

**SECTION 32 84 00
PLANTING IRRIGATION SYSTEM**

PART 1 - GENERAL

1.1 SCOPE

- A. Contractor is responsible for providing a system with full and complete coverage. Furnish all labor, materials, supplies, equipment, tools, and transportation, and perform all operations in connection with and reasonably incidental to the complete installation of the irrigation system, and guarantee/warranty as shown on the drawings, the installation details, and as specified herein. Items of work specifically included are:
1. Procurement of all applicable licenses, permits, and payment of required fees.
 2. Coordination of Utility Locates ("Call Before You Dig").
 3. Maintenance period.
 4. Sleeving for irrigation pipe and wire.
 5. Adjustments and maintenance to existing booster pump.

1.2 RELATED WORK

- A. Division 2-Site Work
B. Section 32 90 00, PLANTING
C. Division 16 – Electrical

1.3 QUALITY ASSURANCE

- A. Contractor:
1. Irrigation Contractor must have demonstrated, using persons directly employed by the Contractor, experience with the installation of at least five (5) irrigation systems having large diameter gasketed pipe (6-inch and larger), centralized control systems with hardwired communication, electrically operated remote control valves, large radius rotary sprinklers (minimum 1-inch inlet with swing joint) and pre-fabricated booster pump stations.
 2. Irrigation Contractor must be licensed in the State of Pennsylvania.
- B. Equipment Manufacturer:
1. Manufacturer regularly and presently manufactures the item as one of their principal products.
- C. System Requirements:
1. Full and complete coverage is required. Contractor shall, at no additional cost to the Government, make necessary adjustments to layout required to achieve full coverage of irrigated areas.
 2. Layout work as closely as possible to drawings. Drawings are diagrammatic to the extent that swing joints, offsets and all fittings are not shown.

1.4 SUBMITTALS

- A. Make submittal and provide number of copies per Division 1 specifications. Unless otherwise noted, provide four (4) copies of irrigation information in a 3-ring binder with table of contents and index sheet. Provide sections that are indexed and labeled for valves, sprinklers, pipe and fittings, wire and wire connectors, ID tags, shop drawings and all other irrigation equipment shown or described on the drawings and within these specifications. Highlight items being supplied on the catalog cut sheets. Submittal package must be complete prior to being reviewed by the Contracting Officer/Contracting Officer's Representative (CO/COR). Incomplete submittals will be returned without review.
- B. Materials List: Include all materials and products that are part of the irrigation system including, but not limited to: pipe, fittings, valves, mainline components, water emission components, and control system components. Quantities of materials need not be included.
- C. Manufacturers' Data: Submit manufacturers' catalog cuts, specifications, and operating instructions for equipment shown on the materials list. For rotary sprinklers include Center for Irrigation Technology Space Pro Single Leg Profile showing the Distribution Uniformity and Scheduling Coefficient for the nozzles being used at the specified offset spacing.
- D. Shop Drawings: Submit shop drawings called for in the installation details. Show products required for proper installation, their relative locations, and critical dimensions. Note modifications to the installation detail.
- E. Testing: Submit a proof of testing report following completion of each test listed in Part 1 of these specifications. Unless otherwise noted, include name of test, date of test, name of the individual completing the test, name of the company completing the test and a summary of the test results. If system fails test, document any and all retests until system passes test.
- F. Maintenance and Operation Instructions: Submit information listed in Part 3 of these specifications.
- G. Record Drawings: Submit information listed in Part 3 of these specifications.

1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. Federal Specifications (Fed. Spec.): RR-F-621E Frames, Covers, Gratings, Steps, Sump And Catch Basin, Manhole
- C. American National Standard Institute (ANSI):
B40.1 Gauges-Pressure Indicating Dial Type Elastic Element
- D. American Society of Agricultural Engineers (ASAE):
S398 Sprinkler Testing and Performance Reporting.
- E. American Society for Testing and Materials (ASTM):
B61-02 Steam or Valve Bronze Castings

- B62-15 Composition Bronze or Ounce Metal Castings
- D1785-12 Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedule 40, 80,
and 120
- D2241-15 Poly(Vinyl Chloride) (PVC) Pressure Rated Pipe (SDR
Series)
- D2287-12 Nonrigid Vinyl Chloride Polymer and Copolymer Molding and
Extrusion Compounds
- D2464-15 Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings,
Schedule 80
- D2466-15 Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule
40
- D2564-12 Solvent Cement for Poly(Vinyl Chloride) (PVC) Plastic Pipe
and Fittings
- D2855-96(2010) Making solvent Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and
Fittings
- D3350-14 Standard Specification for Polyethylene Plastics Pipe and
Fittings Materials
- F714-13 Standard Specification for Polyethylene (PE)4170 Plastic
Pipe (SDR-PR) Based on Outside Diameter
- F477-90 Elastomeric Seals (Gaskets) for Joining Plastic Pipe
- F2164-13 Field Leak Testing of Polyethylene Pressure Piping Systems
- B209-14 Aluminum and Aluminum-Alloy Sheet and Plate
- F. American Water Works Association (AWWA):
- C110-12 Ductile-Iron and Gray-Iron Fittings, 3-Inch Through 48-Inch
for Water and Other Liquids
- C111-12 Rubber Gasket Joints for Ductile-Iron and Gray-Iron Pressure
Pipe Fittings.
- C115-11 Flanged and Ductile Iron and Gray Iron Pipe with Threaded
Flanges
- C151-09 Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand
Lined Molds, for Water or Other Liquids
- C153-11 Ductile-Iron Compact Fittings, 3 Inch Through 12-Inch for
Water and Other Liquids.
- C500-09 Gate Valves for Water and Sewerage Systems
- C504-10 Rubber Sealed Butterfly Valves
- C600-10 Installation for Ductile-Iron water Mains and Their
Appurtenances

C901-08 Polyethylene (PE) Pressure Pipe and Tubing, ½ In. (13 mm)
Through 3 In. (76 mm), for Water Service

G. Manufacturers Standardization Society (MSS):

SP70-2011 Cast Iron gate Valves, Flanged and Thread Ends

H. National Electrical Manufacturers Association (NEMA):

250-2014 Enclosures for Electrical Equipment (1000 Volts Maximum);
Revision 1, May 1986

I. National Electric Code: (latest edition 2014)

J. Uniform Plumbing Code: (latest edition 2015)

1.6 RULES AND REGULATIONS

- A. Work and materials will be in accordance with the latest edition of the National Electric Code, the Uniform Plumbing Code, and applicable laws and regulations of the governing authorities.
- B. When the contract documents call for materials or construction of a better quality or larger size than required by the above-mentioned rules and regulations, provide the quality and size required by the contract documents.
- C. If quantities are provided either in these specifications or on the drawings, these quantities are provided for information only. It is the Contractor's responsibility to determine the actual quantities of all material, equipment, and supplies required by the project and to complete an independent estimate of quantities and wastage.

1.7 DEMOLITION

- A. Remove/salvage existing sprinklers, valves and other irrigation components as indicated on drawings. Remove components in manner to minimize damage. Deliver only salvageable components to Cemetery. Properly dispose of other items.
- B. Abandon existing irrigation pipe in place. If existing irrigation pipe is encountered during installation of new irrigation pipe, cut and remove two (2) feet of existing irrigation pipe on either side of new irrigation pipe.
- C. Reuse existing control wiring as indicated on drawings. Cut existing control wiring at remote control valves or remove existing control wiring from controller. Permanently label end of wire that is to be reused with existing station number. Protect existing control wiring during construction of new irrigation system.

