32 80 00 – Irrigation

1. Introduction

   A. This Construction and Design standard covers Irrigation guidelines to be used in conjunction with other related landscaping sections applicable to the project. Related specification sections may include but are not limited to:

   32 91 13.26 Mulch
   32 01 90 Operation and Maintenance of Planting
   32 01 90 Operation and Maintenance of Planting (Grasses)
   32 01 90.23 Pruning
   32 01 90.26 Watering
   32 90 00 Planting
   32 91 00 Planting Preparation
   32 91 13 Soil Preparation
   32 93 00 Plants
   32 93 13 Groundcovers
   A015120 Tree Protection Zone

   B. All new landscapes shall be irrigated.

   C. Provide underground irrigation system upgrades and expansion for the site as shown and specified. The work includes:

      1. Automatic irrigation system including pipes, fittings, sprinkler heads and accessories.
      2. Valves and fittings.
      3. Controller.
      4. Control wire.
      5. Testing.

2. References

   A. Drawings and general provisions of Contract, including General and Special Conditions, apply to work of this section.

   B. City of Durham, Public Utilities and Public Works Standards,

   C. State of North Carolina plumbing standards,

   D. National Fire Protection Association, (NFPA): National Electrical Code,
E. American Society of Testing and Materials (ASTM),

F. National Sanitation Foundation (NSF).

3. Design Standards

A. MATERIALS

1. General:

   a. Provide only new materials, without flaws or defects and of the highest quality of their specified class and kind to be provided by an authorized Product Distributor. Product Distributors will be asked to submit their factory authorization to sell and service all components that they provide.

   b. Comply with pipe sizes indicated. No substitution of smaller pipes will be permitted. Larger sizes may be used subject to acceptance of the Duke University designated representative. Remove damaged and defective pipe.

   c. Provide pipe continuously and permanently marked with manufacturer’s name or trademark, size, schedule and type of pipe, working pressure at 73 degrees F and National Sanitation Foundation (NSF) approval.

2. Plastic Pipe, Fittings and Connections:

   a. Pipe sizing to be determined and installed per plan and needs to be approved by Duke University designated representative prior to installation.


   c. Flow Sensor – shall be Toro Part # TFS-200 installed per manufacturer’s specification. Installed in Part # NDS-214BC 12" Standard NDS Valve Box. Flow sensor to be installed per manufacturer’s specification.

   d. Main Line Isolation – install main line isolation Part # TI8-2-1/2. Install in a NDS 12" Standard Valve Box Part # NDS-214BC.

   e. Pump & Drive System – provide booster pump and drive pump model Berkley B-1-1/2-TPLS Part # B54498 pump drive Part # PID50.

   f. Wire

      (1) Shielded cable for flow sensor 16/2 Paige Part # P-7162-D.

      (2) Field wiring to be 14/2 twisted strand 14-gauge Part # 170800R.
(3) Green used as tracer wire along main line wrapped at each isolation valve and zone valve Part # 14-G-2500.

(4) Green used as tracer wire along all lateral post valve installation Part # 14-G-2500.

g. Field Controller – shall be enclosed in a stainless-steel metal enclosure. Voltage for field controllers shall be 110-120 V ac. Controller shall be provided complete with at least four (4) levels of surge protection. Controller shall have two (2) sensor inputs and also have a 6-week scheduling calendar. Controllers must have up to eight (8) start times per program. Controllers must have the ability to shut down on excessive draw via draw monitoring. Controllers must provide the ability to connect to a laptop computer to download large station count programs. Controller must provide true two-way communication and have a non-volatile memory. Hand held capability must be available in standalone mode. Controller must have a five (5) year warranty. Controller shall be of the same manufacturer as the central control system. Controller shall be manufactured in the Toro Company Irrigation Division – Riverside, California. Toro Sentinel Part # SBAPS1U.

h. Sprinkler Heads

(1) Spray Heads to be 6” and 12” Toro 570ZPRX with check Part #’s 102-0004 and 102-0010 (no check).

(2) Spray Nozzles – Toro Precision Part # O-T-(XX)-(X).

i. Rotors

(1) Turf Rotors – Rain Bird 5004 Series Part #5004+PCSR.

