DIVISION 2

SITEWORK

SECTION 02200: EARTHWORK STANDARDS

I. GENERAL

A. Whenever site work requires the use of soil or subsurface investigation reports, logs of test borings, or similar geotechnical data as references for the contractor, all such geotechnical data must be provided in the Information Available to Bidders. The Information Available to Bidders disclaims all such geotechnical data; however, General Conditions, Paragraph 3.17, Concealed or Unknown Conditions, requires the University to assume responsibility for conditions that vary from the represented data. (Facilities Manual 4(I):5.4.18)

B. Soils Testing

1. Earthwork may be subject to field observation and testing by a geotechnical engineer, acting as a testing agency as defined in Specification Section 01400.

C. Information from geotechnical report which belongs in specification shall be explicitly specified, not called out via cross-reference to geotechnical report.

D. Refer to Part III Site Requirements, and Specification Section 01530 Tree Protection, for other requirements affecting earthwork.

II. MATERIALS (not used)

III. EXECUTION (not used)

SECTION 02280: SOIL TREATMENT STANDARDS

I. GENERAL

A. All chemical applications used for soil treatment are subject to the approval of the UCSC Office of Environmental Health and Safety (EH&S).

B. Due to subterranean termite problems that have occurred on campus, it is necessary to treat all soil (after earthwork, including root removal, is complete) under slabs or at crawl spaces. This requirement applies to all new construction on campus, not just at wood-frame buildings.

C. Chemical applications will require inspection by UCSC Pest Control Officer or the Office of Environmental Health and Safety.

II. MATERIALS

A Names of currently approved termiticides shall be provided by the Campus Pest Control Officer through the Project Manager.

III. EXECUTION

A. Do not apply soil treatment solution until excavating, filling and grading operations are completed *and prior to placement of drainage rock or membranes*, except as otherwise required in construction operations.

B. To ensure penetration, do not apply soil treatment to excessively wet soils or during inclement weather. *Comply with labeled handling and application instructions of soil treatment product*.

C. Remove foreign matter which could decrease effectiveness of treatment on areas to be treated. Loosen, rake, and level soil to be treated, except previously compacted areas under foundations.

D. Apply soil treatment solution at rates recommended *by label of soil treatment product.*

E. Allow not less than 12 hours for drying after application, before beginning concrete placement or other construction activities.

F. Reapply soil treatment solution to areas disturbed by subsequent excavation or other construction activities following application.

SECTION 02500: PAVING AND SURFACING STANDARDS

I. GENERAL

A. To encouage storm water infiltration in small parking lots eliminate curbs or provide curb openings and slope parking lots to encourage storm water infiltration into vegetation islands and strips where the potential for erosion or hazardous material spill is not expected.

B. Sheeting drainage off roads into vegetated drainage swales or landscaped areas is encouraged (to allow more water absorption into the ground) where the potential for erosion or hazardous material spill is not expected

C. Storm water discharge from new roads will be treated for oil, grease and sediment before being released. Volume based treatment will be calculated using either the 85th percentile, 24-hour storm event or 80 percent of the annual runoff volume. Flow based treatment will be calculated using either the 85th percentile hourly rainfall intensity, multiplied by a factor of two or 10 percent of the 50 year peak flow.

D. Runoff from roads and parking lots; operation centers and municipal yards; vehicle fueling and maintenance facilities and food facility loading docks that include at least 5000sf of new or replacement impervious surfaces will be subject to treatment. Appropriate treatment could consist of discharge to a permeable area, as long as subject to appropriate sizing criteria and
5 treatment design. Volume based treatment will be calculated using either the 85th percentile, 24-hour storm event or 80 percent of the annual runoff volume. Flow based treatment will be calculated using either the 85th percentile hourly rainfall intensity, multiplied by a factor of two or 10 percent of the 50 year peak flow.

E. Runoff from parking lots > 5,000 sq. ft. will be treated for oil, grease and sediment before being released. Volume based treatment will be calculated using either the 85th percentile, 24-hour storm event or 80 percent of the annual runoff volume. Flow based treatment will be calculated using either the 85th percentile hourly rainfall intensity, multiplied by a factor of two or 10 percent of the 50 year peak flow.

