SECTION 02811
UNDERGROUND SPRINKLER SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes the installation of an irrigation system for areas shown on the Drawings. Components to be installed include, (but not limited to) tap to primary main water line, irrigation controllers, main line, sprinkler heads, drip line, automatic drain valves, manual drain valves, drip zone manual valves, air vacuum relief valves, flow sensor, control wiring, fittings, electrical connections, zone valves, filters, pressure indicator flags, manual gate valves, reduced pressure backflow preventer, sleeves under paving, boring under paving, piping, wire decoders, sensors, tree protection, disturbed turf areas, warning tape, trace wire, and all necessary accessories to provide a complete operational system.

B. Contractor shall become familiar with the existing site conditions, existing irrigation system within the project area, and other construction activities. Coordinate with the Owner's Representative on current construction activities, utilities, and other construction trades.

1.2 REFERENCES

A. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM):

1. D1785-83 - Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40 and Class 200
2. D2241-84 -Poly (Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR)
3. D2287 -Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds
4. D2466-78 - Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
5. D2564-80 -Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings
7. D3139-84 -Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals

B. NATIONAL STANDARD PLUMBING CODE.

C. NATIONAL ELECTRIC CODE.

1.3 DEFINITIONS

A. Distribution: Diameter of Coverage - diameter of the surface area receiving water (pertains to full or part circle).

B. Irrigation Heads:

1. Fill-in- heads not located on the basic symmetrical pattern and/or which may not have the same coverage as the heads in the pattern.
2. Pop-up Rotor - water-lubricated, gear-driven head installed flush with the turf, containing a nozzle which rises four (4) inches above the turf when operating.
3. MPR (Matched Precipitation Rate) multi stream rotor on spray head body that allows sprinklers with various arcs and radii to be mixed on the same circuit. It is used in conjunction with rotor zones in lawn areas.

C. Lines:
1. Header - water line leading off from a zone valve; subject to pressure only when zone is operating.
2. Lateral - water line leading off from a header to a head.
3. Main - water line under constant pressure, supplying the sprinkler zones.

D. Valves:
1. Automatic Drain - a low pressure valve used to drain main and lateral lines.
2. Manual - a valve used to activate/terminate flow to a zone.
3. Zone - a section of heads controlled by one valve.

1.4 DESIGN CRITERIA

A. General:
1. The system is a two wire controlled system with controller and remote controlled valves as manufactured by HUNTER INDUSTRIES. Main line shall be drained with manual drains at all low points, while zones shall be drained automatically at all low points.
2. Future irrigation systems will be using raw water provided from a water source on campus. Contractor shall provide non potable identified and purple color coded covers and materials for all sprinkler heads, remote control valve ID handle, quick coupler valves, pvc underground piping, pvc fittings, and enclosure boxes.
3. For design purposes, the irrigation system has been designed with HUNTER rotary sprinkler heads and valves.
4. For design purposes, the drip irrigation system has been designed with Netafim products. Other manufacturer’s may be provided with similar precipitation rates and GPMs. Any changes shall be submitted as a shop drawing for review and approval.
5. Main line shall be manually drained, with manual valves at all low points. Lateral lines shall be automatically drained, with automatic drain valves at all low points.
6. All proposed schedule 40, C900 mainline and lateral line pipe routes shall be marked with appropriate irrigation flags. Mainline and lateral routes shall avoid interference with all existing tree drip lines wherever possible. Construction administrator shall verify flagged mainline and lateral routes before trenching and installation of mainline and laterals begin. All proposed irrigation piping, irrigation heads, or valve boxes that lie within existing shrub bed areas shall be hand dug.
7. All irrigation mainlines and piping shall be trenched, hand dug, or bored as necessary. Vibratory plowing irrigation mainline and piping is not an acceptable installation method.
8. Promptly repair trees damaged by construction operations within 24-hours. Treat damaged trunks, limbs, and roots according to arborist’s written instructions.
9. All existing trees, shrubs, and groundcover shall be retained during construction. Contractor to ensure existing trees and shrubs are protected. If any existing plant material is damaged or lost due to inadequate protection or construction procedures, contractor shall be responsible for repair or replacement of the damaged plant material.
10. Protect existing tree root systems from damage caused by runoff or spillage of noxious materials while mixing, placing or storing construction materials. Protect root systems from ponding, eroding, or excessive wetting caused by construction of irrigation system.
11. Do not store construction materials, debris, or excavated material inside existing tree or shrub root zones; prevent soil compaction over root systems.
12. Do not excavate within existing tree root driplines or root zone areas unless directed by Construction Administrator.
13. Where irrigation mainline and lateral line trenching are required within the dripline or root zones, bore under or around roots. Sleeving will not be required under driplines unless crossing a sidewalk or steam tunnel.
14. Bored pipe shall be to the depths required for each type (primary mainline, mainline, & laterals).
15. Pull trace wire with bored pipe. Identification warning tape will not be required for bored pipe.
16. Root Pruning: Do not cut main lateral roots or taproots; cut only smaller roots that will interfere with installation of mainline or lateral line installation. Cut roots with sharp pruning instruments; do not break or chop. Avoid root pruning wherever possible.

17. Turf Repair: Contractor to repair and replace all disturbed turf areas with sod where trenching has occurred.

B. Protection and Repair of Underground Lines:

1. Request proper utility company to stake exact location (including depth) of all underground utility lines. Take whatever precautions are necessary to protect these underground lines from damage. If damage does occur, all damage shall be repaired by Utility Owner. All costs of such repairs shall be paid by Contractor unless other arrangements have been made.

2. Request Owner, in writing, to locate all private utilities (i.e., electrical service to outside lighting) before proceeding with excavation. If after such request and necessary staking, private utilities which were not staked are encountered and damaged by Installer; they shall be repaired by Owner at no cost to Installer. If Contractor damages staked or located utilities, they shall be repaired by Utility Owner at Contractor’s expense unless other arrangements have been made.

C. Head Layout:

1. The head layout on the Drawings is diagrammatic and represents the design intent for the irrigation systems. The Contractor shall be responsible for installing systems as shown on the irrigation plans and with 100% coverage wherever possible.

2. All lawn areas shall have four (4)-inch pop-up rotor and spray heads

3. All shrub bed areas shall have dripperline.

D. Sleeves:

1. The sleeves shown are the minimum number of sleeves required.

2. Sleeves and Boring under Sidewalks: The Contractor shall add additional sleeves as necessary to insure proper operation of the irrigation system.

E. Two Wire Irrigation System Requirements:

1. Provide Hunter ICD-100 through ICD-600 station decoders with surge suppression and ground wire as needed to group irrigation remote control valves.

2. Locate (1) grounding plate every 500 feet along wiring/main line or every (6) decoders and at the end of each mainline run. Install grounding plates as per manufacturer’s recommendations. Locate grounding plates a minimum distance of six (6) feet perpendicular to the mainline. Locate grounding plate at irrigation controller as per manufacturer’s recommendations. Locate grounding plates as shown on irrigation plans. Minimum ground hardware shall be a four (4) inch x thirty six (36) inch copper plate with at least 10AWG dia. copper wire.