(2) Large Turf Rotor – KRain ProSport Part #14053-SS installed on a 1” swing joint Part # G132-212.

j. Backflow Prevention

(1) Backflow Preventer – size to be determined and installed by Duke Utilities.

(2) Backflow is to be located inside a mechanical room.

k. Valves

(1) Valves to be installed Toro Part # P220-26-94 and P220-26-96.

(2) Line sized isolation valves to be installed prior to each electric valve Part # 2131-010 and 2131-015.
(3) Install using threaded nipples from mainline through isolation valve, union and valve Part # 110-060, 210-030 and 115-060, 215-030.

(4) Install using threaded schedule 80 unions on both sides of the electric valve using thread/toe nipples Part # 898-010 and 898-015.

(5) Quick coupling valve Part # 474-00 provide two keys for this project. Field locate 4 QC’s per owner’s request and notate on drawing to be added to As-Builts.

B. Accessories

1. Drainage fill: 2” washed pea gravel.

2. Fill: Clean soil free of stones larger than 1” diameter foreign matter, organic.
   a. Material and debris:
      (1) Provide imported fill material as required to complete the work. Obtain rights and pay all costs for imported materials.
      (2) Suitable excavated materials removed to accommodate the irrigation system work may be used as fill material subject to the Duke University designated representative’s review and acceptance.

3. Low voltage wire connectors: Socket seal type wire connectors and waterproof gel sealer with wire connectors 3M DBY’s and DBR’s or approved equal only. Part # 270672.

4. Valve access boxes: All valves to be installed in 12” standard valve boxes, Part # NDS-214BC.

4. Documentation and Review Requirements

A. Submittals

1. Submit manufacturer’s product data and installation instructions for each of the system components to include electric valves, heads, controller, wire, pipe, fittings, valve boxes, manual valves, wire splices and all other equipment installed on the project. Submittals must be organized and semi-permanently bound in booklet form with a table of contents to each section. This booklet must be periodically updated as materials change on the project and can be provided to the Owner in PDF form.

2. Submit the follow material samples:
   a. Piping and fittings.
b. Wire.

c. Wire connectors and sealer.

3. Submit the following equipment samples:
   a. Sprinkler heads, one (1) of each type, complete with housing.
   b. Valves and valve access boxes.
   c. Controller.

4. Approved equipment samples will be returned to the Contractor and may be used in the work.

5. Upon irrigation system acceptance, submit written operating and maintenance instructions. Provide format and contents as directed by the Duke University designated representative.

5. Installation and Performance Requirements

A. Quality Assurance

1. Contractor qualifications:
   a. Must have experience excavating and back filling irrigation system work.
   b. All of the following documentation or verification of the qualifications must be provided with your bid in order to be considered responsive:
      (1) Provide proper documentation of NC Irrigation license.
      (2) Registered and approved with Duke University Avetta system.
   c. Proof of a minimum of three (3) projects involving the installation and programming of Toro Sentinel, completed within the last two (2) years.
   d. Experience of an individual working for the contracting company will not be accepted as qualified job submittals. Experience must come from the company. Omission of any required information will be grounds for disqualification.
   e. Contractor must have in-house capability and experience with system programming, troubleshooting and maintenance repairs and the required hardware and software to perform those services.

2. Conform to applicable codes for piping and component requirements.
3. Materials, equipment, and methods of installation shall comply with applicable regulatory codes and standards including but not limited to those referenced in this document.

4. Obtain Duke University designated representative acceptance of installed and tested irrigation system prior to installing backfill materials. All main line and lateral PVC lines must meet these criteria.

B. Delivery, Storage, and Handling

1. Deliver irrigation system components in the manufacturer’s original undamaged and un-opened containers with labels intact and legible. Site contractor will provide staging area.

2. Deliver plastic piping in bundles, packaged to provide adequate protection of pipe ends, either threaded or plain.

3. Store and handle materials to prevent damage and deterioration.

4. Provide secure, locked storage for valves, sprinkler heads, and similar components that cannot be immediately replaced, to prevent installation delays.

C. Project Conditions

1. Known underground and surface utility lines are indicated on the utilities drawings.

2. Prior to starting, the project must be cleared through the Duke University Risk Mitigation Process.

3. Protect existing trees, plants, lawns, and other features designated to remain as natural areas.

4. Promptly repair damage to adjacent facilities caused by irrigation system work operations. Cost of repairs at Contractors expense.