F. If curbs are necessary, provide 6" high concrete or asphalt curb (concrete preferred).

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G. Refer to Part III, Site Requirements, of this Campus Handbook for other required parking, road, and path dimensions.

H. Fire lanes and roads shall have a crown section. Parking areas may use crown, cross slope or inverted crown.

D. Pavement design by a geotechnical engineer may be provided on a project by project basis.

II. MATERIALS

A. *Unless otherwise recommended by geotechnical engineer*, Campus Standards for minimum pavement thicknesses are as follows:

Roads and *traveled ways in parking lots*	Parking areas and walks over 6' wide	Walks less than 6' wide, *not adjacent to roadway or parking*

Asphalt	3"	2"	2"
Base Material	8"	6"	4"

Note: These are the minimum standards. In parking lots where there is traffic other than passenger cars, the pavement section shall be increased to accommodate increased loads. *The soils report shall be reviewed to determine whether greater pavement sections need to be provided.*

B. Minimum grade of base material shall be Class II as defined in CalTrans standards.

C.

1. *Use 1/2" Maximum, medium graded, Hot mix, Type A Asphalt concrete for parking lots and roads.*

2. *Use 3/8" maximum, hot mix, type A asphalt concrete for pathways.*

3. *Grade AR-8000, asphalt cement*

D. Concrete paths and landscape stairs shall incorporate Davis Color #5447 (Miami Buff), 1 lb per sack of cement. Confirm with Project Manager.

III. EXECUTION

A. Asphalt and base applications shall be installed in maximum 2" lifts, each lift compacted to specified levels.

SECTION 02665: WATER DISTRIBUTION STANDARDS

I. GENERAL

A. The campus is divided into four water pressure zones.
The pressure zones serve the campus as follows:

Zone 1: Lower campus

Zone 1a: Arboretum, Farm, Bird Project
Zone 1b: Barn G, Garage, Receiving, Cook House, Carriage House, Faculty Housing

Zone 2: To elevation 420

Zone 2a: Oakes College, Family Student Housing
Zone 2b: College 8, Housing Admin. Building, West Field House

Zone 3: Elevation 420 to 660

Zone 3a: Performing Arts/Visual Arts area, University House
Zone 3b: Stevenson and Cowell Colleges, Classroom Unit I, Whole Earth, Bay Tree Bookstore, Upper Quarry, Hahn Student Services

Zone 4: Elevation 660 to 900

Zone 5: Above PRV Stations located at Firehouse parking lot and above North Remote parking lot.

The zones are interconnected with pressure reducing stations.

B. All water piping shall be chlorinated. The results of water sample analysis shall be negative for the Coliform Aerogenes organisms with a coliform MPN of less than 2.2 and shall have a total plate count of less than 100 bacteria per milliliter.

C. Fire Service water systems shall be looped systems. Provide one fire service main per building compound *only*, and verify all fire service requirements with the Project Manager and the Campus Fire Marshal. The fire service line must exit off of the main line before water meter location. Fire protection water connections to a building shall be made with post indicating valve, check valve and fire department connection that are unique to that building. For very small clusters of buildings, an exception to this requirement may be made by the DCFM after receiving a written request by the project manager and after evaluation of the site plan.

D. Backflow Standards

1. Potable water systems (with no process use in the building)
   a. generally, no backflow controls at connection to water supply main are required, but confirmation with EH &S Department should occur for each project. Also see Industrial water system backflow protection in Division 15.

2. Fire protection system within premises
   a. protection of building potable water system shall be with a spring- loaded double check valve, O S & Y type assembly, located on the fire water.

3. See Division 15 for additional requirements

4. Designer is to consider the latest AWWA recommendations and the California Health and Safety Code regulations before choosing the project method of backflow prevention.

