

SECTION 32 84 23

UNDERGROUND IRRIGATION SYSTEMS

This section replaces section 32 84 23 in the 2017 edition of the Utah Chapter of American Public Works Association Manual of Standard Specifications (APWA).

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Underground irrigation systems complete with heads, valves, controls, and accessories.
- B. Related sections:
 - 1. Section 32 94 23 Planting

1.02 REFERENCE STANDARDS

- A. NFPA 70: National Electric Code.
- B. ASTM: American Society for Testing and Materials
- C. IA: The Irrigation Association: Main BMP Document, Landscape Irrigation Scheduling and Water Management Document.
- D. ASIC: American Society of Irrigation Consultants: ASIC Grounding Guideline
- E. City Codes/Ordinances relating to Landscape and Irrigation

1.03 DEFINITIONS

- A. Water Supply: Culinary and/or secondary pumping, piping, and components provided and installed by others to provide irrigation water to this project. Includes but is not limited to: storage ponds, pump stations, saddles, nipples, spools, shut-off valves, corporation stop valves, water meters, pressure regulation valves, and piping or components upstream of (or prior to) the Point-of-Connection.
- B. Point-of-Connection: Location where the Contractor shall tie into the water supply for landscape irrigation needs and use. Tie to existing piping.
- C. Main Line Piping: Pressurized piping downstream of the point-of-connection to provide water to remote control valves and quick coupling valves. Normally piping is under constant pressure.
- D. Lateral Line Piping: Circuit piping downstream of the remote-control valves to provide water to sprinkler heads, drip system, or bubblers. Normally piping is under pressure only when control valve is in operation.

1.04 PERFORMANCE REQUIREMENTS

- A. The work to be performed under this Section shall consist of furnishing all labor and materials necessary to construct a complete working and tested underground sprinkler irrigation system per all drawings and specifications, providing one hundred (100) percent head-to-head coverage on all lawn and planting areas on the site without overspray onto hardscape, buildings, or other site features. Included also will be system maintenance and warranties.

- B. The efficiency of the completed irrigation system shall meet the following minimum standards:
 - 1. Circuits using spray sprinklers shall perform at a minimum 60% efficiency.
 - 2. Circuits using rotor sprinklers shall perform at a minimum 70% efficiency.
 - 3. Efficiency shall be determined by an independent water audit performed by a certified irrigation auditor selected by the Owner. The Contractor shall include in his bid price the cost of this audit. The audit shall be conducted after substantial completion and before final acceptance of the irrigation system.
- C. The Contractor shall perform, but not be limited to, all of the following functions: paying all connection fees, deposits, and all other charges related to the connection to the water source; obtain all permits; complete all excavation and backfill; provide backflow device, tapping saddle, yoke, stop and waste, corp. cock, concrete vaults and miscellaneous pipe fittings; make necessary road repairs; provide safety barrier; make connection to water source; install all electric valves, valve control devices, isolation gate valves, quick coupling valves, drain valves, meter base, conduit, junction boxes, controller, backflow prevention devices and enclosures, filters and enclosures, and all necessary wiring. All work shall comply with applicable codes and requirements of the utility companies involved.
- D. If any or all of the above-mentioned fees or charges are not listed on the bidding schedule or on the plan, they shall be included in the bid lump sum price of the irrigation sprinkling system item.
- E. Contractor shall verify with the appropriate water district the location of the water service main line and water pressure and complete all requirements necessary to bring water service to the site. Total cost to be included in the irrigation sprinkling system bid item.
- F. The above specification statement supersedes the graphic representation location of the contract limit line. This pertains to the water line location on either side of the street adjacent to the project site.
- G. All work shall be done in accordance with the drawings and specifications, as well as all applicable water and electrical codes.
- H. The Contractor shall operate, maintain until acceptance, and guarantee the new system as specified herein until all lawn and plants installed on this project have become established and have been accepted by the Owner.

1.05 SUBMITTALS

- A. Product Data: Complete set of manufacturer's technical data and installation instructions for all equipment to be installed on the project. Submittal shall be made prior to commencement of any irrigation work.
- B. Main line and lateral line pressure test results: Submitted at the time of occurrence.
- C. Operation and Maintenance (O&M) Manual:
 - 1. O&M manual shall contain the following information:
 - a. Manufacturer cut sheets and current printed specifications for each element or component of the irrigation system.
 - b. Parts list for each operating element of the system.
 - c. Manufacturer's printed literature on operation and maintenance of operating elements of the system.

- d. Section listing instructions for overall system operation and maintenance. Include directions for spring start-up and winterization.
- 2. Manual shall be submitted at least thirty (30) days prior to final inspection and acceptance of the project.
- D. Complete As-Built Drawings:
 - 1. Drawings shall conform to the following criteria:
 - a. One (1) 22" x 34" and one (1) 11" x 17" drawing shall be submitted.
 - b. All submitted drawings shall be made on Mylar or Tyvek original.
 - c. Show detail and dimension changes made during installation.
 - d. Include field dimension locations of sleeving, points of connection, main line piping, wiring runs not contained in main line pipe trenches, valves and valve boxes, quick coupling valves.
 - e. Dimensions shall be taken from permanent constructed surfaces, features, or finished edges located at or above finished grade.
 - 2. A complete set of as-built drawings shall also be submitted in electronic digital format (.pdf).
 - 3. As-Built drawings shall be submitted prior to final inspection and acceptance.
- E. Controller Map: Each controller shall be equipped with a color-coded copy of the area that the controller services. Include valve zone number, type of plant material irrigated, and zone location on the project. Laminate map with heat shrink clear plastic and mount inside controller.

1.06 **QUALITY ASSURANCE**

- A. Acceptance: Do not install work of this section prior to acceptance of the area by the Owner as being properly prepared to receive said work (i.e. at proper grade, properly compacted, permanent fixtures in place, etc.).
- B. Adequate Water Supply: Contractor shall verify that proper connection is available to supply lines and is of adequate size and volume. Perform static water pressure test prior to commencement of work. Notify Owner of problems encountered prior to proceeding.
- C. Workmanship: It is the intent of this specification that all materials herein specified with the best standards of practice relating to the trade.
- D. The Contractor shall provide to the City a document or resume which includes the following information:
 - 1. The Contractor has been installing sprinkler systems on commercial projects for at least ten (10) previous consecutive years.
 - 2. The Contractor is currently licensed to perform landscape construction in the State of Utah.
 - 3. The Contractor is bondable and insurable for the work to be performed.
 - 4. References of at least five (5) projects of similar size and scope completed within the last five (5) years. Three (3) of the projects listed must be located in the general region of the project site.
 - 5. List of suppliers from whom materials will be obtained for use on this project.

1.07 **PROJECT CONDITIONS**

- A. Any discrepancies between existing site conditions and those indicated on the plans

shall be called to the attention of the Landscape Architect or Owner's Representative prior to continuance of the project.

- B. The Contractor shall use only the equipment and products specified in the construction drawings. No substitution of materials will be allowed on the irrigation system without prior authorization from the Landscape Architect and the Owner's Representative.
- C. During delivery, installation, and storage of materials for the project, all materials shall be protected from contamination, damage, vandalism, and prolonged exposure to sunlight. All material stored at the project site shall be neatly organized in a compact arrangement and storage shall not disrupt the project Owner or other trades on the project site. All material to be installed shall be handled by the Contractor with care to avoid breakage or damage. Materials damaged by the Contractor shall not be used but shall be replaced with new materials at the Contractor's expense.
- D. The Contractor shall familiarize himself and his workmen with all hazards and existing utilities prior to commencing work. This shall require local Blue Staking to be completed before any construction activity can begin.

PART 2 PRODUCTS

2.01 GENERAL

- A. The Contractor shall provide all materials to be used on this project. The Contractor shall not remove any material purchased for this project from the project site, nor mix these project materials with other contractor-owned materials. The Owner retains the right to purchase and provide project materials.
- B. Handling and unloading of all equipment, pipe, and fittings shall be in such a manner as to insure delivery to the job site in a sound, undamaged condition. Any installed equipment or pipe found to be damaged or defective in workmanship or materials shall be rejected and removed and replaced at Contractor's expense.

2.02 PIPE

- A. All PVC pipe used on this project for the irrigation system shall conform to the requirements of ASTM -1685. It shall be free of cracks, holes, foreign material, blisters, inside bubbles, wrinkles, and dents.
- B. All main line pipe, three (3) inches inside diameter and smaller shall be Schedule 40 PVC solvent weld bell end unless otherwise specified.
- C. All main line pipe, four (4) inches inside diameter and larger, shall be PVC Class 200 gasketed bell end (except as required for conversion to metal fittings).
- D. All lateral line pipe shall be Schedule 40 PVC solvent weld.
- E. Maximum flows allowed through main line and lateral line pipe shall be determined by water speed in the pipe. The maximum water speed allowed in both main lines and lateral lines is five (5) feet per second. The resulting maximum gallons per minute (gpm) allowed to flow through PVC pipes are as follows:

<u>PIPE SIZE</u>	<u>GPM</u>
3/4"	8
1"	12
1 1/4"	22

1 ½"	30
2"	50
2 ½"	75
3"	110
4"	190
6"	425

For sizes larger than 6", consult manufacturer's recommendations.

- F. No bends in pipe shall be permitted. The Contractor shall use elbow fittings of ninety (90), forty-five (45), twenty-two and one half (22-1/2), and eleven and one quarter (11-1/4) degrees as individual situations demand.
- G. All pipe used from the main line to the control valves shall be solvent weld Sch. 80 PVC pipe unless otherwise noted or shown on the construction drawings.

2.03 FITTINGS

- A. All PVC fittings used on this project for the irrigation system shall conform to the requirements of ASTM D-2466.
- B. Main Line Fittings:
 - 1. All main line fittings four (4) inches inside diameter and larger shall be either M.J. or deep bell push-on, gasketed, ductile iron.
 - 2. All main line fittings three (3) inches and smaller inside diameter shall be solvent weld Schedule 80 PVC, shall be thrust blocked per details.
 - 3. All main line fittings four (4) inches and larger, whether ductile iron or solvent weld, shall be thrust blocked per details.
 - 4. All main lines three (3) inches and larger having a horizontal change of direction shall have proper concrete thrust blocks installed. Vertical changes in direction shall require the use of M.J or ductile iron fittings with thrust restraining devices (Mega Lug, Harco Knuckle Joint Restraints, or approved equal) in addition to appropriate concrete thrust blocking. The size and type of thrust block depends on pressure, pipe size, type of soil, and type of fitting. As a general rule, one (1) cubic foot minimum of class AA (AE) Type II concrete is required for each thrust block. Follow thrust blocking details for calculating thrust block size.
 - 5. M.J. tees, Schedule 80 tees with SxT Schedule 80 bushings, or Harco ductile iron service tees are approved on PVC main lines for automatic control valve installation. M.J. fittings shall be greased and wrapped.
- C. Lateral Line Fittings:
 - 1. All lateral line fittings shall be solvent weld Schedule 40 PVC.
 - 2. All risers and exposed fittings shall be solvent weld Schedule 80 PVC, including conversions to metal pipe and fixtures, unless otherwise noted on the plans.
- D. PVC Cement: Solvent weld or glued joints shall use the following materials:
 - 1. Primer: IPS Weld-On P-70 Primer (purple), ASTM F-656.
 - 2. Cement: IPS Weld-On 711 Heavy Bodied PVC Cement (gray), ASTM D-2564.

2.04 VALVES

- A. Master Valve: All master valves shall be as specified in the Irrigation Equipment

Schedule. Master valve assembly shall be installed according to detail in drawings.

B. Isolation Gate Valve:

1. Isolation gate valves shall only be used on the main line.
2. Isolation gate valves shall be as specified in the Irrigation Equipment Schedule. Valves shall be hydrostatically pressure tested for 400 P.S.I. and shall be designated for a working pressure of 200 P.S.I. Each valve shall contain a resilient wedge urethane rubber seat. Unless otherwise shown or specified, valves three (3) inches and larger shall have flanged end connections.
3. Buried valves shall have two (2) inch square operating nuts. No handles or wheels will be permitted. Valves inside structures (vaults or valve boxes) may have wheel handles if the valve is two (2) inches or less in size.
4. Action unions shall be installed on each side of all valves except flanged valves.
5. The Contractor shall provide adequate material for the connection of valves to the system, i.e., adapters, flanges, nuts, bolts, gaskets, etc.
6. All buried main line isolation valves with a (2) inch square operating nut shall be fitted with a four (4) inch minimum diameter pipe sleeve placed over the top of the valve vertically and extended to grade. Cover with a ten (10) inch round plastic valve box with bolt down lid and set at finished grade.
7. Contractor shall provide appropriate valve key to operate isolation gate valve.