3. Provide 14 AWG/1.6 mm diameter twisted decoder wire in sheathed casing as provided by HUNTER INDUSTRIES. **HUNTER INDUSTRIES wire must be used to maintain warranty provided by HUNTER.** Provide DBR6 or DBY6 wire connectors as manufactured by 3M for connection of decoders to valve connections and decoders to two wire system. Wire runs shall not be looped.

4. Install two wires a minimum of 24” below grade along mainlines, or any other path that does not run along mainline route.

5. Install two wire irrigation systems as per manufacturer’s recommendations to provide a complete and operational system.

1.5 QUALITY ASSURANCE
A. Irrigation Contractor shall be a single firm with over seven (7) years of documented experience in all aspects of irrigation work; irrigation maintenance and capable of installing a two wire irrigation system of this scope. Two wire manufacturer’s representative shall provide assistance to irrigation contractor to successfully execute the proper installation of a complete and operational two wire irrigation system. System shall be installed according to the specification requirements.

B. General: Irrigation contractor shall install all elements of the irrigation system including irrigation controller, pipe sleeving, piping, heads, valves, wiring, valve boxes, decoders, gate valve, backflow preventer and other items necessary to operate the system.

1.6 WORK COORDINATION

A. Scheduling and Existing Information:

1. Schedule and coordinate to facilitate the most expeditious completion of the project in a workmanlike manner.
2. The Contractor shall assume responsibility for locating all site utilities, and perform work in a manner to avoid damage.

1.7 SUBMITTALS

A. Operations and Maintenance (O & M) Data:

1. Operation and maintenance data shall be bound into three (3) individually bound hardback binders and properly indexed. O&M data shall include at least the following:
   a. The index sheet shall indicate the Installer’s name, address, and telephone number.
   b. Manufacturer's specifications, and description, and O&M information for all system components.
   c. Routine recommended maintenance activities of the entire system including weekly, monthly, semi-annual, seasonal and annual activities.
   d. A schedule of the measured or calculated flow rates for each zone, and a recommended controller setting and a schedule of times and duration of operation for each zone for each month or season based on a stated recommended precipitation requirement for the type of turf or plants and the geographical location of the installation.

B. Literature or Product Items include:

1. Schedule 40 Main Line and Sleeves
2. C905/DR18 Gasket End/Fitted Main Line Pipe
3. HDPE Plastic Pipe SDR-11
4. Class 200 Laterals
5. PVC Fittings - Schedule 40
6. HDPE Plastic Pipe SDR-11 to PVC C900 DR 18 Connections
7. Cast or Ductile Iron Fittings-C905/DR18 PVC Mainline Pipe
8. Mechanical Joint Restraints-C905/DR18 PVC Mainline Pipe
9. Pipe to Pipe Restraints-C905/DR18 PVC Mainline Pipe
10. Flexible Vinyl Chloride Pipe
11. PVC Solvent Compound
12. Concrete Mix Designs-Thrust Blocks
Oklahoma State University Raw Water Irrigation Project Phase 2
Stillwater, OK.

13. Two Wire Decoder Controller
14. Conventional Irrigation Controller
15. Reduced Pressure Backflow Preventer
16. Enclosure-Reduced Pressure Backflow Preventer
17. Wireless Rain/Freeze Sensor
18. Grounding Plate and Wire
19. Swing Joints
20. Spray Heads
21. Rotary Heads
22. Zone Valves
23. Gate Valves
24. Air Vacuum Relief Valve
25. Automatic Drain Valves (Laterals)
26. Quick Coupler Valve, Key, and Swivel Hose Ells
27. Wiring
28. Wire Connectors
29. Valve Boxes
30. Identification Tape
31. Wire decoders
32. Trace Wiring for Mainline and Laterals
33. Reclaimed Dripperline Tubing
34. 3/4” and 1’ Filter
35. Pressure Indicator Flags
36. Manual Drain Valves (Drip Zone)

C. Shop Drawings:

1. Submit Shop Drawings as noted on construction drawings. Include a complete materials list indicating manufacturer, model number, and description of all materials and equipment to be used. Show appropriate dimensions and adequate detail to accurately portray intent of construction. If valve groupings and wire path routes deviate from irrigation plans, submit shop drawings indicating valve grouping and wiring path.

D. Record Drawings (As-Builts)

1. At onset of irrigation installation secure mylar sepias of original irrigation design from the Owner. At the end of every day, revise prints for work accomplished that day in red ink. As Built sepias shall be brought up to date at the close of the working day every Friday by a qualified draftsperson. A print of record plan(s) shall be available at Project Site. Indicate zoning changes on weekly as-built drawings. Indicate nonpressure piping changes on as-builts. Upon completion of Project, submit for review, prior to final acceptance, final set of as-built mylar sepias. Dimensions from two permanent points of reference (building corners, sidewalk, road intersections, or permanent structures), location of the following items:
a. Connection to existing water lines
b. Routing of sprinkler pressure lines (dimension maximum 100 feet along routing)
c. Sprinkler control valves
d. Quick coupler valves
e. Drain valves
f. Control wiring routing if not pressure mainline
g. All gate valves
h. Other related equipment as directed

2. Owners Representative will not certify any pay request submitted by the Contractor if the as-built drawings are not current, and processing of pay request will not occur until as-builts are updated.

3. Installed conditions
4. Two dimensions to each remote control valve, quick coupler valves, gate valves, etc. from two secure points.

E. Operation Instructions Submit three (3) written operating instructions including winterization procedures and startup, with cut sheets of products, and coordinate controller/watering operation instruction with Owner maintenance personnel.

1. Controller Charts
   a. Do not prepare charts until record (as-built) drawings have been reviewed by Consultant.
   b. Provide additional chart for existing controller.
      1) Chart may be a reproduction of record drawing, if scale permits fitting of controller door. If photo reduction prints are required, keep reduction to maximum size possible to retain full legibility.
      2) Chart shall be blueline print of actual "as-built" system, showing area covered by that controller.
   c. Identify area of coverage of each remote control valve, using a distinctly different pastel color drawing over entire area of coverage.
   d. Following review of charts by Consultant, they shall be hermetically sealed between two layers of 20 mm thick plastic sheet.
   e. Charts shall be completed and reviewed prior to final review of irrigation system.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver, unload, store, and handle materials, packaging, bundling, products in dry, weatherproof, condition in manner to prevent damage, breakage, deterioration, intrusion, ignition, and vandalism. Deliver in original unopened packaging containers prominently displaying manufacturer's name, volume, quantity, contents, instructions, and conformance to local, state, and federal law. Remove and replace cracked, broken, or contaminated items or elements prematurely exposed to moisture, inclement weather, snow, ice, temperature extremes, fire, or jobsite damage.

