

Project: Installation of Irrigation System & Landscape Improvements

Location: 7142 Makahuena Place, Honolulu, HI 96825

SECTION 02810 – IRRIGATION SYSTEM

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Materials, equipment and services required to install the complete landscape irrigation system as indicated on Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 02900 – PLANTING (Pg 22)

1.03 REFERENCES

- A. ASTM A 126 - Standard Specification for Gray Iron Castings For valves, Flanges and Fittings
- B. ASTM A 536 - Standard Specification for Ductile Iron Castings
- C. ASTM B 32 - Standard Specification for Solder Metal
- D. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings
- E. ASTM B88 - Standard Specification for Seamless Copper Water Tube
- F. ASTM B 302 - Standard Specification for Threadless Copper Pipe, Standard Sizes
- G. ASTM B 828 - Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings
- H. ASTM D 1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
- I. ASTM D 1785 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
- J. ASTM D 2464 - Standard Specification for Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
- K. ASTM D 2466 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
- L. ASTM D 2564 - Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems
- M. ASTM D 3350 – Standard Specification for Polyethylene Plastic Pipe and Fittings Materials
- N. ASTM F 477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
- O. ASTM F 714 - Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter

- P. NEMA 250 - Enclosures For Electrical Equipment
- Q. Water System Standards – Department of Water, County of Kauai; Board of Water Supply, City and County of Honolulu; Department of Water Supply, County of Maui; Department of Water Supply, County of Hawaii; Volume 1 [26].

1.04 QUALITY ASSURANCE

- A. In accord with Section 01440 – QUALITY ASSURANCE AND QUALITY CONTROL.
- B. Workman Qualifications:
 - 1. Contractor with no less than five (5) years of experience installing irrigation systems, similar to the scope and complexity of this project, with documented completion of at least (5) successful installations of commercial, computer-controlled irrigation systems.
 - 2. On-site field superintendent shall have no less than 5 yrs. of continuous experience in the installation of commercial computer-controlled irrigation systems. Supervisor shall remain on site during all specified work in progress.
- C. Tests and Inspections:
 - 1. Do not conceal any work until all required tests and inspections have been completed.
 - 2. Conduct the following tests, inspections and conference with Owner. Provide advanced notification of each according to the times indicated:
 - a. Pre-installation conference: 10 days.
 - b. System layout: 10 days.
 - c. Hydrostatic testing of pressure main line and non-pressure lateral lines installed under paving: 10 days.
 - d. Coverage tests: 10 days.
 - e. Final inspection: 10 days.
 - 3. During final inspection, provide two-way radios and sufficient personnel to provide constant communication between inspection areas and the controller.
 - 4. Hydrostatic tests:
 - a. Furnish force pump and all equipment required to perform hydrostatic testing.
 - b. Center load backfill over pipes, leaving all joints exposed until the installation has been inspected, tested, and accepted by Owner.
 - c. Except for ball valves installed upstream of control valves, all testing shall be completed prior to the installation of all other valves and valve assemblies.
 - d. Perform hydrostatic tests in presence of Owner. Maintain 150 psi pressure in the lines for a period of not less than 30 minutes with pressure not dropping more than 5 psi. If leaks develop, remake joints and repeat tests until the entire system has proven watertight and is accepted by the Owner.

5. Coverage test:
 - a. Upon completion of the sprinkler system and prior to planting of shrubs, ground cover or turf, perform a coverage test in presence of Owner to determine that irrigation coverage for all planting areas is complete and adequate.
 - b. Furnish materials and perform work required to correct any inadequacies of coverage. Re-schedule and perform additional coverage test with Owner for acceptance.
 6. Final Inspection:
 - a. Upon completion of the entire system, schedule and conduct a final inspection of all equipment and perform a coverage test of each valve station with the Project Manager as part of the Final Approval process.
 - b. During final inspection, provide two-way radio communication and sufficient personnel to provide constant communication between inspection areas and the controller.
 - D. Final Acceptance:
 1. Prior to final approval of work, all of the following requirements shall be met:
 - a. Landscape irrigation system completed and accepted by Owner.
 - b. Coverage tests completed and accepted by Owner.
 - c. Punch list items completed and accepted by Owner.
 - d. As-built drawings completed and accepted by Owner.
 2. Maintain irrigation system and sufficient watering schedule until all conditions of acceptance have been completed.
 3. Contracted irrigation maintenance period shall begin upon Owner's Final Acceptance.
- 1.05 PROJECT CONDITIONS
- A. Coordinate work with underground utilities and trades responsible for other underground improvements including the location and planting of specimen trees, and other planting as applicable. Verify locations with Owner of all planting requiring excavations 48 inch in dia. and larger prior to layout of main lines.
 - B. Provide temporary irrigation at all times to properly maintain existing planting where required.
 - C. Existing Irrigation Systems:
 1. The existing automatic irrigation system shall be maintained in uninterrupted operation for the duration of the work.
 2. All existing irrigation valves and irrigation systems adjacent to the work shall be protected in-place and maintained in operation. Any required disconnection or interruption in existing irrigation shall be coordinated with the Owner in advance of work.
 3. Water for construction site may be supplied by existing irrigation lines that are flow sensitive. Contractor shall be responsible for any damage to new or existing planting caused by not coordinating installation with the Owner or

defeating the flow sensing capabilities.

1.06 PRE-INSTALLATION CONFERENCE

- A. At least two (2) weeks prior to the commencement of work, conduct a pre-installation conference with the Owner. This meeting shall include all parties responsible for installation, scheduling and testing of the finish work under this section. Refer to Drawings for archaeological monitoring notes.
- B. Review methods and procedures related to the work of this Section, including, but not necessarily limited to the following:
 - 1. Products and system requirements
 - 2. Review of required submittals
 - 3. Review of required details
 - 4. Schedule and sequencing of work
 - 5. Coordination with other trades and existing site conditions
 - 6. Forecasted weather and procedures for coping with unfavorable conditions
 - 7. Required inspections, reviews and procedures for approvals
- C. Record discussions of conference including all decisions, directions and agreements reached. Furnish copies of record to all parties in attendance.

1.07 SUBMITTALS

- A. In accord with Section 01300 – SUBMITTAL PROCEDURES.
- B. Documentation to substantiate required experience and workman qualifications.
 - 1. Provide copy of certificates for professional memberships, certifications and training.
 - 2. List project names, location, address, and telephone number of contact persons for information regarding completed work.
- C. List of materials:
 - 1. Submit a complete list of materials prior to commencing work. List of materials shall include the name of manufacturer, model number, manufacturer’s product cut sheet, and description of each item intended for use in the installation
 - 2. Irrigation submittal shall be specific and complete. All items shall be listed, including solvent, primer, wire, wire connectors, valve boxes, check valves, and all other items needed to complete work.
 - 3. Although manufacturer and other information may differ, the following is a guide to the proper format for submittal:

Item	Description	Manufacturer	Model No.
1	Pop-up Sprinkler Bodies	Rain Bird	1800 Series
3	Manual Gate Valves	Nibco	T-113

4. Submit operating manuals and maintenance data of equipment.
 - a. No substitutions of materials or equipment will be allowed without prior written approval by Owner.
 - b. Any equipment or materials furnished without the prior approval of Owner will be rejected and required to be removed at Contractor's expense.
- D. Project Record Documents:
 1. Provide and keep up-to-date, a complete red-lined record set of drawings (blackline type prints) which shall be corrected daily. Prints for this purpose may be obtained from Owner at cost. Document every change from the original Drawings and the exact installed locations, sizes, and types of equipment. Final deliverable to client shall be reproducible hardcopy and AutoCAD DWG on disk.
 2. Red-lined drawings shall be kept on job site and shall be used only as a record set. The record drawings shall be available at all times for review by Owner. Formally submit copies of the red-lined record drawings for Owner's review on the first of each month.
 3. Red-lined drawings shall serve as record for the progress of work completed and shall be used by the Owner as a basis for measurement and payment. Should record drawings not be available for review or not be up-to-date at the time of review, it will be assumed no work has been completed.
 4. As-built locations shall be dimensioned from two permanent points of reference, such as building corners, curbs, hardscape edges, roadways, or similar elements. Offsets should be taken at 90-degree angles from reference points whenever possible.

Provide the GPS coordinate location of the following items and include on As-Built:

 - a. Pressure main line routing. Include all changes in direction
 - b. Point of connection to the existing water supply lines
 - c. Sprinkler control valves
 - d. Quick coupling valves and washdown valves
 - e. Gate valves (manual and automatic)
 - f. Communication and flow sensor cable routing
 - g. Flow sensors
 - h. Point of connection to electrical power service
 - i. Diagrammatic routing of irrigation control wire
 - j. Controller location
 - k. Booster pump location
 - l. Irrigation electrical pull box locations
 - m. Other related equipment, as directed by Owner
 5. Two weeks prior to date of Substantial Completion, transfer all information from the redlined set of drawings to AutoCAD format electronic files. Prepare

drawings in accord with Owner's current AutoCAD standards. An electronic file of base drawing will be provided by Owner. Provide drawing plot for Owner's review and approval.

- a. Indicate all component locations noted on redline drawings with Northing and Easting coordinates.
 - b. Indicate elevations for all components where site conditions require installation deeper than 36 in.
6. On or before date of Final Review, provide electronic file of corrected and completed drawing files on disk with two additional copies of printed drawings.
- E. Controller charts:
1. Provide two controller charts for each controller supplied.
 2. Submit As-built drawings for review and acceptance by Owner prior to preparation of controller charts.
 3. Controller charts shall be prepared in AutoCAD. Provide two (2) hard copy prints of controller charts and AutoCAD electronic files on disk.
 4. Controller chart to be a reduced scale drawing of the actual installed system depicting all valve stations from one field satellite or controller. Each valve's area of coverage shall be uniquely identified by a contrasting color to the other adjacent valve stations.
 5. The controller charts are to be completed and approved by Owner prior to final acceptance of the system.

1.08 PRODUCT HANDLING

- A. In accord with Section 01660 - PRODUCT REQUIREMENTS.
- B. Deliver and store products and equipment in manufacturer's unopened packaging until ready for installation.

1.09 ADDITIONAL MATERIALS

- A. Furnish the following extra components prior to Final Approval.
 1. Two long-handled valve key each for square nut and hand wheel equipped gate valves.

1.10 WARRANTY

- A. Submit warranty documents at project closeout.
- B. Warranty the entire landscape irrigation system to give satisfactory service, including all equipment and materials for a period of one (1) year from the date of Final Acceptance.
- C. Warranty the supplemental landscape irrigation system to give satisfactory service for a period of 6 months from the date of its acceptance by Owner.
- D. Should any problems develop within the warranty period due to inferior materials or faulty workmanship, correct problems to Owner's satisfaction at no additional cost.

- E. Any damages or re-work required of the landscape or hardscape due to repairs of the irrigation system shall be completed to Owner's satisfaction at no additional cost.
- F. Owner reserves the right to make temporary repairs, as necessary, to keep the landscape irrigation system in an operating condition. Exercising this right does not in any way relieve the contractor of any responsibilities under the terms of the warranty.
- G. Manufacturer's product warranties shall supplement but not relieve the Contractor of any liability from his contracted installation Warranty.