C. Remote Control Valve Assembly:

1. Remote control valves shall be as specified in the Irrigation Equipment Schedule.
2. Remote control valves shall be globe configuration, electrically activated, normally closed, forward flow design.
3. All pipe on the control valve assembly shall be Schedule 80 PVC pipe. See detailed drawings.
4. Action unions shall be installed on each side of the control valve assembly, allowing valve to be removed from the box for maintenance without cutting pipe.
5. Each control valve shall have a brass gate or ball valve installed immediately upstream of the valve and located within the same valve box.
6. Flows through each remote control valve shall not exceed the following limits:

<u>VALVE SIZE</u>	<u>GPM RANGE</u>
1"	1 - 30
1 ½"	31 - 75
2"	76 - 150

7. Each drip remote control valve assembly shall contain the following components:
 - a. PVC ball valve.
 - b. Inline disc or screen filter with 100 micron/150 mesh filter element.
 - c. Remote control valve capable of operating at very low flow levels.
 - d. Inline pressure regulator.

All components shall be installed according to manufacturer's recommendations, and located within a single valve box, one valve per box (no multi-valve assemblies permitted).

- D. Quick Coupling Valve Assembly:
 - 1. Quick coupling valves shall be as specified in the Irrigation Equipment Schedule.
 - 2. Quick coupling valves shall be heavy duty brass, two-piece, single lug locking cap.
 - 3. The Contractor shall provide to the Owner at least 1 cap lock key and 1 quick coupling key with a swivel hose bib attached. These keys shall be delivered prior to final acceptance of the project.
- E. Manual Drain Valve Assembly:
 - 1. All manual drains shall be three quarter (3/4) inch heavy duty brass ball valve.
 - 2. Manual drain valves shall be required at all low points in the main lines. See plans, notes, and details.
 - 3. The location of each manual drain shall be shown on the "as built" drawing with dimensions from the nearest permanent fixture, such as a building corner, etc.
 - 4. Each manual drain valve will be accessed by a vertical two (2) inch PVC Schedule 40 pipe sleeve, capped by a locking valve cap with a key, enclosed within a ten (10) inch round green valve box with bolt down lid. The top of the drain sleeve shall be three to six (3 - 6) inches below the lid of the valve box.
 - 5. Each manual drain shall empty into a gravel sump, a minimum of twenty-four (24) inches by twenty-four (24) inches by eighteen (18) inches deep, (or six (6) cubic feet total capacity). The gravel shall be washed three quarter (3/4) inch rock.
 - 6. Contractor shall provide appropriate valve key to operate manual drain valve.
- F. Automatic Drain Valves: Automatic drain valves shall not be used.

2.05 VALVE BOXES

- A. All valve boxes shall be HDPE plastic with locking lid or approved equal.
- B. **Valve Boxes and lids shall be TAN or GRAY in color to match the rock mulch.**
- C. Valve box size shall be listed in the installation details for each irrigation system component.

2.06 BACKFLOW PREVENTION ASSEMBLY

- A. Backflow prevention devices shall be a reduced pressure principle backflow preventer consisting of a pressure differential relief valve located between two independently operated spring-loaded "Y" type center guided check valves. Assembly shall also have two full port resilient seated ball valves for shut-off and four resilient seated ball valve test cocks and bronze body construction. Larger sizes (2 1/2" and up) may have two non-rising stem resilient wedge gate valves in lieu of ball valves.
- B. Backflow preventer shall be as specified in the Irrigation Equipment Schedule.

2.07 SWING-LINE PHYSICAL DISCONNECT (NOT REQUIRED)

- A. Where culinary and secondary water may be used interchangeably for irrigation purposes,

a physical disconnect mechanism is required. A swing-line setup is preferred by the City and must meet the following design requirements:

1. Only one water supply source can be used at any given time.
 2. Two (2) supply lines enter a swing-line box, one from secondary water source and one from culinary water source.
 3. Each supply line must have a shut off valve immediately upstream from the swing-line.
 4. One sprinkler feed line exits the swing-line box.
 5. A flexible line is permanently fastened to the sprinkler feed line and a quick disconnecter is attached to the end of each supply line.
 6. The supply line that is not connected to the swing-line must have a secure plug when not in use. Tape is not acceptable.
- B. The swing-line shall be made of reinforced flexible pipe material.
- C. The quick disconnectors shall be plastic camlock style.
- D. The swing-line assembly shall be placed in a large polycrystalline concrete vault. Vault shall be large enough to accommodate clearance around all valves and camlock fittings and swing of hose from one supply to the other.

2.08 FILTER AND ENCLOSURE (NOT REQUIRED ON THIS PROJECT)

- A. Filters and their enclosures shall be required on all systems using secondary water. Systems using reclaimed water (from a wastewater treatment plant) may not require a filter.
- B. Filters shall be as specified in the Irrigation Equipment Schedule. Filters may be either plastic or steel construction, with screen (perforated or weavewire stainless steel) or plastic disc filter elements.
- C. Filter enclosures shall be either commercially or custom fabricated. They shall be constructed of solid sheet marine grade aluminum, with one hundred (100) percent stainless steel hardware and locking mechanism. They shall exhibit vandal- and weather-resistance and offer easy access.
- D. Enclosures shall be mounted on either a pre-manufactured mounting pad with support base or minimum four (4) inch concrete pads. See detail.

2.09 AUTOMATIC CONTROL SYSTEM

- A. Furnish a low voltage automatic control system manufactured expressly for the operation of automatic control valves used in an underground irrigation system.
- B. Automatic controller devices shall be as specified in the Irrigation Equipment Schedule. No substitutions shall be allowed. Unless specified otherwise, install as follows:
1. Install in stainless steel enclosure, model as specified in the Irrigation Equipment Schedule.
 2. Whenever a single site has 2 or more controllers, the 2nd and subsequent controllers shall also be mounted in a separate stainless-steel enclosure as specified in the Irrigation Equipment Schedule.
 3. Metered enclosures, if required, shall be mounted on a 4" thick concrete pad. Regular enclosures may use a pre-manufactured mounting system as specified in the Irrigation Equipment Schedule.

- C. Provide adequate capacity to accommodate each valve on the system separately. Do not double valves to circuits.
- D. The Contractor shall coordinate with the City for the 120-volt electrical service to the controller. Where required, install meter inside meter socket of the enclosure. Coordinate this work with the Owner and other trades involved in the project.
- E. Every controller shall be installed to control a single point of connection (P.O.C.). That point of connection shall be exclusively associated with that controller. Each P.O.C. assembly shall consist of the main line tap, reverse pressure backflow prevention device (if potable water source), filter (if required), master control valve (if specified), flow sensing device (if specified), manual drain valve, and quick coupling valve. No controller shall be wired to control valves which are connected to another P.O.C.

2.10 **CONTROL VALVE WIRE**

- A. All irrigation control wire shall bear approval as U.L. listed type of underground feeder (direct burial) and each conductor shall be of electrical conductivity grade solid copper in accordance with ASTM 30.
- B. No aluminum wire shall be used on this project.
- C. Wire size shall be #14 gauge minimum.
- D. Two spare wires shall be run from each controller to the farthest valve under its control in all directions and any valve which is on a dead-end line.
- E. All wire crossing water, attached to bridges, going under paving, or where conditions require protection, shall be housed in conduit or sleeves. All out-of-ground conduits shall be rigid metal. All buried conduit may be PVC.
- F. All splices shall be water-tight. All connections made inside the box to connect wires to the valve shall be made using a 3M DBR/Y dry-splice connector or pre-approved equal. Each connector shall be completely sealed and water-proofed.
- G. All other splices in control wire shall be housed in a separate valve box.
- H. The pigment or color of the wires shall be integrated into the covering, rather than painted on. All common or ground wires shall be white in color. Where more than one controller is required, a different colored hot wire shall be used for each controller. A separate color shall be used for all spare wires.

2.11 **SPRINKLER HEADS**

- A. General:
 1. All heads used on this project shall be as specified in the Irrigation Equipment Schedule shown on the plans.
 2. All sprinkler heads and nozzles shall be as specified in the Irrigation Equipment Schedule.
- B. Spray/Rotary Sprinklers:
 1. Spray/Rotary sprinklers shall have either four (4), six (6), or twelve (12) inch pop-up height and built-in check valve. In areas where water pressures are high or fluctuating, pressure regulating series sprinklers shall be used.
 2. Spray/Rotary sprinkler nozzles shall be plastic matching precipitation rate nozzles. Variable arc nozzles may be used to meet irregular-shaped areas.
 3. Attachment options shall be as specified in the installation details.

- C. Rotor Sprinklers:
 1. Rotor sprinklers shall be equipped with stainless steel rotor sleeve and check valve.
 2. Rotor sprinkler nozzles shall be as manufactured for each individual model.
 3. Small rotor sprinklers (1/2" bottom inlet) may be installed using swing pipe per installation details. Medium (3/4" bottom inlet) and large (1" or greater bottom inlet) rotor sprinklers shall be installed using swing joints as shown in the installation details. Swing joint size shall match sprinkler inlet size.
- D. Bubblers, Tree Well, and Root Watering Systems: Installed per manufacturer's recommendations. Use only where and when specified.

2.12 DRIP IRRIGATION

- A. Drip irrigation materials shall be as specified in the Irrigation Equipment Schedule.
- B. Emitters shall be of the individual, self-cleaning, pressure-compensating type.
- C. Dripline tubing shall be constructed of high quality linear, low density, UV-resistant, polyethylene resin materials with internal, integral emitters at specified intervals.
- D. All insert barbed fittings shall be constructed of molded, UV-resistant plastic. Each fitting shall have a minimum of two (2) ridges or barbs per outlet. All fittings shall be from the same manufacturer and shall be available in one of the following end configurations:
 1. Barbed insert fittings.
 2. Male pipe threads (MPT) with barbed insert fittings
 3. Female pipe threads (FPT) with barbed insert fittings.
- E. Each drip remote control valve assembly shall contain the following components (in required sequence):
 1. PVC ball valve.
 2. Inline disc or screen filter with 100 micron/150 mesh filter element.
 3. Remote control valve.
 4. Inline pressure regulator.
- F. Provide the following equipment to each drip valve circuit, located and installed per manufacturer's recommendations:
 1. Line flushing valve(s) - minimum of one (1) on each exhaust header, and one (1) on each supply header.
 2. Air/Vacuum relief valve(s) at all high points in the system if required by the manufacturer.

2.13 FLOW SENSING EQUIPMENT (NOT REQUIRED ON THIS PROJECT)

- A. Where specified, each controller shall be installed with its own corresponding flow sensor on a single point of connection to the water source.
- B. The flow sensor shall be compatible with the specified controller.
- C. Size the flow sensor so that it is able to read the high and low flows of the valves used on that particular controller. Install per manufacturer's specifications.

