be assigned to this project and their irrigation experience.
3. That Contractor possesses proper power equipment of appropriate size and quantity to complete project within time limits indicated by Contract.
4. Contractor shall include a listing of the supplier(s) where irrigation related material will be purchased for this Project.
5. Person on project site, in charge (Project Foreman, Superintendent, Supervisor, Manager-etc.) of daily irrigation field construction operations:
 - a. Has at least five consecutive years of commercial irrigation experience.
 - b. That this person is able to communicate with OAR. Is fluent in reading, writing and speaking English.
 - c. That this person is able to communicate rapidly and effectively with his staff in any languages used within his staff.

- d. Is a Certified Irrigation Contractor (CIC) in good standing as set forth by the Irrigation Association. This person shall be on the project site at least 75% of each working day.
 - i. Contractor's CIC shall be a regular full-time employee of the Contractor firm, **or** a sub-contractor to Contractor, where sub-contractor's firm provides **all** irrigation installation for the Project and meets all listed requirements for Experience, Qualifications and Certifications.

B. NOTE: Contractor shall not engage a CIC as a consultant or representative to oversee Contractor's staff install the Project irrigation system, i.e. the Contractor shall not 'rent' a CIC or CIC's license

1.11 CERTIFICATIONS

- A. Contractor shall provide copies of appropriate Certification documents for all applicable staff. In order to provide a minimum level of workmanship, all installation personnel expected to perform any tasks involving PVC pipe, electrical components, and or drip components; shall have Certificates for each task they perform as designated below:
 1. All installation personnel who will work on PVC pipe and PVC fittings in the irrigation system shall be certified by IPS Corporation. The certification shall cover PVC pipe and fitting assembly using solvent weld joining techniques. It is the responsibility of the Contractor to obtain such certification and to provide a copy of the "Certificate of Completion" for each person handling PVC products on the project to the OAR prior to commencement of work. It is the Contractors responsibility to contact IPS Corporation and then the local IPS authorized representative well in advance of commencement of work to schedule his/her attending of a scheduled seminar or to make an appointment to schedule a new seminar. Contact IPS Corporation, Weld-On Customer Service at 800 421-2677, to obtain a referral for the local IPS factory authorized representative contact information.
 2. All installation personnel who will work on the electrical circuits of the irrigation system shall be certified by Paige Electric Co. The certification shall cover irrigation wires, cables, proper installation and splicing methods, and protecting electronic equipment from lightning and power surges. It is the responsibility of the Contractor to obtain such certification and to provide a copy of the "Certificate of Completion" for each person installing electrical products on the project to the OAR prior to commencement of work. It is the Contractors responsibility to contact Paige Electric well in advance of commencement of work to schedule his/her attending of a scheduled seminar or to make an appointment for a new one. Contact Vince Nolletti, Vice President Irrigation Operations, Paige Electric Co, LP, 559 431-2346.

3. If Drip irrigation products are to be used on this Project, all installation personnel who will work on drip components of the irrigation system shall be certified by the manufacturer of the corresponding drip products specified to be used on the Project. The certification shall cover proper application and installation of point source and inline drip irrigation products, and also adaptation of drip product to Project soil types and infiltration rates. It is the responsibility of the Contractor to obtain such certification and to provide a copy of the "Certificate of Completion" for each person installing drip products on the project to the OAR prior to commencement of work. It is the Contractor's responsibility to contact the drip product manufacturer and the local manufacturer's authorized representative well in advance of commencement of work to schedule his/her attending of a scheduled seminar or to make an appointment for a new one. Courtesy contact information for the following manufacturers is shown below:

- a. Rain Bird Corporation—Tiffany Haveron (435) 720-3897
- b. Hunter Industries—Ryan Bushman (385) 232-5730
- c. Netafim USA—Kelly Keicher (303) 513-3738

4. Documents verifying certifications for the following shall be provided to OAR through the General Contractor at least 7 days prior to commencement of any irrigation work on the Project:
 - a. PVC Solvent Weld certification
 - b. Electrical certification
 - c. Drip certification

1.12 CERTIFICATION FOR NON-TRADITIONAL OR CENTRAL CONTROL SYSTEMS

- A. If non-traditional and/or central control equipment or products are to be used on this Project, including but not limited to:
 1. 'SMART' controllers,
 2. Decoders and two wire systems,
 3. Weather-based systems, AND/OR
 4. Soil moisture sensors.
- B. Contractor shall provide copies of appropriate Certification documents for all applicable staff. In order to provide a minimum level of workmanship, all installation personnel expected to perform any tasks involving non-traditional and/or central control equipment shall have Certificates for each task they perform as designated below:

1. All installation personnel who will work on the specific system, equipment or product shall be certified by the manufacturer of the corresponding products to be used on the Project.
 2. The certification shall cover proper application and installation of these products, and also adaptation of the products to this specific Project.
 3. It is the responsibility of the Contractor to obtain such certification and to provide a copy of the "Certificate of Completion" for each person installing these products on the project to the OAR prior to commencement of that portion of work.
 4. It is the Contractor's responsibility to contact the product manufacturer and the local manufacturer's authorized representative well in advance of commencement of work to schedule his/her attending of a scheduled seminar or to make an appointment for a new one.
- C. Local Distributor, Manufacturer's Representative or Manufacturer are authorized to withhold sales or delivery of non-traditional equipment until such time that the Contractor demonstrates adequate understanding of assembly, installation, programming, operation, and maintenance of the equipment.