B. Handling of PVC Pipe Exercise care in handling, loading, and storing of PVC pipe. All PVC pipe shall be transported in a vehicle which allows length of pipe to lie flat so as not to subject it to undue bending or concentrated external loads. All sections of pipe that have been dented or damaged shall be discarded, and if installed, shall be replaced with new piping.

1.9 PROTECTION OF EXISTING CONDITIONS

A. Any existing structures, equipment, utilities, pavement, irrigation zones (not within the limits of
construction), existing and proposed landscaping, etc., damaged by the Contractor during the course of the work, including any subsequent damage caused by equipment activity, leakage or settling of piping shall be restored at the Contractor's expense and to the Owner's satisfaction.

B. Preserve and protect all trees, plants, monuments, structures, and paved areas from damage due to work of this section. In the event damage does occur, all damage to inanimate items shall be completely repaired or replaced by to satisfaction of owner, and all injury to living plants shall be repaired by owner. All costs of such repairs shall be charged to and paid by Contractor.

C. Protect buildings, walks, walls, and other property from damage. Flare and barricade open ditches. Damage caused to asphalt, concrete, or other building material surfaces shall be repaired or replaced at no cost to the owner. Restore disturbed areas to original condition.

1.10 WARRANTY/GUARANTY:

A. Manufacturer shall warrant materials against defects for a period of one or more years from date of substantial completion. Installer(s) shall guaranty workmanship for similar period.

B. Settling of backfilled trenches which may occur during guaranty period shall be repaired at no expense to owner, including complete restoration of damaged property.

C. Expenses due to vandalism before substantial completion shall be borne by Contractor.

D. Owner will maintain existing turf and planting areas during warranty period, so as not to hamper proper operation of irrigation system.

1.11 EXTRA MATERIALS

A. Ten MPR (Matched precipitation rate) multi stream rotor heads with nozzles of each type used

B. Four rotor heads of each type used.

C. Two quick valve keys with swivel hose ells.

D. Reclaimed drip irrigation tubing (200’)

PART 2 - PRODUCTS

2.1 GENERAL

A. Product Schedules: As soon as practicable after notice to proceed and before procurement of any products, submit a complete list of products to be incorporated in the work. List shall include catalog numbers; cuts, diagrams, and such other descriptive data as may be required by the Landscape Architect. Approval of products under this provision shall not be construed as authorizing any deviations from the specification unless attention has been directed in writing to the specific deviation. No consideration will be given to partial lists submitted from time to time. Approval of products will be based on manufacturer's published ratings. Products listed that are not in accordance with these specification requirements will be rejected.

B. Standard Products: Products furnished shall be standard products of manufacturers regularly engaged in the production of such products and shall be manufacturers' latest standard design that complies with the specification requirements.

C. Delivery and Storage: Products delivered to site shall be inspected for damage, unloaded, and stored with the minimum of handling. Do not store products directly on the ground. Inside of
pipes and fittings shall be kept free of dirt and debris.

D. Handling: Products shall be handled in such a manner as to insure delivery to the trench in a sound undamaged condition. Pipe shall be carried to the trench, not dragged. Gasket materials and plastic materials that are not to be installed immediately shall not be stored in the direct sunlight. Valves, controller, sprinkler heads, etc., shall be removed from protective cover only upon installation.

2.2 CONCRETE

A. CEMENT - All cement used in the work shall be a well-known brand of true Portland Cement and shall conform to the Standard Specifications for Portland Cement, ANSI/A.S.T.M. Designation C150. Unless otherwise permitted, the Contractor shall use only one brand of cement in the work and under no condition shall he use more than one brand of cement in the same structure. Cement that for any reason has become partially set or contains lumps or cakes will be rejected and shall be removed from the site of the work. Concrete use on this project shall not contain fly ash.

1. The acceptance or rejection of cement shall be with the Inspector and any cement failing to meet the requirements specified herein may be rejected at his direction. All rejected cement shall be plainly marked for identification, shall be immediately removed from the work, and shall not again be offered for inspection. Cement kept in storage for several months may be subject to repeated tests, if required.

2. The cement shall be delivered in strong cloth or paper bags. No cement shall be used and no cement shall be inspected unless delivered in the original package with the brand and name of the manufacturer plainly marked thereon. Each bag of cement shall contain approximately ninety-four pounds of cement, net weight, and four bags shall be the equivalent of one barrel. Packages received in broken or damaged condition will be rejected or accepted only as fractional packages.

3. The Contractor shall provide, at the site of the work, a suitable weather tight building, or buildings, having a floor properly blocked or raised from the ground, for the storage of cement. The building shall be large enough to supply of cement in quantity sufficient to prevent delays or interruptions to the work, which might be due to the lack of cement. The cement shall be stored in such manner to permit easy access for the proper inspection and identification of each shipment. Cement in bags shall not be piled to a height in excess of seven feet. Suitable accurate scales shall be provided by the Contractor for weighing the cement. After it has been delivered to the job, the Contractor will not be permitted to remove any of the cement to any other job or dispose of any of this cement in any way without the consent of the Owner’s Representative.

4. At the beginning of operations and at all other times while cement is required, the Contractor shall have, at the site of the work, an ample supply of acceptable cement and shall carefully guard against possible shortage on account of rejection, irregular deliveries, or any other cause.

B. WATER - All water used in mixing mortar or concrete shall be free from acid, alkali, oil, salt, vegetable, or other matter in sufficient quantity to be injurious to the finished product, and shall be from an approved source.

C. AGGREGATE - Fine aggregate for concrete shall be clean, hard, durable, uncoated grains of Arkansas River sand or other sand acceptable to the Owner’s Representative. It shall be free from injurious amounts of dust, clay balls, soft or flaky particles, shale, alkali, organic matter, loam, or other deleterious substances. It shall not contain more than three per cent, by weight, of material, which can be removed by standard decantation tests. If the color of the supernatant
liquid is darker than that of the reference standard color solution when subjected to the Standard Test For Organic Impurities in Sands for Concrete ANSI/ASTM C40, the fine aggregate shall be rejected unless it passes the Standard Test for Effect of Organic impurities in Fine Aggregate on Strength of Mortar ANSI/ASTM C87.

1. Fine aggregate shall be graded approximately within the limits shown in the following table. If not enough fines are available in the natural sands, limestone dust, or other approved fines shall be added:

<table>
<thead>
<tr>
<th>Per Cent Passing Standard Square Mesh Screens</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.4</td>
</tr>
<tr>
<td>95-100</td>
</tr>
</tbody>
</table>

2. Coarse aggregate shall consist of the best available crushed limestone or other approved material. River gravel or other material with smooth surfaces shall not be used without specific written approval of the Owner’s Representative. Coarse aggregate shall be clean, tough, sound, durable rock and shall not contain harmful quantities of foreign materials and must be satisfactory to the Owner’s Representative.