PART 3 EXECUTION

3.01 GENERAL

- A. The irrigation plan is diagrammatic in nature, and some drafting liberties have been taken to maintain the graphic clarity of the drawings. All irrigation equipment shall be located in planting areas only, unless noted otherwise. The Contractor shall install piping to minimize changes in direction, avoid placement under trees or large shrubs, and avoid placement under hardscape features. Refer to the irrigation legend, details, and specifications for equipment and proper installation.
- B. Site Visit: The Contractor shall visit and inspect the project site. He shall take into consideration known and reasonably inferable conditions affecting the proposed work. Failure to visit the site shall not relieve the Contractor of furnishing materials and performing the work required. Any discrepancies between existing site conditions and those indicated on the plans shall be called to the attention of the Owner, by the Contractor, prior to continuance of the project.
- C. The Contractor shall keep the premises clean and free of excess equipment, materials, and rubbish incidental to work of this project. Work areas shall be swept clean and trash and debris picked up daily. Open trenches or hazards shall be protected with yellow caution tape. The Contractor is responsible for removal and legal disposal (off site) of trash and debris generated by his work on this project.
- D. Existing Landscapes:
 - 1. Where existing landscape areas are a part of the project, the Contractor shall repair or replace work damaged by his irrigation system installation at his own expense. If the damaged work is new, the Contractor or the original installer of that work shall perform repairs at the Contractor's expense. The existing irrigation system and landscape shall remain in place, protected, undisturbed, and functional.
 - 2. The Contractor shall protect in place and work around all existing plant materials designated to remain.
 - 3. Coordination of trench and valve locations shall be laid out prior to any excavation work. Plant material deemed by the Landscape Architect or Owner's Representative to be damaged by the Contractor shall be replaced with new plant material at the Contractor's expense. The Contractor shall not cut existing tree roots larger than two (2) inches in diameter. Route pipe, wire, and irrigation components around tree canopy drip lines where possible to minimize damage to tree roots.
 - 4. The Contractor shall leave no part of the existing landscape without water for more than forty-eight (48) hours at a time.
- E. Pre-Construction Meeting: A pre-construction meeting shall be held prior to beginning any work on a project. The Owner and/or Owner's Representative, the project designer, and the Contractor and his Sub Contractors shall all be in attendance.
 - 1. The purpose of this meeting is to review project goals and expectations, the project schedule, and all procedures relative to inspections, permits, and changes that may arise.
 - 2. In the pre-construction meeting, it shall be made clear that the construction documents (plans, details, specifications, and contract) shall be binding upon the

Contractor and upon all of his work. Any work not in accordance with the plans and specifications shall be rejected, and the Contractor shall bring the project into compliance at his own expense.

3.02 CONSTRUCTION STAKING

- A. The Contractor shall provide the necessary staking to obtain the layout shown on the plans. The points of reference shall be as indicated in the drawings and shall include such features as the walks, buildings, curbs, etc. Any changes in the system which appear necessary due to field conditions must be called to the attention of the Owner/Owner's Representative and Landscape Architect and approved by the Owner at the time they are discovered and prior to making any changes.

3.03 EXCAVATION AND BACKFILLING

- A. Excavation:
1. Excavation work shall only be as deep and as wide as will be required to safely perform the work, such as making mainline connections or forming vaults.
 2. Trenches shall be deep and wide enough to provide working space for placing two (2) inches of bedding underneath all new mainline pipe and fittings where the soil is rocky or gravelly. Place twenty (20) to thirty (30) inches of cover over the top of all pipe and fittings on main lines. All trench bottoms shall be sloped so the pipes will gravity-drain back to the main connection point or the nearest manual drain. If the existing main line is deeper than thirty (30) inches, the Contractor shall install a riser to a depth of eighteen (18) to thirty (30) inches and then install the new line at the required depth. At no time will the mainline be installed with less than eighteen (18) inches or greater than thirty (30) inches of cover unless prior approval is given by the Landscape Architect or Owner's Representative.
 3. Trenches shall be deep enough to maintain twelve (12) to fourteen (14) inches of cover over the top of all lateral line pipe and fittings. They shall be deep enough to guarantee that all swing joints drain back to the lateral lines. Trenches shall be a minimum of twelve (12) inches away from any walks and/or curbs, buildings, or other hardscape improvements. They shall be of sufficient width to accommodate tees and other fittings that come out sideways (horizontally) from the lateral lines. Lateral lines may be pulled by a mechanical puller provided all other applicable specifications are met.
 4. Any rocks or other debris over one (1) inch in diameter uncovered during excavation or trenching shall be removed from the area.
 5. If more than one (1) pipeline is required in a single trench, that trench shall be deep and wide enough to allow for at least six (6) inches of horizontal separation (if both are lateral lines), or six (6) inches of both horizontal and vertical separation (if one line is a main line) between pipes.
 6. Any existing utility lines damaged during excavating or trenching shall be reported immediately to the Landscape Architect, the utility Owner, and the project Owner. After proper notification to the Landscape Architect, the utility Owner, and project Owner, repairs to the damaged utility shall be made immediately. Repair materials and methods shall meet industry standards and

the utility Owner's satisfaction. Should utility lines be encountered which are not indicated on the plans, the Owner shall be notified. The repair of any damage shall be done as soon as possible by the Contractor or the utility Owner, and proper compensation to the Contractor shall be negotiated with the Owner. Such utility locations shall subsequently be noted on the "As-Built" drawings required before final payment of the irrigation system contract.

7. Where trenching is done in established lawn, care shall be taken to keep the trenches only as wide as is necessary to accomplish the work. The trenches shall be backfilled as specified and then four (4) inches of approved topsoil placed to bring the trench up to existing grade so that sod can be laid. Only new sod shall be used as trench cover. It shall be established new sod, of standard width, and shall be laid along the trenches so as to match the existing sod. No small pieces of sod shall be used, and only standard lengths shall be accepted. No sod from the construction site shall be used unless otherwise specified. In the event of any backfill settlement prior to the end of the guarantee period, the Contractor shall perform the required repairs at his own expense.

B. Backfilling:

1. No backfilling of trenches shall be done until the system has been inspected and approved by the Landscape Architect or Owner's Representative for proper trench depths, installation of equipment, control wire, and location of heads.
2. Before trenches are backfilled, the Contractor must show the Landscape Architect or Owner's Representative the redlined "As-Built" drawing he has been keeping on the site, indicating that changes and corresponding dimensions have been recorded where such changes have been made.
3. Prior to backfilling, the system shall be tested under pressure for leaks and general operation of the equipment. The main line shall be tested for a period of four (4) hours at a pressure of 120 PSI. Any failures detected during the testing period shall be repaired by the Contractor and the testing shall be repeated. The Landscape Architect shall certify the testing to ensure that it has been completed and that the system has met all testing requirements. All defects discovered by the pressurization and operation test shall be corrected by the Contractor at his own expense before proceeding with further work.
4. Trench bedding and backfill material shall be existing site soil free of rocks larger than one (1) inch in diameter and any other debris. Wasted pipe and other excess project materials or rubbish (tape, wire, trash, wrappers, boxes, bottles, etc.) shall not be backfilled into the trenches. All trenches shall be backfilled, and then watered sufficiently to insure no settling of the surface. In the event of any backfill settlement prior to the end of the guarantee period, the Contractor shall perform all required repairs at his own expense.
5. Backfill under and around the lines to the center line of the pipe shall be placed in maximum layers of six (6) inches and thoroughly compacted. Compaction shall be ninety-five (95) percent relative density (modified proctor) under walks and roads, and eighty-five (85) percent in planting areas.
6. Special care shall be taken to assure complete compaction under the haunches of the pipe. Backfill compaction under the haunches of the pipe shall be compacted to the original density. Compaction requirements above the pipe

shall be the same as for surrounding areas.

3.04 POINT-OF-CONNECTION

- A. The Contractor shall verify the location of the irrigation point-of-connection (P.O.C.) and the static water pressure at that location prior to beginning any irrigation work. Verify water pressure during the time of day that the irrigation system is intended to operate.
- B. If the P.O.C. location or water pressure is different than that expressed by the irrigation designer, or if the pressure appears to be unusually high or low, the Contractor shall notify the Landscape Architect or Owner's Representative immediately prior to beginning any irrigation work.

3.05 ELECTRICAL POWER SUPPLY AND AUTOMATIC CONTROLLER

- A. If 120 volt ac electrical service is not already in place, the Contractor shall be required to make all necessary arrangements with the appropriate power company and provide all necessary materials and labor to provide said power, including but not limited to: paying fees, making power connections, providing poles, weatherhead and meter, etc., as specified on the plans or as required by the power company and the Owner. The automatic controller shall be of the type and manufacturer specified and located as shown on the drawings.

3.06 PIPE AND FITTINGS

- A. Install pipe to allow for expansion and contraction as recommended by pipe manufacturer. Where the main line sits uncovered for any length of time in the trench prior to testing, the main line shall be shaded with a thin covering of backfill soil to minimize weather-related expansion or contraction of the pipe. Do not cover up valves or other installed equipment prior to inspection and acceptance.
- B. The ends of all pipe shall be cut squarely and remain free of all inside scale or burrs. Spigot ends of pipes three (3) inches and larger shall be beveled. Threads shall be cut clean and sharp, and to a length equal to one and one eighth (1-1/8) times the length of the female thread receiving the pipe. The threaded pipe shall be screwed into a full length of the female thread.
- C. All threaded pipe joints shall be properly sealed using Teflon tape that is properly applied to the areas to be joined.
- D. Solvent weld joints shall not be glued unless ambient temperatures are at least forty (40) degrees F. Pipe shall not be glued in rainy conditions unless properly tented. Use only the brand and type of primer and glue specified. Glued main line pipe shall cure a minimum of four (4) hours prior to being energized. Lateral lines shall cure a minimum of two (2) hours prior to being energized and shall not remain under constant pressure unless cured for twenty-four (24) hours.
- E. Every care shall be taken during installation to prevent dirt and debris (especially rocks and pipe shavings) from getting into the pipes.
- F. All tees coming out of main lines for valves and other fixtures shall be vertical and constructed with Sch. 80 PVC pipe.
- G. All tees coming out of the lateral lines for heads and other fixtures shall be horizontal so that no direct weight or pressure may be exerted through the head to

the top or bottom of the lateral line pipe. Tees on lateral lines shall also be SxSxT to the head swing joints.

3.07 **THRUST BLOCKS**

- A. Thrust blocks are needed wherever the main pipeline:
 - 1. Changes any direction at tees, angles, and crosses vertical and horizontal.
 - 2. Changes size at reducers.
 - 3. Stops at a dead-end.
 - 4. Valves at which thrust develops when closed.The size and type of thrust block depends on pressure, pipe size, type of soil, and type of fitting. As a general rule, one cubic foot (minimum) of class AA (AE) Type II concrete (2,000 psi minimum) is required for each thrust block. Follow thrust blocking details for calculating thrust block size.
- B. Thrust blocks shall rest against undisturbed original earth in the direction of thrust.
- C. Where a fitting is used to make a vertical bend, use a three-eighths (3/8) inch bar to anchor the fitting to a thrust block braced against undisturbed soil. The thrust block should have enough resistance to withstand upward and outward thrusts at the fitting.
- D. Where concrete thrust blocking shall come in contact with PVC pipe, wrap the PVC pipe with a layer of plastic to protect the pipe from any caustic effects that may be caused by the concrete mix.
- E. Thrust restraining devices may be used in lieu of thrust blocking, but they must be installed strictly according to manufacturer's recommendations. Use of these devices in lieu of thrust blocking shall be approved by the Owner or Owner's Authorized Representative prior to use.

3.08 **PIPE SLEEVES**

- A. Pipe sleeves shall be required for all piping under all new concrete or other new paving. The size of the sleeve shall be at least twice the size of the pipe or wires to be sleeved. Wires shall be sleeved separately within their own sleeve. All pipe sleeves four (4) inches and smaller in diameter shall be PVC Schedule 40 pipe; sleeves greater than four (4) inches in diameter shall be Class 200 PVC, unless otherwise specified on the drawings.

3.09 **VALVES**

- A. General:
 - 1. Isolation valves, remote control valves, and quick coupling valves shall be installed according to manufacturer's recommendations and these drawings and specifications.
 - 2. Valve boxes shall be set over valves so that all parts of the respective valve assembly can be reached for service. Valve box and lid shall be set to be flush with the proposed finished grade.
 - 3. No valve box shall rest directly upon the valve or any fixture associated with it, including main line and lateral lines. Each valve box shall be centered on the valve assembly it covers. Each valve box shall have four (4) inches of three quarter (3/4) inch gravel placed in the bottom underneath the valve and lines to

reduce the potential of mud and standing water therein.

- B. Remote-Control Valve:
 - 1. Each control valve shall have its own gate or ball valve (as specified), and only one (1) control valve and gate/ball valve per valve box. No valve manifolds shall be allowed.
 - 2. The bottom of the remote-control valve shall be a minimum of four (4) inches above the gravel.
 - 3. All control valves shall be located within shrub areas where possible and installed per the details on the plans. No large grouping of valves (greater than 3) in any one spot shall be allowed, unless approved by the Landscape Architect or Owner's Representative.
 - 4. Control valve assemblies shall be installed no closer to one another than two (2) feet.
 - 5. No control valve shall be installed more than twelve (12) inches below finished grade.
 - 6. Tag each control valve with a permanent and non-smearing label indicating its proper controller and valve number as shown on the irrigation plans.
- C. Quick Coupling Valve:
 - 1. Quick coupling valves shall be installed within a ten (10) inch round green plastic valve box, with the top of the valve box at finished grade.

