1. **GENERAL**
	1. RELATED DOCUMENTS
		1. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

#### See Section 007300 “Supplementary Conditions”, if included, for requirements relating to interpretation of the drawings and specifications.

#### See Section 012100 “Allowances”, if included, for use of allowances and what may and may not be included in them.

* 1. SUMMARY

### Scope of Work: Design, furnish and install the complete underground irrigation system specified herein, including all labor, materials, equipment, apparatus, and services for the testing, adjusting, retesting and readjusting as required to place the system in an approved operating condition.

### Arrange for, obtain, and pay for all necessary permits, bonds, and fees.

### Excavating, backfill and compaction for all work as specified, and are to include all machinery and labor.

### To complete underground irrigation system from the point of connection, throughout the site, including piping, fittings, valves, drains, sprinkler fittings, sprinkler heads, automatic controller(s) and any other necessary appurtenances.

### Complete irrigation system for all areas as shown on the drawings.

### To furnish and install all piping, fittings, valves, valve boxes, valve covers, electric valve wiring and appurtenances.

### To furnish and install all automatic control devices and connect controller to electric service.

### To test the entire piping and wiring systems when construction is complete.

### To furnish and install sprinkler heads.

### To regulate and adjust all sprinkler heads, timed sequence control devices, sectional valves, rain overrider, etc.

* + 1. To furnish a qualified, sprinkler system technician to instruct the Owner's operating personnel in the maintenance and operation of the irrigation system.
	1. PERFORMANCE REQUIREMENTS
		1. Irrigation zone control shall be automatic operation with controller and automatic control valves.
		2. Minimum Working Pressures:

* + - 1. The dynamic flow pressure should not be less than what is required minimum pressure for optimal performance of sprinkler heads used in a zone.
		1. Location of Sprinklers and Specialties: Design location is approximate. Make minor adjustment necessary to avoid plantings and obstructions such as signs and light standards. Maintain 100 percent head to head irrigation coverage of areas indicated.
		2. Refer to Appendix C Operation Schedule for daily operation time and controller setup.
	1. SUBMITTALS
		1. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories.
		2. Shop drawings:
			1. Design of the complete underground irrigation system; include the following
				1. Plan Layout, details illustrating location and type, sprinkler heads, valves, piping circuits, controls and accessories
				2. Submit technical data supporting design, including individual circuit (section) GPM and pressure loss calculations.
		3. Wiring Diagrams: For power, signal, and control wiring.
		4. Qualification Data: For qualified Installer.
		5. Zoning Chart: Show each irrigation zone and its control valve.
		6. Controller Timing Schedule: Indicate timing settings for each automatic controller zone.
		7. Field quality-control reports.
			1. Pressure Test Results
		8. Operation and Maintenance Data: For sprinklers controllers and automatic control valves to include in operation and maintenance manuals.

## Field Record Drawings

### Upon completion of the irrigation system, a complete as built drawing will be submitted to the Owner or his agent. This drawing shall indicate thereon all pipe sizes, valve locations, dimensional data from building walls or column center lines, to the piping and valves, sprinkler heads, etc. Accompanying the record drawings shall be instruction sheets and parts lists, covering all operating equipment, bound into a folder.

### Copy of Contractors Certificate for CIC, CID or CLIA.

### QUALITY ASSURANCE

* + 1. Installer Qualifications: An employer of workers that include a Certified Irrigation Contractor (CIC), Certified Irrigation Designer (CID) or Certified Landscape Irrigation Auditor (CLIA), qualified by The Irrigation Association.
		2. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
		3. Pre-installation Conference: Before installing the irrigation, conduct conference at project site with Landscape Architect, UNL Campus Landscape Architect, UNL Landscape Services and UNL Project Manager. Notify participants at least 2 working days in advance of meeting.
		4. Post-installation Conference: After installing the irrigation system, conduct a conference at Project site with Landscape Architect, UNL Campus Landscape Architect, UNL Landscape Services and UNL Project Manager for acceptance of work by the owner.
	1. DELIVERY, STORAGE, AND HANDLING
		1. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.
		2. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