1.13 QUALITY ASSURANCE

A. Inspection Scheduling

1. Contractor shall expect a minimum of five irrigation inspections under the direction of the OAR.
 - a. Main Line pipe and wire
 - b. Main Line pressure test
 - c. Progress inspection
 - d. Final inspection
 - e. Completed 'Punch List' inspection

B. Main Line Piping

1. Main line pipe shall not be buried until approved by OAR. Pipe buried prior to approval shall be excavated and exposed for OAR's review.
2. Upon completion of main line pipe or sections thereof, Contractor shall isolate and pressurize to 120 PSI for two hours.
3. Contractor shall provide OAR with 48 hours request prior to testing date and time.

C. Grounding Resistance Testing

1. Controllers shall be tested by Licensed Electrical Contractor and show resistance of 10 Ohms or less.

2. Grounding not in compliance shall be corrected by Contractor at his expense.
3. Specific grounding requirements for Central Control systems shall be met by Contractor or corrected at his expense.

D. Project Record Copy

1. Maintain on Project site, one copy of all CD's clearly marked 'Project Record Copy'. Mark any deviation in material installation on CD's. Maintain and update sheets at least weekly.
2. Project Record Copy shall be available to OAR on demand.

E. Regulatory Requirements

1. Contractor shall comply with all plumbing requirements which direct work to be done by a licensed plumber.
2. Contractor shall comply with all electrical requirements which direct work to be done by a licensed electrician.
3. All work and materials shall be according to any and all rules, regulations or codes, whether they are local, state or national requirements.
4. Performance Specifications may not be construed or interpreted to permit work or materials not conforming to the above codes.

F. Adequate Water Supply

1. Water supply to this Project may be existing, or also may be installed by trades other than the Irrigation Contractor. Connection to this supply at the POC shall be by this Contractor. Contractor shall be responsible to verify that proper connection exists, and is of adequate size and pressure.
2. Notify OAR verbally immediately and in writing within 48 hours of problems encountered with water supply.

G. Workmanship and Materials

1. It is the intent of the Irrigation Specifications that all material required shall be of the highest quality available and meeting the requirements specified.
2. All work shall be performed in accordance with the best standards of practice relating to this trade.

1.14 PROJECT MATERIALS

- A. Owner shall retain option to purchase materials to be used on Project and provide them to Contractor.

- B. Contractor shall not remove materials purchased for this Project from this site.
- C. Contractor shall not store or co-mingle materials for this Project with materials for other Projects on this site.
- D. Delivery, Storage and Handling
 - 1. All materials shall be protected from contamination, damage, theft, vandalism, and prolonged exposure to sunlight.
 - 2. All material stored on project site shall be neatly organized in a compact arrangement, and this storage shall not disrupt project owner or other trades on Project site.
 - 3. Project materials shall be handled by Contractor with care necessary to prevent damage or breaking.
 - 4. Damaged or blemished materials attributed to Contractor shall be replaced with new, at Contractors expense.
- E. If this Project qualifies for manufacturer rebate, credit or incentive programs; Contractor shall provide OAR with documents in pdf format from distributor and/or manufacturer indicating required information of product purchased and/or dollar value which qualify for corresponding program. Documents shall be delivered to OAR within 14 days of purchase of products.

1.15 EXTRA MATERIALS

- A. Furnish the following items to OAR:
 - 1. One (1) 30" gas cock key (also referred to as sprinkler or meter key) for manual drains.
 - 2. One (1) 5-6' key for stop & waste valve.
 - 3. One (1) 5-6'key for 2" square operating nut valve.
 - 4. Two (2) keys for each automatic controller.
 - 5. Two (2) quick coupler keys with hose swivels attached.
 - 6. One (1) quick coupler valve.
 - 7. One (1) of each size or type of remote control valve used on Project.
 - 8. Five (5) of each sprinkler head and each nozzle used on Project.
 - 9. Two (2) of each type of specialty screwdriver/key/wrench/tool (used to adjust arc, radius, change nozzle etc.) for each type of sprinkler.

1.16 WARRANTY

- A. Contractor shall provide one-year Warranty for Project. Warranty shall cover all material, workmanship, and labor.
- B. Warranty period begins upon date of acceptance by OAR that Project is substantially complete.

- C. Warranty shall include filling and/or repairing depressions, replacing turf or other plantings due to settlement of irrigation trenches or irrigation system components, and adjustment of valve boxes, sprinkler heads and all other irrigation components which have settled from proper finish grade.

1.17 ADDITIONAL SERVICES

A. Winterization:

1. Contractor shall winterize entire irrigation system installed under this Contract prior to the first winter following installation; prior to hard frost--but no later than November 15th, unless directed otherwise by OAR in writing.
2. Winterize entire system via 'blow-out' method, using compressed air.
 - a. Compressor shall be industrial type, capable of evacuating water from all main line and lateral line pipe, with a minimum capacity of 175 CFM.
 - b. **Compressor shall be mechanically regulated to not more than 60 PSI.**

B. Spring Start-up:

1. Contractor shall start up entire irrigation system the Spring following installation; prior to plant need--but following danger of damaging frost, yet no later than April 1st.
2. Contractor shall energize entire main line pipe, all RCV's, and check for correct program installation and operation of Controller, each RCV and each quick coupler valve.

C. As-built documents: Prior to final inspection, prepare and submit to OAR As-built drawings.

1. Show field dimensioned locations of sleeving, POC, mainline piping, wiring runs not in main line pipe trench, and valves/valve boxes.
2. Dimensions are to be taken from permanent site features or finished hardscapes.