1.8 AVAILABILITY AND USE OF UTILITY SERVICES

- A. The government shall make NO utilities available to the Contractor from existing outlets and supplies except as follows. Upon completion of the irrigation system or completion of portions thereof, the contractor through the permanent connection of the new irrigation system to the temporary pumping system, shall be provided water for flushing and testing of the new irrigation system. Once the system is deemed operable and approved, and prior to the final inspection, the contractor may use water at no cost through the irrigation system for

establishing turf and maintaining plant material. No other expressed or implied uses of government furnished water exist.

- B. The Contractor, at Contractor's expense and in a workmanlike manner satisfactory to the CO/COR, shall install and maintain all necessary temporary connections and distribution lines, and meters required by the public utilities. Before final acceptance of the work by the Government, the Contractor shall remove all the temporary connections, distribution lines, meters, and associated appurtenances.

1.9 TESTING

- A. Notify the CO/COR five working days in advance of testing.
- B. Subject pipelines jointed with rubber gaskets or threaded connections to a pressure test after partial completion of backfill. Pipelines jointed with solvent-welded PVC joints will be allowed to cure at least 24 hours before testing.
- C. Subsections of mainline pipe may be tested independently, subject to the review of the CO/COR.
- D. Furnish clean, clear water, pumps, labor, fittings, and equipment necessary to conduct tests or retests.
- E. Volumetric Leakage Test – Gasketed Mainline Pipe:
1. Backfill to prevent pipe from moving under pressure. Expose couplings and fittings.
 2. Purge all air from the pipeline before test.
 3. Subject mainline pipe to the anticipated operating pressure of 100 PSI for two hours. Maintain constant pressure. The amount of additional water pumped in during the test will not exceed:
 4. 0.62 gallons per 100 joints of 3-inch diameter pipe
 5. 0.80 gallons per 100 joints of 4-inch diameter pipe
 6. 1.18 gallons per 100 joints of 6-inch diameter pipe
 7. Replace defective pipe, fitting, joint, valve, or appurtenance. Repeat the test until the pipe passes test.
 8. Cement or caulking to seal leaks is prohibited.
- F. Hydrostatic Pressure Test – Solvent Weld Lateral Pipe:
1. Subject lateral pipe to a hydrostatic pressure equal to the anticipated operating pressure of 80 PSI for 30 minutes.
 2. Cap all sprinkler risers.
 3. Backfill to prevent pipe from moving under pressure. Expose couplings and fittings.
 4. Leakage will be detected by visual inspection. Replace defective pipe, fitting, joint, valve, or appurtenance. Repeat the test until the pipe passes test.
 5. As an alternative to the visual inspection described in Item 4. above, the CO/COR may request that a pressure drop test be performed:

6. Purge air from pipe before test. Attach pressure gauge to a riser in the middle of the lateral. Cap all sprinkler risers.
 7. Pressurize the lateral via the remote control valve then turn down flow control handle on remote control valve to seal off lateral.
 8. Observe pressure loss on pressure gauge. If pressure loss is greater than 5 PSI, identify reason for pressure loss. Replace defective pipe, fitting, joint, valve, or appurtenance. Repeat test until pressure loss is equal to or less than 5 PSI.
 9. Cement or caulking to seal leaks is prohibited.
 10. After lateral passes test and prior to operational test, install sprinklers and backfill and compact all pipe, fittings, joints, or appurtenance.
- G. Operational Test – Remote Control Valves, Lateral Piping and Sprinklers:
1. Activate each remote control valve in sequence from each controller. Manual operation of the valves from the bleed valve on the remote control valve is not an acceptable method of activation. The CO/COR will visually observe operation, water application patterns, and leakage.
 2. Replace defective remote control valve, solenoid, wiring, or appurtenance to correct operational deficiencies.
 3. Replace, adjust, add, or move water emission devices to correct operational or coverage deficiencies.
 4. Replace defective pipe, fitting, joint, valve, sprinkler, or appurtenance to correct leakage problems. Cement or caulking to seal leaks is prohibited.
 5. Repeat test(s) until each lateral pass all tests. Repeat tests, replace components, and correct deficiencies at no additional cost to the CO/COR. Adjust system as needed.
- H. Distribution Uniformity (DU):
1. Irrigation Audits
 - a. Complete an irrigation audit, to include 10 “representative” irrigation zones/test areas.
 - b. Identify the 10 areas to be tested based on cemetery site conditions in consultation with the cemetery foreman and/or irrigation personnel, irrigation auditor, NCA National Irrigation Specialist and CO/COR.
 - c. Test Area Selection Criteria:
 - 1) Proximity to water source
 - a) Minimum one audit close to the source
 - b) Minimum one audit near farthest point of irrigation system from source.
 2. Elevation
 - a. Minimum one audit near the highest point on the site.
 - b. Minimum one audit near the lowest point on the site.
 3. Sprinkler Characteristics

- a. Minimum one audit for each combination of sprinkler model, nozzle type, spacing, and pressure commonly used for the site;
 - b. Minimum of one audit in an area with good sprinkler coverage based on the quality of turf;
 - c. Minimum of one audit in an area with poor sprinkler coverage based on the quality of turf.
4. Final determination of the areas to be tested will be based on the recommendation of the Contractor and their understanding of the purpose and goals of performing these irrigation audits with final approval by the NCA National Irrigation Specialist. Submit a map indicating the locations of the zones to be tested.
5. Follow the methodology found in the current edition of the Irrigation Association Landscape Irrigation Auditor Manual and Irrigation Audit Guidelines for performing irrigation audits.
 - a. During each audit, a wind anemometer shall be used and wind speed information recorded every 5 minutes, and a graph of this information shall be provided with the summary report and audit information.
 - 1) If at any time during the audit the wind exceeds 5 mph, it shall be noted in the summary report.
 - 2) If at any time the wind exceeds 10 mph, the audit shall be stopped and restarted (cans emptied and started anew) when the wind drops below 5 mph for an extended period of time, at the discretion of the auditor.
 - 3) If a site is being audited that consistently has winds above 10 mph, then the Contractor and National Irrigation Specialist will determine the best course of action to proceed as to the effect of the wind on the audits.
6. Provide all data called for in the irrigation audit worksheets used in the current edition of the Irrigation Association Landscape Irrigation Auditor Manual.
 - a. Supply all data in a digital (MS Excel format) as well as paper report format to NCA via VA Resident Engineer.
 - b. Create similar templates/data sheets as those forms represented in MS Excel if none are readily available to the general public from the Irrigation Association.
 - c. Provide copies of all field notes, drawings, and data collection forms used in the field, to be submitted along with the paper report and digital media versions of the audit information.
7. Do not complete the Pre-Audit Inspection Corrective Actions included in the Irrigation Association Guidelines, as the irrigation system is to be audited in its current condition. However, pressure is to be checked at the pressure regulating device on each valve tested by using a schrader valve compatible connection and liquid filled pressure gauge. If