# PRODUCTS

## ACCEPTABLE MANUFACTURERS

### Many materials chosen for the design of the sprinkler system have been specifically referred to by the manufacturer's name so as to enable the owner to establish the level of quality and performance required by the system design and to meet UNL’s central control irrigation system. Equipment by other manufacturers may be used only if approved by the owner. Acceptable manufacturers include but are not limited to:

* + - 1. Hunter Industries
			2. Rainbird
			3. Irritrol
			4. Carson Industries, LLC

## COPPER PIPING

### Copper piping shall be Type K, hard copper, and will be used on all exposed pipe.

### Copper pipe fittings shall be wrought solder‑type cast solder‑joint fittings.

## PVC PIPE

### All PVC pipe shall be virgin, high impact, polyvinyl chloride having a minimum design working pressure rating of Class 200 PVC. All PVC pipe shall be continuously and permanently marked with manufacturer's name, material, size, and schedule of type. Pipe shall conform to US. Department of Commerce Commercial Standard CS 207‑60, or latest revision. Material shall conform to all requirements of PVC 1120, ASTM D‑1785, or latest revision.

### Priming and solvent welding shall cause complete leakproof plasticized joint upon evaporation. Solvent shall conform to U.S. Government Specification No. GS‑256.63.

## SPRINKLER RISER

### Shall be ¾” or ½” Street E1 and combination thread to swing pipe to the head with 6” –18” swing pipe with ¾” or ½” combination E1 swing x male to connect to lateral zone piping. For spray or rotator sprinkler heads.

### Rotary sprinkler heads with a greater than 6 gpm flow must use a pre-fabricated ¾” x ¾” swing joint or equivalent apparatus.

## GATE VALVES & DRAIN VALVE

### Manufacturer’s standard of type and size required brass construction conforming to A.W.W.A. Specifications.

## BOXES FOR AUTOMATIC CONTROL VALVES

### Plastic Boxes

### Manufacturer’s standard of type and size required.

* + - * 1. Carson Industries, LLC or equivalent
			1. Description: Box and cover, with open bottom and openings for piping; designed for installing flush with grade
				1. Size and Shape:

###### 10” round for quick coupler and wire connection and drains

###### 12” square for valves, master valves and flow sensors

## AUTOMATIC IRRIGATION CONTROLLER

### Manufacturer:

#### Rainbird

##### ESP-LXME Rainbird Controller – include Rainbird IQ NCC-EN Ethernet communication cartridge. Module to meet zone capacity and flow sensor module.

### Wiring: The controller to be installed and wired in accordance with the manufacturer's published instructions.

* + - 1. Feeder-Circuit Cables: No. 12 AWG minimum, between building and controllers
			2. Low-Voltage, Branch-Circuit Cables: No. 14 AWG minimum, between controllers and automatic control valves; colors-coded different from feeder-circuit-cable jacket color, with jacket of different colors for multiple-cable installation in same trench.

### Electric control wires from each controller to the automatic valves shall be direct burial UF wire of a different color than the black and white wires used on the 115 volt A.C. power. Ground wire shall be a different color than the control lines. A ground wire shall be required for each controller.

* + - * 1. 18AWC in direct buried jacket is excepted when length from remote valve to controller poses no electrical resistance issues.
				2. Provide 12” expansion coil at each valve and at 200 ft intervals.
				3. Utilize PE-39 #19 AWG for wiring flow sensor to controller module
			1. Splicing Materials: Manufacturer’s packaged kit consisting of insulating, spring-type connector or crimped joint and epoxy resin moisture seal; suitable for direct burial.

### Housing:

#### Rainbird Stainless Steel Metal Cabinet, Model LXMMSS

* + - 1. Controller shall have multi sensor options including automatic rain shut off bypass and ability to adjust for seasonal watering.
			2. Controller location to be approved by UNL Campus Landscape Architect.

## SHRUB AND TURF SPRINKLER HEADS

* + 1. Manufacture:

			1. Hunter Industries
				1. 25’ or greater - I-20 or I-25
				2. Less than 25’ – MP Rotator
				3. 1800 Spray Head
			2. Rainbird
				1. 5000 rotor
				2. Falcon

### All full and part circle sprinkler bodies and nozzles. These sprinklers shall be of the pop‑up type, gear or rotary drive type. Spacing of the heads shall not exceed the manufacturer's maximum recommendations.