PART 2 - PRODUCTS

2.01 PLASTIC PIPE AND FITTINGS

- A. Potable Pipe shall be marked with Manufacturer's name, nominal pipe size, schedule or class, pressure rating in PSI, and date of extrusion.
 - 1. Non-pressure 'lateral line' pipe: Class 200, PVC plastic, ASTM D1785, Type I, Grade I with solvent welded joints. Use Schedule 40, PVC for all pipe installed under paving.
 - 2. Pressure main line pipe, sizes 2 1/2 in. and smaller: Schedule 40, PVC plastic, ASTM D 1785, Type I, Grade I, with solvent welded joints, and Christy's detectable marking tape, green color with irrigation line below warning.
 - 3. Pressure main line pipe, sizes 3 in. and larger: Schedule 40, PVC plastic, ASTM D 1785, Type I, Grade I with rubber gasketed bell and spigot connections, HARCO ductile iron fittings and joint restraints, with Christy's detectable marking tape, green color with irrigation line below warning. Insertion marks shall be visible to show proper depth into spigot.
- B. Fittings shall bear manufacturer's name or trademark, material designation, size, and applicable I.P.S. schedule.
 - 1. Glued socket type, for pipe sizes 2 1/2 in. and smaller; Schedule 40, PVC plastic; Grade I, ASTM D 2466, Type I.
 - a. Solvent cement: ASTM D2546, for PVC pipe and fittings.
 - 2. Threaded type, for pipe sizes 2 1/2 in. and smaller; Schedule 80, PVC plastic; Grade I, ASTM D 2464, and ASTM F 437.
 - 3. Bell-end, sizes 3 in. and larger; Ductile iron, grade 65-45-12 in accord with ASTM A 536, having deep bell push-on joints with gaskets meeting ASTM F477.
 - a. HARCO 'Deep Bell' by the Harrington Corp. of Lynchburg, Virginia., (804) 845-7094.
 - 4. Transition gaskets are not allowed.

2.02 COPPER PIPE AND FITTINGS

- A. Type K, hard tempered pipe, ASTM B 88.
- B. Solder joint type wrought copper fittings, ASTM B 828.

- C. 95/5 solder, ASTM B 32.

2.03 FLEXIBLE TUBING

- A. Rain Bird Swing Pipe, Toro 850-01, or equal thick wall flexible pipe.

2.04 CONDUIT

- A. Gray PVC Schedule 80 conduit with solvent weld fittings.
- B. Use separate conduits for each type of wire or cable run.
- C. Size conduits as indicated on Drawings or as required to accommodate anticipated number of wires without binding or damaging wire insulation.

2.05 SLEEVES

- A. Schedule 40 PVC for applications requiring 3 in. and smaller diameter.
- B. Class 200 PVC for applications 4 in. and larger.
- C. All sleeves shall be 2 pipe sizes larger than the diameter of the protected pipe run for pipe under 6 in. diameter and 2 pipe sizes larger for runs 6 in. and larger.

2.06 CONTROL WIRE

- A. Decoder Communication Wire:
 - 1. UL 493, Type UF multiconductor, with solid-copper conductors; insulated cable; suitable for direct burial; specifically designed and approved for use with Rain Bird LXD decoder-based controllers.
- B. Low-Voltage, Branch Circuit Cables:
 - 1. No.14 minimum between two-wire interface module and automatic control valves.
- C. In all cases, wire size and specifications shall meet the minimum requirements of wire decoder-based irrigation controller. Wire Connectors: DBR/Y-6 direct bury splice kits, UL Listed for 600-volts, by 3M with 'Scotchlok'™ connectors.

2.07 BACKFLOW DEVICE

- A. Backflow Device: Existing indicated on Drawings.

2.08 VALVES

- A. Gate Valves:
 - 1. Manual Gate Valves 2 1/2 in. and smaller:
 - a. Nibco T-113 or Owner-approved equivalent that includes the following options; 200 lb. saturated steam rated brass body, ASTM B62, with threaded joints, non-rising stem, screwed bonnet and bronze hand wheel.
 - 2. Manual Gate Valves 3 in. and larger:
 - a. Kennedy C509 resilient wedge or Owner-approved equivalent that shall include the following options; conform to AWWA C509, 200 lb. W.O.G. fusion-bonded epoxy coated iron body inside and out to AWWA C550 and ASTM A126 Class B, with flanged joints, non-rising stem, fully

encapsulated rubber wedge per ASTM D249, bolted bonnet with 304 stainless steel hardware, and 2 in. square operating nut.

- b. Furnish two steel, tee-handle operating wrenches with one pointed end, stem length to operate deepest buried valve, and socket matching valve operating nut for Project.

B. Ball Valves:

1. Spears No. 2121 series industrial grade PVC ball valve with threaded ends or Owner-approved equivalent that includes the following options;
 - a. Heavy bodied PVC construction with 236 psi min. pressure rating.
 - b. PTFE ball seats.
 - c. EPDM high grade abrasion resistant O-rings.
 - d. NSF listed for potable water.

C. Electric Control Valves: Type and size as indicated on Drawings.

D. Hose Bib: Type and size as indicated on Drawings.

2.09 CONTROLLERS

A. Existing.

2.10 SPRINKLER HEADS

- A. Sprinkler Heads: As specified on Drawings.
- B. Rotator Heads: As specified on Drawings.

2.11 VALVE BOXES

A. All subgrade valves and valve assemblies located within planting areas are to be installed in black plastic boxes with matching green lids as manufactured by Rain Bird.

1. For manual gate valves; 10 in. x 10 1/4 in. round box with bolt-down cover. Extension sleeve shall be PVC with minimum depth of 6 in.
2. For Electric Control Valves; 11 3/4 in. x 17 in. x 12 in. rectangular box with bolt-down cover.
3. For Control Valves with wye strainer assembly; 16 in. x 25 1/2 in. x 12 in. jumbo rectangular box with bolt-down cover.
4. Communication cable and flow sensor wire pull boxes; 12 in. x 18 in. rectangular box, with green bolt-down cover.
5. For quick coupler valves; 10 in. x 10 1/4 in. round box with bolt-down cover.

B. Gate Valves located in hardscape and traffic areas;

1. Rectangle shape concrete boxes with cast iron lids, Brooks brand concrete body with cast iron frame and cast-iron non-locking cover, or Owner-approved equivalent.

2.12 VALVE IDENTIFICATION TAGS

- A. Christy brand, Maxi Tag™, manufactured from polyurethane Bayer Desmopan, 3 in. x 4 in., hot-stamped with black letters on yellow background. Attach one tag to each electric control valve providing field satellite and station numbers.
- B. All valves, regardless of type, shall have 'Non-Potable Water' ID tags attached. Tags shall be Christy brand Maxi Tag™, hot-stamped with black letters on yellow background. Tags shall read "Non-Potable Water - For Irrigation Use Only - Do Not Drink." Tag shall be printed in English and Spanish.
- C. Special order tags from T. Christy Enterprises, 655 East Ball Road, Anaheim, CA 92805. Ph: (800) 258-4583, Fax: (800) 468-4583.

2.13 LIGHTING PROTECTION

- A. Grounding Rods to be 5/8 in. dia. x 10 ft. copper clad, must be less than 8 ohms or meet recommendations of manufacturer; No. 182007 by Paige Electric, (800) 327-2443, or approved equal.
- B. Grounding connections to utilize exothermic welding process; UL Listed Cadweld connectors.
- C. Grounding wire shall be #6 AWG, solid, bare copper wire.
- D. Ground enhancement material shall be Powerset as manufactured by Loresco in 50 lb. bags.

2.14 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating non-conductive insulating material suitable for system fluid, pressure, and temperature.
- B. Dielectric Unions:
 - 1. Factory fabricated union, 2 in. and smaller, 150 psi minimum.
 - 2. End Connections: Solder-joint copper alloy and threaded ferrous; threaded ferrous.
- C. Dielectric Flanges:
 - 1. Factory-fabricated, bolted, companion-flange assembly, 2-1/2 in. to 4 in. and larger; 150 psi minimum.
 - 2. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric Flange Kits:
 - 1. Non-conducting materials for field assembly of companion flanges, 2-1/2 in. and larger; 150 psi minimum.
 - 2. Gasket: Neoprene or phenolic.
 - 3. Bolt Sleeves: Phenolic or polyethylene.
 - 4. Washers: Phenolic with steel backing washers.
- E. Dielectric Couplings:
 - 1. Galvanized steel coupling; 300 psi.
 - 2. End Connections: Female threaded.

3. Lining: Insert and non-corrosive, thermoplastic lining.
- F. Dielectric Nipples:
1. Electroplated steel nipple complying with ASTM F1545; 300 psi.
 2. End Connections: Male threaded or grooved.
 3. Lining: Inert and non-corrosive; propylene.
- 2.15 DETECTABLE WARNING TAPE
- A. Provide products by T. Christy Enterprises, 655 East Ball Road, Anaheim, CA 92805. Ph: (800) 258-4583, Fax: (800) 468-4583.
 - B. Detectable warning tape shall be installed below ground and be detectable with a non-ferrous metal detector when buried flat at depths recommended by the manufacturer. In all cases, install detectable warning tape according to manufacturer's instructions and recommendations.
 - C. Detectable warning tape shall be 5.0 mil overall thickness, five-ply composition. Tape shall have ultra-high molecular weight, consist of 100 percent virgin polyethylene, and be acid, alkaline, and corrosion resistant.
 - D. Detectable warning tape shall have a 0.35 mil solid aluminum foil core. Printed text shall be a repeated warning message, reverse printed on a 0.8 mil clear film, and laminated to aluminum foil with a 3.75 mil clear film backing; encapsulated within 2.55 mil polyethylene backing.
 - E. Tensile strength of tape shall not be less than 7800 psi and in accordance with ASTM D882-80A.
 - F. Elongation properties shall be in accordance with ASTM D882-80A and are less than 150 percent at break point.
 - G. Tape color and legend combination shall be in accordance with APWA or local requirements. Tape lettering shall be 1.5-inches tall minimum.
 - H. Tape width shall be minimum 3 in. wide.
 - I. Tape Color: Green and in accordance with APWA or local requirements.
 - J. Printed Text on Tape: "Cation Irrigation Line Buried Below" and in accordance with APWA or local requirements.
- 2.16 ROOT ZONE WATERING SYSTEM
- A. As specified on Drawings.
 - B. Pre-assembled basket weave canister with pressure compensating bubbler.
 - C. Rigid mesh cylinder of perforated polyethylene.
 - D. Pre-assembled with swing assembly for connection to PVC lateral lines.
 - E. Locking grate cover.
 - F. Integrated bubbler and check valve.
- 2.17 MISCELLANEOUS EQUIPMENT
- A. Surge Arresters:

1. For 120V power wiring: Surge-arresting duplex outlet by Leviton, Model No. 528-I.
 2. For two wire communication path: Rain Bird MSP-1 in-line transient voltage surge protector.
- B. Flex Risers: King Brothers, Global Water System, or Excaliber.
 - C. Stakes: #4 rebar – length as noted.
 - D. Clamps: Stainless steel screw clamps.
 - E. Swing Joints: Dura, Spears, Rain Bird maximum, or Lasco.
 - F. Check Valves: KBI, NDS, Nibco, or approved equal.
 - G. Concrete: 2500 psi/28-day concrete.

PART 3 - EXECUTION

3.01 GENERAL REQUIREMENTS

- A. Layout of irrigation pipe and equipment indicated on Drawings is diagrammatic. Actual locations are contingent upon actual site conditions and integration with other underground utilities.
- B. Verify dimensions, grades and points of connection in field prior to commencement of work.
- C. Do not proceed with installation when it is apparent that obstructions, grade differences or conflicts in the Drawings exist. Bring all such conflicts or discrepancies to the immediate attention of Owner for clarification.
- D. Obtain and pay all plumbing permits and inspections required by governing agencies.