- there is no pressure regulating valve, the closest sprinkler to the RCV will be checked using a pinot tube and liquid filled pressure gauge.
8. Based on the area being audited, the Contractor shall use a number of catch cans that is divisible by 4, with a minimum of 28 catch cans being used for each audit.
 9. Catch cans shall be laid out in a grid format per the current edition of Irrigation Association Landscape Irrigation Audit Manual, based on:
 - a. Number of catch cans used
 - b. Size of the area tested
 - c. Number of sprinklers tested
 - d. Site conditions
 - 1) Spacing shall be consistent and in a square pattern throughout each testing area.
 10. Catch cans shall be as level as possible prior to beginning the audit. Cal Poly ITRC Catch Cans shall be used or approved equal.
 11. If water gets into the catch cans prior to the audit beginning, then all catch cans shall be emptied out and the sprinklers test shall start over.
 12. Depending on the type of sprinklers being audited, the following general rules shall be followed for determining sprinkler run times:
 - a. Rotor type sprinklers – a minimum of 10 minute run time and a maximum of a 30 minute run time;
 - b. Spray type sprinklers (pop ups) – a minimum of 5 minute run times and a maximum of 10 minute run times;
 - c. Rotary/stream type sprinklers – a minimum of 20 minute run time and a maximum of 60 minute run time.
 13. Catch can data collection shall be performed by the same person for all irrigation audits for consistency of data purposes.
 14. All worksheets shall be filled out to the fullest extent possible. As much data as can be reasonably determined on each site for each test shall be provided in the worksheets.
 - a. Any missing worksheet data shall be accounted for with a written explanation as to why the data is not present in the worksheets. An example of this would be:
 - b. No flow meter information provided
 - c. Reason – no flow meter present on site
 - d. Worksheets shall include all collected catch can data and determination of Low Quarter Distribution Uniformity (DULQ) and Precipitation Rate (PR) along with all of the other pertinent data in the worksheets.
 15. On a copy of the irrigation plan accurately (within 1-foot) show the following:
 - a. All sprinklers and associated valves for each test area;

- 1) Any surrounding hardscape, plants, or physical site surroundings (roads, walkways, headstones, benches, water spigots, trees, shrubs, etc.)
 - 2) All catch cans (numbered per the worksheets) and associated data collected.
16. A summary report (maximum of one page per audit) shall be provided along with a map and audit data for each location audited along with associated worksheets filled out as specified above.
17. If any conclusions can be drawn based on the area tested, distribution uniformity or precipitation rate, they should be explained in the summary page, along with any recommendations for improvements of irrigation uniformity for the audit condition.
18. Submit Entire audit report to Resident Engineer within 10 working days of the completed field work.
- I. Acceptance Test Prior to Final Inspection:
1. Upon completion of construction and prior to Final Inspection, an Acceptance Test must be passed.
 2. Coordinate start of Acceptance Test with CO/COR 5 days prior to beginning of test.
 3. During the Acceptance Test, the irrigation system must be fully operational from the control system. The irrigation system must operate with no faults for 14 consecutive days. If at any time during the 14 day test period, a system fault occurs, the source of the fault must be determined and corrected and the 14 day evaluation period will start again. If a system fault occurs, make repairs within 72 hours of notification from CO/COR. Document any faults in the proof of test report listing date of fault, fault, cause of the fault and the corrective action taken.
 4. When the system has operated for 14 days without fault, contact the CO/COR to schedule Final Inspection.

1.10 CONSTRUCTION REVIEWS

- A. The purpose of on-site reviews by the CO/COR is to periodically observe the work in progress, the Contractor's interpretation of the construction documents, and to address questions with regard to the installation.
1. Schedule reviews for irrigation system layout or testing with the CO/COR as required by these specifications.
 2. Impromptu reviews may occur at any time during the project.
 3. A Final Inspection will occur at the completion of the irrigation Acceptance Test. The intent of the Final Inspection is to verify that all installation; testing; maintenance and operation submittals; and project record drawing submittals are completed prior to the start of the Maintenance and Guarantee/Warranty periods.
 4. All costs, including travel expenses and site visits by the Veterans Administration or Veterans Administration representative(s) for additional Inspection(s) that may be required

after the Final Inspection due to non-compliance with the Construction Documents are the sole responsibility of the Contractor.

1.11 GUARANTEE/WARRANTY AND REPLACEMENT

- A. The purpose of this guarantee/warranty is to insure that the Government receives irrigation materials of prime quality, installed and maintained in a thorough and careful manner.
- B. Guarantee/warranty irrigation materials, equipment, and workmanship against defects for a period of one year from Final Inspection by CO/COR. Fill and repair depressions. Restore landscape, utilities, structures or site features damaged by the settlement of irrigation trenches or excavations. Repair damage to the premises caused by construction or a defective item. Make repairs within 72 hours of notification from CO/COR.
- C. Replace damaged items with identical materials and methods per contract documents or applicable codes. Make replacements at no additional cost to the contract price.
- D. Guarantee/warranty applies to originally installed materials and equipment and replacements made during the guarantee/warranty period.

1.12 GENERAL CONSTRUCTION REQUIREMENTS

- A. Coordinate construction of irrigation system with CO/COR and Cemetery Staff. See irrigation plans and installation details for required coordination efforts related to the installation of specific irrigation components.
- B. Control of Excavations: See Section 3.3 for safety and access directions.
- C. Install mainline and wiring sleeving under new roads prior to installation of road base.
- D. Install irrigation components in landscaped areas only.
- E. Construction cannot proceed unless staking of irrigation mainline, remote control valve locations, and sprinkler locations are reviewed and accepted by the CO/COR.

PART 2 - MATERIALS

2.1 QUALITY

- A. Use new materials without flaws or defects.

2.2 SUBSTITUTIONS

- A. Unless noted otherwise, use specified equipment. CO/COR must approve equipment prior to construction. The Contractor through written request prior to purchase or installation may request substitutions to the approved equals listed herein. Changes and associated design costs to accommodate alternative equipment are Contractor's.
- B. Pipe sizes referenced in the construction documents are minimum sizes, and may be increased at Contractor's option.

2.3 SLEEVING

- A. Provide sleeve beneath hardscape for irrigation pipe and wiring. Provide separate sleeve beneath hardscape for wiring.

- B. Use rigid, unplasticized polyvinyl chloride (PVC) 1120, 1220 National Sanitation Foundation (NSF) approved pipe, extruded from material meeting the requirements of Cell Classification 12454-A or 12454-B, ASTM Standard D1784, with an integral belled end.
- C. Use Class 200, SDR-21, rated at 200 PSI, conforming to dimensions and tolerances established by ASTM Standard D2241 for mainline pipe, lateral pipe and wiring sleeves.
- D. Size sleeves are as shown on the drawings and will be twice the nominal diameter of the pipe. Wiring bundle contained in the sleeve should not exceed 40% of the available area within the sleeve per NEC recommendations.

2.4 PIPE AND FITTINGS

- A. Mainline Pipe and Fittings:
 - 1. Use rigid, unplasticized polyvinyl chloride (PVC) 1120, 1220 National Sanitation Foundation (NSF) approved pipe, extruded from material meeting the requirements of Cell Classification 12454-A or 12454-B, ASTM Standard D1784, with an integral belled end.
 - 2. Use Class 200, SDR-21, rated at 200 PSI, conforming to dimensions and tolerances established by ASTM Standard D2241.
 - 3. Use rubber-gasketed pipe equipped with factory installed reinforced gaskets for mainline pipe. Gasketed pipe joints must conform to the "Laboratory Qualifying Tests" section of ASTM D3139. Gasket material must conform to ASTM F477. Use push-on rubber-gasketed ductile iron fittings conforming to ASTM A536 and ASTM F477. Use lubricant approved by the pipe manufacturer. Acceptable manufacturer for ductile iron fittings is Harco or approved equal.
 - 4. Provide joint restraint harness at mainline valve components, changes of mainline pipe directions and at gasketed joints upstream and downstream of changes of pipe direction as recommended by the joint restraint manufacturer. Use joint restraint components constructed of 60-42-10 ductile iron conforming to ASTM A536-80 and ASTM 1674-96.
 - 5. Mainline pipe within sleeves: Provide restrained casing spacers for gasketed joints that occur within sleeve and as necessary along pipe length. Acceptable manufacturer for casing spacers is Ford Meter Box Company or approved equal.
- B. Lateral Pipe and Fittings:
 - 1. Use rigid, unplasticized polyvinyl chloride (PVC) 1120, 1220 National Sanitation Foundation (NSF) approved pipe, extruded from material meeting the requirements of Cell Classification 12454-A or 12454-B, ASTM Standard D1784, with an integral belled end suitable for solvent welding.
 - 2. Use Class 160, SDR-26, rated at 160 PSI, conforming to dimensions and tolerances established by ASTM Standard D2241. Use PVC pipe rated at higher pressures than Class 160 in the case of small nominal diameters not manufactured in Class 160.

