

ITEM 11615.9301 M – LANDSCAPE IRRIGATION

DESCRIPTION

This work shall consist of furnishing and installing Landscape Irrigation in accordance with the details at the locations indicated in the plans or where directed by the Engineer.

MATERIALS

Unless otherwise specified herein, all materials and methods of construction shall conform to the requirements of Manufacturers Standard Cut Sheets, Manufacturers recommended installation standards and All Design Guide and Typical Installation Details latest edition for all manufacturer materials used.

All materials throughout the irrigation system shall be new and undamaged and in perfect working condition.

Irrigation System:

Irrigation System Equipment:

(System irrigation equipment shall be single manufacturer and shall include all sprinkler heads fixed sprays, rotors, controllers, electric valves and quick coupler valves.)

The Toro Company
5825 Jasmine Street
Riverside, CA 92504

Buckener Irrigation
4381 N. Brawley Ave
Fresno, CA 93722

Irritrol Systems
5825 Jasmine Street
Riverside CA 92504-1183

Drip Irrigation:

Drip irrigation Equipment:

Drip irrigation equipment shall be a single manufacturer for all dripper tubing, flush valves, air vent valves, pressure valves, fittings and accessories. The controller and electric valves shall be the same as above.

Netafim USA
Precision Irrigation
5470 East Home Ave.
Fresno, CA 93727

Or equal as approved by the Engineer.

Piping and Fittings:

- A. All piping 63.5mm and smaller shall be solvent weld SDR 21 class 200 PVC pipe, extruded from 100 percent virgin polyvinyl chloride conforming to ASTM D 2241 and shall be continuously and permanently marked with the manufacturers name, material, size and schedule or type. Pipe shall conform to all specifications form ASTM, Department of Commerce, NSF/TL (NSF) or the latest revisions. Pipe shall be Crestline, 300 Warehouse Drive, Crestline, OH 44827, only.
- B. All fittings on 51mm and smaller shall be SCH 40 PVC conforming to ASTM D-2466. No saddle or clamp type fittings shall be used.

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- C. All pipes for sleeves shall be SCH 40 PVC conforming to ASTM D-1785. Sleeve sizes shall be large enough to accommodate the bell housing of the ring tight pipe or the solvent weld belled end pipe. As a minimum, the sleeve pipe ID shall be 36mm times the irrigation pipe OD at the bell housing.
- D. All fittings for pipe 63.5mm PVC and larger shall be Ductile iron. Ductile Iron fittings shall be Harco, 3721 Cohen Place, Lynchburg, VA 24501, or Spears, 15853 Olden St., Sylmar, CA 91342, or approved equal. Conforming to ASTM A-536. No saddle or clamp type fittings shall be used.

Valves:

- A. Gate valve 63.5mm and smaller shall be bronze threaded, class 150 W.O.G with cross handles (tee handle). union or over bonnet , non-rising stem solid wedge Kitz, 10750 Corporate Drive, Stafford, Tx 77477, code 27 . All gate valves shall be in 254mm round valve boxes with a 152mm PVC sleeve.
- B. Ball valves shall be forged brass, 600W.O.G./150WSP two piece, full port, conforming to WWV 35, type II style with T-style handles
- C. Electric control valves for the turf areas shall be as the size and location on the plans. All 25mm and 36mm electric valve shall be Toro P-220 series with pressure regulation by Toro, or approved equal by the Engineer. All electric and line size isolation valves shall be in standard valve boxes with extensions as required.
- D. Quick coupler valves shall be 25mm brass with swing joint and top flange to prevent QCV from being unscrewed from swing joint. Swing joint shall accommodate brass nipple to connect the QCV all QCV shall be in 254mm round valve boxes with a 152mm PVC sleeve. Model QCV100RL or approved equal by the Engineer.