3. Coarse aggregate shall be graded within the limits shown in the following table:

<table>
<thead>
<tr>
<th>Per Cent Passing Standard Square Mesh Screens</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max Size</td>
</tr>
<tr>
<td>2&quot;</td>
</tr>
<tr>
<td>1 1/4&quot;</td>
</tr>
<tr>
<td>3/4&quot;</td>
</tr>
</tbody>
</table>

4. Coarse aggregate shall conform to Standard Specifications for Concrete Aggregates, ANSI/ASTM C33, except as to graduation. The maximum size aggregate to be used in structures six inches thick and under shall be three-quarters inch; in structures from six inches to ten inches thick, the maximum size of aggregate shall be one and one-half inches. If required, the Contractor shall furnish test certificates showing the aggregates meet the above requirements.

5. In case the concrete resulting from the mixture of the aggregates is not of a workable character or does not make the proper finished surface, the Owner’s Representative may require a different grading in order to secure the desired results, or they may allow the use of inert admixtures to correct deficiencies, upon proper showing that such use will not materially lower the strength or increase the permeability of the concrete.

2.3 STEEL REINFORCEMENT

A. All reinforcing steel shall be deformed bars and shall conform to the requirements of the Standard Specifications for Deformed and Plain Billet Steel Bars for Concrete Reinforcement, ANSI/ASTM A615, for grade 40 or grade 60. All steel shall be manufactured in the United States. All reinforcing steel used on this project shall be Grade 60.

B. The Owner’s Representative reserves the right to require a test of three specimens of each size of bar from each carload received. A laboratory shall make these tests or testing firm approved by the Owner’s Representative and the cost of such testing shall be included in the price bid for steel reinforcement.

2.4 STRENGTH AND PROPORTION
A. The concrete shall have a compressive strength of not less than three thousand pounds per square inch, unless otherwise specified in the plans, as determined from test cylinders at twenty-eight days, made, cured, and broken, as hereinafter specified.

B. The concrete shall be mixed in the approximate proportion of 1:2-1/2:4-1/4 and shall contain not less than 5 sacks of cement per cubic yard of finished concrete. With the approval of the Owner’s Representative, admixtures may be added in order to increase workability.

2.5 READY MIXED CONCRETE

A. Ready-mixed concrete may be used on the work, with the approval of the Owner’s Representative, when the Contractor can demonstrate that the concrete can be furnished in accordance with the specifications hereinabove and that delivery can be made at such rate as will insure the continuity of any pour. Standard Specifications for Ready-Mix Concrete, ANSI/ASTM C94, when not in conflict with the specifications herein, shall control the furnishing of ready-mix concrete.

B. All mixer trucks shall be equipped with water meters. Additional water shall be added at the job site only with the specific approval of the Owner’s Representative.

C. Construction joints shall be located as shown on the drawings and at other points as may be necessary during the construction, provided that the location and nature of additional joints shall be approved by the Owner’s Representative, in general, joints shall be located at points of minimum shear, shall be perpendicular to the principal lines of stress, and shall have suitable keys having areas of approximately one-third of the area of the joints.

D. In resuming work, the surface of the concrete previously placed shall be thoroughly cleaned of dirt, scum, laitance, or other soft material, and shall be roughened. The surface shall then be thoroughly washed with clean water and covered with at least one-half inch of cement mortar, after which concreting may proceed. Mortar shall be placed in a manner in order not to splatter forms and reinforcing steel.

2.6 DUCTILE IRON FITTINGS FOR PVC MAINLINE PIPE

A. Fittings for C905/DR18 mainline pipe shall be cast or ductile iron. Cast iron and ductile iron fittings shall conform to the American National Standard for Ductile-Iron and Gary-Iron Fittings, 3-inch through 48-inch, ANSI/AWWA C110; or the American National Standard for Ductile-Iron Compact Fittings, 3-inch through 12-inch, ANSI/AWWA C153. The length of all solid sleeves (both AWWA C110 and C153) shall be the longest length listed in the AWWA C110 specification (12-inch length for 3-inch through 12-inch sleeves, 15-inch length for 14-inch through 24-inch sleeves, and 24-inch length for 30-inch through 48-inch sleeves).

Fittings manufactured by: Tyler, US, Sigma, American Darling, or equal are permitted.

2.7 JOINTS FOR C905/DR18 MAINLINE

A. C905/DR18 mainline pipe fittings shall be jointed with any of the end types as specified below, unless a particular end type is specified. Fittings shall have mechanical joints, unless otherwise specified.

B. Mechanical joints shall conform to, and be tested in accordance with, the American National Standard for Rubber Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings, ANSI/AWWA C111/A21.11.

C. Tapping sleeves manufactured by Smith Blair and Powerseal are permitted.
D. Where restrained joints are specified or required, they shall be a wedge action type mechanical restrained joint assembly equal to the MEGALUG design for the specific type of pipe being used. Set screw type retainer glands will not be permitted.

2.9 POLYVINYL CHLORIDE (PVC) PIPE WATER PIPE AND FITTINGS

A. PVC Plastic (4" and Larger):

1. Where polyvinyl chloride (PVC) pipe four (4) inches in diameter through twelve (12) inches in diameter is specified or required, it shall conform to and be tested in accordance with ASTM 2241, POLYVINYL CHLORIDE (PVC) PRESSURE PIPE, 4 IN. THROUGH 12 IN., FOR WATER, as herein modified. PVC water pipe shall be approved by the Underwriters Laboratory and bear the seal of approval ("NSF" mark) of the National Sanitation Foundation Testing Laboratory for potable water pipe. Polyvinyl chloride water pipe shall be restricted from use adjacent to arterial streets.
2. Pipe 4”- 12”. PVC pipe shall conform to pressure Class AWWA C905/DR18/Pressure Rating 235 for diameters greater than twelve (12) inches.
3. 4” and Larger PVC pipe shall have integral wall-thickened bell ends and shall be jointed using one piece elastomeric gaskets. Solvent cement jointing shall not be permitted.
4. Fittings for PVC pipe shall be ductile or cast iron conforming to these specifications. The use of PVC fittings shall not be permitted.
5. Contractor shall submit certifications from the manufacturer that PVC pipe has been manufactured in accordance with ASTM 2241/AWWA C905, and that it meets the approval of the “NSF”.
6. Where restrained joints are specified or required, the restraint shall meet the OSU Building Requirements, which are listed as follows:
   a. 12” C 900 Series 1612 for the bell joints and Series 2012 PV for the Mechanical restraints on the fittings.
   b. 8” C900 Series 1608 for the bell joints and Series 2008 PV for the Mechanical restraints on the fittings.
   c. 6” C900 Series 1606 for the bell joints and Series 2006 PV for the Mechanical restraints on the fittings.
   d. 4” C900 Series 1604 for the bell joints and Series 2004 PV for the Mechanical restraints on the fittings.
7. Pipe and fittings: Shall be PVC plastic, cast or ductile iron unless otherwise specified. Pipe and fittings shall be rated for a minimum working pressure of 150 psi and a minimum hydrostatic pressure of 200 psi.
8. All PVC pipe and fittings shall be purple non potable color coded with identification.