3.10 **VALVE BOX**

- A. Where indicated in the installation details, valve boxes shall rest on concrete pavers only, thus eliminating any weight or pressure from being exerted on the main line or valve inside the valve box. There shall be a minimum of three (3) inches of clear space between the bottom of the valve box lid and the topmost part of the valve (including solenoid).
- B. Valve box extensions shall be used where necessary to prevent soil around the valve from collapsing into the space inside the valve box.

3.11 **BACKFLOW PREVENTION ASSEMBLY**

- A. The Contractor shall install backflow prevention equipment behind (downstream from) the point-of-connection to the supplying main and lateral lines. Installation shall comply with local, state, and national codes and regulations, and per manufacturer's recommendations (whichever is most restrictive). See plans and details for more information. Install a quick coupling valve just downstream of the backflow prevention assembly for system blowout purposes.
- B. The Contractor shall have the backflow prevention assemblies operation tested within ten (10) days of the time of installation by a certified backflow preventer assembly tester. Testing shall be conducted per state requirements to insure proper and safe operation. Subsequent annual testing at spring start-up shall be the responsibility of the Owner.

3.12 **SWING-LINE PHYSICAL DISCONNECT ASSEMBLY (where allowed)**

- A. Install swing-line disconnect assembly as shown in the City's detail.
- B. Ensure that only one supply line can be operated at any given time.

- C. Unused supply shall be plugged with appropriate camlock plug (not dust cover).
- D. Culinary water supply line must have a reduced pressure backflow prevention device installed upstream from swing-line.
- E. Shut off valves of the type specified in detail must be on each supply line. Shut off valve is not required on irrigation feed line.
- F. City must approve vault prior to installation.

3.13 FILTER & ENCLOSURE

- A. The Contractor shall install the filter and its enclosure just downstream from the point-of-connection and upstream from the backflow prevention assembly (if present).
- B. The filter shall be equipped with a ten (10) foot length of hose that can be attached to the exhaust port of the filter to direct water and debris away from the enclosure during flushing operations. Auto-flush filter models shall be provided with a permanent method of capturing and directing exhaust water away from the filter assembly without creating puddles, ponding, or any other nuisance drainage problems.

3.14 WIRE & CABLES

- A. Multiple wires in the same trenches shall be banded together at ten (10) foot intervals for protection. Where wires pass under paved areas, they shall be installed in Schedule 40 PVC sleeves, separate from lateral or main lines. These sleeves shall be installed prior to installation of the paving, if possible, and prior to installation of the wires. Sleeves for fourteen (14) gauge wires shall be sized as follows:

<u>NUMBER OF WIRES</u>	<u>SLEEVE SIZE</u>
1 - 10	1"
11 - 18	1 1/4"
19 - 25	1 1/2"
26 - 40	2"
41 - 56	2 1/2"
57 - 88	3"
89 - 150	4"

- B. All control wires shall be bundled and taped together every ten (10) feet and installed in the pipe trench directly adjacent to the pipe. Control wires not placed in the trenches adjacent to the pipes shall be placed in PVC electrical conduit and buried eighteen (18) inches or deeper and marked on the "as built" drawings.
- C. Two (2) spare wires shall be run from each controller to the farthest valve under its control in all directions and to any valve which is on a dead-end line. The spare wires shall be a different color from the regular wires and shall be labeled at both ends. Each spare wire shall be brought up to the surface in each valve box it passes through and coiled with twenty-four (24) inches for use in future connections. Each spare wire shall be tested for continuity prior to final acceptance of the project and guaranteed by the Contractor to be functional. Should the maintenance personnel discover a defect within one (1) year afterwards, the Contractor shall locate the problem and cause it to be repaired at his own cost. Install extra wires as needed for moisture sensors (if used).

- D. Run a single 14-gauge wire along the top of the main line to be used for tracking the location of the main line. The color of the tracing wire shall be different than any other wire color used.
- E. All wires shall be installed with twenty-four (24) inches of excess wire (coiled) at the end of each wire run, wire splice, and at each controller.
- F. Isolation valves, quick coupling valves, manual drain valves, and wire splices not specifically associated with the control valve shall be located in separate valve boxes.

3.15 **SPRINKLERS**

A. General:

1. All sprinkler heads shall be installed above grade so as to minimize washing of the topsoil and seed during the landscaping establishment period, except those which border paving or flat work of any kind. These heads shall be installed at the finished grade of the adjacent paving or flat work. Prior to final acceptance of the project, all heads shall be raised or lowered to final lawn or planting grade.
2. All sprinkler heads shall be installed using the bottom inlet. No side outlets shall be used. Tape or plug all open ends while installing to prevent debris contamination.
3. Rotor heads located on hillsides shall be adjusted to the downhill side to avoid cutting into the hill by the stream of water and causing erosion.
4. Heads installed in existing sod shall be set at the grade of the soil.
5. All rotor pop-up heads shall be installed at final grade using Lasco unitized swing joint or Spears swing joint riser assemblies. All swing joints must drain by gravity back to the supply lines.
6. All pop-up, shrub spray/rotary, turf spray/rotary, bubbler and strip spray/rotary heads shall be installed as shown in the details.
7. All pipes, lines, and risers shall be flushed thoroughly with water before installation of any heads. All debris and rocks found at that time shall be removed from the area as soon as possible.
8. All spray sprinklers shall be flushed thoroughly with clean water a second time before installation of nozzles.
9. The Contractor shall adjust all heads to provide a uniform coverage and to keep spray off buildings, walkways, walls, parking areas, and drives.
10. Check valves shall be used where indicated and where necessary to prevent water flow from lower elevation heads when system is turned off. Install per manufacturer's recommendations.

B. Drip Irrigation

1. Point Source Drip System
 - a. Place two (2) drip emitters on opposing sides of each shrub, perennial, and ornamental grass. Place three (3) drip emitters equally spaced around trees. Emitters shall be staked near the edge of the newly planted root ball and inside the watering well.
2. Inline Drip System
 - a. Inline drip tubing shall be spaced approximately equal to the inline emitter

spacing. Inline drip tubing spacing may be adjusted to be slightly less than the emitter spacing in order to achieve uniform spacing. For slope applications, place drip tubing laterals parallel to the slope contour. When slopes exceed thirty (30) percent, increase the recommended lateral spacing by twenty-five (25) percent on the lower one third (1/3) of the slope.

3. Inline dripper tubing shall be installed at finished grade with soil staples and covered with three (3) inches of specified mulch. Supply and exhaust headers shall be installed at normal lateral line depths.
4. All drip tubing shall be held in place by soil staples and shall conform to the following:
 - a. Sandy Soil - One staple per every three (3) feet and two (2) staples on each change of direction (tee, elbow, or cross)
 - b. Loam Soil - One staple every four (4) feet and two (2) staples on each change of direction (tee, elbow, or cross)
 - c. Clay Soil - One staple every five (5) feet and two (2) staples on each change of direction (tee, elbow, or cross)
5. Installation of inline drip circuits shall generally conform to the following steps:
 - a. Assemble and install ball valve, filter, remote control valve and pressure regulating valve assembly in accordance with installation details.
 - b. Assemble and install supply header(s) in accordance with installation details. Tape or plug all open connections to prevent debris contamination.
 - c. Install lateral drip lines in accordance with details and relevant specifications and manufacturer's recommendations. Tape or plug all open ends while installing to prevent debris contamination.
 - d. Assemble and install exhaust header(s) in accordance with installation details. Tape or plug all open connections to prevent debris contamination.
 - e. Install air/vacuum relief valve(s) at the zone's highest point(s) in accordance with installation details.
 - f. Thoroughly flush supply header(s) and connect drip lateral lines while flushing.
 - g. Thoroughly flush drip lateral lines and connect to exhaust header(s) and any interconnecting lateral lines while flushing.
 - h. Thoroughly flush exhaust header(s) and install line flushing valves in accordance with details.

3.16 AS-BUILT DOCUMENTS

- A. The Contractor shall keep a current and accurate record of exact dimensioned locations, grades, elevations, and size of all exterior and interior underground piping, valves, and drains. Dimensions shall indicate distances from columns, buildings, curbs, and similar permanent features on the site. This information shall be recorded on a print as the work progresses but shall be permanently recorded on a reproducible PDF or CAD file, which shall be given to the Owner before the project is accepted.
- B. Final payment for the contract will not be processed until "As-Built" drawings or plans are received by the Owner.

3.17 OPERATIONAL TEST AND MAJOR INSPECTIONS

A. Substantial Completion:

1. At substantial completion of the irrigation system, the Contractor shall call for an operational and coverage test. Substantial completion shall be defined as the complete installation of all irrigation equipment and completion of all backfilling and grading operations in their entirety. Substantial completion shall not be given for designated portions of the project.
2. Notice by the Contractor shall be given, in writing, at least three (3) days in advance to the Owner so that proper scheduling can be made for those who are to attend.
3. At the appointed time, an inspection of all irrigation equipment, including control valve assemblies, controllers, isolation valves, quick coupling valves, drain valves, and sprinklers shall be made. The entire system will be tested for operation, coverage, and head adjustment. Please note that the pressure testing of the main lines shall already have been completed prior to this time.
4. A list of uncompleted items or repairs (punch list) shall be generated by the Owner and distributed to the Contractor and other involved parties within three (3) days of the operational testing. Each item on the punch list shall be corrected before the system will be approved and accepted by the Owner. The Contractor will be back charged for time spent by the Owner and any consultants who have been brought to the site for a final inspection when the project is not ready for said inspection.

B. Maintenance/Establishment Period:

1. The duration of the irrigation maintenance period shall be equal to the plant maintenance/establishment period. It shall begin one (1) day after the substantial completion inspection. The Contractor shall complete all punch list items during the maintenance period, as well as maintain and operate the entire irrigation system.
2. The irrigation Contractor (if different than the landscaping Contractor) shall coordinate with the landscaping Contractor during the entire plant and lawn establishment period on the use, scheduling, and maintenance of the sprinkler system.
3. The maintenance period shall not end until Final Acceptance of the project.

C. Final Acceptance:

1. A second inspection shall be held at the end of the maintenance period to ensure that all punch list items have been completed and the entire system is ready for acceptance by the Owner.
2. Upon satisfaction that the Contractor has completed all punch list items, the irrigation system is fully and completely functional, and the required As-Built drawings and maintenance manuals have been submitted, the Owner shall accept the project.
3. An official letter of final acceptance shall be prepared and issued by the Owner to the Contractor and Landscape Architect. Upon acceptance of the system by the Owner, the Owner shall assume full responsibility for the system, and the guarantee period shall begin.

3.18 **GUARANTEE AND MAINTENANCE**

A. Guarantee:

1. Upon final acceptance of the irrigation system as being operational and properly installed, the Contractor shall guarantee the workmanship, materials, fixtures, and equipment to be free from defects for a period of one (1) year after that date.
2. The Contractor shall insure and guarantee complete drainage of the system. In working with or connecting to an existing system, the Contractor shall guarantee compatibility in operation and drainage between the two systems.

B. Maintenance Required During Guarantee Period:

1. In the fall of the year during the installation and guarantee period, the CONTRACTOR shall meet with the Owner's maintenance personnel on the site. The Contractor shall winterize the system by draining all of the water and doing everything necessary to insure protection of the system until spring. Blowing out the lines by compressor shall be permitted during the one (1) year guarantee. Maximum compressor pressure shall be 30 psi on spray circuits, 50 psi on rotor circuits, and 20 psi on all drip circuits. The individuals involved from both parties shall exchange all information necessary for the eventual take-over of the system by the Owner.
2. The Contractor, with the Owner's maintenance personnel and Owner in attendance, shall energize the sprinkler irrigation system again the following spring and shall repair all defects found as a result of winter damage, improper installation, improper maintenance, defective materials or inadequate sprinkler drainage.
3. At the end of the guarantee period, when the lawn and landscaping have been accepted, the Contractor shall call for a final inspection of the sprinkler irrigation system. There shall be at least five (5) days prior notice given in writing to the Owner so the appropriate people have opportunity to attend.
4. Prior to that time, the Owner shall adjust all heads to their proper pattern, radii, and height. The system shall have been flushed out, checked for operation, and any defects covered by the guarantee shall be repaired. The entire system shall be inspected and checked to determine if everything is in working order. A final list of warranty items found in need of correction (if any) shall be made and the Contractor shall correct them. The Contractor shall notify the Owner when he has verified that every item is corrected.
5. After all warranty items have been corrected, the Owner shall, in writing, officially release the Contractor from all warranty claims pertaining to the irrigation system and assume full and complete responsibility for said system.