Volt Electrical Wire:

- A. All 24-volt control wires from controller to the electric valves shall be #14/1 red wire for direct burial. All 24-volt common wire from the controller to the electric valves shall be #12/1 white wire for direct burial. Splices and connections to the electric valves shall be with 3M DBY and DBR connectors. There shall be no tee splices allowed. The common wire shall be one continuous run; more than one common run may be used and spliced at the controller. Spare wires shall be run from the controller a minimum of eight (8) from each controller location to the last electric valve on the run. Spare wire shall be #14/1 blue wire for direct burial. No wire splices shall be allowed in wire runs of less than 305m.
- B. When control wires must go into the building the proper splice boxes must be used and the same size corresponding wire size shall be used at the splice box location. All wire shall be Paige electric and shall conform to ASTM B3 or B-8 for soft drawn bare copper wire with polyethylene insulation.

Sprinkler Heads and Swing Joints:

- A. Turf sprinklers shall be Toro Super 700 series sprinklers with nozzles and arcs as shown on the plans or approved equals. The 700 sprinklers shall have a swing joint Dura or equal model PVCE008-12 18mm Dura Swing Joint MPT x MPT with a 305mm lay. The lay on all swing joints shall not be less than 35 degrees nor greater than 60 degrees from the horizontal lateral PVC zone pipe.

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1. The electric valve pressure setting shall be set at 0.31Mpa for all 700 zones no 700 head sprinkler shall be spaced greater than 15m. The contractor is required 100% coverage in all areas.
- B. The Fixed Spray sprinkler shall be capable of accepting all 570 series MPR spray, stream, flood, and microspray nozzles and male-threaded risers and extenders. The sprinkler shall operate within a 0.14Mpa-0.52Mpa pressure range.

The body and cap of the sprinkler shall be injection molded from ABS, a non-corrosive, impact-resistant, UV-resistant, heavy-duty plastic material. The sprinkler shall have a color-coded riser screen filter, stainless steel or plastic, appropriately sized to prevent entry of foreign material to the nozzle. All parts shall be removable through the top of the sprinkler case.

The sprinkler shall have a single-piece riser/body seal, that flushes only upon retraction to clear any debris from around the riser, and a stainless-steel spring to ensure positive retraction. The seal shall have no flush during pop-up to allow the maximum number of sprinklers per station. The seal shall be a single piece injection molded from Alcryn, a synthetic rubber.

The sprinkler shall be capable of nozzle alignment via a two-piece ratcheting riser. The sprinkler shall be available in models with a check valve or standard models shall be capable of accepting a check valve that will prevent low-head drainage with elevation differences up to 2.13m. A 13mm NPT plug shall be provided with all side inlet models to plug the unused inlet.

A biodegradable debris label shall be factory-installed to eliminate debris intrusion during installation and line flushing.

A lavender effluent water use indicator shall be available and capable of snap fitting to all sprinkler caps.

Drip Irrigation:

- A. Drip irrigation shall be Techline self-cleaning, pressure-compensating dripperline. The dripperline shall consist of nominal-sized 17mm low density linear polyethylene tubing, housing internal pressure compensating, self cleaning, integral drip emitters. The tubing shall have an outside diameter of 17mm and an inside diameter of 15mm, the emitters shall have the ability to independently regulate discharge rates, with varying input pressure rates. The emitter discharge rate shall be 3.41 LPM. The emitters shall continuously clean themselves while in operation; the spacing between emitters shall be 457mm. As manufactured by Netafim or equal.
1. Each drip zone shall have two (2) 10-F-01-operation pressure indicators set at each end visible to view.
 2. Techline 17mm fittings shall be used for all connections to dripperline and as required to complete the drip irrigation system. TLS6 soil staples shall be placed every 1.22m and two (2) staples shall be used on all fittings, i.e. tees, elbows, crosses and couplings.
 3. All Techline drip zones shall use automatic flush valves at the ends of each independent zone area or dripperline. When drip zones are split in the middle by a zone valve there shall be a flush valve

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on each leg of the drip zone. This valve shall be capable of flushing 3.79 L (1gal) at the beginning of the drip cycle. The flush valve shall be Netafim model TI050MFV-1 or approved equal. All flush valves shall be in an economy turf box to be flush with finished grade.