D. Central Control system and equipment shall be inspected by Factory authorized technician and commissioned by the same. Equipment shall be turned over to OAR in programmed and operating condition.

1.18 OWNER'S INSTRUCTION

- A. After system is installed, inspected, and approved; Contractor shall instruct OAR or other OAR designated individuals in complete operation and maintenance procedures of irrigation system. Coordinate instruction with references to previously submitted Operation and Maintenance manual.

1.19 COORDINATION

- A. Coordinate and cooperate with other Contractors as necessary to enable the work to proceed as rapidly and efficiently as possible.

1.20 INSPECTION OF SITE

- A. The Contractor shall be acquainted with all site conditions. Should utilities not shown on the plans be found during excavations, immediately notify the Engineer. Failure to do so will make the Contractor liable for any and all damage thereto arising: from his/her operations subsequent to discovery of such utilities not shown on plans.

1.21 EXISTING UTILITIES

- A. Before any trenching, excavation or digging below the surface for any reason is begun, the Contractor shall have the area "Blue Staked" in order to determine as close as possible the location of all underground utilities. The Contractor shall have a representative of the airport locate any airport or FAA underground utilities. The Contractor will conduct the work in such a manner to protect all utilities from damage. It is the responsibility of the Contractor to repair or replace any damage incurred by the Contractor or the Contractor's employees at no expense to the owner.

1.22 PROTECTION OF EXISTING SITE CONDITIONS

- A. The Contractor shall take necessary precautions to protect site conditions to remain. Should damage be incurred, the Contractor shall repair the damage to its original condition at the Contractor's own expense.

1.23 SUBSTANTIAL COMPLETION

- A. The date of Substantial Completion for the irrigation system will be when the complete irrigation system is working as intended. This will be determined by observation by the Engineer and Owner's Authorized Representative. The Contractor shall supply the owner or owner's agent, at this inspection, with complete 'Record Drawings', written suggested start- up and shut-down procedures.

1.24 GENERAL CONDITIONS

- A. All work performed shall reflect a total "turn-key" installation. This would include all equipment and materials necessary to install new controllers, all necessary wiring, communications equipment and communication lines needed to for a completely functional irrigation control system.

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- B. Include the installation of master valve and flow sensor at point of connection. These valves and sensors shall be connected just downstream of the backflow preventer.
- C. Provide first year backflow testing and certification for new backflow preventers to the Engineer.
- D. The Centralized Irrigation Control System shall be warranted to be free of defects and properly installed for one (1) year from the date of final acceptance. All equipment shall have a manufacturer's guarantee against faulty design, improper assembly, defective workmanship, or defective materials for a period of one (1) year from final acceptance.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Pipe and materials installed throughout the system shall be new and in satisfactory condition. After award of the contract and prior to beginning work, the Contractor shall submit for approval a complete list of materials that he/she proposes to install. No deviations from the specifications shall be allowed, except as provided for in these documents.

2.2 POWER SOURCE

- A. Power source for irrigation equipment shall not be included in the irrigation Contractor's portion of this Contract.
- B. Control System Components
 - 1. Irrigation Control System Hardware and Software. The Irrigation Control System shall be HyrdoPoint WeatherTRAK WTOXR-C-18-SPH, as per drawings.
 - 2. Data Communication
 - a. Communication Wire between Controller and Flow Sensor shall be as recommended by manufacturers.
- C. Grounding Systems
 - 1. #6 AWG solid bare copper wires.
 - 2. Copper ground plate 4 inches wide, 96 inches long, 0.0625 inches thick with 25 feet continuous length of 6 AWG solid bare copper wires attached by the manufacturer.
 - 3. Copper clad steel ground rod 5/8 inch diameter, 10 feet long, UL listed.
 - 4. Cadweld GR1161 G 'One-Shot' welding kit.
 - 5. Power Set earth contact material by Paige Electric. 1-800-327-2443
 - 6. Ground network shall be 10 ohms or less when tested.

D. Flow Sensors and Accessories

1. As noted on drawings with the following accessories:
 - a. Direct burial Paige Wire PE-39 or PE-89 20 AWG cable or approved equal.
 - b. Wire Connector Kits, 3M DBR/Y-6 or DBO/B-6

2.3 POWER WIRE

A. Direct bury wire for field located wall or pedestal mounted controllers:

1. All power cables shall be Paige Wire, type Tray Cable.
2. Wire shall be Paige Wire specification number P7266D for 10 AWG and smaller.
3. Wire shall be Paige Wire specification number P7267D for 8 AWG and larger.
4. 120 VAC wires shall be 3 conductor (hot, neutral and ground)
5. 240 VAC cables where service is provided to **controller only**, shall be 3 conductor (2 hot and 1 ground)
6. 240 VAC cables where service is provided to controller **and** other 120 VAC equipment (such as a convenience outlet) shall be 4 conductor (2 hot, 1 neutral and 1 ground)

B. Conventional wiring for wall mounted controllers:

1. Power wire or cable for conventionally wired wall mount or conduit-fed pedestal mount shall be according to local and NEC codes.

2.4 CONTROL WIRE

- A. Remote Control Valve wire shall be Paige Electric specification number P7354D – Rev 4.
- B. Different colored jackets shall be used for each controller on project.
- C. For projects with more than one controller, a separate color of 14 AWG wire (other than white, yellow, red or blue) shall be used as the ‘hot’ or ‘control’ wire for each additional controller.