END OF SECTION

SECTION 32 91 19

LANDSCAPE GRADING

This specification replaces in its entirety Section 32 91 19 - Landscape Grading currently found in the Utah Chapter APWA Manual of Standard Specifications - 2017 Edition.

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Final grade topsoil for finish landscaping.
- B. Related Sections:
 - 1. Section 31 05 05 - Earthwork.
 - 2. Section 32 94 23 - Planting.

1.2 SUBMITTALS

- A. Submit maximum laboratory dry density and optimum laboratory moisture content for:
 - 1. Subgrade material
 - 2. Each type of fill material to be used.

1.3 QUALITY ASSURANCE

- A. Do not change material sources or aggregate without Engineer's knowledge.
- B. Reject backfill material that does not comply with requirements specified in this section.
- C. Landscape grading is aesthetic by nature and subject to continual monitoring and modification during the backfilling process. Work closely with the Engineer, particularly when grading and constructing berms, channels, or other aesthetic considerations.

1.4 STORAGE

- A. Safely stockpile backfill materials.
- B. Separate differing materials, prevent mixing, and maintain optimum moisture content of back fill materials.
- C. Avoid displacement of and injury to Work while compacting or operating equipment.
- D. Movement of construction machinery over Work at any stage of construction is solely at the Contractor's own risk.

1.5 SITE CONDITIONS

- A. Do not place, spread, or roll any backfill material over material that is damaged by water. Remove and replace damaged material at no additional cost to the Owner.
- B. Control traffic and erosion. Keep area free of trash and debris. Repair settled, eroded, and rutted areas.
- C. Reshape and compact damaged structural section to required density.

1.6 WARRANTY

- A. Any settlement noted in the landscaped surfaces will be considered to be caused by improper compaction methods and shall be corrected at no cost to the Owner.
- B. Restore incidentals damaged by settlement at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 TOPSOIL

- A. All planting areas shall receive either a minimum of four (4) inches of stockpiled or imported topsoil in turf areas and twelve (12) inches in planting beds.
- B. All topsoil used on this project (stockpiled or import) shall meet the following criteria:
 - 1. pH:..... 5.5 - 8.0
 - 2. EC (electrical conductivity):..... <2.0 mmhos per centimeter
 - 3. SAR (sodium absorption ratio):..... <3.0
 - 4. % OM (percent organic matter):..... ≥2%
 - 5. Texture (particle size per USDA classification):
 - a. Sand: <70%
 - b. Clay: <30%
 - c. Silt: Balance
 - 6. Stone Fragments (gravels or any soil particle greater than two (2) mm in size): <5% (by volume)
 - 7. Rocks Present > 1.5" None
- C. In addition, the topsoil shall be fertile, friable, natural loam and shall be capable of sustaining vigorous plant growth. It shall be free of stones, lumps, clods of hard earth, plants or their roots, sticks, and other extraneous matter. The topsoil shall contain neither noxious weeds nor their seeds. It shall not be used for planting operations while in a frozen or muddy condition.

2.2 BACKFILL MATERIALS

- A. Earthwork, Section 31 05 05.

2.3 ACCESSORIES

- A. Water. Make arrangements for sources of water during construction and plan for delivery of water to the site. Comply with local Laws and Regulations at no additional cost to the Owner when securing water from water utility company.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify trench backfilling has been inspected.

3.2 PREPARATION

- A. Identify required line, levels, contours, and datum.
- B. Stake and flag locations of underground utilities.
- C. Upon discovery of unknown utility or concealed conditions, notify the Engineer.

- D. Verify stockpiled fill meets gradation requirements, areas to be backfilled are free of debris, snow, ice or water, and ground surface is not frozen.
- E. If subgrade is not readily compactable, secure written authorization for extra excavation and backfill. Refer to Section 31 23 16.

3.3 SUBSTRATE PREPARATION

- A. Eliminate uneven areas and low spots.
- B. Remove debris, roots, branches, and large stones. Remove contaminated subsoil.

3.4 PROTECTION

- A. Protect existing trees, shrubs, lawns, existing structures, fences, roads, sidewalks, paving, curb and gutter, and other features.
- B. Protect above or below grade utilities. Contact utility companies to repair damaged top utilities. Pay all costs of repairs.
- C. Protect subgrade from desiccation, flooding, and freezing.
- D. Do not fill adjacent to structures until excavation is checked by the Engineer.
- E. Do not use compaction equipment adjacent to walls or retaining walls that may cause wall to become over-stressed or moved from alignment.
- F. Do not disturb or damage foundation perimeter drainage, foundation, damp-proofing, foundation waterproofing and protective cover, or utilities in trenches.
- G. Restore any damaged structures to its original strength and condition.
- H. Prohibit construction traffic over topsoil.

3.5 LAYOUT

- A. Maintain all benchmarks, control monuments and stakes, whether newly established by surveyor or previously existing. Protect from damage and dislocation.
- B. If discrepancy is found between Contract Documents and the site, the Engineer shall make such minor adjustments in the Work as necessary to accomplish the intent of the Contract Documents without increasing the cost of the Work to the Contractor or the Owner.

3.6. GRADING

- A. Grading Intent: Spot elevations and contours indicated are based on the best available data. The intent is to maintain constant slopes between spot elevations. If a spot elevation is determined to be in error, or the difference in elevation between points change, then the minimum percentage of slope as a result of field adjustment of specific spot elevations is as follows:
 - 1. Pavement Areas:..... 1 percent.
 - 2. Concrete or Brick Areas:..... 0.30 percent
 - 3. Lawn or Planted Areas:..... 0.75 percent.
- B. Conduct the Work in an orderly manner. Do not create a nuisance. Do not permit soil accumulation on streets or sidewalks. Do not allow soil to be washed into sewers and/or storm drains.

- C. Grade slopes to provide adequate drainage after compaction. Do not create water pockets or ridges. Use all means necessary to prevent erosion of freshly graded areas during construction until surfaces have been constructed and landscaping areas have taken hold.
- D. Remove surface stones greater than 1 inch from finished grading.
- E. In planting areas, provide a finished grade that conforms to Section 32 94 23 Planting.

3.7 PLACING TOPSOIL

- A. Place topsoil in areas where seeding is required to nominal depth of 4 inches. Place topsoil during dry weather.
- B. Fine grade topsoil to eliminate rough or low areas. Maintain profiles and contour of subgrade.
- C. Remove roots, weeds, rocks, and foreign material while spreading.
- D. Manually spread topsoil close to trees and buildings to prevent damage.
- E. Lightly compact placed topsoil.
- F. Remove surplus subsoil and topsoil from site.

3.8 TOLERANCES

- A. Top of Topsoil: $\pm 1/2$ inch.

3.9 SCHEDULE

- A. Compacted topsoil thickness: 4 inches under turf areas, 12 inches in planter bed areas (unless specifically otherwise stated).

3.10 SURFACE RESTROATION

- A. Restore paved surfaces, Section 33 05 05.
- B. Finished landscaped surfaces with grass, or with other groundcover shall comply with the following:
 - 1. Backfill areas to contours and elevations indicated. Do not use frozen materials.
 - 2. Make smooth changes in grade. Blend slopes into level areas.
 - 3. Remove surplus backfill materials from site and dispose of legally.
 - 4. Leave stockpile areas completely free of excess fill materials.
 - 5. Slope grade away from buildings at a minimum of 3 inches in 10 feet unless specified otherwise.

3.11 CLEANING

- A. Remove stockpiles from the site. Grade site surface to prevent free standing surface water.
- B. Leave borrow areas clean and neat.

END OF SECTION 32 91 19

SECTION 32 94 23

PLANTING

This section replaces section 32 92 00, 32 93 13, 32 93 43 and 32 98 00 in the 2017 edition of the Utah Chapter of American Public Works Association Manual of Standard Specifications (APWA).

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Trees, shrubs, perennials, vines, and groundcover requirements.
 - 2. Bedding, topsoil, and temporary support.
- B. The work to be performed under this section shall consist of furnishing all materials, labor, and plants necessary for the proper planting of all trees, shrubs, perennials, vines, and groundcovers of the kind and sizes specified at the prescribed locations, and otherwise in accordance with the drawings and specifications or as directed by the Landscape Architect or Owner's Representative or Owner's Representative.
- C. Related sections:
 - 1. Section 32 84 23 Underground Irrigation Systems

1.02 REFERENCES

- A. AAN: American Associations of Nurserymen, Inc.
- B. ANSI Z60.1-2004: American Standard for Nursery Stock.
- C. FS O-F-241: Fertilizers, Mixed Commercial.
- D. ICN: International Code of Nomenclature for algae, fungi, and plants.
- E. City Standards/Ordinances relating to irrigation and planting.

1.03 QUALITY ASSURANCE

- A. Perform work in conformity with applicable requirements of AAN.
- B. Upon receiving Notice to Proceed, the Contractor shall provide written proof that the specified plant material is available and has been secured or reserved specifically for this project. Obtain nursery stock and other plant materials from reliable and stable sources prior to order and delivery.
- C. Provide plants that are declared free of disease and insect pests.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Exercise care in digging, transporting, handling, and packing of all plants.
- B. Handle plants so roots are protected at all times. If delivery is in open vehicles, cover entire load without causing over heating.
- C. Deliver plant material immediately prior to placement. Keep plant material moist.
- D. Protect root balls from sun and wind by covering with soil or other suitable material if not planted immediately on delivery.
- E. Store fertilizer in a weatherproof location such that its effectiveness will not be impaired.

1.05 ACCEPTANCE

- A. Plants shall not be accepted if the ball of earth surrounding roots (rootball) has been cracked or broken.
- B. Plants shall be accepted if burlap, staves, and ropes required in connection with transplanting are installed and still intact upon delivery.
- C. Heeled in stock from cold storage shall not be accepted.

1.06 SAMPLES

- A. Samples of the topsoil, bark mulch, fertilizer, and tree ties listed below shall be submitted to the Landscape Architect or Owner's Representative for inspection and approval prior to the beginning of work under this contract.

- B. Delivery of materials may begin only after samples have been approved. All materials furnished for the work shall conform in every respect to the approved samples. Any non-conforming materials will be rejected.

PART 2 PRODUCTS

2.01 GENERAL

- A. The planting plan is diagrammatic, and all plant locations are approximate. Plant symbols take precedence over plant quantities shown on the plans and in the plant material schedule. The Contractor shall verify all plant quantities and notify the Landscape Architect or Owner's Representative of any discrepancies between the quantities and the symbols shown.
- B. Provide plants of normal growth and uniform height, according to species, with straight canes and well developed leaders, roots, and tops.
- C. Provide plants of sizes indicated. The size stated in each case shall be interpreted to mean dimensions of plant as it stands in its mature position in the nursery without straightening of any branches or leaders.
- D. Provide legible labels attached to all plants, specimens, bundles, boxes, bales, or other containers indicating botanical genus, species, and size of each.
- E. Plants cut back from larger sizes to meet specifications shall be rejected.
- F. Balled and burlapped deciduous shrubs may be acceptable in lieu of container growth deciduous shrubs only if there is a demonstrated significant shortage of container grown stock.