B. PVC Plastic (3” and smaller):

1. Pipe shall conform to ASTM D1785, Schedule 40 and Class 200, Class 12454-B. PVC 1120. Fittings for use with Class 200 pipe shall conform to the requirements of ASTM D2464 or D2467. Fittings for schedule 40 pipe shall be solvent weld socket type conforming to ASTM D2466.
2. PVC pipe shall conform to pressure Schedule 40, Class 200 for diameters 1”to 3”.
3. Main Lines: Schedule 40
4. Lateral Lines: Class 200
5. Sleeves Under Paving: Schedule 40
6. Flexible vinyl chloride pipe: from laterals to heads.

C. Reclaimed Water PVC pipe and fittings: All PVC pipe and fittings shall be purple non potable color coded with identification.

1. Manufacturer: SLOANE, LASCO, and SPEARS.

E. Swing Joints (for use with Quick-Couplers)

1. The full circle swing joint shall be rated at 200 psi maximum working pressure at 73°F. The swing joint shall be molded of rigid poly (vinyl) chloride (PVC), Type 1; with N.P.T. threads and pipe sockets. Each rotating joint shall be sealed with a nitrile (or equivalent material) rubber O-ring, installed pre-compressed in a sealing groove free of parting lines to prevent leakage. Modified stub threads shall have special engineered diameters and clearances to allow full-circle (360°) movement and to reduce stress concentrations and joint fracture at threaded roots.
2. Lay length shall be a minimum of 24-inches and pipe has a diameter of 1-inch.
3. Inlet configurations shall be socket and outlet configuration shall be M.I.P.T.
4. Manufacturer:
   a. LASCO

2.10 SAND FOR CUSHION OR BACKFILL (6” C905/DR18 PVC MAINLINE PIPE)

A. Sand shall be a SW or SP classification according to ASTM, free from objectionable material. One hundred per cent shall pass a three-quarter inch screen, and ninety-five per cent shall pass a number four screen.

2.11 DRIP IRRIGATION SYSTEM

A. The system shall be manufactured by: NETAFIM, or approved equal – Material and Equipment. System components shall consist of the following:

1. Landscape Drip Line:
   a. Reclaimed Landscape Dripline (TLRW6-18)-NETAFIM
   b. Color: Brown with purple stripe
   c. Diameter: (O.D.-0.66", I.D.-0.56")
   d. Maximum System Pressure: 70 psi.

2. Blank Distribution Tubing
   a. Distribution Tubing (TLRW BLANK TUBING)

3. Pressure Regulators (40 psi)
   a. Flow Range: 0.5 to 20.0 gpm.
   b. Maximum pressure: 120 psi.

4. NETAFIM Fittings (Barbed Fittings) and MPT Adapters to be used in securing and connecting drip line to each other and pvc. Under no circumstance are SCH. 40 PVC fittings to be used above ground in connecting supply headers and exhaust header to drip line.

B. Valve and Filtration (1” ICV-101G) HUNTER INDUSTRIES or approved equal.

1. Flow: 0.5-20 GPM
   Filter: Techfilter as manufactured by Netafim or approved equal. Filter shall be equipped with a replaceable disc ring that distributes an even amount of trifluralin throughout the piping network.

C. Air/Vacuum Relief Valve

1. Air Vacuum Relief Valve Model # TLAVRV manufactured by Netafim or approved equal.
2. Install at the highest elevation in each zone. More than one may be required in a zone.
3. Install in a 6” Round Valve Box
D. Line Flushing Valve

1. Automatic Line Flushing Valve Model #TL050MFV-1 manufactured by Netafim or approved equal.
2. Install one (1) Line Flushing Valve for every 15 GPM of zone flow, and shall be installed at a point farthest away from the source (typically on an exhaust header) as possible.
3. Install in a 6” Round Valve Box

2.12 SPRINKLER HEADS

A. General: Heads shall be constructed of high-impact plastic and shall incorporate purple color coded and identified reclaimed water covers on all newly installed irrigation heads. Heads shall consist of a body, nozzle, and any parts necessary to the item function. All heads shall be manufactured by HUNTER or approved equal. All heads shall have built-in check valves to prevent low-end pressure seepage.

B. Rotor: Rotor heads in the lawn areas shall be the 4-inch pop-up type and as specified on the Drawings.

2.13 VALVES

A. Zone Valves: Valves shall be pressure regulating and sized as shown on Drawings. All valves shall have purple color coded reclaimed ID handle. Valves shall be manufactured by HUNTER INDUSTRIES or approved equal.

B. Gate Valves

1. Bronze or Brass gate valves smaller than 3 inches shall conform to MSS SP-80, Type 1, Class 150.

C. Manual Drain Valve: Valves shall be brass or bronze globe valves conforming to MSS SP-80.

D. Automatic Drain Valves

1. Valves shall be spring-loaded, plunger type.
2. Manufacturer: KING TECHNOLOGY or approved equal.

E. Quick Coupling Valves

1. Quick coupling valves, keys and swivel hose ells shall be as shown on the Drawings and manufactured by RAINBIRD or approved equal.
2. Quick coupling valves shall have purple color coded and identified non reclaimed water covers.

2.14 GATE VALVES FOR C905/DR18 PRIMARY MAINLINE

A. Where gate valves are specified or required, they shall conform to, and be tested in accordance with, the AWWA Standard for Gate Valves, 3-inch through 48-inch, Nominal Pipe Size, for Water and Sewage Systems, ANSI/AWWA C500. Gate valves shall have double disc parallel seats, non-rising stem, vertical mounting “O” ring stem seal, counter-clockwise opening, and ends to fit the pipe or fitting to which attached (mechanical).

B. Only the following makes of gate valves will be permitted: Mueller or American Darling.

C. Where resilient seated gate valves are specified or required for waterworks distribution service,
they shall conform to and be tested in accordance with the AWWA Standard for Resilient Seated Gate Valves, 3” through 12” nominal pipe size, Water and Sewer Systems, ANSI/WWA C509. The valve shall be bubble tight from either direction at a rated design working pressure of 200 psi. The valve shall have a single disc gate with synthetic rubber seat bonded or mechanically attached to the disc; non-rising stem with 2” AWWA operating nut; counter clockwise opening, “O” ring stem seals, corrosion resistant interior coating acceptable for potable water; and end to fit the pipe or fitting to which is attached (mechanical).