3.02 SUPPLEMENTAL IRRIGATION

- A. Provide a supplemental drip irrigation system for all palm trees and all boxed trees with root balls 24 in. and larger installed under this contract. This system is to ensure that installed trees will be automatically irrigated during the plant establishment period.
- B. The supplemental system shall be designed by a qualified irrigation design professional that is experienced with drip and low flow irrigation systems.
 1. Submit for Owner approval, prior to commencing with work, schematic drawings showing intended drip irrigation design with all pertinent information for temporary water connections, equipment and installation.
- C. System to be installed and operational prior to tree planting, regardless of the availability of a permanent water connection. If permanent irrigation water is not available at the time the system is installed, provide a temporary water connection until a permanent connection can be made.
- D. Pipe and/or tubing, not in a hazardous area, to be installed on-grade. Pipe installed as a part of temporary irrigation shall not be re-used as any part of the permanent landscape irrigation system.
- E. All pipe and/or tubing shall be buried and sleeved under construction or access roads at a proper depth to prevent damage.

- F. Protect temporary system during entire planting process. Repair any damage to landscape caused by leaking or broken lines.
 - G. The system should be designed at 90% capacity to allow for additional plant material or emitters as required. 10% additional emitters to be included in contract and installed at Owners discretion.
 - H. Use the following table to determine the required quantity of emitters or spray stakes;
 - 1. 1 spray stake/emitter for all rootballs up to 2 ft. measured in the largest dimension.
 - 2. 2 spray stakes/emitters for all rootballs up to 4 ft. measured in the largest dimension.
 - 3. 3 spray stakes/emitters for all rootballs up to 6 ft. measured in the largest dimension.
 - 4. 4 spray stakes/emitters for all rootballs up to 8 ft. measured in the largest dimension.
 - I. Flow rates should be calculated using .25 GPM per emitter.
 - J. Upon completion of the permanent irrigation system, remove the supplemental system without damaging landscape. Battery operated controllers and valves to be turned over to Owner. Remainder of supplemental materials to be salvaged or properly disposed of off-site.

 - K. PREPARATION
 - L. Layout of irrigation pipe and equipment indicated on Drawings is diagrammatic. Actual locations are contingent upon site conditions and integration with other underground utilities.
 - M. Verify dimensions, grades, and point of connection in the field prior to commencement of the Work.
 - N. Do not proceed with installation when it is apparent that obstructions, grade differences, or conflicts with Drawings exist. Bring all such conflicts or discrepancies to the immediate attention of the Owner for clarification.
 - O. Set stakes to identify locations of proposed irrigation system. Obtain Owner's acceptance before excavation.
- 3.03 POINT OF CONNECTION
- A. Utilize existing irrigation mainline or point of connection unless otherwise indicated.
- 3.04 TRENCHING
- A. Lay-out system using an approved staking method.
 - B. Coordinate routing of mainline piping and trenching with underground utilities and specimen tree locations.
 - 1. Planting locations shall take precedence over sprinkler and piping locations where possible.

2. Maintain minimum clearance between pipes as required by code.
 3. Notify and coordinate with Owner of any major deviations from original layout.
- C. Trenching shall be done under the presence of the Archaeological Monitor.
- D. Trenching operations shall be done via mechanical or hand methods and to as true a line as possible. Trenching with grader or bulldozer will not be allowed. Excavate trenches with straight and vertical sides. No trench shall be excavated in such a manner that the trench section appears triangular or trapezoidal. Any trench excavated in an objectionable manner, as determined by the Owner, shall be backfilled and re-compacted by the Contractor before retrenching, at no additional cost.
- E. Provide continuous support for pipe on bottom of trenches. Lay pipe to uniform grade.
1. Bottom of trench shall be free of rocks, clods, and other sharp-edged objects. The Owner reserves the right to have trench over-excavated 3-inches and filled with accepted material at no additional cost should the trench bottom contain rocks or other objectionable material.
 2. Trench backfill material shall be on-site or imported select material in accord with geotechnical report. Backfill material shall be free from rocks greater than 1/2-inch.
 3. Maintain 1 in. minimum clearance between lines which cross at 45 degree to 90-degree angles.
 4. Maintain 6 in. minimum clearance between sprinkler lines and between lines of other trades. Do not install sprinkler lines directly above any other pipes or utilities.
 5. Maintain 12 in. minimum clearance between mainline and potable water lines. Irrigation mainline crossings passing above potable water lines shall be concrete jacketed and conform to "Water System Standards" Department of Water, County of Kauai; Board of Water Supply, City and County of Honolulu; Department of Water Supply, County of Maui; Department of Water Supply, County of Hawaii; Volume 1 [26], county-adopted plumbing code, as amended, and other water purveyor requirements.
- F. Where irrigation lines occur within landscaping, trench depths shall be:
1. Provide minimum cover of 24 in. over all pressure main lines 6 in. and larger. Maximum cover shall be 48 in. unless otherwise approved by Owner.
 2. Provide minimum cover of 24 in. over all pressure supply main lines 4 in. and larger. Maximum cover shall be 48 in. unless otherwise approved by Owner.
 3. Provide minimum cover of 10 in. over non-pressure lateral lines. Maximum cover shall be 18 in. unless otherwise approved by Owner.
- G. Where irrigation lines occur under vehicular paving, depth of coverage shall be measured from the bottom of paving material. Trench depths shall be:
1. Provide minimum cover of 36 in. over all sleeves or direct-bury pressure main lines 6 in. and larger. Maximum cover shall be 48 in. unless otherwise approved by Owner.
 2. Provide minimum cover of 36 in. over all sleeves or direct-bury pressure

supply main lines smaller than 6 in. Maximum cover shall be 48 in. unless otherwise approved by Owner.

3. Provide minimum cover of 36 in. over all sleeves or direct-bury non-pressure lateral lines. Maximum cover shall be 24 in. unless otherwise approved by Owner.
- H. Where irrigation lines occur under pedestrian walkway paving, depth of coverage shall be measured from the bottom of paving material. Trench depths shall be:
 1. Provide minimum cover of 24 in. over all sleeves or direct-bury pressure main lines 6 in. and larger. Maximum cover shall be 36 in. unless otherwise approved by Owner.
 2. Provide minimum cover of 24 in. over all sleeves or direct-bury pressure supply main lines smaller than 6 in. Maximum cover shall be 48 in. unless otherwise approved by Owner.
 3. Provide minimum cover of 24 in. over all sleeves or direct-bury non-pressure lateral lines. Maximum cover shall be 36 in. unless otherwise approved by Owner.
- I. Install, under mainline, one continuous No. 14 AWG UF tracer wire in all locations where control wires are not installed in same trench as mainline. Tracer wire shall be black with a white stripe.

3.05 BACKFILLING

- A. Backfill and compaction: As indicated on Drawings.
- B. Initial backfill over all pipe shall be clean, fine granular material.
- C. Backfill trenches via mechanical means or by hand methods. Loose soil shall be placed in the trench in lifts of 6-inches and compacted by tamping after each lift is placed. The top 6-inches of backfill in planting areas shall be accepted imported screened soil. Should any settling of the soil over trenches occur after completion of the irrigation system, the Contractor shall refill and compact the soil as directed at no additional cost to the Owner.
- D. Backfill only when pipe is cool. During hot weather, pipe can be cooled by operating the system for a short time prior to backfilling.
- E. Provide marking tape over all pressure supply main lines.
- F. Properly compact backfill in trenches to dry density equal to the adjacent undisturbed soil, and conform to adjacent grades without dips, sunken areas, humps, or other irregularities.
- G. Restore grades and repair any damage where settlement may occur.

3.06 PLASTIC PIPE AND FITTINGS

- A. Install and connect plastic pipe in accord with manufacturer's recommendations.
- B. Install groups of pipes parallel to each other, spaced to permit valve servicing.
- C. Install fittings for changes in direction and branch connections.
- D. Install flanges adjacent to valves and to final connections to other components with 2-1/2 in. or larger pipe connection.

- E. Install ductile iron fittings and pipe restraints for 2-1/2 in. or larger pipes in accord with manufacturer's recommendations.
- F. Install underground piping according to ASTM D2774 and ASTM F690.
- G. Prepare all welded joints with approved cleaner prior to applying primer and solvent.
 - 1. Allow welded joints at least 15 min. set-up and curing time before moving or handling.
 - 2. Partially center load pipe in trenches to prevent movement or shifting when water pressure is applied.
 - 3. Do not permit water in pipe for a minimum of 4 hrs. after applying solvent welds.
 - 4. When the temperature is above 80 degrees Fahrenheit, allow solvent weld joints at least 24 hr. curing time before water is introduced under pressure.
 - 5. Suspend all solvent welding if air temperature falls below 40 degrees Fahrenheit. Pipe and fittings installed at temperatures below 40 degrees Fahrenheit shall be removed and replaced at no cost to Owner.
- H. Installing pipe under existing pavement:
 - 1. Piping under existing pavement may be installed by jacking, boring, or hydraulic driving. Hydraulic driving will not be permitted under asphalt paving.
 - 2. Secure permission from Owner prior to cutting or breaking any existing pavement. Repairs or replacement to existing paving shall be approved and completed to the satisfaction of the Owner and shall be installed at no additional cost.
- I. Install transition fittings for plastic-to-metal pipe connections according to the following:
 - 1. Underground Piping:
 - a. 1-1/2 inches and Smaller: Plastic-to-metal transition fittings.
 - b. 2-inches and Larger: AWWA transition couplings.
 - 2. Aboveground Piping:
 - a. 2-inches and Smaller: Plastic-to-metal transition unions.
 - b. 2-inches and Larger: Use dielectric flange kits with one plastic flange.
- J. Install dielectric fittings for dissimilar-metal pipe connection according to the following:
 - 1. Underground Piping:
 - a. 2-inches and Smaller: Dielectric coupling or dielectric nipple.
 - b. 2-1/2 inches and Larger: Prohibited except in control valve box.
 - 2. Aboveground Piping:
 - a. 2-inches and Smaller: Dielectric union.
 - b. 2-1/2 inches to 4-inches: Dielectric flange.
 - c. 5-inches and Larger: Dielectric flange kit.

3. Piping in Control Valve Boxes:
 - a. 2-inches and Smaller: Dielectric union.
 - b. 2-1/2 inches to 4-inches: Dielectric flange.
 - c. 5-inches and Larger: Dielectric flange kit.
 - K. Detectable Marking Tape: Install continuous identifying and detectable warning tape above all pressure and mainline piping. Install at depth recommended by the manufacturer to ensure detection by non-ferrous detector.
 - L. Flushing System:
 1. After all sprinkler pipe and risers are in place, open control valve and thoroughly flush system clean prior to installing sprinkler heads.
 2. Contractor shall be responsible for repair of clogged nozzles for a period of thirty days after notice of substantial completion.
- 3.07 JOINT CONSTRUCTION
- A. Ream ends of pipes and tubes and remove burrs. Bevel plan ends of steel pipe.
 - B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
 - C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
 - D. Flanged Joints: Select rubber gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
 - E. Copper-Tubing Brazed Joints: Construct joints according to CDA's "Copper Tube Handbook," using copper-phosphorus brazing filler metal.
 - F. Copper-Tubing Soldering Joints: Apply ASTM B813 water flushable flux to tube end unless otherwise indicated. Construct joints according to ASTM B828 or CDA's "Copper Tube Handbook," using lead-free solder alloy (0.20 percent maximum lead content) complying with ASTM B32.
 - G. PE Piping Fastener Joints: Join with insert fittings and bands or fasteners according to piping manufacturer's written instruction.
 - H. PVC Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.
 2. PVC Pressure Piping: Join schedule number, ASTM D1785, PVC pipe and PVC socket fittings according to ASTM D2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D2855.