4. All Techline drip zones shall have an air/vacuum relief valve at its high points. The purpose of this valve is to evacuate air from the zone at start up and to relieve vacuum at system shut down. The air/vacuum valve shall be Netafim model TLAVRV 13mm MPT threads with a maximum operating pressure of 0.96Mpa or approved equal. All air/vacuum valves shall be in an economy turf box to be flush with finished grade.

5. All electric dripperline zone valves shall have a pressure regulator unit with externally accessible regulation unit that can be serviced without removing the valve from the system. The regulator shall have a built in indicator that shows when the proper outlet pressure is reached. The regulator shall be able to respond immediately to any inlet pressure variations. The regulator shall be capable of regulating from 0.10Mpa to 0.34Mpa using interchangeable color-coded springs. The pressure regulator shall be Netafim model PRV075LFXX, with a PRV35 regulator spring or approved equal. All pressure regulators shall be placed in a standard valve box with drip zone valve and other accessories as shown on the details, to be flush with finished grade.

6. All electric dripperline zone valves shall have a disc filter with color-coded filter elements indicating the mesh size of the element being used. The discs shall be constructed of chemical resistant thermoplastic for corrosion resistance. The disc filter shall be Netafim model TF-075-4-18 or approved equal. All disc filters shall be placed in a standard valve box with drip zone valve and other accessories as shown on the details, to be flush with finished grade.

Controller:

- A. The controller shall be capable of nine to forty eight (9 to 48) stations. The controller shall operate as a stand-alone controller. The controller shall have 16 total start times; the controller shall have 4 independent programs, offer concurrent operation capability, with a 7 day calendar, odd/even or day interval options for one to 30 days. The controller shall have excluded day option, when used with the odd/even day option, allow for no watering on specific days. The station run times shall be from one (1) minute to ten (10) hours with percent of adjust by program from ten (10) to two hundred (200) percent. The controllers shall be Toro model CC-MXX or approved equal by the Engineer.
- B. Zone valves shall be paired at the controller. All paired zones shall be of similar sprinkler type or drip zones and of similar flows in zones. No zones shall be paired with greater than five (5) percent differences in zone flow. The Contractor shall submit a controller zone pairing schedule to the Engineer for approval prior to starting of system. No more than two (2) zones shall be on any controller station.

Valve Boxes:

- A. All electric zone valves, isolation valves, drain valves, quick coupler valves, splices; air vent valves and flush valves shall be in valve boxes as manufactured by Ametek valve boxes or approved equal by the Engineer. All electric zone valves shall be placed in standard valve boxes with the extensions

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required to provide the proper drainage and cover of the zone valve. The valve boxes and extensions shall extend to the bottom of the zone pipe feeding the zone and installed in accordance with the details associated with these specifications.

1. All isolation valves, drain valves, splices and quick coupler valves shall be placed in 254mm circular valve boxes, with a piece of 152mm PVC pipe reach wells.
2. All valve box-lifting tools and unlocking tools shall be supplied to the State after installation. The Contractor shall provide three (3) sets of these tools.
3. All electric valves shall be placed in Ametek Standard valves model (AM170106) box with 152mm extensions model (AM170103) manufactured by Ametek, Station Square, Paoli, PA 19301.

Isolation Valves:

- A. Main line isolation gate valves 76mm and larger shall be cast iron epoxy coated body units, which meet A.W.W.A specifications. The valves shall have push-on ends specifically designed for use with PVC pipe, 1.38Mpa rated, with a 51mm operating nut as manufactured by Kennedy Valve Co., 1021 E. Water St., Elmira, NY 14901, or approved equal by the Engineer.
- B. Isolation gate valves 76mm and smaller shall be Over bonnet or Union bonnet brass or bronze, solid wedge, 200 PSI rated, non-rising stem with threaded ends over bonnet with cast bronze cross handles as manufactured by Nibco, 1516 Middlebury St., Elkhart, In 46516, Kitz, or approved equal by the Engineer.
- C. Lateral line isolation valves servicing sprinklers 76mm and smaller shall be Over bonnet or Union bonnet brass or bronze, solid wedge, 1.38Mpa rated, non-rising stem with threaded ends over bonnet with cast bronze cross handles as manufactured by Nibco, Kitz or approved equal by the Engineer.