D. Only the following makes of resilient seated gate valves will be permitted: Mueller or American Darling.

2.15 AIR RELIEF VALVES AND COMBINATION VALVES

A. Where air relief valves are specified or required, the valve shall be heavy-duty combination air release and vacuum type for 150 psi working pressure, tested to 300 psi, size shown on plans. Body, cover, and baffle shall be cast or ductile iron. All internal parts to be either highest quality stainless steel or bronze, and the inside of valve coated with rust inhibitor.

B. Combination air and vacuum valves shall be designed to allow large quantities of air to escape out of the orifice when filling a pipeline and to close watertight when the liquid enters the valve. The air and vacuum valve shall also permit large quantities of air to enter through the orifice when the pipeline is being drained to break the vacuum. An automatic air release valve shall be mounted on the combination valve body to allow air to escape under pressure. The discharge orifice area shall be equal or greater than the inlet of the valve. The valve shall consist of a body, cover, baffle, float and seat. The baffle will be designed to protect the float from direct contact of the rushing air and water to prevent the float from closing prematurely in the valve. The seat shall be fastened into the valve cover without distortion and shall be easily removed if necessary. The float shall be stainless steel designed to withstand 1000 psi or more. The float shall be center guided for positive seating. The body and cover shall be cast iron with a stainless steel float and a buna-N seat.

C. Only the following makes will be permitted: APCO, VAL-MATIC, and BERMAD.

2.16 BACKFLOW DEVICE

A. Backflow Device: Shall be in accordance with OSU’s approved standards.

1. Backflow Cover: “EZ-BOX” as manufactured by Hot Box, 250 N. Lane Avenue, Jacksonville, Florida 32254, 1-(800) 736-0238. For 2 ½” & 3” backflow preventers use HoxBox Model #LB3N. For 4” backflow preventers use HoxBox Model #LB3ES. EZ-BOX shall be installed on a 4” thick concrete pad (size pad to be 2” larger than EZ-BOX on all sides). EZ-BOX shall be mounted to concrete pad.

2. The backflow preventer and enclosure shall be as per City and university codes, standards and regulations. The size and location is shown on the Drawings. OSU will supply electrical power to the backflow preventer. Contractor to install backflow preventer and connect to heat tape at backflow preventer.

2.17 CONTROL WIRES

A. Provide 14 AWG/1.6 mm diameter twisted decoder wire in sheathed casing as provided by Hunter Industries. Provide DBR6 or DBY6 wire connectors as manufactured by 3M for connection of decoders to valve connections and decoders to two wire system. Wire runs shall not be looped. All two wire control wiring shall be buried a minimum depth of 24” along Schedule 40 mainlines, or any path that does not run along the mainline route.

B. Conventional electrical control wires shall be type UF, U.L. approved with polyvinyl chloride
(PVC) insulation. Wire shall be sized according to requirements with common ground and color coded for each zone. The use of multi-stranded direct burial wire is prohibited.

2.18 VALVE BOXES

A. Boxes shall be high impact-strength plastic. Boxes shall have a lockable cover. Two keys shall be furnished with each system for each type of box provided. All valve boxes shall have the purple color coded and identified reclaimed water covers. Refer to irrigation detail sheets for enclosure sizes.

1. Manufacturer: Carson or approved equal.

2.19 TWO WIRE IRRIGATION DECODER CONTROLLER

A. Controller shall be Model no. ACC-99D. Include Hunter ET System. Controller shall be equipped for compatibility with the HUNTER IMMS Central Control System. Controller to be pedestal or wall mounted and located as shown on the irrigation plans. Irrigation contractor to provide power to controller as necessary. OSU will supply electrical power to the controller. Contractor to install controller in location as shown on irrigation plans.

2.20 CONVENTIONAL IRRIGATION CONTROLLERS

A. Replacement controllers shall be Model No. ACC-3600. Refer to irrigation plan for quantities of ACM-600 modules necessary for each proposed conventional controller located on project. Controller shall be equipped for compatibility with the HUNTER IMMS Central Control System. Controller to be wall mounted and located in existing locations as shown on the irrigation plans. OSU will supply electrical power to the controller. Contractor to install controllers in locations as shown on the irrigation plans.

2.21 CENTRAL CONTROL

A. The central control software shall be Hunter Industries model IMMS3CD with software option IMMS-ET. The ET sensor platform shall be Hunter Industries model ET SENSOR installed at specified Hunter model ACC controller locations, as directed by owner. The wind speed sensor shall be Hunter Industries model ETWIND, which shall be added to the ET Sensors as specified. The field controllers shall be Hunter Industries model ACC with communications modules and sensors installed as described.

2.22 CENTRAL CONTROL COMPUTER

A. The central computer shall have a minimum 1 Gb RAM for Windows XP and Vista, 2 Gb RAM for Windows 7. Computer operating system shall be Windows XP, Windows Vista, or Windows 7 (32 bit or 64 bit versions).

2.23 WIRELESS FREEZE SENSOR AND RAIN SENSOR & ET SENSOR

A. Freeze Sensor: Sensor shall keep irrigation system from operating during freezing or near freezing temperature. Sensor shall have a temperature set point of 37°F and a temperature differential of +1°F. Freeze sensor shall be U.L. listed. Sensor shall be wireless. Mount sensors on buildings or controller panel boxes in open area above any roof drain or guttering systems. Coordinate with owner on final mounting location.

1. Manufacturer: HUNTER IND.

B. Rain Sensor: Sensor shall measure rainfall by a water absorption material and shall cut power supply between controller and remote control valves after rainfall quantities of 1/8-inch to 1-
inch. Sensor shall be accurate to within ±1/8-inch and restore power after 2-20 hours depending on conditions. Rain sensor shall be U.L. listed. Sensor shall be wireless. Mount sensors on buildings or controller panel boxes in open area above any roof drain or guttering systems. Coordinate with owner on final mounting location.

1. Manufacturer: HUNTER IND.

C. ET System: The ET System shall be Hunter Industries Model ET SYSTEM. The Wind speed sensor shall be Hunter Industries Model ET WIND. The ET Sensor shall be pole or post mounted within 100 ft./33m of the irrigation controller. The ET Sensor shall include individual sensors for solar radiation, relative humidity, and air temperature, and shall also include a rain gauge reading in .01”/.254mm increments, and all sensors shall be integrated into a single sensor array. The ET Sensor shall be mounted approximately 6 ft./2m above a representative irrigated plant area in direct sunlight, and shall not be mounted within the spray or stream of any irrigation device. The ET Sensor shall connect all power and communications over a single pair of 18 AWG/1mm wires from the ET Module, and shall not require additional external power connections of any kind. The ET Sensor shall include an additional sensor for wind speed, installed on the sensor array platform with an integrated bracket, for increased accuracy of evapo-transpiration calculation. The sensor platform, when equipped with the wind sensor, shall not be mounted within 15 ft/5m of any wall or structure which inhibits wind measurement in the irrigated area.