3. PVC Non-pressure Piping: Join according to ASTM D2855.

3.08 CONDUITS

- A. Install conduit where control wires pass through or under walks, walls and paving. Conduits shall be of adequate size to accommodate retrieval of wires for repair and shall extend 18 in. beyond edges of walls and pavement.
- B. Install continuous conduit for all flow sensor and communication cables.

3.10 SLEEVES

- A. Install sleeves for all pipes and conduits passing through or under walks, walls and paving as indicated on Drawings. Sleeving shall be of adequate size to accommodate retrieval of wiring or piping for repair and shall extend 18 in. beyond edges of paving or other construction.
- B. Field verify location, size and depth of existing sleeves where noted on the Drawings. Notify to the start of installation.

3.11 CONTROL WIRE

- A. Control wire shall be run in same trench adjacent to mainline pipe whenever possible. Multiple wires in run to be bundled and taped together at 12 ft. intervals.
- B. Install control wire in PVC SCH. 40 gray conduit when not run with mainline.
- C. Use only continuous wire between controller and remote control valves. Do not use wire splices.
- D. Make underground wire connections to electric remote control valves with UL-listed 3M DBR/Y-6 connectors.
- E. An expansion curl shall be provided at each wire connection. Expansion curl shall be of sufficient length at each control valve, so that the valve bonnet may be brought to the surface for maintenance without disconnecting the wires.

3.12 VALVE ASSEMBLIES

- A. Install and connect all assemblies in accord with Drawings.
- B. Do not install multiple assemblies on individual service tees. Provide each assembly with its own outlet. When used, the pressure relief valve shall be the last assembly.
- C. All threaded fittings shall be assembled using Teflon tape applied to the male threads.
- D. When specified, install backflow assemblies in shrub areas at the minimum height required by local codes.
- E. Locations for all equipment, as indicated on Drawings, such as point of connection, field satellites and valves are approximate.
 - 1. Minor modifications to layout and location of equipment shall be provided at no additional costs to Owner.
 - 2. Stake out all equipment locations for Owner's review and obtain approval prior to installation. Failure to obtain Owner's approval prior to installation

may require Contractor to relocate or re-work installation at no additional costs to Owner.

3. System modifications shall be recorded and made part of the record drawings.

3.13 GATE VALVES

- A. Install in accord with Drawings.
- B. Check and tighten valve bonnet packing before backfill.

3.14 ELECTRIC CONTROL VALVES

- A. Install in accord with Drawings.
- B. Install at sufficient depth to provide not more than 6 in. and not less than 4 in. cover from top of valve to finish grade.
- C. Install valves in a plumb position with 24 in. minimum maintenance clearance from other equipment.
- D. Valves shall be located away from walkways and in locations as inconspicuous as possible.
- E. Electric control valves shall be connected to field satellites in numerical sequence as indicated on Drawings.
- F. Provide and install DC-Latching solenoids for valves connected to solar powered controllers.

3.15 HOSE BIB

- A. Install in accord with Drawings and Details.

3.16 CONTROLLERS

- A. Controller Interconnect Circuitry:
 1. Warranty tests shall be performed by the approved supplier on all electrical circuits. Provide Owner with written approval from the equipment supplier prior to start of maintenance period.
 - a. Wire loop resistance (continuity): Test each circuit for maximum loop resistance not to exceed manufacturer's written recommendations.
 - b. Ground fault: Test each circuit with an ohm meter, after each interconnect circuit has been installed and connections have been made. Minimum ground resistance shall not exceed manufacturer's written recommendations. After test has been completed, remove splices and leave exposed in pull box for future access.
 - c. Record results of circuitry tests and submit to Owner prior to acceptance of work.
 - d. Functional test: Perform test to demonstrate each and every part of the system functions as specified and intended.
 - (1) The functional test for each new or modified electrical system shall consist of not less than 5 days of continuous, satisfactory operation. If unsatisfactory performance of the system develops, correct the

condition and repeat test until 5 days of continuous satisfactory operation has been obtained.

- (2) Functional tests and turn-on shall not be started on a Friday, or on a day preceding a legal holiday. Shutdown caused by factors beyond Contractor's control shall not constitute discontinuance of the functional test.

B. Interconnect Conductors:

1. Irrigation interconnect conductors shall be pulled by hand, leave 2 ft. of coiled slack at each field controller and at each pull box.
2. Splices shall occur within controller enclosure, unless specifically authorized otherwise by Owner.
3. Make splices with UL-listed 3M DBR/Y-6 connectors only. Splices shall be capable of satisfactory operation under continuous submersion in water.

- C. Contractor shall employ the services of authorized Rain Bird representative, to certify all controllers are properly installed, programmed, communication with booster pump control is functioning, and assist with providing End-User training to the Owner to ensure full understanding on how the irrigation system functions and proper operation.

3.17 GROUNDING

- A. Multiple controller locations shall have separate grounding for each controller or group of controllers. Lightning protection grids shall be installed in an irrigated area.
- B. Install ground rods a min. of 12 ft. from the controller and connect via a permanent exothermic Cadweld connection to #6 solid, bare copper wire. Additional rods shall be spaced at 20 ft. intervals. The copper wire is to be installed in as straight a line as possible, and where necessary to make a turn or bend, it shall be done in a sweeping curve with a minimum radius of 9 inches and a minimum included angle of 90 degrees. There shall be no splices in the bare copper wire.
- C. Top of each grounding rod shall be driven into the ground to below finish grade and covered with a standard 10 in. round plastic valve box with lid.
- D. Grounding plates to be installed horizontally at 36 in. below grade with 100 lbs. of 'Powerset'™ ground enhancement material spread evenly above and below each plate in accordance with manufacturer's directions.
- E. Install a minimum of 6 in. of 4 in. perforated polyethylene pipe over each plate and cap with a flat PVC drain grate for periodic inspection. Plates shall also be covered with a 4 in. grated cover as specified, set a minimum of 1 in. below grade, to facilitate drainage onto the plate. Cover shall be installed on a minimum of 36 inches of 4 in. ADS corrugated polyethylene, perforated drainage pipe.

3.18 SPRINKLER HEADS

- A. Install in a plumb position, perpendicular to finish grade, at intervals not to exceed maximum spacing indicated on drawings.
- B. Install heads 1/2 in. above finish grade along curbs, walks, paving, and similar

areas.

- C. Lay out sprinkler heads and make all minor adjustments required due to differences between site conditions and Drawings. All such deviations in layout shall be within the intent of the original Drawings, and without additional cost to Owner. Routing and layout of all piping shall be approved by Owner prior to installation.
- D. After all permanent sprinkler pipe lines and risers are in place and prior to installation of sprinkler nozzles, open control valves and flush out the system with a full head of water.
- E. Install nozzles of the required size and pattern for the area of coverage. Install pressure compensating screens per manufacturer's recommendations.

3.19 DRIP EMITTERS

- A. Install emitters and/or self-piercing barb connectors in emitter tubing using proper emitter installation tool.
- B. Flush all emitter tubing and PVC lateral lines prior to installation of emitters. Refresh lines after installation of emitters.

3.20 TRENCH RESTORATION

- A. Where irrigation systems are laid in existing lawns, the trenches, upon being properly backfilled and settled, shall be filled with approved existing onsite soil or imported screened soil to a depth of 4-inches, fine graded, completely re-grassed by use of sod or stolons, unless otherwise noted on the Drawings. The re-grassed trenches shall be maintained by watering, weeding, and fertilizing for a period to match plant establishment requirement for the Project.

3.21 FINAL ADJUSTMENTS

- A. Adjust sprinkler heights and vertical alignment as required to maintain proper relationship to established grades and planting. Re-grade and replant around sprinkler heads as necessary.
- B. Fill-in all depressions that may arise from possible settlement over trenching or other excavations, with proper soil mix. Compact lightly, and replant as needed to maintain planting design.
- C. Adjust nozzles to provide optimum coverage with no overspray to hardscape or building walls.
- D. Replace nozzles where required to provide full and complete coverage.
- E. Adjust irrigation schedule and run times to provide adequate water to maintain landscaping.

3.22 INSTRUCTIONS

- A. After the irrigation system has been completed, inspected, and approved, the Contractor shall arrange for the services of a qualified instructor to instruct the maintenance personnel in the operation and maintenance of the system.

END OF SECTION

SECTION 02900 – PLANTING

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Labor, equipment, materials, plants, soil preparation, planting, and maintenance requirements for all landscaping work as indicated on Drawings.

1.02 RELATED SECTIONS

- A. Section 02810 – IRRIGATION SYSTEM (Pg. 1)

1.03 DEFINITIONS

- A. Injury; defined, without limitation, as any bruising, scarring, tearing, or breaking of roots, trunk, bark, branches or foliage which may lead to or result in permanent damage to plant health or significantly alter the desired aesthetics of the plant for which it was selected.
- B. Dead Tree; is a tree that has died or that has been damaged or stressed to an advanced state of decline and has been determined to be so by the Owner's Certified Arborist.
- C. Drip Line; defined as the outer most limits of the tree canopy.
- D. Certified Arborist; an individual with a current certification from the International Society of Arboriculture (ISA) or member of the American Society of Consulting Arborists trained and experienced in all aspects of proper tree care.

1.04 REFERENCES

- A. International Society of Arboriculture (ISA) "Guide for Plant Appraisal 8th Edition 1992," prepared by the Council of Tree and Landscape Appraisers (CTLA).
- B. Standardized Plant Names; as established by Hortus III.
- C. ANSI A 300 - American National Standards For Tree, Shrub, and Other Woody Plant Maintenance - Standard Practices: 1995.
- D. ANSI Z 60.1 - American Standards for Nursery Stock: 2004., as approved by the American Association of Nurseryman.
- E. Cabling, Bracing, and Guying Standards for Shade Trees, as published by the National Arborist Association (NAA), 174 Rt. 101, Bedford, NH 03102.

1.05 ALLOWANCES

- A. Allowances for plants are specified in Division 01.
 - 1. Perform planting work under quantity allowances and only as authorized. Authorize work includes work required by Drawings and the Specifications and work authorized in writing by Landscape Architect.
 - 2. Notify Landscape Architect weekly of extent of work performed that is attributable to quantity allowances.
 - 3. Perform work that exceeds quantity allowances only as authorized by

Change Orders.

4. Furnish plants as part of plant allowances.

1.06 UNIT PRICES

- A. Work of this Section is affected by unit prices.
- B. Unit prices apply to authorized work covered by quantity allowance.
- C. Unit prices apply to additions to and deletions from the Work as authorized by Change Orders.