Backflow Prevention Assemblies:

- A. The reduced backflow prevention assembly shall be a reduced pressure assembly consisting of two (2) independent “Y” type spring loaded check valves, a differential pressure relief valve mounted between the two checks and three test cocks. The working pressure rating on the backflow assembly shall be 1.20Mpa, the pressure difference between the two (2) checks valves shall be maintained at least 0.03Mpa lower than the inlet pressure. The reduced pressure backflow prevention assembly shall be model 825YA size as shown on our plans and as manufactured by Febco, PO Box 8070, Fresno, CA 93747, or approved equal.
- B. The backflow prevention assembly shall have an air gap drain AGD-L 63.5mm or larger and be piped to a positive drain line in the building that will handle the maximum flows from the backflow assembly. The Contractor shall verify with the plumbing contractor as to the locations and size of the supply and the drain location prior to installation, the Contractor shall report to the Engineer any discrepancies that exist prior to installation.

Rain Sensor:

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- A. All controllers shall have separate rain sensors that will shut the irrigation cycle off during periods of rain or rainfall accumulated amounts. The rain sensor shall interrupt the controller's common wire and be able to have a bypass switch for testing and to override the rain sensor. Rain Sensor location shall be located by Engineer. The rain sensor shall be Mini-Click II or approved equal by the Engineer.

Grounding:

All controllers shall be grounded in accordance with the manufacture's recommendations and shall be 10 Ohms or less. Should the grounding requirements not be achieved the Contractor shall submit a cost and options for reducing the resistance reading to the Engineer for approvals.

Permits and Fees: The Contractor shall obtain all permits and pay required fees to any governmental agency having jurisdiction over the work including all inspection fees that may be required by local ordinances.

Drawings, Specifications, and Details:

Scale and Dimensions: Consider drawings and specifications as being compatible and therefore work called for by one and not the other shall be furnished and installed as though called for by both. When discrepancies exist between scale and dimensions or between the works to be accomplished by each trade, they shall be called to the attention of the Engineer immediately. The Engineer's decision regarding such discrepancies shall be final and binding.

Where diagrams and details not to scale have been shown to piping connections and other accessories the Contractor is cautioned that these are diagrammatic only and not to be used for obtaining lineal runs or numbers and types of fittings or materials used.

All measurements shall be verified at the site; all pipe routing is for diagrammatic purposes and shall be staked out in the field prior to installation, and approved by the Engineer.

Quality Assurance: **Manufacturer's Qualifications:** Companies regularly engaged in manufacturing irrigation system materials and products, of types and sizes required as specified, whose products have been in satisfactory use in similar projects for not less than fifteen (15) years.

Installer's Qualifications: Companies who have successfully completed a minimum of five (5) contracts over a three (3) year period involving installation of irrigation and piping projects similar in size and scope to that required for this project. Such experiences and references shall be attached to the bid sheet for this project.

Submittals: The Contractor shall be responsible to submit three (3) binders of manufacturers' data for materials to be used including sprinkler heads, controllers, electric valves, isolation valves, gate valves, PVC piping and SCH 40 fittings, valve boxes, control wires, wire splices, backflow preventer, quick coupler valves, swing joints and rain sensors to the Engineer.

Drawings of Record: At the project close, a drawing of record shall be submitted in Microstation/J - V7 showing all the locations of the irrigation plan and any and all changes. The main elements of the drawing of record, i.e.; main line fittings, electric valves, gate valves, quick coupler, splice boxes and locations of ends of sleeves shall be shown on the drawing of record. All measurements shall be triangulated by means of tape measurements, no wheel measurements shall be allowed, and the Contractor may use GPS. During the

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installation process the contractor shall keep a field copy of changes on site and deliver a field copy to the Engineer.