2.24 TRACE WIRE AND WARNING TAPE

A. Trace Wire (Lateral and Mainlines)-Wire shall be installed directly above all new irrigation mainline and lateral lines with 3” of specified backfill between the wire and the pipe. The wire is not to come in contact with the pipe. Continuous runs of trace wire without splices are preferred. If the wire needs to tie into existing trace wire, or if lengths of trace wire need to be extended or repaired, use appropriate splice kits. Install in accordance with manufacturer’s instructions. If any existing trace wire is cut or damaged during construction, it must be spliced back together using a splice kit. The trace wire is to end in a suitable above ground location where locating equipment can be easily connected. See applicable OSU Building Design Standards. Trace wire shall be tested for continuity before backfilling and retested for continuity after backfilling. Wire shall be # 12 type UF or USE solid copper. Insulation color shall match Oklahoma One-Call (OKIE) color coding schedule for irrigation mainline and lateral lines.

B. Warning Identification tape (Irrigation Lateral & Mainline)-Underground warning tape shall be installed directly above the irrigation mainline approximately 6” below the final finished grade. Tape shall be labeled “CAUTION NON POTABLE IRRIGATION WATER LINE BURIED BELOW.” Warning tape shall be plastic, manufactured for this specific use. Tape color shall match OKIE color coding schedule for irrigation mainlines. Manufacturer shall be:

1. PRESCO PRODUCTS, Sherman, TX, 800.527.3295 or approved equal.

C. Splice Kits- Splice connections shall be made using prepackaged gel-filled insulator tubes-3M Direct Bury Splice Kit, DBE-6 or OSU approved equal.

2.25 GROUNDING PLATES

A. Solid copper grounding plates (4” x 96” x 0.064”) shall be provided as necessary at the proposed controllers as shown on plans. Solid copper grounding plates shall be provided along the main two wire path. Locate grounding plates 30” below grade as shown on the irrigation detail sheets. Provide earth contact backfill material part no. 1820058 at all grounding plates. Grounding plate and earth contact backfill material as manufactured by Paige Grounding Systems. Install grounding plates and earth contact backfill material as per manufacturer’s recommendations.
2.26 SOD

A. Bermuda Sod: Type A: A cultivated grass sod; ‘U-3’ Bermuda grass (Cynodon dactylon) with a strong fibrous root system, Oklahoma grown, free of stones, burned or bare spots; containing no more than 10 weeds per 1,000 square feet.

B. Fescue Sod: Turf type Fescue Sod: ASPA Certified grade; a cultivated grass sod; Blend of Turf-Type Fescue Grass (Festuca spp. as grown by Tulsa Sod & Grass Farm) with a strong fibrous root system, Oklahoma grown, free of stones, burned or bare spots; containing no more than 10 weeds per 1,000 square feet. Turf type fescue designated for disturbed trenching areas that lie underneath existing trees or heavily shaded areas. The beginning of the week shall be an acceptable installation time. Contractor to coordinate installation time with OSU.

2.27 WATER

A. During construction and testing of the irrigation system, the domestic water from the Project property will be obtained on site from the existing irrigation water sources on campus as shown on the irrigation plans. The Contractor shall utilize the water in a conservative manner. Irrigation water meters to be supplied by OSU and installed by contractor as per OSU or city codes and standards.

PART 3 - EXECUTION

3.1 GENERAL

A. General: Examine installation areas. Report unsatisfactory condition in writing to Landscape Architect. Do not proceed until unsatisfactory conditions have been corrected.

1. Locate all Site Utilities: Locate all site utility systems and perform work in a manner that will also avoid damage.

B. Starting installation constitutes acceptance of conditions or satisfactory for installation of underground irrigation system by Contractor, who shall correct damage and defects or unsatisfactory work at no additional cost.

C. Coordinate with the construction administrator on the location of existing trees and shrub beds in relationship to the location of irrigation mainline, lateral lines, valve boxes, and sprinkler heads.

D. Verify existing site irrigation main line pressure.

3.2 INSTALLATION:

A. Water Source: Water source connection as shown on the irrigation plans.

B. Trenching:

1. Sprinkler mains, laterals, and control wires shall be installed in common trenches wherever possible. Wiring shall be separated from pipe a minimum of 6-inches to avoid possibility of current leakages and short circuits. Primary Mains shall be installed a minimum of 36-inches below finished grade. Mains shall be installed a minimum of 24-inches below finished grade. Headers and laterals shall be a minimum of 18-inches below finished grade. Soft, spongy, or otherwise unstable material that will not provide a firm foundation for the pipe shall be removed and replaced with satisfactory fill material as defined therein.

2. Clearances:
a. Piping 3 inches and larger make trenches of sufficient width (14 inches minimum) to properly assemble and position pipe in trench. Minimum clearance of piping 3 inches or larger shall be 5 inches horizontally on both sides of the trench.
b. Piping smaller than 3 inches trenches shall have a minimum width of 7 inches.
c. Line clearance: Provide not less than 6 inches of clearance between each line, and not less than 24 inches of clearance between lines of other trades.

3. Pipe and Wire Depth:
   a. Primary Mainline Piping 36 inches from top of pipe.
      Pressure Supply Piping 24 inches from top of pipe.
   b. PVC Sleevings 18, 24, and 36 inches from top of pipe.
   c. Nonpressure Piping 18 inches from top of pipe.
   e. Control Wiring Side of pressure main.

4. Boring will be permitted only where pipe must pass under obstruction(s) which cannot be removed. In backfilling bore, final density of backfill shall match that of surrounding soil. It is acceptable to use sleeves of suitable diameter installed first by jacking or boring, and pipe laid through sleeves. Observe same precautions as though the pipe were installed in open trench. Locate equipment as near as possible to locations designated. Deviations shall be reviewed by Consultant prior to installation.

5. There shall be no mechanical trenching under tree drip lines. All excavation work under the tree drip line shall be hand. Cutting of tree roots must be approved by OSU Grounds Maintenance staff. Root cutting will depend on tree species and distance from the tree trunk.

6. All trench excavation and bore pits must comply with applicable OSHA standards.

C. Sleeves:
   1. Sleeves installed as per plans under sidewalks 36-inches below grade for primary main, 24-inches below grade for main line and 18-inches for laterals.
   2. Where plans call for pipe to be sleeved, the contractor shall be responsible for providing the pipe sleeve size required to accommodate the bell end of the pipe and any applicable restraints. This may require a larger pipe sleeve than what is called for on the drawings.

D. Pipe Laying:
   1. Snake pipe in trench at least 1-foot per each 100-feet to allow for expansion and contraction.

E. Backfilling:
   1. After piping has been tested according to paragraph TESTING, trenches shall be cleared of trash and debris. Material for backfilling shall be satisfactory fill material, properly moistened to obtain optimum compaction and compacted by hand or machine tampers to density of undisturbed adjacent earth or compacted fill.
   2. Install continuous line markers, located directly over buried main lines at 6-8 inches below finish grade during backfilling and topsoil operations.