2.02 PLANTS

- A. All plants shall comply with federal and state laws requiring inspection for plant disease and infestations.
- B. Any inspection certificates required by law shall accompany each delivery of plants and such certificate shall be given to the Landscape Architect or Owner's Representative. All plants shall be subject to inspection and approval at the place of growth or upon delivery to the site for their quality, size, species, and variety. Such approval shall not impair the right of inspection and rejection at the site or during progress of work for size and condition of the plants, latent defects, or injuries. Any and all rejected plants shall be removed immediately from the premises by the Contractor. The Contractor shall make all replacements at his expense should he fail to comply in full with any of the specifications. Necessary replacements will be made as soon as weather conditions permit, and all such plants replaced shall conform to all specifications herein.
- C. Names and Grades:
 - 1. Plant names shall conform to the nomenclature of "Standardized Plant Names," "International Code of Nomenclature for algae, fungi, and plants (ICN)," or "International Code of Nomenclature for Cultivated Plants (ICNCP), 9th edition." When a name is not found in any of these references, consult the accepted name used in the nursery trade. All plants shall be tagged by the nursery with the proper identification labels to insure the correct varieties of plants.
 - 2. Size and grading standards shall conform to those of the American Association of Nurserymen, Inc., as published in "American Standard for Nursery Stock", 2014 Edition, with all current revisions unless otherwise specified.
 - 3. The caliper of trees shall be measured six (6) inches above the surface of the ground.
 - 4. Measurements on all trees and shrubs shall be taken with the branches in a normal position. Height and spread dimensions specified refer to the main body of the plant and not from branch or root tip to tip. No trees which have had their leaders cut, or are so damaged that cutting is necessary, will be accepted.
- D. No substitution of size, grade, variety or any species shall be permitted except by written permission of the Landscape Architect or Owner's Representative.

- E. Plant Size:
 - 1. All plants shall conform to the size, age, and condition as specified in the plant list shown on the drawings. Undersized plant material shall not be approved.
 - 2. No additional compensation shall be due the Contractor if larger than specified plant material is provided.
 - 3. Only balled and burlapped or container stock shall be accepted. No bare root stock shall be accepted.
 - 4. Plants cut back from larger sizes to meet specifications shall be rejected.
- F. Plant List:
 - 1. Plants lists indicate minimum size requirements only. Plant materials shall be equal to or greater in size than those specified.
 - 2. Any discrepancies between plant lists and plans shall be immediately brought to the attention of the Landscape Architect or Owner's Representative.
 - 3. In all cases the Contractor shall be held responsible for all plant materials indicated on the plans unless otherwise directed in writing by the Landscape Architect or Owner's Representative.
 - 4. Each bidder shall investigate sources of supply and satisfy himself that he can supply all of the plants mentioned in the planting lists in size, variety, and quantity noted and specified before submitted his bid. Failure to take this precaution will not relieve the successful bidder from his responsibility as Contractor to furnish and install all plant material in strict accordance with the contract requirements without additional expense to the owner.
 - 5. If a shortage of the specified plant material truly exists and can be verified by the Contractor, the Contractor shall notify the Landscape Architect immediately and discuss what varieties and sizes are available as a suitable substitution. Last minute substitutions are not acceptable.
- G. All plants shall be fresh and vigorous, of normal habit and growth, and free of disease, insects and insect eggs and insect larvae, weeds and weed seed. No heeled-in plants from cold storage shall be accepted except on approval by the Landscape Architect or Owner's Representative prior to installation.

2.03 SEED

- A. All seed shall be accurately labeled and tested for purity and germination, using the procedure sanctioned by the Association of Official Seed Analysts.
- B. The seed tag shall indicate the date of testing, along with the testing results showing purity (percentage of the labeled species by weight), the percentages of other crop, weed, inert material, dormant or hard seed, and also the percentage of seed that will germinate.
- C. Seed labels or tags shall list the following:
 - 1. Manufacturer's name and address.
 - 2. Date and location of packaging.
 - 3. Name of the species of seed or seeds being sold.
 - 4. Variety of seed or seeds being sold.
 - 5. Percent purity of the seed. (Purity is defined as the percent weight of the entire sample of each seed species or variety that is present in excess of 5% of the total.)
 - 6. Percent other seed crop. (Other seed crop is defined as the percent weight of the entire sample of seed found in the sample that are less than 5% of the total seed weight and are generally recognized by the Association of Official Seed Analysts as seeds or plants grown as crops. If more than one crop species or cultivar is found in the sample, their weights are combined and reported.)
 - 7. Percent weed seed. (Weed seeds are all other seed species that the Association of Official Seed Analysts does not classify as crop seeds.)
 - 8. Percent inert matter. (Inert matter is defined as the percent weight of the sample that is not viable seed. It can include plant parts, broken seeds or other materials that are not viable seeds.)
 - 9. Percent germination.

10. Percent hard and/or dormant seed. (Hard seed is the percent of the number of seeds that remain hard at the end of the testing period because they have not absorbed water because of an impermeable seed coat. Dormant seed is defined as the percent of the number of seeds, other than hard seed, that fail to germinate, but are determined to be viable by subjecting them to other seed testing techniques. Both of these seed types are generally considered to be seed that will germinate at a later date than seed reported in the percent germination calculation.)
11. Percent Total Viability.
12. Noxious weed seeds of the continental USA found in the seed mix.
13. Last date the seed was tested for germination.
14. Bulk pound quantity of seed contained in the bag.
15. Pure Live Seed (PLS) pound quantity contained in the bag.

2.04 SOD (NOT USED ON THIS PROJECT)

- A. Sod shall be obtained only from approved sources. The sod shall have been mowed regularly and carefully maintained from planting to harvest.
- B. The sod shall be free of grassy and broad-leaf weeds, contain no bare or burned spots, and be clean and strongly rooted. It shall be of the varieties noted on the plans and notes.
- C. The sod shall be cut using approved methods and equipment. It shall be cut in pieces not exceeding one (1) square yard, with a minimum of three quarter (3/4) inch and maximum one and one half (1 ½) inch thickness. All sod for a particular contiguous area must have the same thickness.
- D. For very large turf areas and all athletic fields, large roles of sod shall be used. All sod roles shall be of uniform and consistent thickness within the range described above.

2.05 TREE STAKES & TIES

- A. Tree stakes shall be two by two (2x2) inch square or two (2) inch diameter round wood stakes ten (10) feet in length as indicated on the plans. Steel stakes may not be used.
- B. Tree stake ties shall be manufactured of virgin flexible vinyl meeting ASTM-D-412 standards for tensile and elongation strength. The material shall be black in color for ultraviolet resistance. Hose and wire shall not be used.

2.06 TOPSOIL

- A. All planting areas shall receive either a minimum of four (4) inches of stockpiled or imported topsoil in turf areas and twelve (12) inches in planting beds.
- B. All topsoil used on this project (stockpiled or import) shall meet the following criteria:
 1. pH:..... 5.5 - 8.0
 2. EC (electrical conductivity):..... <2.0 mmhos per centimeter
 3. SAR (sodium absorption ratio):..... <3.0
 4. % OM (percent organic matter):..... ≥2%
 5. Nitrogen (NO₃N)..... 48 ppm min.
 6. Phosphorous (P) 11 ppm min.
 7. Potash (K) 130 ppm min.
 8. Iron (Fe) 5.0 ppm min.
 9. Texture (particle size per USDA classification):
 - a. Sand: <70%
 - b. Clay: <30%
 - c. Silt: Balance
 10. Stone Fragments (gravels or any soil particle greater than two (2) mm in size): <5% (by volume)
 11. Rocks Present > 1.5" None
- C. In addition, the topsoil shall be fertile, friable, natural loam and shall be capable of sustaining vigorous plant growth. It shall be free of stones, lumps, clods of hard earth, plants or their roots, sticks, and other extraneous matter. The topsoil shall contain neither noxious weeds nor their seeds. It shall not be used for planting operations while

in a frozen or muddy condition.

2.07 WEED BARRIER FABRIC

- A. If specified, a weed barrier fabric shall be placed in all planting beds to prevent the growth and spread of unwanted vegetation. The fabric shall be Typar #3301B or approved equal.

2.08 MULCH

- A. Mulch shall be used as a top dressing for all planting beds unless specified otherwise. See plant material schedule for mulch types to be used.
- B. Shredded bark mulch shall conform to the following criteria:
 - 1. Bark pieces shall not exceed two (2) inches when passed through a screen of that size.
 - 2. Large chunks of bark or wood shall not be mixed in with the mulch.
 - 3. The bark mulch shall be primarily from coniferous trees.
- C. Where used, mulch shall be placed to a depth of three (3) inches on top of the topsoil.
- D. Other mulches may be used only as specified on the drawings or in the planting notes and details.

2.09 FERTILIZER

- A. Commercial fertilizer shall be uniform in composition, dry, and free-flowing. Deliver fertilizer mixed as specified in bulk or bag, showing weight analysis, formula, and manufacturer's name.
- B. A 16-16-16 balanced fertilizer shall be used. Any exceptions to this formula shall be based on horticultural recommendations resulting from a site-specific soil test and must be approved prior to application by the Landscape Architect or Owner's Representative.

2.10 MOWSTRIP (NOT USED ON THIS PROJECT)

- A. Where turf areas are separated from planting beds, a concrete mowstrip shall be used. No other edging materials may be used unless specifically noted on the plans and approved by the Landscape Architect or Owner's Representative.
- B. The mowstrip shall be constructed using concrete having a compressive strength rating of two thousand five hundred pounds per square inch (2,500 psi) or greater, and a maximum slump of four (4) inches.
- C. A three eighth (3/8) inch diameter rebar (#3) shall be used to provide support and help prevent differential settling of the mowstrip after cracking.
- D. Include a concrete mowstrip at the base of all fences. Said mowstrip shall be six (6) inches deep and eighteen (18) inches wide, with the fence posts located in the center of the mowstrip.

2.11 METAL EDGING

- A. Where specified on the plans, metal edging shall be of the product or material specified on the plans (or approved equal).

PART 3 EXECUTION

3.01 GENERAL

- A. Site Visit: The Contractor shall visit and inspect the site and take into consideration known and reasonably inferable conditions affecting work. Failure to visit the site will not relieve the Contractor of furnishing materials and performing the work required.
- B. Prior to any planting operations, the irrigation system shall be fully operational and all planting areas shall be thoroughly moistened.
- C. Where weeds or other undesirable vegetation are present in planting areas, the Contractor shall apply a contact herbicide a minimum of ten (10) days prior to commencement of any planting or irrigation work. Apply herbicide per manufacturer's

recommendations. The poisoned vegetation shall be allowed to completely die back, including the roots, before proceeding with the work. Dead vegetation shall then be removed from the site and disposed of in a legal manner.

- D. The Contractor shall conform to the following requirements with regard to existing vegetation:
1. The Contractor shall be fully responsible for any damage to existing trees or shrubs. He shall use all reasonable means to protect and preserve plants on the project not designated for demolition.
 2. No pruning, thinning, or cutting of existing vegetation shall be allowed unless written permission is given by the Landscape Architect or Owner's Representative.
 3. The Contractor shall replace any trees or existing shrubs damaged by him or his sub-contractors with like kind and size.

3.02 PLANTING SEASONS

- A. All new plant installation shall be completed between April 15 and October 15. If planting must be done after October 15 or before April 15, the Contractor shall obtain specific approval to do so from the Landscape Architect or Owner's Representative prior to beginning any planting operations.
- B. No planting shall be done in frozen soil or during unfavorable weather conditions, subject to the approval of the Landscape Architect or Owner's Representative.

3.03 TOPSOIL

- A. The Contractor shall obtain a soil analysis from any authorized soil testing agency of any existing stockpiled or imported topsoil to be used on the project to verify that it conforms to the topsoil specifications. Test results shall include horticultural recommendations. The soil samples shall be obtained per the testing agency directions. Allow ten (10) working days to obtain test results. The costs for such testing shall be the responsibility of the Contractor.
- B. Prior to delivery of the imported topsoil to the site, the Contractor shall provide to the Landscape Architect or Owner's Representative the name and location of the topsoil source, along with the certified soil analysis of the topsoil to be used. The analysis shall verify that the proposed topsoil meets the topsoil specifications and is capable of supporting healthy plant growth.
- C. After imported topsoil has been delivered to the site, a second soil test may be required to verify that it is indeed the same soil as previously tested and designated for use in this project. No substitution of topsoil shall be allowed without prior written authorization from the Landscape Architect.
- D. The following procedure shall be followed in placing all topsoil:
1. All cut areas to receive topsoil which have a slope of less than ten (10) percent shall be cross-rippled to a depth of two (2) to four (4) inches.
 2. The subgrade material shall be rough graded to plus or minus one tenth (± 0.1) foot of the final rough grade, which will allow the Contractor to achieve final finished grade through the placement of the topsoil.
 3. The surface of the subgrade shall be scarified to a depth of two (2) inches to provide a transition zone between the subgrade and the topsoil. Place the topsoil on the subgrade and fine grade to the final finished grade and topsoil depths as indicated on the drawings and in these specifications.
 4. Any required soil amendments (i.e. mulch, organic matter, etc.) shall be placed directly on the topsoil at the required rates and spread evenly over the planting area. The amendments shall then be thoroughly blended into the topsoil to a depth of four (4) inches. Where only a dry, granular fertilizer is to be added, it may be applied to the surface and raked in during the fine grading procedures.
- E. The Contractor shall maintain a minimum of two (2) percent drainage away from all buildings, structures, and walls. Finished grades shall be smoothed to eliminate puddling or standing water.
- F. All finished grades shall be approved in writing by the Owner prior to installation of any

plant materials.