CONSTRUCTION DETAILS

Provide all irrigation materials and factory-fabricated products of size, types, pressure ratings and capacities as indicated. If there are any discrepancies in materials or interpretation of their use, the Contractor shall be responsible to obtain proper clarification before any materials are installed.

The Contractor shall verify all site features and utilities prior to installation of the irrigation system. The Contractor shall call for MARK OUT NY ONE CALL 1-800-272-1000 and notify the Engineer four (4) days prior to commencement of installation of the irrigation system. The Contractor shall verify all site features and utilities including but not limited to existing landscape planting, all site utilities, plumbing, architectural, electrical and mechanical.

Inspection of Site: The Contractor shall acquaint themselves with all site conditions. Should utilities not shown on the plans be found during excavations, the Contractor shall promptly notify the Engineer for instructions as to further action. Failure to do so shall make the Contractor liable for any and all damage that arises from neglect.

The Contractor shall take the necessary precautions to protect all existing site conditions, including plant materials. Should damage be incurred, the Contractor shall repair or replace the damage to its original condition at no cost to the State.

Piping Arrangements: The Contractor shall make necessary adjustments in the layout of the irrigation system and the pipe routing. Should conflicts arise during installation the contractor shall obtain a change order for this adjustment to the plan. This change order shall not authorize an additional fee but shall resolve any existing site condition problems.

The Contractor shall not proceed without the change order and shall provide written assurance that such changes will not cause any extra costs due to these changes. Any work that does not receive a work order and is in conflict with existing site conditions shall be removed and reinstalled by the Contractor at no cost to the State.

Workmanship: The Contractor shall follow the manufacturer's recommendations for installing all PVC pipe, fittings, valves, electric valves, sprinklers, controllers and all other appurtenances. The Contractor shall also follow all standards and installation practices which have been established by all related associations and local, state, and federal codes. The Contractor shall always perform work in a professional and orderly manner. The Contractor at all times shall have a Project Superintendent on the site who is completely familiar with all installed materials and shall be responsible for the installation of all materials.

Accuracy: Lay out work as accurately as possible to the drawings. The drawings, though carefully drawn, are generally diagrammatic to the extent that swing joints, offsets, and all fittings are not shown.

Coverage: The Contractor shall be responsible for full and complete coverage of all irrigated areas and shall make any necessary minor adjustments at no additional cost to the State. If not specified on the plans, the

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Contractor shall be responsible for proper nozzle choice and arc adjustment to assure matched precipitation of all heads within each area and zone, proper flow rates not to exceed 1.5m/second in any piping, drip zones not to exceed manufacturers recommendations.

Revisions: Any major revisions to the irrigation system must be submitted to the Engineer and answered in written form, along with any negotiated change in contract price.

Coordination: All work shall be coordinated with other trades on the site; any conflicts shall be resolved by the Engineer in order to proceed with the work as rapidly and efficiently as possible.

Maintenance Schedule:

Irrigation system maintenance is an important part of the overall system performance and is necessary to inspect and repair as needed after the initial installation of the system. Outlined below are procedures to inspect, winterize and start up the irrigation system. The Contractor shall maintain the irrigation system for the period of establishment of the planting, which is three years from the completion of the planting, unless directed otherwise by the E.I.C. in writing. At the end of the establishment period, the Contractor shall either winterize and shut down the system or shall turn over maintenance to another entity designated by the State, as directed by the E.I.C. or Regional Landscape Architect in writing.

Inspection:

Controller: The irrigation system needs to be inspected regularly to make sure that all components of the irrigation systems work as designed and installed. The controller needs to be inspected to make sure it is keeping the proper time, date and timing for each zone operations. It is also at this point you can make a check of the zone valves to see if they are operating in the manufactures range for electrical draw or check to see if there are any problems with the solenoid or wire to the valve. A simple volt meter with the ability to check continuity is all that is required. Most controllers have printed circuit boards and it is necessary to check to see if they are working properly.