2.5 WIRE CONNECTORS

- A. RCV wire splicing connectors shall be Paige P7364D, Paige part number 270670 or 270671 (3M model ‘DBR/Y-6’). **No substitutions allowed.**
- B. Communication wire splicing or connection shall be Super Serviseal model 8006137. Contractor may submit to OAR; alternate: Paige brand, model 273211 (3M model SliC) and Paige brand, model 270228R (3M model 316IR). **No use of alternate without written approval from OAR.**

2.6 POINT(S) OF CONNECTION

A. Contractor shall be prepared for a variety of POC conditions including:

1. Tapping, Saddling, Pac-Joint connection, extension, flared end connectors.

2.7 BACK FLOW PREVENTER

- A. Febco 825YA, see drawings.
- B. Aluminum, solid wall, insulated cabinet, as manufactured by VIT Strong Box.

2.8 HYDROMETER

- A. Netafim Photo Diode Register.

2.9 SLEEVING PIPE

- A. Minimum sleeve size shall be 2" pipe.
- B. Sleeving 2" through 4" shall be S/40 PVC pipe. Sleeving 6" and larger shall be CL/200 PVC pipe.
- C. Sleeves shall typically be two nominal sizes larger than the pipe to be placed within them. Sleeve material and sizes shall be according to the following

D. SLEEVING TABLE:

INTERIOR PIPE	SLEEVE PIPE	INTERIOR PIPE	SLEEVE PIPE
3/4" S/40	2" S/40	4" CL/200	8" CL/200
1" S/40	2" S/40	6" CL/200	10" CL/200
1-1/4" S/40	2-1/2" S/40	8" CL/200	12" CL/200
1-1/2" S/40	3" S/40	10" CL/200	14" C905
2" S/40	4" S/40		
3" S/40	6" CL/200		

2.10 TRENCH BEDDING MATERIAL

- A. Bedding material shall be a sandy material free of rocks over 1 inch in diameter. Where existing soil does not meet this requirement, approved imported material shall be used.

2.11 PIPE PLUGS AND MARKERS

- A. Inside Sealing Pipe Plug - High impact polystyrene plastic retainers, rubber meeting ASTM C443, and corrosion resistant plated metal parts.

- B. Sleeve Marker Stake - 2x4 wood 24 inch minimum length. Painted green.

2.12 MAIN LINE PIPE

- A. Pipe 3/4" through 1-1/2" shall be S/40, solvent weld-bell end.
- B. Pipe 2" through 3" shall be CL/315, solvent weld-bell end.

2.13 MAIN LINE FITTINGS

- A. All main line fittings 2-1/2" and smaller shall be S/80.
- B. All main line fittings 3" and larger shall be gasketed ductile iron.
 - 1. Ductile iron fittings shall be manufactured by Harco, Leemco or OAR approved equal.

2.14 JOINT RESTRAINT SYSTEMS:

- A. Concrete Thrust Blocks
 - 1. Provide thrust blocks on mainlines at any change of direction (for slip joint fittings).
 - 2. Concrete shall have compression strength of 2500 PSI.
- B. Pipe Bell Joint Restraint components shall be tested and certified to meet the requirements of ASTM F1674 and shall be manufactured by Harco or Leemco. Grip ring serrations shall be machined. Restraint rods, bolts, and nuts shall be of ductile iron or low alloy steel.
- C. Valve to Fitting Restraint shall consist of a ductile iron (ASTM A536) split ring that fits behind the bell of the valve and threaded rod ending in an eye-bolt and nuts that fit onto the lugs of the fitting and shall be supplied by Harco or Leemco.
- D. Valve to Pipe Restraint shall consist of a ductile iron (ASTM AS36) split ring that fits behind the bell of the valve and a ductile iron split ring with machined serrations that grips the pipe and shall be supplied by Harco or Leemco.

2.15 MANUAL CONTROL VALVES

- A. Line or isolation valves 2" and smaller shall be:
 - 1. Apollo 77CLF10XXX. Or OAR approved equal.
- B. Isolation valves for RCV Manifolds (1" through 2-1/2") shall be:

1. Apollo 77C-10X-01 bronze ball valve Or OAR approved equal.

C. Drain Valves shall be:

1. 3/4" Mueller Oriseal model H-10288.

2.16 QUICK COUPLER VALVE

- A. Rain Bird 5LRC 1 inch brass quick coupling valve. On manufacturer assembled O-ring swing joint with threaded brass insert.

2.17 CONTROL VALVES

- A. Automatic control valves shall be Rain Bird PEB Series electric remote control valves, size appropriate for sprinkler zones.
- B. All Automatic control valves shall have Action Machining, Inc. manifold systems as per detail. All 2 inch valves shall have 2 inch action manifolds, all 1-1/2 inch – 1 inch valves shall have 1-1/2 inch action manifolds.

2.18 VALVE BOXES

- A. Carson Industries Specification Grade valve boxes, 'T' top configuration.
- B. Box, lid color to be brown, tan, or gray or green to match adjacent bark or stone mulch color.

2.19 LATERAL PIPE

- A. All lateral piping 3/4" through 1-1/2" shall be new, S/40 PVC, solvent weld bell end. Sized as indicated on plans.
- B. All lateral piping 2" through 3" shall be new, CL/315 PVC, solvent weld bell end. Sized as indicated on plans.

2.20 LATERAL LINE FITTINGS

- A. First two fittings downstream of control valve manifold shall be S/80
- B. All other lateral line fittings shall be new S/40 PVC.

2.21 ROTARY HEAD SPRINKLERS

- A. Nozzles for spray heads shall be required for area covered and proper spacing.