5. Promptly notify the Duke University designated representative of unexpected subsurface conditions.

6. Irrigation system layout is diagrammatic. In the field, **Contractor and the Duke University designated representative shall establish exact locations of piping, sprinkler heads, valves, and other components at the time of installation. Contractor will stake main line, all heads and valves and receive approval from Duke University designated representative prior to excavation.** Contractor is ultimately responsible for maintaining 100% head to head coverage on entire irrigated site.
a. Space sprinkler components as indicated on plan.

b. Minor adjustments in system layout will be permitted to clear existing fixed obstructions. Final system layout shall be acceptable to the Duke University designated representative.

7. Cutting and patching:

a. Cut through concrete and masonry with core drills. Jackhammers are not permitted.

b. Materials and finishes for patching shall match existing cut surface materials and finish. Exercise special care to provide patching at openings and exterior walls. Subject to approval of General Contractor’s Representative and Duke University designated representative.

c. Methods and materials used for cutting and patching shall be acceptable to the Duke University designated representative.

D. Execution

1. Inspection

a. Examine final grades and installation conditions. Verify that field measurements are as shown on drawings. Do not start irrigation system work until unsatisfactory conditions are corrected.

b. Verify the location of utilities, plant materials, shrub bed lines, and tree lines. No irrigation lines are to be routed within 5 feet of any tree on the project. Contractor is responsible for coordinating the location of all trees with landscape contractor. No irrigation head will be installed until all trees have been installed or staked.

c. Verify that required utilities are available, in proper location, and ready for use.

d. Beginning installation means Contractor/Installer accepts existing conditions.

e. Contractor shall have an employee on staff that is licensed as NC Irrigation Contractor who will provide direct supervision during the installation of this project. Employee will be the primary point of contact and must be able to immediately address Duke University concerns in order to move the project forward in an acceptable manor. The Duke University representative will be supplied the licensed contractor’s contact information (to include email and cell phone number) prior to commencing work.

f. Contractor must provide one experienced on-site foreman or supervisor subject to approval of the Duke University designated representative, who must be on site at
all times when a crew is working. The Duke University representative will be supplied this designated individual's contact information (to include email and cell phone number) prior to commencing work.

2. Preparation

a. Prior to excavation, utility companies shall be notified in accordance with local codes and ordinances. Contractor must acquire proper dig permit prior to beginning of installation. All current dig ticket rules for contact and digging will be followed.

(1) Contractor shall be responsible for damage to existing utilities and structures due to negligence and/or misuse by his crews or equipment.

(2) Layout and stake the location of each pipe run and all sprinkler heads and sprinkler valves. Obtain Duke University designated representative's acceptance of layout prior to excavating.

(3) Tamping and replacement of turf as directed by Duke University Representative.

(4) Place sleeves as necessary for installation of piping and control wire. All piping under walks and walls shall be within a schedule 40 PVC sleeve two sizes larger than the pressure pipe.

(5) Water meter and electrical to be provided by Owners.

3. Installation

a. Excavating and back filling:

(1) All excavation shall be considered unclassified excavation and include all material encountered.

(2) Excavate trenches of sufficient depth and width to permit proper handling and installation of piping and fittings.

(3) Excavate to depths required to provide 3” depth of debris free earth, fill or sand bedding for piping when rock or other unsuitable bearing material is encountered.

(4) Fill to match adjacent grade elevations with approved earth fill material. Place and compact fill in layers not greater than 8” depth.

   (a) Provide approved earth fill or sand to a point 4” above the top of pipe.
(b) Fill to within 6" of final grade with approved excavated or borrow fill materials free of lumps or rocks larger than 1" in any dimension.

(c) Provide clean topsoil fill free of rocks and debris from top 6" of fill.

(5) Install irrigation lateral lines with a minimum cover of 18" based on finished grades. Install irrigation mainline with a minimum of 24" based on finished grade.

(6) When two (2) pipes are to be placed in the same trench, a six (6) inch space is to be maintained between the pipes. The Contractor shall not install two (2) pipes with one directly above the other.