Valves: The solenoid valves need to be checked to make sure they are properly working, the wire splices need to be inspected to make sure they are water tight. The body of the valve needs to be inspected for leaks or any valve damage due to improper winterization. The electric valve at this point can be checked with a volt meter to see if it performs with in manufacturer's specifications. All valve boxes shall be installed in accordance with the details associated with these specifications.

Sprinkler Heads: Sprinkler heads are the most susceptible part of the irrigation system to be damaged and vandalized and need to be inspected more frequently. The sprinkler heads need to be checked to make sure they are intact and operating to manufacturer's specification. If a sprinkler is missing a nozzle the properly designed nozzle needs to be replaced, if the sprinkler head is not performing it needs to be taken apart and inspected for debris or other materials which will cause the sprinkler not to perform.

Drip Zones: Drip zones need to be inspected to see that all the components are working properly, this element needs to be inspected with a little more care than the sprinkler heads type of irrigation system due to the amount of drip tubing in the ground. The air vent and flush valves need to be inspected to make sure they are working properly, if damaged or not performing properly they need to be changed. The electric valve assembly needs to be inspected for proper assembly and no visible leaks or damage, the electric valve needs

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to be examined in the same way as mentioned above in the valve section. The pressure regulation device needs to be inspected and the filter assembly needs to be taken apart and cleaned as needed or replaced if damaged.

The installation of all drip zones shall be in the strictest accordance's with the manufacturers standards and practices for the use of dripline applications. The contractor shall bring to the attention of the Engineer any irregularities that may arise during the installation of these drip zones. The dripper line shall be pinned at 1.22m intervals with 204mm sod staples.

General Equipment: There are other components of the irrigation system that need to be inspected to see if there is any damage or performing problems. All the valve boxes need to be inspected to make sure there are no broken or missing valve box covers and collapsed valve boxes that restrict access to the valves. Quick coupler valves need to be inspected to make sure they are not clogged or protective covers are not missing. Splice boxes need to be inspected to make sure that all splices are water tight.

Winterization: The irrigation system needs to be winterized and purged from water in the system to prevent freezing and damage to the irrigation system. The irrigation system needs to be purged of water by means of an air compressor that will generate a high volume of air at a constant low pressure. The winterization of the irrigation system needs to start at the backflow device and by means of compressed air run through the piping system and through each zone valve until the entire system has been purged of water. It is usually best to start at the farthest valve from the point of connection (Backflow Device).

Spring Start Up: Spring start up is almost the reverse of winterization in that the irrigation system is filled with water and each zone is charged. The system is filled at a slow rate as to not cause damage from the compression of air in the pipes. When the system is filled it is again best if it is filled from the farthest zone from the point of connection (Backflow Device). At this time it is necessary to perform the first time inspection of the irrigation system

System Abandonment: If it is determined that the irrigation system is to be abandoned in the future, the winterization process needs to be performed to ensure the system protection from freezing. Other requirements would be to disconnect any power to all the controllers and to remove the Backflow Devices and controllers from there locations. All valve boxes need to be secured by bolting down the valve box lids to prevent vandalism. The sprinkler heads and drip pipe should remain in place in the event the irrigation system needs to be reactivated.

Stake Out: The Contractor shall stake out all proposed lines prior to trenching operations. The location of said lines shall conform in general with the locations shown on the Plans. The location of the stakes shall be checked by the Engineer and approved prior to trenching.

Of particular importance is the location of sprinkler heads where prevailing winds, surface slope and special ground conditions must be taken into consideration. The final location of all sprinklers must be approved by the Engineer.

Excavation: Trench for pipe shall be wide enough to allow for proper tamping around the pipe in accordance with the manufacturer's recommendations. Trenches shall also be made wide enough to allow a minimum of 51mm between parallel pipelines. Trenches for pipelines shall be made of sufficient depths to provide minimum cover from finish grade as follows:

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1. 609mm minimum cover over main lines.
2. 406mm minimum cover over control wires from controller to valves (or as required by code).
3. 406mm minimum cover over lateral lines to heads.