3.04 PLANT CONDITION

- A. All precautions customary in commercial landscape installation practice shall be taken in preparing plants for planting. Workmanship that fails to meet these minimum standards shall be rejected. All balled and burlapped plants shall have firm and natural balls of earth around their roots. No plant shall be planted if the rootball is cracked or broken, either before or during the process of planting. Loose, broken or manufactured root balls shall be rejected.
- B. All plants materials in five (5) gallon containers or larger shall have been established in that container for a period of not less than six (6) months and not more than two (2) years. Plant material shall not be root bound. They shall exhibit sound, healthy, and vigorous growth and be free from diseases and pests.
- C. The Contractor shall have the Landscape Architect or Owner's Representative approve plant material size and quality prior to installation. Any plants which are not true to form, appear stressed or unhealthy, are infested with pests, infected with disease, or are undersized for their containers shall be rejected.
- D. All plant material shall be planted as soon upon arrival on the premises as possible. If planting cannot be done immediately, the roots shall be protected from the sun and kept in a moist condition until the time of planting. Such protection may be provided by laying the plants on the north side of the building and covering the roots with wet straw.
- E. If it is anticipated that planting will not be done for more than twenty-four (24) hours after the arrival of plants upon the premises, the balled and burlapped stock shall be heeled-in on the north side of a building and all roots completely covered with dirt which shall be wetted down frequently. Care will be taken in the handling of all ball and burlap materials so that the earth around the roots is disturbed as little as possible.

3.05 PLACEMENT OF PLANTS

- A. Plants shall be generally located as indicated by the drawing. The Contractor shall stake out the location of all plants and planting areas with identified plant stakes, and no excavation shall commence until such locations have been approved by the Landscape Architect or Owner's Representative or Owner's Representative.
- B. In the event that underground construction work or obstructions are encountered during excavation of the plant holes, alternate locations will be assigned and approved by the Landscape Architect or Owner's Representative or Owner's Representative.
- C. Except for turf and groundcovers, plants shall not be placed within twenty-four (24) inches of sprinkler heads.
- D. The Contractor must locate and stake any sprinkling head or valve box within the dripline of a proposed or existing tree location and must establish the direction of the lateral or main irrigation line that serves the staked sprinkler head or valve box. This procedure will help eliminate damage to existing or future tree roots.

3.06 PLANT INSTALLATION

- A. All concrete work, sprinkling systems, and finished grading shall be completed and approved by the Landscape Architect or Owner's Representative before any planting of the specified plant materials is begun.
- B. No tree planting shall be initiated until sprinkling system is complete and tested. However, tree planting shall precede lawn planting.
- C. Each plant will be placed in an individual plant pit. The sharing of pits shall not be allowed.
- D. All trees and shrubs shall be planted in pits as detailed in the planting details contained herein or as noted on the drawings. Tree and shrub pits shall be circular in outline, with a diameter at least two (2) times the diameter of the rootball of each plant to be installed. They shall be one to two and one half (1 - 2 ½) inches shallower than the rootball depth. When the plant is properly placed in the plant pit, the root collar shall be approximately one (1) inch above finished grade of the topsoil. For perennial plants (which have no root

- collar), the top of the rootball shall be even with the finished grade or the topsoil. The sides of the plant pit shall be roughened, and not smooth or sculpted.
- E. Plant backfill mix shall be as indicated on the plans.
 - F. For container grown plants, remove the container and place the plant vertically in the plant pit, directly on undisturbed soil. The root crown or collar shall be at or just above the finished grade. Perennial and ornamental grass plants shall be planted with the root collar at finished grade.
 - G. For balled and burlapped plants, place the plant vertically in the center of the pit, with the rootball resting on undisturbed soil. Cut and remove the wire basket and burlap or other wrapping material from the rootball. This may be done with the rootball in the pit. Any burlap or wire pieces underneath the rootball may be left in place if they cannot be removed. Do not fold the burlap over but cut away as much as possible without disturbing the rootball. No burlap shall be pulled from under the rootball. Backfill the bottom one third (1/3) of the pit as the wire and burlap are removed. In all cases, maintain the integrity of the rootball.
 - H. Specified backfill material shall be carefully and firmly worked and tamped under and around the rootball to fill all voids. When backfilled and compacted to two thirds (2/3) the depth of the pit, thoroughly water with a hose to completely soak the roots and remove any air pockets.
 - I. The plant pit shall then be completely backfilled with the specified backfill mix and tamped well. A shallow watering basin or rain cup shall be formed around each plant. This basin will be equal in diameter to that of the original planting pit.
 - J. Monitor all plants to ensure that no settling occurs. Pits which settle shall be immediately filled with additional soil mixture at no additional expense to the Owner.
 - K. After planting, the following operations shall be performed:
 - 1. Stake and mulch all trees per installation details.
 - 2. Remove all nursery stakes ties, and tags from all plants. Prune and remove any dead, damaged, or broken branches. Maintain side growth on all trees.

3.07 STAKING

- A. All trees, including evergreen trees, shall be staked.
- B. Staking shall be performed as follows:
 - 1. Two (2) 2"x 2" square or 2" diameter round wood stakes, ten (10) feet in length, shall be used to support each tree planted under this contract unless otherwise indicated.
 - 2. Tree ties shall conform to the staking detail shown on the planting detail sheet.
 - 3. Each stake will be located adjacent to the rootball, on opposing sides, to provide maximum support to the trunk. Do not penetrate the rootball with the stake.
 - 4. The stakes will be driven into the pit bottom after the tree has been placed in the pit, but before backfilling begins so as to avoid damage to the roots.
- C. Stakes and ties shall be removed after one (1) full growing season from the time the tree was installed.

3.08 WATERING

- A. All plants shall be thoroughly watered immediately after planting. This shall mean full and thorough saturation of all backfill in the pits and beds during the same day of planting. Water shall be applied only by open end hose at very low pressure to avoid creating air pockets, causing injury to the plant, or washing away of backfill. When installed, watered, and fully settled, the plants shall be vertical with the root collar at the appropriate level.
- B. Subsequent watering shall be provided by the site's irrigation system. The Contractor shall insure that all plants, especially trees, receive sufficient water to maintain healthy growth and vigor. Overwatering shall be avoided, and prolonged saturation of the soil around the trees shall be eliminated by appropriately controlling the irrigation circuit which provides water to that area.

3.09 WEED BARRIER FABRIC (if specified)

- A. Prepare final grade prior to placing fabric. Placement of fabric shall comply with the following:
 - 1. Place pre-emergent herbicide prior to installing fabric.
 - 2. Install fabric directly on topsoil. With drip tubing, install tubing on top of fabric.
 - 3. Overlap and secure per manufacturer's recommendations.
 - 4. Cut an "X" where plant will be located. Peel back corners to allow plant installation. Fold corners back in to place after plant is installed.

3.10 MULCHING

- A. Shredded bark mulch shall be placed to a depth of three (3) inches on top of the topsoil in all planting beds and over tree planting pits.
- B. The finished grade of the bark mulch shall be as follows:
 - 1. Two (2) inches below the surface or finished grade of any paving, mowstrips, or walks adjacent to the planting area.
 - 2. At adjacent finished grade of the turf surrounding tree planting pits.
- C. In tree pits, the bark shall be kept six (6) inches away from the base of the tree.
- D. Just prior to placement of the mulch, the Contractor shall treat the mulched areas with a pre-emergent herbicide according to the manufacturer's recommendations.

3.11 MOWSTRIP

- A. Form the concrete mowstrip using typical concrete forming methods. Ensure concrete depth as specified in the plans and details. Concrete forms shall be uniform in width and follow the curves and tangents as shown in the plans. Locate border line edging with string or other means to assure border straightness and curves as designed.
- B. Finish concrete with a medium broom finish and tool the edges for a neat, rounded edge to prevent chipping and spalling.
- C. Place the rebar continuously in the center of the mowstrip. Overlap joints a minimum of twelve (12) inches.

3.12 METAL EDGING

- A. Pre-manufactured metal edging:
 - 1. Preparation: Ensure all underground utility lines are located and will not interfere with the proposed edging installation before beginning work. Locate border line edging with string or other means to assure border straightness and curves as designed. Dig trench one inch (1") deeper than the set of edging bottom.
 - 2. Set edging into trench with top at the correct height above the topsoil with the mulch depths calculated into the total depth. When placed metal edging should be one-half inch ($\frac{1}{2}$ ") above the finished grade of the surrounding material. Drive stakes through edging loops until locked into place (or other means dictated by manufacturer). Place stakes at spacing specified by manufacturer. Ensure stakes are installed with freeze thaw cycles in mind and place stakes into compacted (not loose) soil.
 - 3. Where edging sections turn at corners follow manufacturer's recommendations for bending, cutting, or ordering preformed corners as provided by manufacturer.
 - 4. Backfilling and Cleanup: Backfill both sides of edging, confirm and adjust if necessary that sections are securely held together, and compact backfill material along edging to provide top of edging at one-half inch ($\frac{1}{2}$ ") above finished grade. Cleanup and remove excess material from the site.
- B. Custom weld metal edging (NOT USED ON THIS PROJECT):
 - 1. Preparation: Ensure all underground utility lines are located and will not interfere with the proposed edging installation before beginning work. Locate border line edging with string or other means to assure border straightness and curves as designed. Dig trench one inch (1") deeper than the set of edging bottom.
 - 2. Set metal edging into trench with the top at the correct height above the topsoil with the mulch depths calculated into the total depth. When placed metal edging should be one-half inch ($\frac{1}{2}$ ") above the finished grade of the surrounding material. Weld

edging using butt joint welding methods. Weld and stake each joint. Stakes shall be welded to the edging using seam weld methods. Additional stakes shall be placed at every change in direction, every joint, and a minimum of every six feet (6') O.C.

3. Grind and paint all welds to prevent rust and corrosion over time.
4. All edging should be installed plumb to the finished grade such that the angle between the edging and ground plane form ninety-degree angles (90°).
5. Backfilling and Cleanup: Backfill both sides of edging, confirm and adjust if necessary that sections are securely welded together and at the correct elevation and angle, and compact backfill material along edging to provide top of edging at one-half inch (1/2") above finished grade. Cleanup and remove excess material from the site.

3.13 SOD INSTALLATION (NOT USED ON THIS PROJECT)

- A. The Contractor shall notify the Landscape Architect or Owner's Representative of the source of the sod prior to placement.
- B. The sod shall be free of grassy and broad-leaf weeds, contain no bare or burned spots, and be clean and strongly rooted. It shall be of the varieties noted on the plans and plant materials schedule.
- C. The sod shall be cut using approved methods and equipment. It shall be cut in pieces not exceeding one (1) square yard, with a uniform thickness on all pieces. Sod thickness may vary between a minimum of one (1) inch and maximum one and one half (1 1/2) inches but must be consistent throughout this project. For very large turf areas and all athletic fields, large rolls of sod shall be used. Sod shall be placed using equipment specifically designed to lay large sod rolls.
- D. The Contractor shall notify the Landscape Architect of the source of the sod prior to placement. The sod shall be stripped and delivered to the site not more than twenty-four (24) hours prior to laying. The sod shall be maintained in a moist and healthy condition to encourage immediate growth.
- E. The following procedure shall be followed when installing the sod:
 1. Lay the sod on smooth, moist topsoil, working off planks if required.
 2. Rake the topsoil to loosen and level prior to placing each course of sod.
 3. Lay strips perpendicular to the direction of the slope. Strips shall be parallel to each other, with their end seams staggered. The sod shall be neither stretched nor overlapped, and all joints shall be butted tightly together.
 4. Roll the sod immediately after placing and thoroughly water with a fine spray to a depth sufficient that the underside of the new sod and the soil immediately below the sod are thoroughly wet.
 5. On slopes two (2) horizontal to one (1) vertical or steeper, lay the sod perpendicular to the slope and secure every row with wooden pegs at two (2) feet maximum on center. Drive the pegs flush with the soil portion of the sod.
 6. Sod pieces shall be laid tightly together. Sod areas with gaps caused by pieces not being laid tightly enough together or with ridges from overlapping pieces shall not be accepted and the Contractor will be required to re-lay the sod.