3. Use solvent weld pipe for lateral pipe. Use Schedule 40, Type 1, PVC solvent weld fittings conforming to ASTM Standards D2466 and D1784 for PVC pipe. Use primer approved by pipe manufacturer. Solvent cement to conform to ASTM Standard D2564, of type approved by pipe manufacturer.
- C. Specialized Pipe and Fittings:
1. Use mechanical joints conforming to ANSI A 21.10 (AWWA C110) and ANSI A21.11 (AWWA C111) or flanged fittings conforming to ANSI/AWWA C110 and ANSI B16.1 (125#).
 2. Joint sealant: Use only teflon-type tape or teflon based paste pipe joint sealant on plastic threads. Use nonhardening, nontoxic pipe joint sealant formulated for use on water-carrying pipes on metal threaded connections.

2.5 MAINLINE COMPONENTS

- A. Master Valve Assembly:
1. Existing Master Valve: 6-INCH Bermad Model No. 04-G-12-410-M per Record Drawings
 2. Existing master valve is not operational. Remove and replace diaphragm, controls and external plumbing components to convert the existing normally closed valve to a normally open valve that is compatible with the existing control system.
- B. Isolation Gate Valve Assembly:
1. As presented in the installation details.
 2. Iron body, bronze mounted, double disc with parallel or inclined seats, non-rising stem turning clockwise to close, 200 PSI minimum working pressure. AWWA C509. Acceptable manufacturers are Clow, Kennedy, Mueller, Waterous or approved equal.
 3. Valve Box: Use plastic 10-inch round valve box with black lid. Acceptable manufacturer is Carson, Maclean Highline (Pentek), Rain Bird or approved equal.
 4. Filter Fabric: Use a spunbond polyester 3.5 oz. per square yard landscape fabric.
- C. Air-Vacuum Relief Valve Assembly:
1. As presented in the installation details.
 2. Cast Iron body with epoxy coating, polypropylene float, glass fiber reinforced nylon kinetic float, Buna-N seals and O-rings, stainless steel nuts and bolts, pressure range 2 PSI to 230 PSI. Use a continuous acting combination air and vacuum and air release valve. Acceptable manufacturer is Bermad, Crispin, Fresno, Waterman or approved equal.
 3. Stainless Steel Ball Valve: Use a stainless steel ball rated Acceptable manufacturer is Apollo, Nibco, Watts or approved equal.
 4. Valve Box: Use plastic jumbo rectangular valve box with black lid. Acceptable manufacturer is Carson, Maclean Highline (Pentek), Rain Bird or approved equal.
 5. Filter Fabric: Use a spunbond polyester 3.5 oz. per square yard landscape fabric.
- D. Quick Coupling Valve Assembly:

1. As presented in the installation details.
 2. Brass construction, 1-inch nominal size, operating pressure 5-125 PSI with locking rubber or vinyl cover. Acceptable manufacturer and model is Rain Bird 5LRC to match and be compatible with existing equipment.
 3. Swing Joint: Use pre-manufactured triple swing joint. Acceptable manufacturer is Spears, Lasco or approved equal.
 4. Quick Coupler Anchor: Use pre-manufactured bolt on anchor. Acceptable manufacturer is Harco or approved equal.
 5. Valve Box: Use plastic 10-inch round valve box with black lid. Acceptable manufacturer is Carson, Maclean Highline (Pentek), Rain Bird or approved equal.
 6. Filter Fabric: Use a spunbond polyester 3.5 oz. per square yard landscape fabric.
- E. Pressure Regulating Valve Assembly:
1. As presented in the installation details.
 2. Single chamber ductile iron valve with one-piece disc and diaphragm assembly. Valve should have only one moving part allowing it to open, close and modulate as commanded by the pilot control system. Use 150 flanged valve rated to 250 PSI. 316 Stainless steel trim. Buna-N diaphragm. Stainless steel stem, nut and spring. Pilot control system must be capable of modulating to a constant pressure regardless of varying flow rates. Acceptable manufacturers are Watts, Wilkins or approved equal.
 3. Valve Box: Use plastic jumbo rectangular valve box with black lid. Acceptable manufacturer is Carson, Maclean Highline (Pentek), Rain Bird or approved equal.
- F. Flower Water Station Hydrant Connection Assembly:
1. As presented in the installation details.
 2. Yard Hydrant: Use Murdock to match and be compatible with existing equipment.
 3. Curb Stop Valve: Brass body, 300 PSI minimum working pressure. ASTM B-62, female threaded connections, with stop and waste feature. Acceptable manufacturers are Ford, Mueller, A.Y. McDonald or approved equal.
 4. Pressure regulator: Use an adjustable, bronze body pressure regulator with integral stainless steel strainer. Spring range 10-125 PSI, 1-inch inlet and outlet. Acceptable manufacturers and models are Apollo Series 36, Watts Model 223, Wilkins Model 600, or approved equal.
 5. Copper Pipe: Use Type "M" soft tubing conforming to ASTM Standard B88. Use wrought copper or cast bronze fittings, soldered, flared mechanical, or threaded joint per installation details. Use a 95-percent tin and 5-percent antimony solder.
 6. Valve Box: Use plastic valve box with black lid. Acceptable manufacturer is Carson, Maclean Highline (Pentek), Rain Bird or approved equal.
 7. Filter Fabric: Use a spunbond polyester 3.5 oz. per square yard landscape fabric.

2.6 SPRINKLER IRRIGATION COMPONENTS

A. Remote Control Valve Assembly:

1. As presented in the installation details.
2. Remote Control Valve: Use a normally closed 24 VAC 50/60 cycle solenoid actuated globe pattern design. The valve pressure rating will not be less than 200 PSI. The valve body and bonnet will be constructed of heavy-duty glass-filled UV resistant nylon and have stainless steel studs and flange nuts; diaphragm will be of nylon reinforced nitrile rubber. The valve will have both internal and external manual open/close control (internal and external bleed) to manually open and close the valve without electrically energizing the solenoid. The valve's internal bleed will prevent flooding of the valve box. The valve will house a fully encapsulated, one-piece solenoid. The solenoid will have a captured plunger with a removable retainer for easy servicing and a leverage handle for easy turning. This 24 VAC 50/60 Hz solenoid will open with 19.6 volt minimum at 200 PSI. At 24 VAC, average inrush current will not exceed 0.41 amps. Average holding current will not exceed 0.23 amps. The valve will have a brass flow control stem for accurate manual regulation and/or shutoff of outlet flow. The valve must open or close in less than 1 minute at 200 PSI and less than 30 seconds at 20 PSI. The valve will have a self-cleaning stainless steel screen designed for use in dirty water applications. Provide for all internal parts to be removable from the top of the valve without disturbing the valve installation. The valve must have an integral pressure regulation module to regulate outlet pressure as specified. Acceptable manufacture and model are Rain Bird PESB to match and be compatible with existing equipment.
3. Shut off valve: Use an AWWA C135 rated angle valve, ductile iron epoxy coated with stainless steel valve mechanism and restraint system. Acceptable manufacturer and model is Leemco LV212/218, Harco Swivel 90 lateral isolation valve or approved equal.
4. PVC Union: Use a Schedule 40 threaded union with O-ring seal. Acceptable manufacturer is Spears or approved equal.
5. Valve Box: Use plastic standard valve box with black lid. Acceptable manufacturer is Carson, Maclean Highline (Pentek), Rain Bird or approved equal.
6. Filter Fabric: Use a spunbond polyester 3.5 oz. per square yard landscape fabric.
7. Install assembly over gravel sump as presented in the installation details.
8. Wire connectors: Use 3M DBR/Y-6.
9. Use standard Christy I.D. tags with hot-stamped black letters on a yellow background.