Maintain all warning signs, shoring, barricades, flares and red lanterns as required by OSHA, and any local ordinances. The bottom of the trench shall be clean and smooth, with all rock, loose soil, and organic matter removed. The Contractor shall insure that there are no conditions in the trench that could damage the pipe or the wires. Any deviations from the above must be approved by the Engineer. Vibratory plowing of wire and solvent weld pipe will be acceptable subject to Engineer approval of plowing equipment and procedures. Restore all surfaces, existing underground installations, etc., damaged or cut as a result of the excavations to their original condition and in a manner approved by the Engineer.

Rock Removal: If subsurface conditions along with the proposed trench line are such that excavating equipment of the type and size correctly suited to this installation cannot properly excavate the trench, excavation shall be carried out by means of hoe ram. Blasting will not be permitted.

Only experienced personnel shall be used and protection shall be provided for all persons. The Contractor shall be responsible for any personal or property damage resulting from this work. The Contractor shall remove and dispose of, off site, all excess and other material unsuitable for backfill.

Deleterious Material: Excavated material that consists of rock larger than 36mm in diameter or other material unsuitable for backfill (as defined by the pipe manufacturer's installation instructions) shall be classified as deleterious material. The Contractor shall remove this material and haul it to an off-site dump location. In back-filling excavations where deleterious material has been removed, the Contractor shall install select backfill. The Contractor shall provide a supply of select backfill at one on-site location.

Pipe Line Assembly: Plastic pipe and fittings shall be solvent welded using solvents and methods as recommended by manufacturer of the pipe, except where threaded connections are required. Pipe and fittings shall be thoroughly cleaned of dirt, dust and moisture before applying solvent with a non-synthetic bristle brush. Pipe may be assembled and welded on the surface. Snake pipe from side to side of trench bottom to allow for expansion and contraction. Make all connections between plastic pipe and metal valves or steel pipe with threaded fittings using SCH 80 PVC.

Thrusting: Install thrust blocks or anchoring for all isolation valves larger than 76mm, and all piping including changes in direction and reducers, in strict accordance with pipe manufacturer's recommendations. Construct thrust blocks of Sakrete or concrete of the following mix, having a compressive strength of 13.8Mpa : 1 part concrete; 2.5 parts sand; 4 parts washed gravel. All thrust blocks must bear against undisturbed soil. In no case will fieldstone or wood of any form be acceptable for thrusting.

Sprinkler Heads: Install sprinklers as per manufacturer's recommended specifications. Install all sprinkler heads on specified swing joints.

Closing Pipe and Flushing Lines: Cap or plug all openings as lines have been installed to prevent the entrance of materials that would obstruct the pipe. Leave in place until removal is necessary for completion of installation. Thoroughly flush out all water lines before installing heads. Test in accordance with paragraph on Hydrostatic Tests. Upon completion of the testing, the Contractor shall complete assembly and adjust sprinkler heads for proper distribution.

Hydrostatic Tests: Request the presence of the Engineer in writing at least 48 hours in advance of testing.

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Testing to be accomplished at the expense of the Contractor and in the presence of the Engineer. Center load piping with small amount of backfill to prevent arching or slipping under pressure. Apply a continuous and static water pressure of 0.55Mpa when welded plastic joints have cured at least 24 hours and with the risers capped as follows:

1. Main lines and sub mains to be tested for 3 hours.
2. Lateral lines to be tested for 2 hours (If laterals and individual sub-mains downstream of control valves have less than 0.31Mpa) working pressure or less than 18.9 IPM flow, hydrostatic tests are waived for these laterals).

Repair leaks resulting from tests.

Automatic Controllers: Connect sprinkler valve wires to controller in a logical sequence to correspond with specification. Controller wires shall not be connected until system is ready to be activated.