(7) Trenches located under paving shall be backfilled with sand (a layer six (6) inches below the pipe and three (3) inches above the pipe) and compacted in layers of 95% compaction. Depth of trenches shall be sufficient to provide a minimum cover above the top of the pipe as follows:

(a) 18 inches over non-pressure lateral lines.

(b) 18 inches over non-pressure lateral lines under paving.

(c) 24 inches over control wires.

(d) 24 inches over sprinkler main line.

(e) 24 inches over sprinkler main line under paving.

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

(9) Replace stripped sod in sufficient time to allow for satisfactory sod recovery and growth. Water stripped and reinstalled sod until irrigation system in place is operational. All sod work to be approved to Duke University designated representative.

b. Plastic pipe:

(1) Install plastic pipe in accordance with manufacturer’s installation instructions. Provide for thermal expansion and contraction. Do not install plastic pipe if temperature is below 32 degrees.

(2) Saw cut plastic pipe. Use an electric miter saw, to ensure a square cut. Remove burrs and shavings at cut ends prior to installation. Use a hand beveller on all gasket pipe cuts.
(3) Use solvent recommended by the pipe manufacturer. Install plastic pipe fittings in accordance with pipe manufacturer’s instructions. Contractor shall make arrangements with pipe manufacturer for all necessary field assistance.

(4) Make plastic to metal joints with plastic male adapters.

(5) Make solvent weld joints in accordance with manufacturer’s recommendations.

(6) All lateral connections to the main line as well as other connections shall be made to the side of the mainline pipe. No connections to the top of the line shall be allowed.

(7) All joints to set at least 24 hours before pressure is applied to the system.

(8) Pressure Test Procedure:
   
   (a) Completely install main lines, isolation valves and control valves. Do not install laterals.
   
   (b) Open all isolation valves.
   
   (c) Fill all lines with water and shut off meter.
   
   (d) Pressurize the main lines with air to 70 PST. Monitor gauge for pressure loss for four (4) hours.
   
   (e) Leave lines and fittings exposed throughout testing period.
   
   (f) Leaks resulting from tests shall be repaired and the test process repeated until the system passes.

(9) Maintain pipe interiors free of dirt and debris. Close open ends of pipe by acceptable methods (duct tape ends) when pipe installation is not in progress.

c. Sprinklers, Fittings, Valves and Accessories:

   (1) Install fittings, valves, sprinkler heads, risers and accessories in accordance with manufacturer’s instructions, except as otherwise indicated.

   (2) Set sprinkler heads perpendicular to finished grades, except as otherwise indicated.
(3) Locate sprinkler heads to assure 100% head to head coverage, of indicated areas. Do not exceed sprinkler head spacing distances indicated. Contractor is responsible for site adjustments to achieve desired coverage.

(4) All rotors and spray heads to be installed with proper nozzles to provide Matched Precipitation Rates.

(5) Install quick-coupling valves with an adjustable double swing joint riser assembled by the use of at least three (3) standard 90-degree elbows. Fabricate double swing joint risers of schedule 80 PVC nipples and schedule 40 PVC elbows. Pre-fabricated swing joints are acceptable. Top of the quick coupler valve to be no more than 2" below finished grade.

(6) Install controller in accordance with manufacturer’s written instructions. All controller footings will be 12” deep concrete.

(7) Install valve access boxes on a suitable base of bricks to provide a level foundation at proper grade and provide drainage of the access box. 1 1/2 cubic feet of pea gravel below box to be provided for drainage.

(8) Automatic valves shall be installed plumb with valve access box with all valve handles, bolts, connections and electrical splices accessible through the valve box opening (not less than 6” below valve box cover).

(9) Seal all threaded connections of control valves with Teflon tape. Plastic joint type compound is not acceptable.

d. Control Wiring:

(1) Install two-wire cable and green tracer wire in 1” conduit with sweeps into and out of valve boxes. Contractor to coil green tracer wire at each valve and isolation valve. Where necessary to run wire in a separate trench, provide a minimum cover of 24”. Wire cannot be plowed or pulled with a vibratory plow. All splices to be made in valve boxes.

(2) During installation wire is to be protected from nicks, cuts, kinks and sun exposure.