B. Pop-Up Gear-Driven Rotary Sprinkler Assembly:

1. As presented in the installation details.
2. Rotary Sprinkler: Use a gear drive sprinkler capable of covering the radius with the discharge rate at the pressure as presented on the drawings. Furnish part circle sprinklers

with an adjustable arc of 20- to 340-degrees, and full circle sprinklers with a non adjustable arc. Furnish sprinkler with stainless steel pop-down spring. Nozzle must be tested per ASAE S398.1 and be verified to deliver Distribution Uniformity of 80% or more and a Scheduling Coefficient of 1.2 or less at the specified offset spacing. Furnish sprinkler with stainless steel risers, integral check valve in base of the case capable of holding back 10 feet of elevation. Minimum pop-up height is 3 ½-inches. Acceptable manufacturer and model is Rain Bird 5000 or 8005 to match and be compatible with existing equipment.

3. Swing Joint: Use pre-manufactured triple swing joint. Acceptable manufacturer is Spears, Lasco, Rain Bird or approved equal.
 4. Sod: Use grass sod per Landscape Specifications.
- C. Pop-Up Spray Sprinkler Assembly:
1. As presented in the installation details.
 2. Sprinkler: Use a spray sprinkler capable of covering the radius with the discharge rate at the pressure as presented on the drawings. Furnish sprinkler with pressure reducing module in the riser stem and integral check valve in base of the case capable of holding back a minimum of 8 feet of elevation. Minimum pop-up height is 4-inches. Acceptable manufacturer and model is Rain Bird 1800 Series to match and be compatible with existing equipment.
 3. Swing Joint: Use pre-manufactured triple swing joint. Acceptable manufacturer is Spears, Lasco, Rain Bird or approved equal.

2.7 CONTROL SYSTEM COMPONENTS

- A. Existing Control System: The existing control system components include a central controller and irrigation controllers.
1. Central Controller: Rain Bird Site Control with hardwire communication.
 2. Satellite Controllers: Rain Bird ESP with conventional wiring. Unused stations on existing controllers will be used for new irrigation system.
 3. Weather Station: Rain Bird WS-PRO
- B. Relocate Existing Satellite Controller:
1. As presented in the installation details. Reuse existing controller. Use associated components as specified herein.
 2. Electrical conduit: Use PVC Schedule 40 conforming to the dimensions and tolerances established by ASTM Standard D-1785. Fittings for PVC conduit will be Schedule 40, Type 1, PVC solvent weld fittings, ASTM Standards D2466 and D1784.
 3. Wire markers: Prenumbered or labeled with indelible nonfading ink, made of permanent, nonfading material.

4. Lightning protection: Provide one 12"x36"x0.0625" ground plate, one 5/8"x10 foot copper clad UL listed grounding rod, approximately 30 feet of #6 AWG bare copper grounding wire, two 6-inch plastic round valve boxes, and one CADWELD connector at each satellite or satellite controller group.

C. Power Wire:

1. Electric wire from the power source to satellite control unit shall be solid or stranded copper, Type TC Round Jacketed multi conductor cable with ground, direct burial, UL listed, rated at 600 volts. Power wires shall be black, white, and green in color. Size as presented in the drawings. If the control system changes, the Contractor is responsible for verifying that the power wire sizes are compatible and adequate for the control system being used.
2. Splices: Use 3M #82-A2 Series with Split Bolts or Butt Connectors for inline splices and 82-B1 or 90-B1 Series for wye splices.
3. Electrical conduit: Use PVC Schedule 40 conduit conforming to dimensions and tolerances established by ASTM Standard D-1785. Use Schedule 40, Type 1, PVC solvent weld sweep fittings for PVC conduit conforming to ASTM Standards D2466 and D1784 for buried installations. Use rigid metallic conduit with sweep elbows for above grade installations.
4. Warning tape to be installed 6-inches above all power wire and communication cable, use non-detectable marking tape 4.0 mil thickness, linear low-density polyethylene, specifically formulated for extended use underground. The legend shall continually repeat a minimum of every three feet. The tape tensile strength shall be in accordance with ASTM D882 and not be less than 4100 MD and 3650 TD. Elongation properties shall be in accordance with ASTM D882 and be greater than 550% at break point. Tape flexibility shall be in accordance with ASTM D671 and shall remain pliable. Tape composition shall be of virgin LLDPE/LDPE. The tape color shall be red. The legend shall read "Caution Electric Line Buried Below". The tape width shall be 3-inch. Manufacturer T. Christy Enterprises, or approved equal.

D. Communication Cable:

1. Use shielded and jacketed cable designed for direct burial, as recommended by the control system manufacturer and to match existing.
2. Splices: Use splice connector as recommended by central control system manufacturer.

E. Controller Wire:

1. Control Wire: Use American Wire Gauge (AWG) #14 solid copper, Type UF or PE cable, UL listed for direct underground burial from satellite controller to solenoid at VIH sprinkler or remote control valve assembly.

2. Common wire: Use American Wire Gauge (AWG) #12 solid copper, Type UF, Penteked, UL listed for direct underground burial from the satellite controller to solenoid at VIH sprinkler or each remote control valve assembly.
3. Construction of UF Wire:
 - a. Conductor: Solid-annealed, uncoated copper conforming to UL Standard 719, Parts 18-22.
 - b. Insulation: Polyvinyl chloride, 60°C rated conforming to UL Standard 719, Parts 23-25.
 - c. Construction Data: UL heavy duty PVC, colored, conforming to UL Standard 44.
 - d. Manufacturer's Identification: Surface embossed with manufacturer's name, voltage rating, size and type designation.
 - e. Underwriters Laboratories Approval: All cables will be tested physically and electrically in accordance with UL Standard 719 and will bear UL labels.
4. Construction of PE Wire:
 - a. Conductor: Soft drawn bare copper meeting the requirements of ASTM Specification B-3 or B-8.
 - b. Temperature Rating: -55°C to + 60°C.
 - c. Insulation Thickness: .045"
 - d. Pentek: 0.005" x .5" type 304 stainless steel tape helically wrapped with a minimum of 33% overlap.
 - e. Manufacturer's Identification: Surface marked with voltage rating, size and type, and UL file number.
 - f. Underwriters Laboratories Approval: All cables will be tested physically and electrically in accordance with UL Standard 493 and 83 (paragraphs 28.1, 29.1, and 29.2). All reels and cartons bear UL labels.
 - g. Tests: Material must be able to pass the following tests without showing signs of degradation.
 - 1) Cold bend: The insulation will not show any cracks when sample is bent around a mandrel of 3 x wire diameter after being subjected to -55°C +/- 1°C for one hour.
 - 2) Electrical: AC test voltage, 5 minutes at 3,000 volts.
 - 3) Environmental Aging: Immersed for 14 days in concentrated solutions of fertilizers, herbicides and insecticides.
5. Color: Use white for common ground wire. Use easily distinguished colors for other control wires. Wire color must be continuous over its entire length.
6. Splices: Use 3M DBR/Y-6 splices.
7. Valve Box: Use plastic standard rectangular valve with black lid. Acceptable manufacturer is Carson, Maclean Highline, Rain Bird or approved equal.