1.07 QUALITY ASSURANCE

- A. Qualifications of workmen:
 1. Contractor to be licensed by the State of Hawaii and a member in good standing of the Landscape Industry Council of Hawaii (LICH).
 2. Contractor shall have a minimum of 5 years of documented experience with successful landscape installations similar to the size and scope of work for this project.
 3. Contractor shall maintain a competent supervisor or foreman on site who is fluent in English and satisfactory to Owner. Supervisor shall not be changed, except with prior consent of Owner. Supervisor shall be present on-site during all operations and specified work in progress.
 4. Provide at least one person who is a Certified Arborist, to direct and be present during all tree pruning operations.
- B. Tests and Inspections:
 1. Plant Material:
 - a. All plant material shall be received in a healthy condition, free from pests and disease. Plants delivered to Contractor that are found to be damaged, root bound, diseased or distressed shall be brought to Owners' attention prior to accepting delivery.
 - b. Plants shall be subject to inspection and approval by Owner and/or Owner's Representative at nursery, growing grounds and upon delivery to site, for conformity to Specifications. Such approval shall not impair the right of further inspection or rejection during progress of work.
 - (1) Pre-selection and tagging of plant material by Owner or Landscape Architect is to meet design intent only and does not constitute any guarantee by Owner of the selected plants. Health and vigor of plant material shall remain the sole responsibility of Contractor. All trees shall be pre-selected and tagged by Landscape Architect. Tags must remain on trees until final maintenance inspection. Provide Landscape Architect prior notification for the following with the advanced times indicated:
 - (a) Tree selection & tagging: 7 days.
 - (b) Shrub and groundcover inspection at nursery: 7 days and/or

coinciding with tree selection at similar nursery

- c. Owner reserves the right to have plant samples analyzed at any time to verify plant health and conformity to Specifications. Furnish samples upon request. Testing to be done by Owner's designated laboratory.
 - (1) Cost of testing plant samples will be responsibility of Contractor. Lab fees for testing found to be negative will be reimbursed by Change Order to the Contract.
 - (2) Rejected material shall be promptly removed and replaced at no cost to Owner.
2. On-site Soils:
 - a. Pre-Construction Testing: Preconstruction testing of existing on-site soil shall be performed on native soil not previously impacted by prior construction. Native soil boundaries are defined in "Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii" by United States Department of Agriculture, Soil Conservation Service, Issued August 1972.
 - b. After rough grading has been completed and prior to planting operations, on-site soils are to be tested for agronomic suitability, biological function, and chemical characteristics. Soils report shall include amending requirements in order for on-site disturbed soils to be restored to optimal biological function and chemical characteristics. Contractor shall make all adjustments to improve the soils' characteristics and comply with final soils analysis recommendations as directed by soils report.
 - c. In the event that soil amendment recommendations are substantially different than those described for base bid, adjustments will be made by Change Order to Contract as agreed upon by Owner.
 - d. Owner shall engage the services of a qualified agricultural soils testing laboratory to perform soil testing services of all areas to be planted.
 - (1) Soils testing shall be performed by Crop Nutrient Solutions, Inc., Post Office Box 40, Waimanalo, Hawai'i, 96795; Phone: (808) 386-4120.
 - e. Laboratory services shall include the following:
 - (1) A minimum of six samples or one sample per every 5000 sq. ft. (whatever quantity is greater) of base soil after completion of rough grading in landscape areas as directed by Owner.
 - (2) Chemical analysis and written report of each individual sample to cover the following:
 - (a) Soil structure and percentage of organic matter.
 - (b) pH, Salinity and Lime content
 - (c) Mineral nutrients, including concentrations of nitrogen, phosphorus, potassium, calcium, magnesium, iron, manganese, zinc, copper, sulfur, and molybdenum.
 - (d) Potential hazards to healthy plant growth such as high salinity, sodium chloride, boron, impaired soil structure, or drainage.

- (3) Recommendations for organic materials, fertilizers, and other materials found necessary to amend base soil for optimum plant growth.
 - (4) Recommendations for backfill mix or mix as appropriate to be utilized in installation of all plants for the project.
 - (5) Testing laboratory shall follow standards set forth in the USDA Agricultural Suitability Test in accord with Handbook-60 and in accord with the Methods of Soil Analysis by the Soil Science Society of America, Inc.
- f. Testing laboratory may be employed by Owner to provide additional periodic sampling and testing of amended landscape planting areas to ensure compliance with recommendations.
3. Imported Soil Amendment Material:
- a. The Contractor shall be responsible for submitting a soils analysis of the amended and restored soils at the end of the project for review and approval by the Owner in order to demonstrate that restored soils have optimum biological function and chemical characteristics and meet recommendations provided by soils report.
 - b. All proposed imported soil amendments for planting areas shall meet specified requirements and be pre-approved by Owner based on soil test results.
 - c. Cost for soils tests for this purpose shall be paid by Contractor. Provide chemical analysis report, written recommendation, and intended source of imported soil amendments for each individual sample to Owner.
 - d. In the event that the initial proposed imported soil amendment is found unsuitable, additional sources shall be found and tested at Contractor's expense.
4. Imported Screened Soil Material:
- a. The Contractor shall be responsible for submitting a soils analysis of the imported screen soil material at the beginning of the project for review and approval by the Owner in order to demonstrate adherence to recommendations provided by soils report.
 - b. All proposed imported soils for planting areas shall meet specified requirements and be pre-approved by Owner based on soil test results.
 - c. Cost for soils tests for this purpose shall be paid by Contractor. Provide chemical analysis report, written recommendation, and intended source of imported soil for each individual sample to Owner.
 - d. In the event that the initial proposed imp shall be found and tested at Contractor's expense.
5. Observation Schedule
- a. Observation and inspection of the work will be made on an ongoing basis and at the following stages of the work. Provide Owner prior notification to of the following with the advanced times indicated:
 - (1) Pre-installation conference: 7 days.

- (2) Completion of finish grading and soil preparation: 7 days.
- (3) Plant delivery to site: 7 days.
- (4) Tree locations prior to excavation of pits: 7 days.
- (5) Shrub layout prior to excavation pits: 7 days.
- (6) Pre-mulch inspection: 7 days.
- (7) Pre-maintenance: 10 days.
- (8) Final walk-through: 10 days.

1.08 SUBMITTALS

- A. Submit manufacturer's data sheets for all proposed products to be used in work. Indicate specific items and product numbers.
- B. Unless indicated as Owner-furnished, Contractor shall furnish all plant material indicated on Drawings. Any and all substitutions due to unavailability shall be requested in writing prior to confirmation of ordering.
 1. Submit for Owner's approval within 30 days after award of contract and prior to any start of work:
 - a. Photo documentation listing all required plant material by size, source, and quantity. Sort list by construction zone sequence if applicable. For all plants not inspected by Landscape Architect, Contractor shall provide photo documentation of all plants for Landscape Architect's approval.
 - b. Weed control program. Include all product information and schedule of operations.
 - c. Proposed schedule and sequence of work plan for all planting operations, with start dates and completion dates for planting trees, shrubs and groundcover.
 - d. List of proposed equipment to be used for tree planting and plan for plant storage on-site.
 - e. Soil test results and schedule of recommended fertilizers and amendments to correct soil deficiencies. Schedule of fertilizers and amendments shall include applications rates for pre-planting, planting, and post planting operations.

1.09 EXISTING CONDITIONS

- A. Protect all existing plant material that is to remain within or directly adjacent to the work to be performed. This shall include installing and maintaining protective barriers and/or temporary fencing.
- B. Maintain foliage of existing plants free of dust and debris from all construction operations.
- C. Do not damage existing paving or fencing.
- D. Vehicles and equipment shall not be parked, serviced, or operated within the drip line of existing trees or within newly planted areas. Access to all planting areas shall be limited to the personnel required for landscape installation.

1.10 WARRANTY

- A. Warranty all plant material, smaller than 15 gallon container size, to be in healthy and flourishing condition of active growth for a period of 180 days after date of Substantial Completion.
- B. Warranty all plant material, 15 gal. or larger, to be in healthy and flourishing condition of active growth for a period of one (1) year from the date of Substantial Completion.
- C. Promptly replace all plant material found dead, dying, or damaged during the warranty period.
- D. Replacement shall be with material of same variety, size, form and character. Final selection to be approved by Owner.
- E. Replacement shall include cost of plant material, delivery, labor, equipment and materials required for installation.
- F. Specimen trees that require replacement shall be removed and replaced in a timely and expedient manner. Coordinate with Owner for selection of replacement tree and timing of work.
- G. Contractor will not be held responsible for failures that are directly attributed to Acts-of-God, vandalism or proven negligent care by Owner. Acts of God do not include diseases, pests, or moisture extremes noted herein.
- H. Special Warranty:
 - 1. All plant materials furnished shall be warranted as to the species, hybrid, flower color and/or variety specified.
 - 2. If after acceptance of the project, any warranted plant material proves to be of a different species, hybrid, flower color and/or variety not initially determinable, replace that plant with a new plant of the originally specified species, hybrid, flower color and/or variety. The new plant shall be equal in size to that of the incorrect plant at the time of its removal. The new plant shall meet the quality standards, be subject to the warranty, and be installed according to the specifications.
 - 3. There is no time limit to this warranty, although it does not include plants reverting to the general species. The Owner will determine the nonconformance of plant materials and notify the Owner in writing of the required replacement work. All materials and work shall be at the expense of the Owner.

1.11 PRODUCT HANDLING

- A. Delivery:
 - 1. Deliver fertilizers to site in original unopened packages and containers, bearing manufacturer's name, trademark, guaranteed chemical analysis and conformance to State Law. Deliver bulk materials to site with certificate that includes manufacturer name, trademark, guaranteed chemical analysis, conformance to State Law and quantity delivered.
 - 2. Furnish delivery receipts for all amendments to Owner.
 - 3. Notify Owner 7 days in advance of plant material deliveries.

4. Submit an itemized list of plants included in each delivery.
 - B. Deliver all plants with legible identification labels.
 1. Label trees, bundles, or containers of like shrubs or ground cover plants.
 2. State correct botanical name and container size.
 3. Use durable waterproof labels with UV and water-resistant inks. Do not remove labels until so directed by Owner.
 4. Protect plant material from damage during delivery. Plants loaded for delivery from nurseries should not be double stacked or vertically layered in any way to cause damage or stress.
 5. Inspect all plant material for injury, disease and insect infestation. Evaluate trees and shrubs for improper pruning. In the event such conditions are found, bring to Owner's attention for direction and remedial action to be taken.
 6. Owner-furnished plant material that includes delivery from nursery, is to be shipped in full-truck loads. Should Contractor desire 'partial load' shipments, any additional costs shall be the Contractor's responsibility.
 - C. Handling:
 1. Exercise care in handling, loading, unloading, and storing of plant material. Plants that have been damaged prior to or during installation shall be replaced at Contractor's expense.
 2. Provide equipment of suitable size and capacity to safely off-load, transport and plant all trees.
 3. The "choke" strapping method of lifting trees is strictly forbidden (except for single trunk palms); any trees hoisted in this manner will be rejected.
 - D. Storage:
 1. Plant materials shall be maintained in a healthy growing condition. Protect plants from physical damage by construction operations as well as inclement weather conditions such as high winds, excessive heat or dust.
 2. Plants stored on-site shall be spaced to allow clearance for light and air and not be spaced tightly together such that limbs are crowded.
 3. Maintain root balls with adequate moisture at all times.
 4. Plants grown in shade conditions shall be stored and maintained in equivalent shade conditions.
 5. Do not store plants directly on asphalt paving.
- 1.12 VERIFICATION OF DIMENSIONS AND QUANTITIES
- A. All scaled dimensions are approximate. Before proceeding with any work, carefully check and verify all dimensions and quantities. Immediately inform Owner of all discrepancies between Drawings, Specifications, and actual conditions. Do not do work in any area where there is a discrepancy until approval to proceed has been given by Owner.
- 1.13 REGULATORY REQUIREMENTS

- A. Provide for all inspections and permits required by federal, state, and local authorities for furnishing and transporting plant materials.
- B. Perform work in accord with all applicable laws, codes, and regulations including licensing and training requirements for pesticide and herbicide applications.