(3) Exposed ends during installation to be placed in proper DBYR Kit.

(4) 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.

(5) Connect each remote-control valve to one individual decoder.
(6) Make wire connections to remove control electric valves and splices of wire in the field, using waterproof wire connectors and sealing cement in accordance with manufacturer’s recommendations, dry splices will not be accepted. Make wire splices in accessible splice or valve boxes 10” in diameter or greater. All splices to be contained inside valve boxes ONLY.

(7) Provide tight joints to prevent leakage of water and corrosion build-up on the joint.

(8) When control wiring is in common trench with main line, wiring shall be below main line with 4” of fill dirt between pipe and wire.

(9) Above ground wire is to be installed in conduit and/or in accordance with electrical codes.

(10) All materials and methods of installation shall conform to local electrical codes.

e. Quick Coupling Valves: Provide a 10” valve box for location. Stabilize the valve with a stake and 1 ½” cubic feet of pea gravel (½” to ¾”).

f. Field Satellite: Shall be installed as per manufacturer’s recommendation. All grounding equipment shall be included.

g. Flushing, Testing and Adjustment:

(1) Perform system testing upon completion of each section. Make necessary repairs and retest-repaired sections as required.

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

(3) Moisture Sensors installed as follows: one (1) sensor per five (5) zones maximum of sixteen (16) sensors per controller. Field location to be determined by Duke University designated representative.

(4) Adjust all electric remote-control valves flow control stems for system balance. Contractor must set pressure-regulating valves.

(5) Test and demonstrate the controller by operating all programs, day, hour, and station selection features as required to automatically start and shutdown irrigation cycles to accommodate plant requirements and weather conditions.

(6) 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.
h. Service:

(1) Contractor shall return to the site during the subsequent fall season and winterize the system. Drain all water from the system and blow out the system with compressed air.

(2) Contractor shall return to the site during the subsequent spring season and demonstrate to the Owner Representative the proper procedures for the system start up, operation and maintenance.

(3) After three (3) months of continuous operation following acceptance of the job, contractor must return to the site and re-adjust all irrigation heads, by repacking heads that have become dislodged due to resettling of ground, torque of spray, or vibration. Re-adjust radius, arc and trajectory of spray on all heads.

4. Cleaning

a. Should be performed during installation of the work and upon completion of the work. Remove from site all excess materials, soil, debris, and equipment.

b. Repair damage resulting from irrigation system installation.

5. Disposal of Waste Material

a. Stockpile, haul from site, and legally dispose of waste materials, including unsuitable excavated materials, rock, trash and debris.

b. Maintain work site clear, clean and free of debris.

6. Acceptance

a. Test and demonstrate to the Duke University designated representative the satisfactory operation of the system free of leaks.

b. Instruct the Owners designated personnel in the operation of the system including adjustment of sprinklers, controller(s), valves and pump controls.

c. Upon acceptance, the Owner will assume operation of the system.

d. Provide Owner with all manuals for products used on the project.

e. Provide Owner with two (2) Quick Coupler Keys for this project.

f. Provide irrigation system record drawings as defined under As-Built Requirements.

6. As-Built Requirements
a. Provide irrigation system record drawings:

(1) Legibly mark drawings to record actual construction.

(2) Indicate a measured distance triangulated to locate each installed valve-automatic, manual, quick-coupling type.

(3) Any pipe repairs made to the system during installation to be notated on the As-Built.

(4) If wiring is damaged during installation when repaired it must be placed inside a 10" valve box.

(5) Identify field changes of dimension and detail and changes made by Change Order, if any.

(6) Submit three (3) copies of As-Built drawings to the Owner on base drawings provided by the Duke University designated representative.

(7) As-Builts shall also indicate control valve wiring routing paths, wire splice locations and controller location.

b. Guarantee

(1) The Contractor shall guarantee all workmanship covered by the specifications to be free of defects for a period of two (2) years from the date of final acceptance of the project. He shall replace any part of parts found to be defective with the period of guarantee at no cost to the Owner, except repairs or replacement necessitated by damage by others.

(2) Backfilling of all excavation shall be guaranteed. If, at any time during the first year of the guarantee period, trenches or heads should settle, the irrigation contractor shall repair any settling at no cost to the Owner.