### Matched precipitation will be required on all full and part circle sprinklers on the same zone.

## AUTOMATIC VALVES

* + 1. Manufacture:

#### Master Valve – Rainbird EFB-CB for indoor installation

##  Rainbird PGA Series for PVC mainline installations

* + - 1. Irritrol (700 Series) UltraFlow Electric Globe shall be used for Remote Zone Control Valves

### Remote control valves shall be as indicated on the drawing. Valve shall be solenoid operated, diaphragm, globe‑type having IPS threads and suitable for underground burial without protection.

### Construction: Valve shall be packless, without sliding seals, and completely serviceable without removing body from pipeline. Design shall be normally closed requiring solenoid to be energized to open valve, thereby causing automatic closure in event of power failure. Solenoid shall comply with Class 2 National Electric Code and when operating require a maximum of 3.0 watts at 24 volts AC. Solenoid shall be coated in epoxy to form a corrosion and moisture proof unit with exposed metal components of non‑corrosive material.

### Operation: Solenoid shall be energized to open the valve hydraulically and de‑energized to close. Pressure to the hydraulic chamber shall be supplied internally through a nonmetallic, corrosion‑free orifice in the diaphragm. There shall be no external bleeding or external tubing to furnish actuating pressure. Valve shall operate in any position without water hammer at normal flow velocities. A manual bleed lever shall be included.

## FLOW SENSORS

### Rainbird Flow Sensor – Brass for indoor copper installations, plastic for PVC installation

## RAIN SHUT‑OFF

### A wireless automatic rain shut-off shall be supplied with the controller. The site of installation to be approved by UNL Campus Landscape Architect.

## QUICK COUPLING VALVES

### Manufacture:

* + - 1. Rainbird Corporation – RC #44 quick coupler with anti rotation
			2. OR #44 with a LS 120 Leemco quick coupler stabilizer attachment
		1. Description: Factory-fabricated, bronze or brass, two-piece assembly. Include coupler water-seal valve; removable upper body with spring-loaded or weighted, rubber-covered cap; hose swivel with ASME B1.20.7,3/4-11.NH threads for garden hose on outlet; and operating key
			1. Include (2) two matching keys.

### Locate in intervals along all mainline pipe adjacent to plant beds. Verify final locations. Provide one per plant bed.

### Quick coupling valves shall be installed in a 10 inch diameter valve box with cover.

### Fill: Clean soil free of stones larger than 2" diameter, foreign matter, organic matter and debris. Provide imported fill material as required to complete the work. Obtain rights and pay all costs for imported materials. Suitable excavated materials removed to accommodate the irrigation system work may be used as fill.

### Drainage Backfill: Cleaned gravel or crushed stone, graded from 3" maximum to 3/4" minimum.

### Thrust Blocks: 2,500 psi concrete.

# EXECUTION

## SYSTEM DESIGN

### Inspection: Examine existing elevations and conditions at site. Do not begin system design until all existing conditions are satisfactorily understood.

### Design Pressures: Contractor to verify static water pressure available at connection to water supply. Actual working pressure in an individual circuit shall fall between manufacturer's recommended minimum and maximum operating pressures for the last sprinkler head in the circuit.

### Design Velocities: Velocity of water in sprinkler system should not exceed 5-6 fps.

### Location of Sprinkler Heads: Begin sprinkler head location at areas to be bordered (buildings, etc.). Fill in with sprinklers in the middle areas. Design for 100% radius overlap coverage. Locate sprinkler heads based on manufacturer recommendations. Locate sprinkler heads so that trees are approximately halfway between heads wherever possible. Do not spray buildings, or deck areas. Do not spray sidewalks.

### Sectioning of Irrigation System: Individual circuits shall be designed so that total GPM required per circuit does not exceed available GPM. System shall be designed so that areas irrigated by individual circuits exhibit compatible conditions, including soil type, plant material type and sun exposure. System shall be designed so that sprinkler head types and precipitation rates of sprinklers are compatible on same circuit. Design system so that circuits furthest from supply require lowest total GPM. Design system to include quick coupling valves in locations indicated by owner.