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- B. All rotary heads shall be on a swing joint assembly composed of: 12-24" of swing pipe, two ½" spiral barb elbows, 12-24" swing pipe, one M412-005 ½" marlex street elbow.
- C. Contractor shall submit for approval: rotary heads, rotary head nozzles, and swing joint assembly components.

2.22 DRIP EMITTER EQUIPMENT

- A. All drip emitters shall be as specified herein and described in the details.
- B. Rain Bird X CZ-100-PRB-COM wide flow drip control zone kits.
- C. **Netafim** Landscape Drip Line: Netafim TLCV-06-12, 0.6 GPH emitters spaced 12 inches apart.
- D. Netafim compression fittings compatible with Drip line.
- E. Hunter Drip Indicator: Hunter ECO ID
- F. Netafim Flush Valve: TLSOV
- G. Contractor shall submit for approval.

PART 3 - EXECUTION

3.1 GENERAL

- A. Contractor shall repair or replace work damaged by irrigation system installation.
- B. If damaged work is new, Contractor shall engage original installer of that work to perform repairs.
- C. Plant material deemed damaged by OAR shall be replaced at Contractor's expense.
- D. Contractor shall route pipe, wire, and other irrigation elements around outside of tree canopy drip line to minimize damage to tree roots.
- E. Contractor shall not cut existing tree roots larger than 2" to install this Project.
- F. Coordination of trench and valve locations shall be laid out with OAR prior to any excavation occurring.
- G. Contractor shall have no part of existing irrigation system used by other parts of Project landscape without water for more than 48 hours.

- H. The Contractor prior to installing the system, must verify existing water pressure and volume. If there is a failure to obtain the needed pressure or if an excess of pressure exists for normal operation, the contractor shall contact the Engineer for any adjustments to the system. Failure to report any discrepancies in pressure due to whatever reason, and installation done prior to notification of Engineer shall be done at the expense of the Contractor.
- I. Verify site conditions and note irregularities affecting work of this section. Report irregularities to the Engineer prior to beginning work. Verify locations of underground utilities including the existing irrigation system components and control wire in areas where excavation is to occur.
- J. Layout work as accurately as possible. All irrigation lines shall be installed in common trenches where possible. Where possible, all trenching shall occur on soft spaces.
- K. Stake out the irrigation control system. Items staked out are to include: controllers, sleeve locations, control wire, central control system wire routing, master valve/flow sensor locations, and electrical power wire routing.
- L. Irrigation system layout review will occur after the layout has been completed. Notify the Engineer 2 days in advance of review. The Engineer at this review will identify modifications.
- M. If for any reason complete coverage of all irrigation areas does not cover; irrigation Contractor shall be responsible to contact the Engineer before continuing with his work.
- N. Any Major Revisions to the irrigation system must be submitted and answered in written form, along with any change in contract price.
- O. Install all irrigation systems as per State and Local codes.

3.2 CENTRAL CONTROL SYSTEM

- A. All clocks shall be as specified on the drawings and installed according to the details. Ground controller system as per manufacturer's recommendations. Exact location of clock shall be determined on site by the OAR.
- B. Irrigation Control Units: The locations of the control units depicted on the drawings are approximate; the owner's representative, with assistance from the manufacturer's representative, will determine the exact site locations at the system layout review.
- C. Owner will provide all telephone drop locations as designated on plans. Contractor is responsible for all connections from that point. Coordinate with Engineer.

- D. Owner to provide all 120VAC power for control units. Coordinate location of power with owner's authorized representative.
- E. Install electrical connections between central control unit components and satellite control units per manufacturer's recommendations.
- F. Install electrical connections between satellite control units and monitoring equipment per manufacturer's recommendations.
- G. Install all surge protection as per manufacturer's latest instructions.
- H. Supplementary Grounding:
 - 1. Provide and place grounding system for component(s) being protected.
 - 2. Install all grounding circuit components in straight lines.
 - 3. When necessary to make bends, do not make sharp turns.
 - 4. Install all grounding equipment away from wires and cables.
 - 5. Bond Supplementary Ground to the service ground using No. 6 AWG solid bare copper wire.
 - 6. All splices shall be made using welding kit.
 - 7. Drive one ground rod into the soil as specified. Secure wire to grounding rod assembly with welding kit.
 - 8. Place grounding plate 30 inches deep with PowerSet earth contact material per manufacture's recommendations. Connect controller to grounding rod and plate as detailed with AWG No.6 solid conductor copper wire. Secure wire to plate assembly with welding kit.
- I. Attach wire markers to the ends of control wires inside the controller unit housing. Label wires with an identification number that consists of the name and station number of the existing controller to which the control wire had been previously connected.
- J. Connect control wires to corresponding control unit terminal, Connect wires to the satellite controller in the same order they were connected to the existing controller if applicable.
- K. Coordinate location of wall mount controllers with building or electrical Contractor to facilitate electrical service and future maintenance needs. Wall mount shall be securely fastened to surface. If exterior mounted, wall mount controllers shall have electrical service wire and field control wire in separate, appropriate sized weatherproof electrical conduit, PVC pipe shall not be used.
- L. Coordinate with OAR and Electrician to ensure that no conflicts exist with interference with high voltage electrical equipment in service area which would affect operation. Relocate if necessary.