8. Warning tape: Inert plastic film highly resistant to alkalis, acids, or other destructive chemical components likely to be encountered in soils. Three inches wide colored red and imprinted with "CAUTION: BURIED ELECTRIC LINE BELOW", in black lettering.

2.8 EXISTING BOOSTER PUMP

- A. Adjustment and Maintenance: Existing booster pump is no longer operating at the originally specified operating point of 300 GPM at 60 PSI boost. Contract with the manufacturer's authorized service representative to complete following maintenance efforts:
 1. Complete full maintenance inspection of station to identify operational issues
 2. Reset station to originally operating point of 300 GPM at 60 PSI
 3. Replace non-functional display panel for VFD
 4. Repair, rewire or replace non-operating electronic butterfly valve (EBV)
 5. Complete any additional recommended service efforts that are recommended based on the age of the booster station.

2.9 OTHER COMPONENTS

- A. Tools and Spare Parts: Provide operating keys, servicing tools, spare parts and other items indicated in the General Notes of the drawings.
- B. Other Materials: Provide other materials or equipment shown on the drawings or installation details that are part of the irrigation system, even though such items may not have been referenced in these specifications.

PART 3 - EXECUTION

3.1 INSPECTIONS AND REVIEWS

- A. Site Inspections:
 1. Verify construction site conditions and note irregularities affecting work of this section. Report irregularities to the CO/COR prior to beginning work.
 2. Beginning work of this section implies acceptance of existing conditions.
- B. Utility Locates ("Call Before You Dig"):
 1. Arrange for and coordinate with local authorities the location of all underground utilities, and with cemetery maintenance personnel.
 2. Repair any underground utilities damaged during construction. Make repairs at no additional cost to the contract price.
- C. Irrigation System Layout Review: Irrigation system layout review will occur after the staking has been completed. Notify the CO/COR one week in advance of review. The CO/COR will identify modifications during this review.

3.2 LAYOUT OF WORK

- A. Stake locations of alley and sprinklers in burial sections using a licensed surveyor. Use alleys as identified on the drawings.

- B. Stake out the irrigation system. Items staked include: irrigation mainline pipe, isolation gate valve assemblies, air/vacuum relief valve assemblies, quick coupling valves, remote control valves, lateral piping, and sprinklers.
- C. If staked irrigation components conflict with utilities or other components or site features, coordinate rerouting of components with CO/COR.
- D. Sprinklers in Pre-Placed Crypt Sections:
 - 1. After pre-place crypts are installed but prior to the pre-placed crypts being covered with soil, visually inspect, identify and stake sprinkler locations inside the pre-placed crypt section as identified on the drawings.
 - 2. Confirm monumentation offset with Cemetery staff.
 - 3. As presented in the installation details, each sprinkler must be located such that after installation, each the sprinkler is centered between the monumentation.
 - 4. Record the location of each sprinkler using a method that cannot be altered during the backfill process for the pre-placed crypts. Use a permanent stake, GPS coordinates or other method so that each sprinkler is installed at the proper location, centered between the monumenation.
 - 5. Prior to staking, inform CO/COR of recording method to be used for sprinkler locations.

3.3 EXCAVATION, TRENCHING, AND BACKFILLING

- A. Excavate to permit the pipes to be laid at the intended elevations and to permit workspace for installing connections and fittings.
- B. Survey Markers:
 - 1. Protect markers during construction.
 - 2. If a survey marker is disturbed during construction, the Contractor is responsible for replacing the marker. The Contractor must hire a licensed surveyor to resurvey the location of the marker and replace it.
- C. Minimum cover:
 - 1. 36-inches or deeper to match existing irrigation mainline pipe in roads. (distance from top of pipe to bottom of road base)
 - 2. 36-inches over irrigation mainline pipe in landscaped areas. (distance from top of pipe to finish grade)
 - 3. 18-inches over irrigation lateral pipe to sprinklers in landscaped areas. (distance from top of pipe to finish grade)
 - 4. 22- to 28-inches over irrigation lateral pipe in preplaced crypt field. Lateral pipe must be installed 4-inches below crypt lid.
 - 5. 18-inches over control wire when not in common trench with mainline or lateral piping. (distance from top of control wire to finish grade)

6. 18-inches vertical separation between lateral and mainline pipe installed in a common trench.
7. 6-inches above warning tape.
8. 2-inches minimum horizontal separation between pipes and wiring in a common trench.
9. Install sleeves at depth to maintain specified depth of pipe or wire routed through sleeve.
- D. Install and maintain safety fencing around all unattended excavation. Place safety signs adjacent to construction area roadway to the satisfaction of the CO/COR.
- E. All excavations must be backfilled by the end of each workday. Do not leave any open trenches overnight, on weekends or on holidays.
- F. If trenching operation restricts access to a burial section, provide plywood and safety fencing across open trench to allow access to burial section. Provide access to the satisfaction of the CO/COR.
- G. Excavated material is generally satisfactory for backfill. Backfill will be free from rubbish, vegetable matter, frozen materials, and stones larger than 2-inches in maximum dimension. Remove material not suitable for backfill. Backfill placed next to pipe will be free of sharp objects that may damage the pipe.
- H. Enclose pipe and wiring beneath roadways, walks, curbs, etc in sleeves. Backfill sleeves in the following manner:
 1. Backfill trench using excavated material in 6-inch layers. Minimum compaction of backfill for sleeves shall be a minimum 95% Standard Proctor Density, ASTM D698-78. Backfill to bottom of road base under roads or to finish grade under walks and curbs.
- I. Backfill mainline pipe, lateral pipe and wiring in turf areas in the following manner:
 1. Backfill the trench by depositing the backfill material equally on both sides of the pipe or wire in 6-inch layers and compacting to the density of surrounding soil.
- J. Enclose pipe and wiring beneath roadways, walks, curbs, etc., in sleeves.
- K. Dress backfilled areas to original grade. Remove excess backfill to on-site location as directed by the CO/COR.
- L. Where utilities conflict with irrigation trenching and pipe work, contact the CO/COR for trench depth adjustments.

3.4 SLEEVING AND BORING

- A. Install sleeving at a depth that permits the encased pipe or wiring to remain at the specified burial depth.
- B. Extend sleeve ends a minimum of 12-inches beyond the edge of the paved surface. Cover pipe ends and mark edge of pavement with a chisel or saw.
- C. Verify that sleeve sizing is adequate prior to installation. Note that sleeves required for pipe with restrained casing spacers are larger than twice the diameter of the pipe.

3.5 ASSEMBLING PIPE AND FITTINGS

A. General:

1. Keep pipe free from dirt and pipe scale. Cut pipe ends square and debur. Clean pipe ends.
2. Keep ends of assembled pipe capped. Remove caps only when necessary to continue assembly.
3. Trenches may be curved to change direction or avoid obstructions within the limits of the curvature of the pipe. Minimum radius of curvature and offset per 20-foot length of mainline and lateral pipe by pipe size are shown in the following table. All curvature results from the bending of the pipe lengths. No deflection will be allowed at a pipe joint.