### Piping: Avoid following piping layout situations:

#### Avoid piping layout along sides of structures.

#### Avoid odd angles in piping layout.

#### Avoid unbalanced friction losses.

#### Avoid high friction losses.

#### Avoid excessive trenching.

#### Avoid trenching within dripline of trees – if trenching beneath dripline must occur obtain UNL Campus Landscape Architect approval prior to commencement of work.

## EXCAVATING AND BACKFILLING

### An excavation shall be considered unclassified excavation and include all materials encountered.

### Excavate trenches of sufficient depth and width to permit proper handling and installation of pipe and fittings.

### If the pulling method is used, the pipe "plow" shall be a vibratory type. Starting and finishing holes for pipe pulling shall not exceed a 1'-0" by 3'-0" opening on 1” lateral lines.

### Excavate to depths required to provide 2" depth of earth fill or sand bedding for piping when rock or other unsuitable bearing material is encountered.

### Fill to match adjacent grade elevations with approved earth fill materials. Place and compact fill in layers not greater than 6" depth. Provide approved earth fill or sand to a point 4" above the top of pipe. Fill to within 6" of final grade with approved excavated or borrow fill materials free of lumps or rocks larger than 2" in any dimension. Provide clean topsoil free of rocks and debris for top 6" of fill. Install irrigation lines with a minimum cover of 14" for main lines. 10" for laterals based on anticipated finished grades.

### Excavate trenches and install piping and fill during the same working day. Do not leave trenches or partially filled trenches open overnight.

### Promptly notify the UNL Campus Landscape Architect of unexpected sub-surface conditions.

## INSTALLATION

### Unless otherwise indicated, comply with requirements of Uniform Plumbing Code.

### Point of Connection: Point of connection is as shown on the drawings.

### Circuit Valves: Install in accordance to manufacturer's instructions. Install in 12” valve box, arranged for easy adjustment and removal. Install valve access boxes on a suitable base of gravel to provide a level foundation at proper grade and to provide drainage of the access box. Seal threaded connections on pressure side of control valves with teflon tape or plastic joint type compound. Adjust automatic control valves to provide flow rate of rated operating pressure required for each sprinkler circuit.

### PVC Pipe: Install plastic pipe in dry weather when temperature is above 40 degrees F. in accordance with manufacturer's installation instructions. Provide for thermal expansion and contraction. Lay pipe on solid subbase, uniformly sloped without humps or depressions. For circuit piping, slope to drain valve at least 1/2" in 10' of lawn.

### Saw Cut Plastic Pipe: Remove burs and shavings at cut ends prior to installation.

### Make plastic to plastic joints in solvent weld joints or slip seal joints. Use only solvent recommended by the pipe manufacturer. Install plastic pipe fittings in accordance with pipe manufacturer's instructions. Owner shall make arrangements with pipe manufacturer for all necessary field assistance. Make plastic to metal joints with plastic male adapters. Make solvent weld joints in accordance with manufacturer's recommendations. Allow joints to set at least 24 hours at temperature above 40 degrees F. before pressure is applied to the system.

### Maintain pipe interiors free of dirt and debris. Close open ends of pipe by acceptable methods when pipe installation is not in progress.

### Install thrust blocks on distribution lines at locations that make an abrupt change of direction on 2 ½” pipe or larger.

### Piping shall be located at the approximate location shown on the drawings.

### The pipe shall be installed and maintained at the proper lines and grades with joints centered and with fittings and other appurtenances at the required locations.

### All risers to heads shall be constructed of nipples, elbows and/or swing pipe to permit height adjustment of head. Install heads two inches back of any hard surface.

### All plantings and landscape material damaged or destroyed in the installation operation shall be replaced with planting materials, equal in type, size, age, and condition at the contractor's expense.

### The installation of all pipes shall be done by irrigation installers skilled in this work and under adequate and competent work supervision.

## DRAINAGE

### Drain pits shall consist of one (1) cubic foot well, filled to capacity with crushed stone. Drain locations shall be determined on job site by the contractor. Provide manual drains at all low points in the branch piping and in the main at intervals not to exceed 300 feet of pipe. Install drain at the end of a 4" PVC pipe and valve cover. Top of 4” PVC pipe shall arise in center of 10” round of valve box 3” from the top. Furnish Owner with valve handle extension. Individual zones shall have one automatic drain installed at its low point with 6” cube of gravel.