- M. Wire under hardscape surfaces shall be placed continuously in conduit.
- N. Controllers shall be oriented such that Owner's Representative maintenance personnel may access easily and perform field system tests efficiently.
- O. Place Standard valve box at base of controller or nearby to allow for three to five feet of slack field control wire to be placed at each controller.
- P. This Contractor shall provide conduit access if needed for Electrical contractor. Electrical supply and installation, as well as hook-up to controller shall be by this Contractor.

3.3 MASTER VALVE / FLOW SENSOR

- A. Install master valves and flow sensors as per manufacturer's directions.
- B. Master valve and flow sensor shall be installed in valve boxes per specification on detail sheet.
- C. Underground wiring of FlowmecFlow Sensor products:
 - 1. Cable: Flowmec sensors may be located up to 2000' from pulse transmitters or displays. All data communications while connecting flow sensors to the electronics that are buried below grade, with or without conduit, shall be constructed to direct burial specifications similar to Telecommunications Exchange Cable (REA PE-89).
 - 2. The cable shall be constructed of 20 AWG, or larger, copper conductors twisted into pairs of varying lengths to prevent cross talk. Conductors shall be insulated with polyethylene or propylene with a suggested working voltage of 350 volts. The cable shall feature an aluminum-polyester shield and be finished with a black high-density polyethylene jacket Cable should be equivalent to AT&T PE- 39 or PE-89.
 - 3. Splices: It is important that all wire connections be absolutely watertight with no leakage to ground or shorting from one conductor to another. All splices shall be 3M DBY/R-6 from Paige Wire.
 - 4. Surge Protection for Sensors: Per Manufacturer's recommendations.
- D. All grounds to a 10-ohm or less earth ground.
- E. Surge Arrestors shall be installed on the 2-wire communication path at each solitary satellite unit or the first satellite within a satellite cluster. The MSP-1 Surge Arrestor shall be mounted in the stainless steel mounting bracket in the pedestal of the satellite unit or other suitable location. This surge arrestor shall be for the purpose of helping to prevent surges coming in on the 2-wire path and damaging the satellite.

3.4 ELECTRICAL CONTROL WIRES

- A. Electrical control wires shall be installed in the same trench as the main line wherever possible. Wires shall be laid alongside the pipe by "snaking" into the trench to allow as much slack as possible for contraction and expansion of the wire. All wire connections at remote control valves and at all wire splices will be left with two feet of wire so that the splice or the valve manifold can be brought to the surface for repairs without disconnecting the wires.

3.5 It is important that the joint be absolutely waterproof so that there is no chance for leakage of water and corrosion build-up on the connection. All wiring shall be accomplished with as few splices as possible.

- A. Splices in electric control wires shall be soldered first and then fitted with a 3M DBY Direct Bury Splice Kit. All splices shall be contained in a valve box, preferably in the same box as the electric remote control valves. Do not run short pieces of wire. Consult with the Engineer if any questions arise as to length or size of wire. Failure to do so will result in the replacement of the wire at the Contractors expense.

3.6 TRENCHES

- A. Trenches shall be dug as deep and wide as necessary to properly place pipe. All sleeves are to be placed prior to laying of any hard surface. All trenches shall be backfilled and compacted to that of the surrounding material.
- B. The Contractor, in placing the irrigation lines, etc. may uncover material not suitable for finished grading. This material shall be removed from the site. After the installation of the lines, the finished grading shall be smoothed over and restored to its original condition, using additional topsoil where necessary.

3.7 SLEEVE ASSEMBLY

- A. The site may contain existing sleeves. Should conditions necessitate the rearrangement or placement of additional sleeves, the Contractor, before proceeding with the work, shall obtain approval from the Engineer before commencing work shown by the drawings.
- B. Depth of sleeves to be determined by the type of line that is to be placed in sleeve. In the case of new construction, all sleeves are to be placed. Prior to laying of any hard surface. In the case of existing construction, the sleeves must be installed by boring under the existing hard surface.
- C. PVC joints shall be glued according to manufacturer's recommendations.
- D. Place pipe plug in each end of each unused sleeve pipe prior to backfilling.

- E. Sleeves shall be extended 12” minimum beyond walk or edge of pavement.
- F. Wire or cable shall not be installed in the same sleeve as piping but shall be installed in separate sleeves.
- G. Sleeve ends on sleeve sizes 4” and larger shall be capped with corresponding sized PVC slip cap, pressure fit, until used, to prevent contamination.
- H. Sleeve ends on sleeve sizes 3” and smaller may be thoroughly taped to prevent contamination.
- I. Sleeves shall be installed at appropriate depths for main line pipe or lateral pipe
- J. Contractor shall be responsible to protect existing underground utilities and components.
- K. Sleeve all piping and wiring that pass under paving or hardscape features.
- L. Sleeves shall be positioned relative to structures or obstructions to allow for pipe or wire within them to be removed if necessary.

3.8 PIPE ASSEMBLY

- A. All ductile iron fittings having change of direction shall have proper concrete thrust block installed.
- B. Over excavate trenches both in width and depth. Ensure base of trench is rock or debris free to protect pipe and wire. Grade trench base to ensure flat, even support of piping. Backfill with clean soil or import material.
- C. Contractor shall backfill no less than 2” around entire pipe with clean, rock free fill.
- D. Main line piping and fittings shall not be backfilled until Owner’s Representative has inspected and pipe has passed pressure testing. Perform balance of backfill operation to eliminate any settling.
- E. Place irrigation pipe and other elements at uniform grades. Automatic drains shall not be installed on this Project. Manual drains shall only be installed at POC where designated on Construction Drawings.
- F. Install pipe to allow for expansion and contraction as recommended by pipe manufacturer.
- G. Contractor shall install piping to: minimize change of direction, avoid placement under large trees or large shrubs, avoid placement under hardscape features.