PART 2 - PRODUCTS

2.01 TOPSOIL

- A. Contractor shall provide imported screened soil as source of soil material or imported amendments for amendments to existing soil. Source and location to be approved by Owner. Contractor to submit soils reports for Owner’s approval.
- B. Soil shall meet the following requirements;
 - 1. General: Free of roots, clods, and stones larger than 1/2 in. in the greatest dimension, pockets of coarse sand, noxious weeds, sticks, brush, and other litter. It shall not be infested with nematodes or other undesirable disease organisms such as insects and plant pathogens. Soil shall be friable and have sufficient structure in order to give good tilth and aeration to the soil. Total pore space content on a volume/volume basis shall be at least 15% when moisture is present at field capacity. Soil shall have a field capacity of at least 15% by weight.
 - 2. Gradation: Soil shall be a sandy loam, or loam, and similar to the native site soil. The definition of soil texture shall be in accord with USDA classification scheme. Obtain Owner’s approval prior to grading operations.

Class	Particle Size Range	Maximum Percentage	Minimum Percentage
Coarse Sand	0.5-2.0 mm	40%	0%
Clay	<0.05 mm	20%	10%
Silt	<0.05 mm	40%	10%
Gravel	2-13 mm	20%	0%
Rock	13-25 mm		10% volume
Organic		15%	0%

- 3. Permeability: Hydraulic conductivity rate shall be not less than 1 in. per hr. or more than 20 in. per hr. when tested in accord with USDA Handbook No. 60, Method 34b or other Owner-approved methods.
- 4. Acidity: Soil pH range measured in the saturation extract (USDA Handbook No. 60, Method 21a) shall be 6.0 to 7.9.
- 5. Salinity: Salinity range measured in the saturation extract (USDA Handbook No. 60, Method 3a) shall be 0.5 to 2.0 dS/m. If calcium ions and sulfate ions both exceed 20 milliequivalents per liter in the saturation extract, the max salinity shall be 4.0 dS/m.
- 6. Chloride: Maximum concentration of soluble chloride in the saturation extract (USDA Handbook No. 60, Method 3a) shall be 150 mg/l (parts per million).
- 7. Boron: Maximum concentration of soluble boron in the saturation extract (USDA Handbook No. 60, Method 3a) shall be 1 mg/l (parts per million).
- 8. Sodium Absorption Ratio (SAR): Maximum SAR shall be 6 measured in accord with USDA Handbook No. 60, Method 20b.

9. Organic Matter Content: Sufficient soil organic matter shall be present to impart good physical soil properties, but not be excessive to cause toxicity or cause excessive reduction in the volume of soil due to decomposition of organic matter. Soils shall have a minimum 5% Organic Matter as Humus content, utilizing Walkley-Black soil testing method.
10. Heavy metals: Maximum permissible elemental concentration in soil shall not exceed the following:

Metal	Parts per million (mg/kg)¹
Arsenic	3
Cadmium	2
Chromium	10
Cobalt	2
Lead	30
Mercury	1
Nickel	5
Selenium	3
Silver	0.5
Vanadium	3

¹ Ammonium Bicarbonate/DTPA Extractable, dry weight basis.

11. Fertility - Range of essential elemental concentration in soil shall be as follows:

Element	Low¹	High¹
Phosphorus	2	40
Potassium	40	220
Iron	2	35
Manganese	0.3	6
Zinc	0.6	8
Copper	0.1	5
Boron	0.2	1
Magnesium	50	150
Sodium	0	100
Sulfur	25	500
Molybdenum	0.1	30

¹ Ammonium Bicarbonate/DTPA Extractable, parts per million) (mg/kilogram), dry weight basis.

- (1) If soil pH is between 6 and 7, maximum permissible elemental concentration shall be reduced 50%. If soil pH is less than 6.0, maximum permissible elemental concentration -12. Phytotoxic constituent, herbicides, hydrocarbons, and similar materials: Germination and growth of plant shall not be restricted more than 10% compared to standard controls. Standard controls shall be both monocots and dicots. Total petroleum hydrocarbons shall not exceed 100 mg/kg dry soil measured in accord with modified EPA Method No. 8015. Total aromatic volatile organic hydrocarbons (benzene, toluene, zylene, and ethylbenzene) shall not exceed 2 mg/kg dry soil measured in accord with EPA Method No. 8020.

12. Red Humic latasol soils, or types known as “Palolo Clay” or “Lualualei Clay”

or similar materials shall not be accepted.

13. Screened to pass through 1/2 in. screen.

- C. Contractor responsible for providing imported screened soil over all planting areas. Refer to Drawings for locations of various soil depths.
- D. Contractor responsible for providing 6 in. min layer of imported light weight soil mixture over all planting areas above structure. Refer to Drawings for limits of light weight soil mixture. Light weight soil mix shall not exceed 75 lb. per cubic foot saturated weight.
- E. Contractor responsible for placement of additional soil material over all areas noted to be mounded and/or bermed as shown on drawings, provide min. 36" layer of imported screened soil at Conical Mound.
- F. Backfill Mix for Trees, Shrubs, and Groundcovers: Mix thoroughly prior to placing:
 - 60% screened soil
 - 25% 3/8 in. minus black cinder
 - 15% "Menehune Magic"/organic composted soil amendment
 - 1 lb. Sustane Fertilizer per cubic yard of mix

2.02 AMENDMENTS

- A. Organic Amendments:
 - 1. Types of acceptable products are composts low in salts and heavy metals, free from weed seeds, pathogens and other deleterious materials meeting U.S. Composting Council specifications.
 - 2. Composed wood products are conditionally acceptable (stable humus shall be present). Wood based products which are based on red wood or cedar are not acceptable.
 - 3. Sludge-based materials are not acceptable.
 - 4. The compost shall be aerobic without malodorous presence of decomposition products.
 - 5. Humus material with an ash content of not less than 8% and not more than 50%.
 - 6. The pH shall be between 6 and 7.5.
 - 7. Salt content shall be less than 10 milliohm/cm at 25° Celsius (ECe less than 10) in a saturated paste extract. The maximum rate of application shall not exceed 15% by volume unless the salinity is lower than 10 milliohm/cm at 25° Celsius.
 - 8. Boron content of the saturated extract shall be less than 1.0 parts per million.
 - 9. Silicon content (acid-insoluble ash) shall be less than 20%.
 - 10. Calcium carbonate shall not be present.
 - 11. Carbon: nitrogen ratio shall be less than 20:1.
 - 12. Approved organic amendments and suppliers include Ferto (6-4-2) or Gro-Power Plus (5-3-1) or Owner approved equal.
- B. Sand: Washed, No 16 granite. Min. 40% uncompacted voids per ASTM C 1252.

Sieve No. (US Standard)	Percent Dry Weight Passing
10	100
16	95-100
20	0-20
30	0-10
40	0-2

- C. Perlite: Coarse or No. 2 perlite, free of weeds and impurities.
- D. Calcium Carbonate: Minimum 95% calcium carbonate, 100% passing a No. 60 sieve.
- E. Single Super Phosphate (0-20-0): Granular commercial grade, minimum 20% P205.
- F. Soil Conditioner: Menehune Magic by Hawaiian Earth Products, ph (808) 682-5895.

2.03 FERTILIZER

- A. Organic Fertilizer Tablets: N-P-K as recommended by soil analysis, uniform in composition, slow releasing, free-flowing and suitable for application with approved equipment, delivered to the site in unopened containers. Each fully labeled, conforming to the applicable fertilizer laws, and bearing the name or mark of the manufacturer. Sustane Enhanced with Sumicoat Controlled Release Fertilizer in Root Zone Feeder Pack, by Sustane, ph (507) 263-3003, www.sustane.com
- B. Organic fertilizer: N-P-K as recommended by soil analysis, uniform in composition, slow release nitrogen, free-flowing and suitable for application with approved equipment, pathogen and weed free, no sewage, blood or meat products, delivered to the site in unopened packaging. Each fully labeled, conforming to the applicable fertilizer laws, and bearing the name or mark of the manufacturer; apply according to manufacturer's written instructions. Sustane Fertilizer, ph (507) 263-3003, www.sustane.com

2.04 HERBICIDE

- A. Pre-emergent Herbicide: Chipco Ronstar-G as manufactured by Bayer.
- B. Pre-planting Herbicide: Round-Up or equal
- C. Soil Fumigant: Basamid G® Granular Soil Fumigant as manufactured by Cetris USA, Ltd.

2.05 PLANT MATERIALS

- A. Nomenclature: Plant names listed on Drawings conform to "Standardized Plant Names" established by Gardens of Hawaii by movie C. Neal and/or Hortus III. Except for changes covered therein, established criteria of horticulture nomenclature is followed.
- B. All plants shall meet or exceed American Standards for Nursery Stock, ANSI Z60.1 latest edition.
- C. Plants shall be symmetrical as is typical for their variety and species, in a condition of healthy and vigorous growth with healthy normal root systems well filling their containers, but not to the point of being rootbound. They shall be free

- from plant disease, insects or their eggs or soil borne pathogens.
- D. Height and spread of all plants shall be measured with branches in their normal position. Where specific dimensions of any plant material are omitted from Plant List, plants shall be as approved by Owner.
 - E. All liners, plugs, dug sprigs, and flatted material shall be fully rooted. Plants should not be pruned prior to delivery, except as authorized by Owner.
 - F. Balled and burlap plant material shall meet standards of American Standards for Nursery Stock. Burlap shall be 100% natural fiber. No leno will be accepted.
 - G. Palm Trees: Palms shall have square shaped root balls cut a minimum of 30 in. from base of trunk face. Retain a minimum of six fronds on head of palm, or as directed by Owner.
 - H. Caliper measurement shall be taken at a point on the trunk 6 in. above natural ground line for trees up to 4 in. in caliper, and at a point 12 in. above the natural ground for trees over 4 in. in caliper
 - I. Grass Plug, species to match existing turfgrass:
 - 1. Shall be healthy, living, with well-developed roots, 3 1/2 in. to 4 in. in length, freshly separated plugs and free from weeds.
 - 2. The source is to be inspected and approved by the Owner.
 - 3. Immediately following harvesting, the plugs shall be thoroughly watered then kept moist during storage and transportation until planted. No plugs shall be accepted which are not in a cool, moist, fresh condition.
 - 4. Plugs are to be delivered and planted on the same day they are harvested to assure optimum rooting. If, for any reason, it is impossible to plant them at once, plugs shall be placed in a cool shady place so air can get to them, and they should be kept moist.
 - J. Grass (Turfgrass) Sod, species to match existing turfgrass:
 - 1. The turf shall be sufficiently dense so that no soil is visible when mowed to a 1 1/2 in. height. Sod shall be of uniform density, color, and texture and shall be capable of vigorous growth and development when planted.
 - 2. Purchased in fresh, mature state from local suppliers, delivered pest-free, disease-free, and weed-free containing no more than 1% undesirable grasses.
 - 3. Growing media shall be friable and well-drained and shall not exceed 1/2 in. when cut. Standard size sections of turf grass shall be strong enough that they can be picked up and handled without damage. Broken pads, irregularly shaped pieces, and torn or uneven ends will be rejected.
 - K. Grass Stolons, species to match existing turfgrass:
 - 1. Shall be healthy, living, well developed runners, 1 1/2 in. to 2 1/2 in. in length, freshly dug up sprigs and free from weeds.
 - 2. The source is to be inspected and approved by the Owner.
 - 3. Immediately following harvesting, the stolons shall be thoroughly watered then kept moist during storage and transportation until planted. No sprigs or stolons shall be accepted which are not in a cool, moist, fresh condition.