SIZE	RADIUS	OFFSET PER 20' LENGTH
1 ½"	25'	7'-8"
2"	25'	7'8"
2 ½"	100'	1'-11"
3"	100'	1'-11"
4"	100'	1'-11"
6"	150'	1'-4"

B. Mainline Pipe and Fittings:

1. PVC Rubber-Gasketed Pipe:
 - a. Use pipe lubricant. Join pipe in the manner recommended by manufacturer and in accordance with accepted industry practices.
 - b. Ductile iron fittings will not be struck with a metallic tool. Cushion blows with a wood block or similar shock absorber. Use compatible joint restraint system.
 - c. Install joint restraints at locations and in the manner recommended by manufacturer and in accordance with accepted industry practices.
2. Fittings: The use of cross type fittings is not permitted.

C. Lateral Pipe and Fittings:

1. PVC Solvent Weld Pipe:

- a. Use primer and solvent cement. Join pipe in manner recommended by manufacturer and in accordance with accepted industry practices.
- b. Cure for 30 minutes before handling and 24 hours before pressurizing or installing with vibratory plow.
- c. Snake pipe from side to side within trench.

2. Fittings: The use of cross type fittings is not permitted.

D. Specialized Pipe and Fittings:

1. Mechanical joint connections: Install fittings, fasteners and gaskets in manner recommended by manufacturer and in accordance with accepted industry practices.
2. PVC Threaded Connections:
 - a. Use only factory-formed threads. Field-cut threads are not permitted.
 - b. Apply thread sealant in manner recommended by component, pipe and sealant manufacturers and in accordance with accepted industry practices.
 - c. Use plastic components with male threads and metal components with female threads where connection is plastic-to-metal.

3.6 INSTALLATION OF MAINLINE COMPONENTS

A. Master Valve Assembly:

1. Install new diaphragm, controls and external plumbing to convert existing normally closed valve to normally open per manufacturer's instructions.
2. Verify communication with existing central control system.
3. Perform an operational test that simulates a mainline break. Confirm that the master valve will close properly under high flow conditions based on flow readings from existing flow sensor.

B. Isolation Gate Valve Assembly:

1. As presented in the installation details, per manufacturer's instructions.
2. Install where indicated in the irrigation plans.
3. Brand "GV" in 2-inch high by 3/16-inch deep letters on valve box lid.

C. Air/Vacuum Relief Valve Assembly:

1. As presented in the installation details, per manufacturer's instructions.
2. Install where indicated in the irrigation plans.
3. Brand "AV" in 2-inch high by 3/16-inch deep letters on valve box lid.

D. Quick Coupling Valve Assembly:

1. As presented in the installation details, per manufacturer's instructions.
2. Install where indicated in the irrigation plans.
3. Brand "QC" in 2-inch high by 3/16-inch deep letters on valve box lid.

E. Pressure Regulating Valve Assembly:

1. As presented in the installation details, per manufacturer's instructions.
2. Install where indicated in the irrigation plans.
3. Brand "PRV" in 2-inch high by 3/16-inch deep letters on valve box lid.

F. Flower Watering Station Hydrant Connection Assembly:

1. As presented in the installation details, per manufacturer's instructions.
2. Sequence of construction:
 - a. Coordinate exact location with CO/COR.
 - b. Components up to and including Copper Type 'M' pipe are to be installed before concrete components. After concrete components is finished, complete installation of remaining components. Coordinate installation with concrete contractor.
3. Location:
 - a. Stations will be installed at locations indicated on drawings, centered between adjacent sprinkler locations.
 - b. Route adjacent piping around stations. No mainline or lateral pipe is to be installed under Flower Watering Stations.
 - c. Brand "FW" in 2-inch high by 3/16-inch deep letters on valve box lid.
 - d. Attach "Do Not Drink" sign to hydrant.

3.7 INSTALLATION OF SPRINKLER IRRIGATION COMPONENTS

A. Remote Control Valve Assembly:

1. Mainline Flushing:
 - a. Thoroughly flush mainline before installation of Remote Control Valve Assemblies.
 - b. Identify remote control valve service tee(s) to be used for mainline flushing. Plug service tees not being used for flushing.
 - c. Connect 2-inch pipe to flushing service tee(s). Use pipe to direct water away from trench and into drainage swale, curb section or storm sewer, i.e. to an area that will direct the water away from the work area. Direct water so that it does not disrupt the cemetery operations.
 - d. Use a volume of water such that the velocity in the largest pipe flushing to this point is 3 FPS.
 - e. Multiple points may be flushed simultaneously.
 - f. Flush for a minimum of 20 minutes. Continue flushing until the water is clear of any and all debris.
 - g. CO/COR will review the flushing operation and clarity of water before stopping the flushing operation.
2. Disconnect pipe from service tee(s) and install remote control valve(s).
3. Install per manufacturer's recommendations where indicated on the drawings.

4. Adjust pressure regulating valve to regulate the downstream operating pressure to 70PSI for rotor sprinklers and 35 PSI for spray sprinklers and bubblers.
5. Wire connectors and waterproof sealant will be used to connect control wires to solenoid wires. Install connectors and sealant per the manufacturer's recommendations.
6. Install only one remote control valve to a valve box. Locate valve box 5-feet from and align square with nearby edges of paved areas.
7. Attach ID tag with controller station number to control wiring at solenoid.
8. Brand controller and station number in 2-inch high by 3/16-inch deep letters on valve box lid.

B. Pop-Up Gear-Driven Rotary Sprinkler Assembly:

1. Thoroughly flush lateral pipe before installing sprinkler assembly. Water must be clear of any debris before flushing operation stops.
2. Install per the installation details at locations shown on the drawings.
3. Install sprinklers perpendicular to the finish grade.
4. Install swing joint with the appropriate angle between the lateral pipe and the lay length nipple per the installation details.
5. Supply appropriate nozzle or adjust arc of coverage of each sprinkler for best performance.
6. Adjust the radius of throw of each sprinkler for best performance.
7. Install 2-foot square piece of sod around all rotary sprinklers in areas to be seeded.

C. Pop-Up Spray Sprinkler Assembly:

1. Thoroughly flush lateral pipe before installing sprinkler assembly. Water must be clear of any debris before flushing operation stops.
2. Install per the installation details at locations shown on the drawings.
3. Install sprinklers perpendicular to the finish grade.
4. Install swing joint with the appropriate angle between the lateral pipe and the lay length nipple per the installation details.
5. Supply appropriate nozzle or adjust arc of coverage of each sprinkler for best performance.
6. Adjust the radius of throw of each sprinkler for best performance.

3.8 INSTALLATION OF CONTROL SYSTEM COMPONENTS

A. Satellite Controllers:

1. Install existing satellite controller at new location as shown in the drawings per the construction documents.
2. Connect new irrigation system to existing satellite controllers as shown in the drawings.

3. Install electrical connections per control system manufacturer's recommendations.
Electrical connections are to be completed by control system manufacturer's trained representative.
4. Lightning protection: Drive grounding rod into soil its full length. Connect #6 AWG copper grounding wire to rod and plate using CADWELD connections.
5. Attach wire markers to the ends of control wires inside the controller unit housing. Label wires with the identification number (see drawings) of the remote control valve to which the control wire is connected.
6. Connect control wire to the corresponding control unit terminal.