- H. Plastic pipe shall be cut squarely. Burrs shall be removed, spigot ends of pipes 3" and larger shall be beveled.
- I. Pipe shall not be glued unless ambient temperature is at least 50 degrees F. Pipe shall not be glued in rainy conditions unless properly tented.
- J. All solvent weld joints shall be assembled using IPS 711 glue and P70 primer according to manufacturer's specification, no exceptions.
- K. Glued main line pipe shall cure a minimum of 24 hours prior to being energized. Lateral lines shall cure a minimum of 2 hours prior to being energized and shall not remain under constant pressure unless cured for 24 hours.
- L. All threaded joints shall be wrapped with Teflon tape or paste unless directed by product manufacturer or sealing by O-ring.
- M. All main line pipe, lateral line pipe and other irrigation elements shall be bedded and backfilled with clean soil, free of rocks 1" and larger.
- N. Contractor shall furnish and install additional backfill material as necessary due to rocky conditions.
- O. Trenches and other elements shall be compacted and/or water settled to eliminate settling.
- P. Debris from trenching operations un-usable for fill shall be removed from project and disposed of properly by Contractor.
- Q. Maximum acceptable flow through piping shall be 5.0 FPS maximum flow through piping shall be:
 - 1. 1"—13 GPM
 - 2. 1-1/4"—22 GPM
 - 3. 1-1/2"—30 GPM
 - 4. 2"—50 GPM
 - 5. 2-1/2" 75 GPM
 - 6. 3"—110 GPM
- R. Bedding material shall be placed a minimum of 6 inch in all directions around all mainline pipes prior to backfilling. Lateral line pipes shall have a minimum of 2 inch in all directions.
- S. All mainlines, as shown on drawings, shall be installed to a depth of 18 inches minimum.
- T. All lateral lines as shown on drawings shall be installed to a depth of 12 inches minimum.

- U. Lines bordering curbs or sidewalks shall be 12 inches away to allow for maintenance and access to the lines.
- V. All pipes shall be spaced with a minimum of 6" of separation horizontally from other pipes. Pipes shall not be placed above other pipes in a vertical condition.
- W. Thrust Blocks: All solvent weld mainlines greater than 2 inches in size shall be installed with thrust blocks wherever a change of direction 45 degrees or greater occurs and as follows:
 - 1. Bearing area of concrete thrust-block based on 200 PSI pressure and safe soil bearing load of 2,000 pounds per square foot.
 - 2. Concrete blocking shall be cast in place and have a minimum of 114 square foot bearing against the fittings.
 - 3. Block shall bear against fittings only and shall be clear of joints.
 - 4. Contractor shall install block adequate to withstand full test pressure as well as to continuously withstand operation pressure under all conditions of service.
- X. Joint Restraints: All bell and gasket joints shall have appropriate joint restraint systems.
 - 1. Joint restraints on all fittings at directional changes in pipe and at all couplings within 50 feet of directional change.
- Y. PVC joints shall be glued according to manufacturer's recommendations. Glued joints shall set for 24 hours before pressure is applied to lines. Before trenches are backfilled all lines shall be pressurized and checked for leaks.

3.9 FLUSHING AND TESTING

- A. When the pipe lines are connected and the valves in place but before any drip tubing are installed, the control valves shall be opened and flushed with a full head of water to clean out the system. Main lines shall be tested before backfilling for a period of not less than one hour and shall have no leakage or loss of pressure.
- B. Testing will be performed after. Completion of each circuit and after completion of the entire system. At this time any necessary repair work will be done at the Contractor's expense and the entire system will be in good working order prior to the issuance of the Certificate of Substantial Completion.

3.10 PIPING INSPECTIONS

- A. Before any pipes are covered, the Engineer shall inspect the system for compliance with specifications and drawings. Any required changes will be made at this time at the expense of the Contractor.

3.11 SYSTEM OPERATION

- A. The entire system will be tested in the presence of the Engineer and Property Owner's Authorized Representative, in order to ensure COMPLETE coverage of all areas to be watered and the automatic operation of the system using the central control system. If applicable, any changes required will be made at this time at the Contractor's expense.

3.12 VALVES AND ASSEMBLIES

- A. Backflow Preventer: install using ductile iron spools and fittings for 2-1/2" and larger, brass fittings, unions and nipples for 2" and smaller. Encase backflow devices in aluminum enclosure, insulated.

3.13 QUICK COUPLER VALVE

- A. Install one (1) quick coupler at point of connection, at the end of all mainline runs, and per plan and details.
- B. Top of quick coupler valve cover shall allow for complete installation of valve box lid, but also allow for insertion and operation of key.
- C. Base of quick coupler valve and top of quick coupler swing joint shall be encased in 3/4" gravel.
- D. Contractor shall not place quick coupler valves further than 100 feet apart, to allow for spot watering or supplemental irrigation of new plant material.
- E. Quick coupler valve at POC shall not be eliminated or relocated.

3.14 MANUAL CONTROL VALVE

- A. For 3" and larger valves, place sleeve of 6" or larger pipe over top of valve vertically and then extend to grade. Place 10" round valve box over sleeve at grade. See detail for additional information.
- B. Isolation valves 2-1/2" and smaller shall be contained in a Carson Standard size valve box. Valves shall be installed with S/80 PVC TOE Nipples one both sides of valve.