4. Sprigs and/or stolons are to be delivered and planted on the same day they are harvested to assure optimum rooting. If, for any reason, it is impossible to plant them at once, stolons or sprigs shall be placed in a cool shady place so air can get to them, and they should be kept moist.

L. Grass Seed, species to match existing turfgrass:

1. Seed shall be certified to the following properties:

Pure Seed	95% minimum
Crop Seed	1% maximum
Weed	0.5% maximum
Inert Material	5% maximum
Germination	85% minimum

2. Seed shall comply with Hawaii Administrative Rules Title 4, Subtitle 6, Chapter 67 Seed Rules; shall be certified for compliance by a Hawaii-licensed seed dealer; and shall be purchased from that dealer.
3. Seed shall be delivered to the Project in labeled and sealed containers. Seed and labels shall be subject to the testing provisions of the Association of Official Seed Analysts. Owner will not accept for use seed that is more than 12 months old from date of certified germination test.

M. Hydromulch: Mulch shall be (paper or virgin wood cellulose fiber mulch) specifically processed fiber containing no growth or germination inhibiting factors. It shall be such that after addition and agitation in the hydraulic equipment with seeds, fertilizer, water and other additives not detrimental to plant growth, the fibers will form a homogeneous slurry. The hydromulch equipment shall be capable of mixing all the necessary ingredients to a uniform mixture and to apply the slurry to provide uniform coverage. Fertilizer and mulch mix shall be applied in one operation by approved hydraulic equipment. The equipment shall have a built-in agitation system with an operating capacity sufficient to keep the mix in uniform distribution until pumped from the tank. Distribution and discharge lines shall be large enough to prevent stoppage and shall be equipped with hydraulic discharge spray nozzles, which provide a uniform distribution of the slurry.

2.06 MISCELLANEOUS MATERIALS

- A. Water: Furnished by Owner. Distribution and connections by Contractor.
- B. Tree Stakes: Lodgepole Pine wood stakes treated with wood preservative in strict compliance with state and federal regulations. 2 in. diameter x length as required per Drawings.
- C. Staking Ties: Cinch Ties, 32 in. by V.I.T. Products, Inc., Tel: (760) 735-2450
- D. Tree Guys:
 1. Type A: #12 ga galvanized iron wire for 15 and 25 gallon trees, #9 ga. Galvanized iron wire for field stock trees, up to 3 in. caliper, or Owner-approved equivalent. Hose shall be 1/2 in. diameter black rubber hose.
 2. Type B: Duckbill DTS Guy Kit, Model DTS-88 and Model DTS-138 for trees 10 in. caliper and larger by Forsight Products, Inc., www.earthanchor.com, Tel: (800) 325-5360.
 3. Type C: Duckbill DTS Guy Kit, Model RBA-88 and Model RBK-138 for

rootball anchoring systems of palm trees. Foresight Products, Inc.,
www.earthanchor.com, Tel: (800) 325-5360.

- E. Rebar: #4 24 in. minimum length for trees 25 gallon and smaller. #7 36 in. minimum length for larger trees.
- F. Marker: Plastic surveyor tape. Bright color, minimum 18” length. Use same color throughout project.
- G. Recycled Composite Edging: Benda Board by Epic Plastics, “Teak Brown” color, 1x6 dimension,
- H. Tree Root Barriers: DeepRoot Tree Root Barriers, www.deeproot.com, ph (415) 781-9700.
- I. Landscape Filter Fabric: WINFAB 1510, UV resistant woven polypropylene textile by WINFAB, www.winfabusa.com, ph (912) 534-5757.
- J. Gravel: Washed No. 3b fine blue rock, 3/4 in. minus.
- K. Pea Gravel: Washed fine blue rock, 3/8” minus.
- L. Black Cinder: 3/8 in. minus crushed black cinder.
- M. Mulch: Mulch shall be certified by manufacturer to be free of weeds, herbicides, fungus, and other deleterious material. Provide from one of the following Owner approved types or approved equal:
 - 1. ‘Deco Mulch – Natural’ (3 in. minus)’ as supplied by Hawaiian Earth Products, ph (808) 682-5895
 - 2. ‘Cover Mulch Single Screened (3 in. minus)’ as supplied by Hawaiian Earth Products, ph (808) 682-5895

PART 3 EXECUTION

3.01 SITE PREPARATION

- A. Weed Control:
 - 1. Before and during preliminary and finish grading, dig out all noxious or invasive weeds and grasses by roots and dispose of off-site. Any non-perennial type grasses, except for Torpedo and Nut Grass, less than 2 1/2 in. high and not bearing seeds, may be turned under. Prior to planting, eliminate any weeds present in delivered plant stock.
 - 2. Site shall be maintained weed-free throughout planting operations and until final acceptance. Prior to mulching, apply pre-emergent herbicide to all shrub and groundcover areas.
 - 3. Fumigate soil for all sodded or seeded planting areas with Basamid® G granular fumigant. Apply per manufacturer’s directions.
- B. Soil Preparation (pre-tillage) for all planted areas on grade:
 - 1. All planting areas that are compacted 85% to 90% are to be cross-ripped to 12 in. depth. Areas with over 90% compaction shall be cross-ripped to 24 in. depth, and all unacceptable materials removed.
 - 2. In areas to receive import soil, scarify top of the existing soil to 4 in. minimum depth prior to backfilling.

3. Soil for planting shall be free of rocks over 1/2 in. in dia., and any foreign debris, refuse, plant roots, clods, weeds, sticks, solvents, petroleum products, concrete, plaster, or other deleterious, undesirable and unwanted materials. Such materials shall be removed, including all temporary road bases or pavement already in place.
 4. Soil shall be free of soil-borne diseases and capable of sustaining healthy plant life.
 5. Thoroughly blend planting soil off-site before applying soil amendments, before spreading blended topsoil.
- C. Landscape Erosion Control:
1. Provide for all planting areas as necessary. This shall include, but not necessarily limited to; installation of silt fences at top and bottom of slopes and at 10 ft. intervals along the face. Do not block irrigation coverage with silt fences.
 2. Provide sand bags, silt socks, sod, and/or erosion control silt fence at drainage swales until planting is established and soil has been stabilized.
 3. Repair all scars caused by erosion to original grades.

3.02 LAYOUT

- A. Confirm locations and depth of all underground utilities and obstructions. If underground construction or utility lines are encountered during excavation for planting, alternate locations for may be selected by Owner.
- B. Preliminary layout for trees shall be accomplished with colored flags or wooden stakes, each indicating plant name and container size (or other Owner approved method). Shrub material shall be spotted and approved in place by Owner prior to planting.
- C. Specimen trees that require installation prior to establishing finish grade, shall be located by surveyor for position and elevation. Provide grade stakes outside of each planting pit to determine proper elevations for trees. Scope of work shall include the adjustment or replanting of all plant material that do not properly meet final grades.

3.03 FINISH GRADING

- A. Minor grading modifications may be required to establish final grades.
- B. Finish grading shall ensure proper drainage of site, do not alter existing grades.
- C. Planting areas shall be graded such that final grades will be 2 in. below adjacent paving, sidewalks, headers and similar conditions unless otherwise indicated on Drawings.
- D. Turf area finish grade will be graded to account for the thickness of sod. Finish grade of turf area (lawn) shall be plus or minus 1 in. below adjacent paving, sidewalks, and headers.
- E. Surface drainage shall be away from building foundations at 1/4 in. per foot to aid in water runoff.
- F. Remove or redistribute excess soil before application of fertilizer. Make

allowances when establishing finish grades for earth excavation from planting pits and mulch.

- G. Trenches: If sprinkler system has been installed after grading and fertilizing has been completed, re-till trench backfill and fertilize to depth specified for area, to conform to specified requirements.
- H. Eliminate all erosion scars after each erosion event and prior to commencing maintenance period, unless directed otherwise by Owner.

3.04 INSTALLATION

A. General:

1. Ensure that final grades to ± 0.10 ft. have been established. Provide for inclusion of all amendments, settling, and other preparatory needs. Ensure that finish grading of all planting areas is as indicated on Drawings and as directed by Owner. Ensure all drainage swales and flow lines have been established.
2. Do not commence any planting until completion of all soil import, soil amendment and grading operations have been completed and approved by Owner.
3. Do not commence shrub planting until the landscape irrigation system has been installed and approved for proper coverage. Trees may be planted in advance of final landscape irrigation system provided provisions for adequate interim watering have been made. Interim watering may include providing automatic drip irrigation to all trees. Refer to irrigation Drawings and Specifications for requirements.
4. Actual planting shall be performed only during periods of suitable weather and soil conditions and during daylight hours.
5. Only as many plants as can be planted and watered on that same day shall be distributed in a specific planting area.
6. Relative position of each tree and plant as shown on the Drawings is subject to Owner approval and shall, if necessary to achieve project design objectives, be relocated prior to planting at no additional cost to Owner. Verify exact layout and locations of all plants with Owner prior to planting.

B. Planting:

1. Excavate plant pit sizes as indicated on Drawings.
 - a. Auger drain holes in bottom of planting pits.
 - b. Excavation for planting shall include stripping and stacking of all acceptable topsoil encountered within areas to be excavated for trenches, tree pits, plant pits, and planting beds.
 - c. Excess soil generated from planting pits not used as backfill, water basins, or in establishing final grades shall be removed from site.
2. Handle each plant in such a manner as to not cause injury or damage during placement or planting. Any plants damaged as a result of Contractor's operations shall be rejected and replaced at Contractor's expense.
3. The "choke" strapping method of lifting trees is strictly forbidden (except for

single trunk palms); any trees hoisted in this manner will be rejected.

4. Scarify root ball as needed and to cut any circular root systems. Properly cut off broken or frayed roots.
5. Center plants in pits or as directed by Owner.
6. Face plants with fullest growth facing forward or as directed by Owner.
7. Plant trees and shrubs to expose original container soil and set with root crown approx. 1 in. above finished grade. Backfilling will not be permitted around trunks.
8. All plants which settle deeper than their surrounding grade are to be carefully raised and replanted at correct elevation at no additional cost to Owner.
9. Set each plant plumb and hold rigidly in position until soil has been tamped firmly around rootball. All palm apical meristems shall be plumb. Fill pit with prepared soil, progressively settling soil by water jetting and flooding to remove air pockets and voids.
10. Water thoroughly immediately following planting. Backfill all voids which develop with additional prepared planting soil to bring to finish grade.
11. Box container removal:
 - a. Remove bottom of wood boxes before planting. If it is not possible to remove box bottom because of size, soil type or condition of rootball, remove every other bottom board, or other method approved by Owner.
 - b. Remove sides of box without damage to root ball after positioning plant and partially backfilling.
12. Ball and burlap removal: Remove burlap away from the crown of the tree or palm. Cut away as much of burlap as possible without injury to root ball. Remove wire basket to 18 in. below finish grade

C. Backfill:

1. Planting pits shall be backfilled with amended soil mix. Water jet to remove all air pockets.
2. In a suitable area "central mix" all backfill soil to achieve a uniform blend with amendments. The intent is to achieve a consistent well blended soil in one location and not amend soil adjacent to each planting pit. Clean-up unused excavated soil and dispose of off-site. Protect mix from water until it has been placed around plants.