B. Power Wire:

1. Route power wire as directed on plans. Install with a minimum number of field splices. If a power wire must be spliced, make splice with recommended connector, installed per manufacturer's recommendations. Locate all splices in a separate 12-inch standard valve box. Coil 2 feet of wire in valve box. Brand "WS" in 2-inch high by 3/16-inch deep letters on valve box lid.
2. All power wire shall be laid in trenches. The use of a vibratory plow is not permitted.
3. Green wire shall be used as the common ground wire from power source to all satellites.
4. Carefully backfill around power wire to avoid damage to wire insulation or wire connectors.
5. Unless noted on plans, install wire parallel with and below mainline pipe. Install wire a minimum 2-inches below top of PVC mainline pipe.
6. Encase wire not installed with PVC mainline pipe in electrical conduit with a continuous run of warning tape placed in the backfill, 6-inches above the wiring.
7. Surface mount wire installed above grade in a professional manner with routing approved by the CO/COR.
8. Connect wire to power source.

C. Communication Cable:

1. Route as directed on plans. Install with minimum number of field splices.
2. Install cable using open trenches. Use of vibratory plow is not permitted.
3. Carefully backfill around cable to avoid damage to wire insulation or wire connectors.
4. If cable must be spliced, make splice with recommended connector, installed per manufacturer's recommendations. Locate splices in separate 12-inch standard valve box with black lid. Coil 3-feet of cable in valve box. Brand "WS" in 2-inch high by 3/16-inch deep letters on valve box lid.
5. Install cable parallel with and below mainline pipe unless noted otherwise on plans.
6. Protect wire not installed with PVC mainline pipe with a continuous run of warning tape placed in the backfill 6-inches above the wiring.

D. Control Wire:

1. Bundle control wires where two or more are in the same trench. Bundle with pipe wrapping tape spaced at 10-foot intervals.
2. Control wiring may be chiseled into the soil utilizing a vibratory plow device specifically manufactured for pipe pulling and wire installation. Appropriate chisel must be used so that wire is fed into a chute on the chisel, and wire is not subject to pulling tension. Minimum burial depth must equal minimum cover previously listed.
3. Provide a 24-inch excess length of wire in an 8-inch diameter loop at each 90 degree change of direction, at both ends of sleeves, and at 100-foot intervals along continuous runs of wiring. Do not tie wiring loop. Coil 24-inch length of wire within each remote control valve box.
4. Install common ground wire and one control wire for each remote control valve. Multiple valves on a single control wire are not permitted.
5. If a control wire must be spliced, make splice with wire connectors and waterproof sealant, installed per the manufacturer's instructions. Locate splice in turf areas using a valve box that contains an irrigation valve assembly, or in a separate valve box. Use same procedure for connection to valves as for in-line splices. If a separate valve box is used for wire splices, brand "WS" in 2-inch high by 3/16-inch deep letters on valve box lid.
6. Unless noted on plans, install wire parallel with and below mainline pipe.
7. Protect wire not installed with PVC mainline pipe with a continuous run of warning tape placed in the backfill 6-inches above the wiring.
8. Cap all exposed wire ends with wire nuts.

3.9 BOOSTER PUMP

A. Adjustment and Maintenance:

1. Complete maintenance and service efforts using techniques recommended and approved by the booster pump manufacturer using the manufacturer's authorized service representative.
2. Following completion of service efforts, test booster pump station for proper operation. System must operate per original specifications.
3. Provide written documentation of service efforts completed and test results. Certify that booster pump station meets or exceeds manufacturer's original specifications.

3.10 INSTALLATION OF OTHER COMPONENTS

A. Tools and Spare Parts:

1. Prior to the Review at completion of construction, provide operating keys, servicing tools, spare parts, and any other items indicated on the drawings.

B. Other Materials:

1. Install other materials or equipment shown on the drawings or installation details that are part of the irrigation system, even though such items may not have been referenced in these specifications.

3.11 MAINTENANCE AND OPERATION INSTRUCTIONS

A. Irrigation System Maintenance:

1. Prior to Final Inspection, provide a two-day training session to operating personnel on proper operation and maintenance of the irrigation system including pumping system. Training session should be for a period of not less than 16-hours and cover aspects of maintaining, operating and repairing the new irrigation system components.
2. Unless otherwise noted, provide irrigation operation and maintenance information in a 3-ring binder with table of contents and index sheet. Provide sections that are indexed and labeled. Provide the following information:
 - a. Catalog cut sheets for control system, valves, sprinklers, pipe and fittings, wire and wire connectors, ID tags, shop drawings, and all other irrigation equipment shown or described on the drawings and within these specifications.
 - b. Manufacturer's Operation and Maintenance manuals.
 - c. Manufacturer's Technical Service Bulletins.
 - d. Manufacturer's Warranty Documentation.
 - e. Recommended routine maintenance inspections for weekly, monthly and annual inspections and recommended actions for the inspections and a recommended method for recording the findings of the inspections.
 - f. Predictive schedule for component replacement.
 - g. Listing of technical support contacts.
3. Operation and maintenance submittal package must be complete prior to being reviewed by the CO/COR. Incomplete submittals will be returned without review.

B. Control System Programming:

1. Create and program each controller with a peak season irrigation schedule for the areas being irrigated by the controller.
2. Using the precipitation rate results of the Distribution Uniformity tests calculate the peak season run time for each station.
3. Verify operation of program.
4. Prepare a memorandum documenting the details and assumptions of the programming. Turn over memorandum to CO/COR. Completion of the memorandum is a prerequisite for final inspection and operational testing of the irrigation system.
5. Program must be created by manufacturer's training personnel or an individual with documented experience in programming the control system. Provide documentation of programming experience if requested by the CO/COR.

3.12 COLORED CONTROLLER CHARTS:

- A. Prepare a map diagram showing location of all valves, lateral lines, and route of the control wires. Identify all valves as to size, station, number and type of irrigation. "As-built" drawings must be approved before charts are prepared.
- B. Include legend listing components used for the controller. Include a separate sprinkler table listing station number, sprinkler manufacturer and model, zone capacity, and number of sprinklers on the zone.
- C. Provide one colored full sized controller chart for each irrigation controller showing the area covered by the controller. Provide two 11"x17" reduced colored charts of the actual "as-built" drawing. Chart must be readable at the reduced size.
- D. Laminate one 11"x17" sized colored chart and place laminated chart in lid of controller.

3.13 PROJECT RECORD DRAWINGS

- A. The Contractor is responsible for documenting installed system and all changes to the design. Maintain on-site and separate from documents used for construction, one complete set of contract documents as Project Documents. Keep documents current. Do not permanently cover work until as-built information is recorded.
- B. Record irrigation components, pipe and wiring network alterations. Record work that is installed differently than shown on the construction drawings. Record accurate reference dimensions, measured from at least two permanent reference points, of each irrigation system valve, each controller or control unit, each stub-out for future pipe or wiring connections, and other irrigation components enclosed within a valve box.
- C. Prior to project completion label each sheet of the project drawings (redlines) as "Record Drawing" and turn over to CO/COR for delivery to Engineer. Completion of the Record Drawings is a prerequisite for Final Inspection.

3.14 MAINTENANCE

- A. Operate and maintain irrigation system for a duration of 30 calendar days from Final Inspection. Make periodic examinations and adjustments to irrigation system components so as to achieve the most desirable application of water as needed.

3.15 CLEANUP

- A. Upon completion of work, remove from the site all machinery, tools, excess materials, and rubbish. Restore site to normal or original condition.

--- END ---