3.15 ELECTRIC REMOTE CONTROL VALVE

- A. Contractor shall place remote control valves in groups as practical to economize on quantity of manifold isolation valves.
- B. Remote control valves shall be located separately and individually in separate control boxes.
 - 1. Flows through 1" valves shall be 1-22 GPM.
 - 2. Flows through 1-1/2" valves shall be 23-50 GPM.
 - 3. Flows through 2" valves shall be 51 through 75 GPM
- C. Valves shall be located in boxes with ample space surrounding them to allow access for maintenance and repair.
- D. Where practical, group remote control valves in close proximity, and protect each grouping with a manifold isolation valve as shown in details. **Manifold Main Line (or Sub-Main Line) and all manifold components and isolation valves shall be at least as large as the largest diameter lateral served by the respective manifold.**
- E. Valve boxes shall be set over valves so that all parts of the valve can be reached for service. Valve box and lid shall be set to be flush with finished grade.
- F. Only one remote control valve may be installed in a Carson 1419124 box.
- G. Place a minimum of 4" of 3/4" washed gravel beneath valve box for drainage.
- H. Bottom of remote control valve shall be a minimum of 2" above gravel.
- I. See remote control valve manifold detail for more information.
- J. Control valves shall be located in bark mulch areas. Avoid locating valves in areas of high pedestrian and vehicular circulation.
- K. Each bank or section of control valves shall be enclosed in an adequate size valve box and extensions to allow the disassembly of valves contained within. Valve boxes shall be at finished grade with valve stems 4 inches below top of box and with 6 inch of clean gravel under the valve box. Isolation valves at all valve banks.

3.16 VALVE BOXES

- A. Valve boxes shall be set flush with the finished grade. Valve manifolds shall be set 12 inch below the top of the box including ball valves and quick couplers where called for. Do NOT install more than two (2) electric remote control valves in a single valve box. All valves must have ample room and access for repair.
- B. All valve boxes shall have valve number or identification branded in lid via headed steel or brass branding irons, minimum 2" tall.

1. Valves shall list Controller ID and station number (X00)
2. Wire splice boxes shall list (WS)
3. Stop & Waste shall list (S&W)
4. Ball Valves shall list (BV)
5. Quick couplers shall list (QC)
6. Master Valve shall list (MV)
7. Flow meter shall list (FM)

3.17 DRIP EMITTERS

- A. Drip emitters shall be installed as detailed and as per manufacturer's recommendations.
- B. Planting beds shall be graded to continuous uniform finish grade prior to emitter installation. Surface installed drip tubing shall be installed after plant material, but prior to bark mulch being installed. Any tubing visible at bark surface shall be re-installed at Contractor expense.
- C. Contractor shall place filters, regulators, air/vac vents and flush valves as necessary to meet manufacturer's minimum recommendations.
- D. Field conditions, specifically soil type conditions shall dictate any alteration in emitter size and emitter spacing. Contractor shall notify OAR to request confirmation of soil type prior to ordering drip tubing products to ensure proper product and proper spacing are used.

3.18 INSPECTION

- A. At the time of final inspection the entire system must then be tested in the presence of the Engineer. It must operate in a satisfactory manner, with a full coverage of the areas indicated on the plans.
- B. Before the final inspection is complete; the Contractor must furnish "as-built" drawings. These drawings should be updated on a daily basis to assure accuracy. The drawings must show the location of all valves, pipe, heads, controller control lines, and drain valves used on the job. These drawings and maintenance manuals must be submitted at the time of final inspection or in accordance to the general conditions. Measurement for equipment shall be triangulated from two fixed points within the project hardscape.
- C. Test and demonstrate to the Engineer the satisfactory operation of the system free of leaks. Instruct the owner's designated personnel in the operation of the system pursuant to the training section already outlined in the specifications.
- D. A minimum of 30 hours of training for up to 2 user personnel shall be conducted by the Distributor's training personnel at a place and time to be determined. The Contractor is to

schedule, coordinate, and attend the training session. Training shall include an overview of system operations as well as detailed one-on-one training for selected individuals for both software and hardware operation.

3.19 ADJUSTMENT AND CLEAN-UP

- A. After completion of grading, planting, and mulching carefully adjust irrigation system as required.
- B. Sprinkler heads shall be adjusted to proper height when installed.
- C. Changes in grade or adjustment of head height after installation shall be considered a part of the original contract and at Contractor's expense.
- D. Adjust all sprinkler heads for arc, radius, proper trim and distribution to cover all landscaped areas that are to be irrigated. Adjust sprinklers so they do not water buildings, structures, or other hardscape features.
- E. Adjust run times of stations to meet the needs of plant material the station services.
- F. No sprinkler shall be located closer than 6" to walls, fences, or buildings.
- G. Heads adjacent to walks, curbs, or paths shall be located at grade and 2" away from hardscape.
- H. Control valves shall be opened and fully flush lateral line pipe and swing joints prior to installation of sprinklers.
- I. Spray heads shall be installed and flushed again prior to installation of nozzles.
- J. Contractor shall be responsible for adjustment if necessary due to grade changes during landscape construction.
- K. Contractor shall clean all work areas daily, leaving areas accessible to the public in a 'broom clean' condition.
- L. Open trenches and or hazards shall be protected by chain link fence, snow fencing, or caution tape as directed by the OAR.
- M. Contractor shall coordinate with OAR for periodic as well as final cleanliness inspection.
- N. Upon project completion, Contractor shall remove all excess material, construction debris, packing, etc. attributable to his work.

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Construction Documents

- O. Completed project shall be left in a 'broom clean' condition.