F. Piping:
   1. All PVC piping shall be purple non potable standard color and shall be identified on the pipe.
   2. General: Joints connecting pipe of differing materials shall be made in accordance with the manufacturer’s recommendations using approved transition fittings or procedures.
   3. Flushing: When the pipelines are connected and the sprinkler risers in place, but before any heads are installed, the control valves shall be opened and the full head of water used to flush out the system.
   4. Pitch: Mains shall be pitched down not less than 1/4-inch in 10-feet in the direction of
drainage valves. Laterals and headers shall be pitched toward the automatic drain valves at not less than 1/8-inch in 10-feet.

5. PVC:
   a. Pipe shall be installed in accordance with manufacturer's instructions or as hereinafter noted.
   b. Solvent cement joints shall be made in accordance with ASTM D2855 and the manufacturer's instructions.

G. Sprinkler Heads:
   1. Sprinkler heads shall be flush with existing grade upon completion of irrigation and turf repair work. Sprinkler heads shall be four (4) inches from pavement and eight (8) inches from all buildings.

H. Valves:
   1. Quick coupler valves shall be installed as per Drawings and manufacturer's recommendations and with top of valve not less than 1 inch below bottom of lid valve.
   2. Gate valves, remote control valves, and manual drain valves shall be installed with extension valve boxes with tops set flush or not more than 1/2-inch above finished grade. Manual drain valves shall drain into sump pits made of gravel, sufficiently large in size to accommodate the volume of water released. All valves shall be installed as per Drawings and manufacturer's recommendations and with top of valve not less than 1 inch below bottom of lid valve.
   3. Automatic drain valves shall be furnished at all low points on a mainline or within a zone but no closer than 12-inches from the last head. Valves shall be installed at 45 degrees below horizontal into a gravel sump or as recommended by the manufacturer. Sump shall be of sufficient size to accommodate the water released.

I. Control Wiring:
   1. Wiring shall be installed a minimum of 24-inches below finished grade to the side of or below piping where possible.
   2. Looped slack at valves shall be provided for electrical wiring. Wires shall be snaked in trenches with and expansion loop at 100-foot intervals.
   3. Provide a two wire system to each solenoid valve from the controller.

3.3 TESTING

A. Notification: The Construction Administrator shall be present at all phases of testing and shall be notified 24 hours in advance of testing.

B. Hydrostatic Testing: Water piping and valves shall be tested psi before piping is covered with earth. Test at a hydrostatic pressure of 100 pounds per square inch without pumping for a period of one hour with an allowable pressure drop of five (5). If hydrostatic pressure cannot be held for a minimum of three hours, make adjustments or replacements and the tests repeated until satisfactory results are achieved and accepted by the Landscape Architect. Piping may be tested in sections to expedite work.

3.4 INSPECTION

A. Examine areas and conditions under which Work of this Section is to be performed. Do not proceed with Work until unsatisfactory conditions have been corrected.

3.5 OPERATION AND MAINTENANCE
A. General Information: Provide operating instructions for a period of one hour prior to final acceptance. Provide on-site consultation with the Owner’s operating personnel for a period of six (6) months, not to exceed four (4) hours per month at no additional cost.

B. Winterization includes cost in bid for winterizing complete system at conclusion of sprinkling season (in which system received final acceptance) within 3 days notification by the owner. System shall be voided of water using compressed air or similar method reviewed by consultant. Reopen, operate, and adjust system malfunctions accordingly during following season within 3 day of notification by Owner.

3.6 SOD

A. Laying Sod

1. Moisten prepared surface immediately prior to laying sod.
2. Lay sod immediately (within 24 hours of harvesting) after delivery to site to prevent deterioration. Sod will be rejected if not installed within this time period. Sod shall be laid so that the top of sod is one (1)-inch below adjacent paving.
3. Place sod parallel with the trenches.
4. Lay sod tight with no open joints visible, and no overlapping; stagger end joints 12-inches minimum. Do not stretch or overlap sod pieces.
5. Lay smooth. Align with adjoining grass areas and flush with grade.
6. Water sodded areas immediately after installation. Saturate sod to 4-inches of soil. Water by hand to prevent the root system from drying. Sod shall be kept moist. Dry sod will be rejected and replanted according to this specification.
7. Once conditions are favorable, roll sodded areas to ensure a good bond between sod and soil and to remove minor depressions and irregularities. Roll sodded areas with a roller not exceeding 250 lbs.
8. Prior to sod installation; ensure that trenches are fully compacted in six (6) inch layers.

B. Sod Maintenance

1. Maintain the newly sodded grass areas as follows:
2. Neatly trim edges and hand clip along trail edge a minimum of two (2) times and prior to final acceptance.
3. Water to prevent grass and soil from drying out.
4. Roll surface and topdress with topsoil to remove irregularities.
5. Weed Control: Apply a weed control herbicide. Notify the Landscape Architect prior to herbicide application. Apply herbicides in accordance with manufacturers’ instructions. Remedy damage resulting from improper use of herbicides.
6. Immediately sod areas that show deterioration or bare spots.

3.7 FINAL TESTING AND ACCEPTANCE:

1. Walk Through for Substantial Completion:
   a. Arrange for consultant’s presence 48 hours in advance of walkthrough.
   b. Entire system shall be completely installed and operational prior to scheduling of walkthrough.
   c. Operate each zone in its entirety for consultant at time of walkthrough and additionally, open all valve boxes if directed.
   d. Generate a list of items to be corrected prior to Final Completion.
   e. Furnish all materials and perform all work required to correct all inadequacies of coverage due to deviations from contract documents.
2. Walk Through for Final Completion:
   a. Arrange for consultant’s presence 48 hours in advance of walkthrough.
b. Show evidence to consultant that owner has received all accessories, charts, record drawings, and equipment as required by the before final completion walkthrough is scheduled.

c. Operate each zone in its entirety for consultant at time of walkthrough to insure correction of all incomplete items.

d. Items deemed not acceptable by the consultant shall be reworked to complete satisfaction of consultant.

e. If after request to the consultant for walkthrough for final completion of irrigation system, consultant finds items during walkthrough which have not been properly adjusted, reworked, or replaced as indicated on list of incomplete items from previous walkthrough, contractor shall be charged for all subsequent walkthroughs. Funds will be withheld from final payment and/or retainage to the contractor, in amount of equal to additional time and expenses required by consultant to conduct and document further walkthroughs as deemed necessary to insure compliance with contract documents.

3. Final testing shall show proper operation of all components and actual measured application rates at representative and selected locations. All irrigated areas shall have 100% coverage, if extra heads, piping and accessories are required for 100% coverage, these items shall be at no additional cost.

4. Final acceptance will be the same date as final acceptance of the entire project. Upon final acceptance the Owner will assume responsibility for maintenance of the irrigation system. Said assumption does not relieve the Contractor of obligations under warranty.

END OF SECTION