D. Fertilizer Tablets:

1. Apply in accord with manufacturer's recommendations.
2. Initially set required number of tablets on the top of each root ball while plants are still in their containers to facilitate planting and verification by Owner.
3. Locate plant tablets 1/3 depth of root ball in accord with manufacturer's instructions.

E. Watering Basins:

1. Where no other temporary watering system is required, construct an earthen basin around each tree. Each basin shall be of a depth sufficient to hold at

least 4 in. of water. Maintain water basins until removal is required for installation of shrubs or turf.

2. Monitor tree and shrub root balls for adequate moisture content. Deep water and/or flood water basins as needed to maintain proper soil moisture.
- F. Tree Staking and Guying:
1. Staking and guying of all trees shall be completed immediately after planting. Provide new stakes and ties or guying cables and anchors as shown on Drawings. Remove and dispose of all original nursery stakes and ties.
- G. Pruning: shall be limited to the minimum amount necessary to remove injured branches and to shape tree for design intent as directed by Owner. This shall include, but not be limited to: lifting of branch structure, thinning of canopy, and elimination of cross branching. Pruning is not to be done in nursery prior to delivery. Pruning paint shall not be used.
- H. Auger Holes: Provide 12 in. dia. augered drain holes at 15 ft. o.c. in all planting areas and in each tree pit and as indicated on drawings. Triangular space auger holes in large areas. Backfill with amended planting soil. Required depth of drain holes is to be to free draining soil layer below planter or a maximum of 6 ft. below bottom of planting pit.
- I. Root Control Barriers: Prior to backfilling, install root control barriers around rootballs as required for specified trees shown on drawings. Connect panels to form a continuous barrier around root ball. Install per manufacturer's directions.
- J. Soil Preparation:
1. For sodded, seeded and ground cover areas (except slopes 2:1 or greater): After approximate finished grades have been established, uniformly apply required amendments and thoroughly cultivate by means of mechanical tilling into the top 6 in. of soil.
 2. The following rates and quantities shall be used for basis of bid only. Specific recommendations will be made after rough grading operations are complete and soil samples have been tested. In the event conditions are substantially different than described, adjustment will be made by Change Order as agreed upon with Owner.

Application rates given are per 1000 sq. ft.:

- a. Organic amendment: 2 cu. yd. (Humus material).
- b. Fertilizers: Single superphosphate (0-20-0) 6 lb.
- c. Potassium sulfate (0-0-50): 4 lb.
- d. Ureaformaldehyde (38-0-0): 1/2 lb.
- e. Polyacrylamide (PAM): 12 lb.

NOTE: If PAM is unavailable, increase organic amendment to 3 cu. yd. per 1000 sq. ft.

3. For soil preparation with PAM, broadcast the amendments and fertilizers as noted above. Apply PAM with a drop spreader. Use caution to avoid drift onto non-soil areas. PAM must be kept dry until it has been incorporated into the soil. Rototill amendments thoroughly into the soil 6 in. deep within 4 hours

after application of PAM. Slightly dampened soils will need an immediate tillage after the PAM application. If the organic amendment is damp and is applied after the PAM, rake the PAM into the soil to the addition of the organic amendment or allow the amendment to dry prior to application of PAM. Irrigate the soil to allow water to penetrate to a depth of 6 in. The soil needs to be damp but not saturated. Allow the soil to dry or at least dry to the point where the stringiness has disappeared, then re-rototill the soil 6 in. deep.

K. Sod Planting:

1. Preparing soil: Remove rocks, debris and perform weed abatement for area to be sodded. Rip soil to a depth of 6 in. and break up all clods to less than 1 in. in size. Soil prep as described elsewhere in Specifications.
2. Grading and rolling: Carefully smooth surface areas to be sodded. Roll areas to expose soil depressions or surface irregularities. Regrade as required to obtain optimum conditions.
3. Fertilizing: As noted in soil preparation. Verify turf fertilizer with Soils Report prior to purchasing.
4. Laying sod: Lay sod within 24 hours of harvesting. Do not lay sod if ground or soil is muddy. Lay first strip of sod slabs along a straight line (use a string in irregular areas) to form a solid mass. Butt joints tightly, do not overlap edges. On second strip, stagger joints (much as in laying bricks). Avoid damage to soil or sod during installation. Use a sharp knife to cut sod to fit curves, edges, and sprinkler heads. Do not use sod strips less than 10 in. wide. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering soil and any adjacent grass.
5. For slopes exceeding 1:3, lay sod across slope.
6. Watering: Do not lay entire lawn area before watering. When a conveniently large area has been sodded, water lightly to prevent drying out. Continue to lay sod, and to water, until installation has been completed. Do not create muddy soil.
7. Rolling sod: After laying of sod has been completed, lightly roll to eliminate irregularities and to form good contact between sod and soil. Avoid very heavy rollers or excessive initial watering to avoid roller marks.
8. Irrigation: Thoroughly water complete lawn surface with fine water spray within two hours of laying sod. Soil should be moistened at least 4 in. deep. Repeat sprinkling at regular intervals to keep sod moist 2 in. deep at all times. After sod is established, decrease watering frequency and increase amount of water per application as needed. Do not allow water to pond. Avoid excessive watering. Soil shall be moist but not saturated. Monitor irrigation as required.
9. Replacement: Replace all dead or dying sod with equivalent quality material as directed by Owner.
10. Minimize pedestrian traffic over sodded areas during its growth establishment (90 days).

L. Hydromulch

1. Areas to be hydro-sprigged/hydro-seeded shall be brought to a smooth even surface. Maintain previously established grades and swales.
2. After ground surfaces have been raked smooth and on an even plane, in accordance to specifications and upon approval by Architect and Owner or his representative, proper soil moisture must be obtained then broadcast stolons/seed uniformly at rates listed on the Drawings.
3. Determine the proper fertilizer required, for both planting and on-going maintenance, for the plant materials. Determine the quality, analysis and ratio; method of application; and frequency of the fertilizer, to insure sufficient nutrients for the sustained growth of the plant material.
4. On the same day and immediately following sprigging operations, indicated field areas are to be capped with wood fiber using conventional "Hydromulch" equipment as manufactured by the Bowie Machine Works, or approved equal. When hydraulically sprayed on the soil, the fibers shall form a blotter like ground cover, which readily absorbs water and allows infiltration to the underlying soil. In every application, complete coverage of the soil shall be attained. Mulch shall be applied at the minimum rate of 40 lb. per 1,000 sq. ft. (1700 lb. per acre) using water at the rate of 25 gallons per 1,000 sq. ft. (1,000 gallons per acre).
5. Hydromulching of turf areas shall consist of mixing the hydromulch slurry, pre-plant fertilizer product, and spraying the mixture over the newly installed grass sprigs and soil.

3.05 PLANT MAINTENANCE

- A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring watering basins, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings. Stake shrubs as necessary to ensure upright growth.
 1. Use clean pruning equipment to avoid transmitting disease and insects between plants. Clean pruning equipment each time when pruning dead tree or shrub limbs.
- B. Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, re-grade, sand, mulch, and replant bare or eroded areas as necessary to produce a uniformly and evenly finished turf lawn. Provide materials and installation the same as those used in the original installation.
 1. Apply fertilizer after initial turf mowing and when grass is dry. Use fertilizer that will provide actual nitrogen of at least 1lb./1000 sq. ft. to turf area. Use organic fertilizer whenever possible.
- C. Fill in, as necessary, soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or list in areas of subsidence.
- D. Apply treatments as required to keep plant materials, planted areas, turf, and soils free of pests and pathogens or disease. Use integrated pest management practices when possible to minimize use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

- E. Watering: schedule watering to prevent wilting, puddling, erosion, and displacement of mulch. Do not walk over muddy or newly planted areas that was recently irrigated.
- F. Mowing: Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height than 1/3 of grass height. Remove no more than 1/3 of grass-leaf growth in initial or subsequent mowing. Do not delay mowing until grass blades bend over and become matted (thatched). Do not mow when grass is wet. Remove mow clippings. Schedule initial and subsequent mowing to maintain the following grass height:
 - 1. Seashore Paspalum: 1/2 to 1 inch.
 - 2. Zoysia 'El Toro': 1 to 1.5 inches.
- G. Pesticide Application: Apply pesticides and other chemical products and biological control agents in accordance with requirements of authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed. Apply post-emergent herbicides (selective and non-selective) only as necessary to treat already germinated weeds that are difficult to remove by hand; apply in accordance with manufacturer's written recommendations.

3.06 CLEAN UP & PROTECTION

- A. Pick up all trash resulting from this work no less frequently than the last working day of each week or as directed by Owner. All trash shall be removed completely from site. After planting operations have been completed, remove trash, excess soil, empty plant containers and rubbish from property. Scars, ruts, and other marks in ground caused by this work shall be repaired and the site left neat and orderly throughout.
- B. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.
- C. Promptly remove soil and debris by work from paved areas. Leave site area broom-clean and wash down all paved areas within Contract area, leaving premises in a clean condition.
- D. Remove non-degradable erosion-control measures after plant and grass establishment period.
- E. Erect temporary fencing or barricades, and warning signs as required to protect newly planted areas from traffic and from other trades and contractors. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.
- F. Damage documentation: Provide to Owner photo documentation of damages to plants, turf, topsoil, and landscape materials by other trades during construction and during the maintenance period. The General Contractor shall be held responsible for all documented damages, which includes plant, turf, topsoil, and landscape materials replacement.

3.07 MAINTENANCE SERVICE

- A. Maintenance Service for Trees and Shrubs: Provide maintenance by skilled

employees of Landscape Installer. Maintain as required in 3.05 PLANT MAINTENANCE. Begin maintenance immediately after plants area installed and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below:

1. Maintenance Period: Six months from date of acceptance of planting completion.

B. Maintenance Service for Ground Cover and Other Plants: Provide maintenance by skilled employees of Landscape Installer. Maintain as required in 3.05 PLANT MAINTENANCE. Begin maintenance immediately after plants area installed and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below:

1. Maintenance Period: Three months from date of acceptance of planting completion.

3.08 FINAL ACCEPTANCE

- A. Maintain all planted areas free of debris and insects. Mow, cultivate, weed and water all areas until final acceptance of work is made by Owner. All punch list items shall be completed and all irrigation to be operational prior to Owner's acceptance of project installation.
- B. Satisfactory sodded turf shall be healthy, well-rooted, even-colored, viable, free of weeds, free of open joints, bare areas, and surface irregularities.
- C. Prior to final approval of work:
1. Re-sod or replant areas where necessary to obtain full and even coverage.
 2. Remove all debris resulting from work of this Section.
 3. Regrade, lightly compact, and replant around sprinkler heads where necessary to maintain proper vertical positioning in relation to established grade.
 4. Fill all depressions and eroded channels with sufficient soil mix to repair grade and ensure proper drainage. Compact lightly, and replant filled areas in accord with Drawing requirements.
- D. Final acceptance of work and approval by Owner for Substantial Completion shall include, but may not be limited to:
1. Punch list items completed and approved by Owner.
 2. Final grades approved in accord with Drawings and Specifications.
 3. Site weed-free and in accord with approved weed control plan.
 4. Trees, shrubs, groundcovers, turf, and mulches are all installed in accord with Drawings and Specifications.
 5. Landscape irrigation system complete and fully operational.
 6. As-built drawings complete and submitted to Owner.
- E. Owner will issue a Letter of Acceptance upon final completion and approval of all work.

END OF SECTION