3.14 HYDROSEEDING (if used)

- A. General:
 1. Wood fiber mulch shall be virgin wood fiber, free of growth- or germination-inhibiting substances. The mulch shall be air dried with not more than fifteen (15) percent moisture by weight. The total organic weight shall be a minimum of ninety-eight (98) percent. Inorganic ash content shall be 0.7±0.2 percent. Water holding capacity shall be 1000G/100G (oven dried weight). The pH range shall be 4.0 - 6.0. The fiber length shall meet the following:
 - a. Fifty (50) percent shall be at least 0.15 inches in length or longer.
 - b. Fifty (50) percent shall be retained on the twenty-eight (28) mesh screen. It shall be Echofiber or Conwed or approved equal.
 2. The seed mix shall be as specified on the plans. Provide written certification that

the seed conforms to Utah seed law and is in compliance with Utah State Department of Agriculture regulations.

3. The tackifier shall be M-Binder or Plantego or equal.
 4. The fertilizer shall be a chemically prepared, dry, homogenous pellet product with a balanced formula of 16-16-16.
 5. Application rates shall be as follows:
 - a. Wood fiber mulch..... 50 pounds (min.)/1,000 SF
 - b. Seed mix..... See plans (7 pounds/1,000 SF typ.)
 - c. Tackifier 100 pounds/Acre
 - d. Fertilizer 1 pound or actual nitrogen/1,000 SF
 - e. Water 92 gallons/1,000 SF
- B. One-step preparation and application of hydroseed mulch shall be as follows:
1. The wood fiber mulch, seed, tackifier, fertilizer, and water shall be mixed together in a hydroseeding machine having a capacity of at least two thousand (2,000) gallons to allow for a homogeneous slurry which is thoroughly mixed and can be applied easily without clogging. The machine shall be mounted on a traveling unit which is either self-propelled or drawn by a separate unit. Equipment used in the hydroseeding process shall be thoroughly cleaned of all seed and other materials used in any previous hydroseeding process, prior to hydroseeding on this project.
 2. The equipment shall have a built in agitation system and operating capacity sufficient to agitate, suspend, and homogeneously mix a slurry containing not less than fifty (50) pounds of organic mulching amendment plus chemical additives and solids for each one hundred (100) gallons of water.
 3. The slurry shall be prepared at the site and its components shall be mixed to supply the rates of application as specified. The slurry preparation shall begin by adding water to the tank when the engine is at one half ($\frac{1}{2}$) throttle. The engine throttle shall be open to full speed when the tank is one half ($\frac{1}{2}$) filled with water. All organic amendments, fiber, and chemicals shall then be added by the time the tank is two thirds ($\frac{2}{3}$) to three fourths ($\frac{3}{4}$) full. At this time and not before, the seed mix shall also be added. Spraying shall commence immediately when the tank is full, and the slurry is mixed.
 4. Apply the hydroseed to form even appearing cover over the required areas. The slurry shall be applied in a downward drilling motion via a fan stream nozzle. It is important to ensure that all of the components enter and mix with the soil. Use only qualified and trained personnel to insure uniformity of the hydroseed applications.
 5. The hydroseeding slurry components shall not be left in the hydroseed machine for more than two (2) hours in order to avoid seed deterioration.
- C. A two-step hydroseeding procedure may be used in lieu of the one-step method. The two-step procedure shall consist of first sowing the seed mix by broadcasting, and second, applying the hydromulch. Specifically, this procedure shall conform to the following:
1. The seed shall be broadcast over the planting bed at the rates noted in the plant schedule. The seed shall be sown in two (2) perpendicular directions with a cyclone seeder or other similar mechanical seeder. Lightly rake the seed into the soil.
 2. Apply a fine spray watering immediately after each area has been sown.
 3. Prepare and apply hydromulch slurry (minus the seed mix) according to the procedure outlined in 3.12 B, steps 1 through 5 above.

3.15 DRILL SEEDING

If seeding operations are to be done using a drill seeding method, the following requirements shall apply:

- A. All topsoil shall be placed, and the fine grading completed prior to any seeding operations.
- B. The seed bed shall be prepared by loosening the surface of the soil and mixing the

specified fertilizer into the top two (2) inches of the topsoil. The finished surface shall be smooth and even, with no high or low spots, no rocks, nor other deleterious materials. The use of a Rotodairon or similar piece of equipment to prepare the seed bed is encouraged.

- C. The seed shall be drilled using a Brillion type seeder, specifically designed for drilling grass seed. An agricultural grain drill is not acceptable. A cultipacker, harrow, or similar apparatus shall be a part of the seeder or dragged behind to help ensure that the seed is covered by the soil and the surface is left smooth and even.

3.16 CLEAN UP

- A. Throughout the course of planting, excess and waste materials as well as excavated subsoil shall be continuously and promptly removed. All areas shall be kept clear and all reasonable precautions taken to avoid damage to existing structures, plants, and grass.
- B. When planting has been completed in an area, it shall be thoroughly cleaned of all debris, rubbish, subsoil, and waste materials. These shall be removed from the property and disposed of legally. All planting tools shall also be put away.
- C. The ground surface shall be left in a condition satisfactory to the Landscape Architect or Owner's Representative.

3.17 AS-BUILT DOCUMENTS

- A. The Contractor shall keep a record of all departures from the working drawings that occur during construction. These changes shall be shown on a clean set of prints, and the prints kept on the job site at all times for review.
- B. As a part of his observation work, the Landscape Architect or Owner's Representative shall review the as-built drawings regularly to verify that changes are being recorded. At the conclusion of the work, the Contractor shall present to the Owner fresh, clean drawings of all the changes made and recorded previously and they shall become part of the permanent record of the project.

3.18 MAINTENANCE

- A. Substantial Completion:
 - 1. At Substantial Completion of all planting work outlined in these plans, the Contractor shall contact the City to arrange for a walk through to verify that all aspects of the work have been completed. Work must be fully completed (except for final clean-up) according to all plans, notes, and specifications and exhibit professional workmanship. Substantial completion shall be defined as the complete installation of all plant materials, staking, mulching, and other work on the project in its entirety. Substantial completion shall not be given on designated portions of the project.
 - 2. Notice by the Contractor shall be given, in writing, at least three (3) days in advance to the Landscape Architect or Owner's Representative so that proper scheduling can be made for those who are to attend.
 - 3. At the appointed time, an inspection of all plant materials, including staking and mulching, shall be made.
 - 4. A list of uncompleted items (punch list) shall be generated by the Landscape Architect or Owner's Representative and distributed to the Contractor and other involved parties within three (3) days of the substantial completion inspection. Each item on the punch list shall be corrected before the project will be approved and accepted by the Landscape Architect or Owner's Representative. The Contractor will be back charged for time spent by the Owner and any consultants who have been brought to the site for a final inspection when the project is not ready for said inspection.
- B. Maintenance/Establishment Period:
 - 1. The maintenance/establishment period shall begin one (1) day after the substantial completion inspection. The Contractor shall complete all punch list items during this period, as well as maintain and operate the entire irrigation system.

2. In cases where the maintenance/establishment period runs beyond October 15 of any given year, the balance of the maintenance/establishment period days shall be extended into the spring of the following year. Counting of the balance of days shall begin no sooner than April 15, unless mutually agreed upon by both the Contractor and the City prior to that date. Early counting shall be based on weather conditions at the time.
3. The Contractor shall maintain all plantings until the turf is fully established. The turf shall be considered fully established when grass stands come in uniform and thick, with no bare or thin spots, and roots have begun to spread and knit together. No weeds shall be allowed in the grass. If the turf grass is hydroseeded, the Contractor must complete the hydroseeding by September 1. The maintenance/establishment period shall be a minimum period of sixty (60) days.
4. The maintenance work required shall include but not be limited to the following:
 - a. Appropriate watering of all plant materials.
 - b. Weeding and removal of all weeds from groundcover and planting areas.
 - c. Replacement of any dead, dying, or damaged trees, shrubs, perennials, or groundcover.
 - d. Filling and replanting of any low areas which may cause standing water.
 - e. Adjusting or sprinkler head heights and watering patterns.
 - f. Filling and recompaction of eroded areas, along with any required reseeding and/or replanting.
 - g. The grass shall be mowed when the blades reach three (3) inches tall and maintained to a minimum height of two (2) inches. No more than one third (1/3) of the blade shall be removed per cutting. The cutting frequency shall be once every five (5) to seven (7) days depending upon grass height and growth rate.
 - h. Weekly removal of all trash, litter, clippings, and all foreign debris.
 - i. At thirty (30) days after planting, a balanced fertilizer (16-16-16) shall be applied to the grass areas at a rate of one half (½) pound of nitrogen per one thousand (1,000) square feet.
 - j. At intervals of thirty (30) days after the first application of fertilizer to the grass, apply a balanced fertilizer (16-16-16) at a rate of one half (½) pound of nitrogen per one thousand (1,000) square feet until the grass is established.
5. The maintenance period shall not end until Final Acceptance of the project.
 - C. Final Acceptance:
 1. A final inspection shall be held prior to the end of the maintenance period to ensure that all punch list items have been completed and the entire project is ready for acceptance by the Owner.
 2. Upon satisfaction that the Contractor has completed all punch list items, the irrigation system is fully and completely functional, and the required As-Built drawings, mylars and maintenance manuals have been submitted, the Owner shall accept the project.
 3. An official letter of final acceptance shall be prepared and issued by the Owner to the Contractor, designer, and the Landscape Architect. Upon final acceptance of the project by the Landscape Architect or Owner's Representative, the Owner shall assume full responsibility for the project, and the guarantee period shall begin.

3.19 GUARANTEE

- A. Upon final acceptance of the project as being properly installed, the Contractor shall guarantee the plant materials as follows:
 1. All shrubs and groundcovers shall be guaranteed by the Contractor as to growth and health for a period of sixty (60) days after completion of the maintenance period and final acceptance.
 2. All trees shall be guaranteed by the contractor to thrive and grow in an acceptable upright position for a period of one (1) year after completion of the maintenance period and final acceptance.

- B. The Contractor shall, within fifteen (15) days after receiving written notification by the Landscape Architect or Owner's Representative, remove and replace all guaranteed plant materials which die or become unhealthy or appear to be in a badly impaired condition at any time during the guarantee period. Any plants that settle below or rise above the desired finished grade shall also be reset to the proper grade.
- C. All replacements shall be plants of the same kind, size, and quality as originally specified in the "plant list" and they shall be furnished, planted, staked, and maintained as specified herein at no additional cost.
- D. The Contractor will not be responsible for plants destroyed or lost due to occupancy of the project, vandalism on the part of others, or improper maintenance or lack thereof.
- E. At the conclusion of the guarantee period and prior to final inspection of the plant materials by the Landscape Architect or Owner's Representative, the Contractor shall remove all tree stakes. This period of time shall be approximately 1 year after initial planting.
 - 1. Stakes shall be removed by first cutting the ties securing the tree to stakes and secondly pulling stakes or guys out of the ground.
 - 2. Stakes shall not be broken off above, at, or below ground levels but removed completely.
- F. At the conclusion of the guarantee period a final inspection of all planting included in this contract shall be made by the Landscape Architect or Owner's Representative. At that time any plant found to be unhealthy, broken, damaged, or otherwise in an impaired condition shall be noted. Plants so noted shall be removed immediately from the site by the Contractor and replaced by him, as specified under this section, with plants of like kind and size in the manner previously specified for the original planting without extra compensation.

END OF SECTION