Electric Zone Valves: All electric zone valves shall be installed as per details on plans. The Contractor shall take extra caution to avoid over tightening the nipples on the inlet side or the discharge side of the electric valve. No pipe dope shall be used: only Teflon tape.

The Contractor shall lower the electric zone valve assembly completely with valve boxes and extension to cover the PVC lateral pipe with the valve box. All brick supports shall be complete around the valve box and brick shall be placed on undisturbed soil.

Prior to installation of zone valves all main line piping shall be flushed and free from contaminants.

Wire and Wire Splicing: Do not yank, stretch, or pull wires during installation. Provide a minimum of 305mm of slack, in an expansion loop, in each 30.5m of wire. Lay wire on a firm even bed in the trench, which shall support the entire length. At splice locations, provide sufficient slack to allow the splice to be raised a minimum of 610mm above grade for inspection. Do not lay wire above, or on top of the pipe, except when wire and pipe are being plowed simultaneously. When power wire runs do not follow the pipe, lay them in a straight line, which shall be carefully located on the as-built plan. Minimum 63.5mm pipe shall be used as wire conduit for all sleeves.

Splice all wires to requirements of local minimum regulations or to the following recommendations, whichever is more restrictive: Make all splices by baring a minimum of three-quarters of an inch of copper conductor, twisting the leads together, and soldering them with a non-acid core solder. Wire nuts are acceptable in lieu of soldering. Make the splice completely waterproof by using connector kits in strict accordance with the manufacturer's recommendations.

Automatic Control Wiring: Install control wires, sprinkler mains and laterals in common trenches wherever possible. Install control wires at least 305mm below finish grade and lay to the side and below main line. Provide looped slack at valves and snake wires in trench to allow for contraction of wires. Tie wires in bundles at 3m intervals. Control wire splices shall be allowed only in runs more than 457m. Any splices must be installed in an existing valve box or separate valve box installed flush with finished grade. On runs longer than 762m contractor shall use 12/1 field and 10/1 common.

All wire passing under existing or future paving, construction, etc., shall be encased in plastic or galvanized steel conduit extending at least 406mm beyond edges of paving or construction.

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Valve Boxes: All valve boxes shall be set at finished grade and supported by brick foundations on undisturbed soil. All valve box sizes shall include all special tools necessary for removal and unlocking of lids. Contractor shall clean out all sediment materials from valve boxes and provide pea gravel sumps as indicated on plans. The Contractor shall maintain the valve boxes during the construction process to protect them from damage and excessive sedimentation.

Backflow Prevention Assemblies: The Contractor shall coordinate installation of the backflow prevention assembly with the plumbing contractor. The backflow prevention assembly shall be installed according to all local, state, and federal codes, the manufacturer's specifications, and approving agencies including the University of Southern California Foundation for Cross-Connection Control and Hydraulic Research, the American Waterworks Association, the American Society of Sanitary Engineers, and Underwriters Laboratories. The backflow prevention assembly shall have an air gap drain and be piped with the appropriate sized piping to handle the maximum discharge of the backflow prevention device.

Backfill and Compacting: After system is operating and required tests and inspections have been made, backfill excavations and trenches with clean soil, free of rubbish and deleterious material. Backfill for all trenches, regardless of the type of pipe covered, shall be compacted to a minimum 95% density. Compact trenches in areas to be planted by thoroughly flooding the backfill. Dress off all areas to finish grades. Contractor shall be responsible for all trench settlements for one year. The contractor shall fill, level, compact and reseed all trenches that settle more than 13mm.

Clean Up: The Contractor shall be responsible for the removal from the site all debris resulting from work of this section. Job site must be left clean and repaired as per contract and the Engineer's approval.

METHOD OF MEASUREMENT

The work will be measured for payment as the number of SQUARE METERS of Landscape Irrigation satisfactorily furnished and installed.

BASIS OF PAYMENT

The unit price bid for Landscape Irrigation shall include the cost of all labor, materials and equipment necessary to satisfactorily perform the work.