### Sprinkler Heads: Flush circuit lines with full head of water and install heads after hydrostatic test is completed. Install fittings, heads, risers and accessories in accordance with manufacturer's instructions. Set sprinkler heads perpendicular to finished grades at manufacturer's recommended heights.

### Install quick coupling valves with an adjustable double swing joint riser assembled by the use of at least 3 standard 90 degree elbows. Fabricate double swing joint risers of Schedule 80 PVC nipples and Schedule 40 PVC elbows. Pre-fabricated swing joint risers are acceptable.

### Control Wiring: Install electric control cable in the piping trenches wherever possible. Place wire in trench adjacent to pipe. Install wire with slack to allow for thermal expansion and contraction. Expansion joints in wire may be provided at 200 foot intervals by making 5 or 6 turns of the wire around a piece of 1/2" pipe instead of slack. Where necessary to run wire in a separate trench, provide a minimum cover of 12".

### Provide sufficient slack at site connections at remote control valves in control boxes and at all wire splices to allow raising the valve bonnet or splice to the surface without disconnecting the wires when repair is required.

### Connect each remote control valve to one station of a controller except as otherwise indicated. Connect remote control valves to a common ground wire system independent of all other controllers. Make wire connections to remote control electric valves and splices of wire in the field, using wire connectors and sealing cement in accordance with manufacturer's recommendations.

### Provide tight joints to prevent leakage of water and corrosion build up on the joint.

### Flushing, Testing and Adjustment: After sprinkler piping and risers are installed and before sprinkler heads are installed, open control valves and flush out the system with full head of water. **Pressure test all lines before joint areas are backfilled**. Backfill a portion of the trench area to maintain pipe stability during test period. All mainline piping shall be tested at maximum hydraulic pressure available. Upon visual inspection of each joint and the ground, any leak detected shall be repaired. The line shall be re‑tested until the necessary repairs made to put the system in good working order. After testing, the system shall be flushed with a minimum of 150% of the operation flow passing through each pipe, beginning with the larger mains and continuing through the smaller mains in sequence.

### Perform system testing upon completion of each section. Make necessary repairs and retest repaired sections as required.

### Adjust sprinklers after installation for proper and adequate distribution of the water over the coverage pattern. Adjust for the proper arc of coverage.

### Tighten nozzles on spray type sprinklers after installation. Adjust sprinkler adjusting screw on lateral line or circuit as required for proper radius. Interchange nozzles patterns to give best arc of coverage.

### Adjust all electric remote control valve pressure regulators and flow control stems for system balance and optimum performance.

### Test and program the controller for operating appropriate day, hour and station selection features as required to automatically start and shut down irrigation cycles to accommodate plant requirements and weather conditions.

## CLEANUP AND PROTECTION

### Perform cleaning during installation of the work and upon completion of the work. Remove from site all excess materials, soil, debris, and equipment. Repair damage resulting from irrigation system installation.

### Protect irrigation system and materials from damage due to performance of work, operations by other contractors, trades and trespassers. Maintain protection during installation and testing periods.

### The entire area shall be left clean and neat.

### The contractor shall be responsible for all damage caused by his operations to trees, shrubs, curbs, paving, structures, utilities, etc., on the site or adjacent to the site of the work and shall repair, replace or otherwise make good any damage caused by him.

### The contractor is to coordinate this work with other trades.

### The contractor shall check the system two weeks after acceptance and four weeks after acceptance. The Contractor shall drain the system in the Fall following installation, turn it on and completely checking it in the Spring following installation.

## GUARANTEE

### The entire sprinkler system will be unconditionally guaranteed against defects in material and workmanship, including settling of backfilled areas below grade and adjusting heads to proper level for a period of one year from the date of acceptance.

### In addition to minor adjustments, any defective electrical controls, valves, sprinkler heads or other working parts will be repaired or replaced without cost to the Owner for a period of one year from the date of acceptance.

### Damage by others during, the one year guarantee period will be the Owner's responsibility.

END OF SECTION 32 84 00