E. All water distribution main piping shall be designed to comply with NFPA 24.

F. See also Division 15 for plumbing standards.

G. At all domestic, irrigation and hydrant connections to the main provide a gate valve.

H. At all high points in water system, provide an air release valve.

I. At specific areas across campus , provide a sample tap station. Verify requirement with project manager.

II. MATERIALS

A. Acceptable piping materials are:

1. Class 200 AWWA C-900 PVC, Ductile iron pipe, cement lined

B. All piping,*valves and appurtenances* shall be rated for 200 P.S.I. working pressure.

C. Provide isolating valve at maximum spacing of 1000 feet.

D. Provide fire hydrants at max. spacing of 400 feet. Fire hydrants shall be U.L. approved, wet barrel type with *6" inlet ,* one 4-1/2 in. steamer outlet and two 2-1/2 in. hose outlets. All outlets shall have National Standard Hose Threads and shall be protected with caps chained to the hydrant. *Fire hydrants shall be wet barrel fire hydrants complying with ANSI/AWWA C503 and shall provide break off check valve with fire hydrant assembly. Provide gate valve at connection of hyrdrant piping to the main water line. Fire hydrants shall be painted yellow, with two coats factory applied paint over primer. Touch up all scratches after installation.*

E. *Valves*

All water distribution system valves, water supply valves, and fire system supply valves, including valves over 12", shall be rated to a minimum working pressure of 200 PSI. All valves shall open by turning the stem counterclockwise (left). Buried valves shall be non-rising stem with double o-ring seals equipped with a 2 inch square operating nut. The exterior shall be bituminous coated. Buried valves shall have stem extensions to place operating nut within 6" of the top of the value box. Valve boxes shall be precast concrete valve boxes with cast iron ring and lid, rated for H 20 loading. Provide eye bolt for valve identification tag within top 3 inches of valve box. Valve boxes and extensions shall be installed so that no loads are transferred to the valve, valve body or pipe. All valves shall be suitable for frequent operation as well as service involving long periods of inactivity. Valves shall be capable of operating satisfactorily with flows in either direction, and shall provide zero leakage past the seat. End connections shall be flanged or mechanical joint as required for the type of pipe and use. Contractor shall provide manufacturer affidavit of compliance per AWWA.

1. *All gate valves 3 inch through 12 inch nominal diameter shall be resilient seat gate valves, manufactured in accordance with AWWA Standard Specification C509, with the following requirements or exceptions. Valves shall be cast iron body, resilient seated wedge with non-rising stem. Gate valves shall be installed vertically in buried, horizontal water lines without gearing, bypasses, rollers, or tracks. Diameter of stem and number of turns to open shall conform to Table 4 of AWWA Standards C509. Stem seal shall consist of two 0-ring type stem seals in accordance with Section 4.7 of AWWA Standard C509. Bonnet and gland bolts shall be either fabricated from a low alloy steel for corrosion resistance or electroplated with zinc or cadmium. The hot-dip process in accordance with ASTM Designation A 153 is not acceptable. Flanges shall comply with Section 4.4 of AWWA Standard C509. Flanges shall be machined to a flat surface with a serrated finish in accordance with AWWA Standard C207. All exterior ferrous surfaces, except the flange faces, shall be evenly coated with black asphalt varnish in accordance with Section 5.3 of AWWA Standard C509, or epoxy in accordance with AWWA Standard C550. All interior ferrous surfaces, including the inside of the wedge, shall be evenly coated with epoxy in accordance with AWWA Standard C550. Epoxy coating shall be applied to a minimum thickness of 4 mils. Flange faces shall be shop coated with a rust preventive compound, Dearborn Chemical "No-Ox-Id", Houghton "Rust-Veto 344", or Rust-Oleum "R-9".*

2. *All butterfly valves 14" and above shall be rubber seated butterfly valves, manufactured in accordance with AWWA Standard C504, with a side mounted gear box, designed for buried use.*

F. Valve boxes shall be *Heavy Traffic rated*, precast concrete with cast iron traffic covers. Traffic box shall be circular with the word "WATER" embossed on the top surface.

G. Provide air release valves at all high points in the system.

H. *Provide blow-offs at low points in the system.*

I. *Provide water quality sample tap station at each building complex when the project includes work on the water supply, including adding new water supply in area.*

J. Approved reduced pressure principle backflow prevention assemblies (as per City of Santa Cruz Water Dept.):

1. Must be equipped with resilient seated shut-off valves and ball valve shut offs on test cocks. Must be supplied as complete assembly

2. Current list of approved manufacturers and models is available from the City of Santa Cruz.

K. Meters reading in cubic feet of water per hour and provided with a pulse contact for connection to the Energy Management System (EMS) shall be provided for the following building classifications:

I. Academic Buildings
2. Housing
3. Food Service
4. All irrigation points of connection. See section 02810.
5. Other areas as determined for specific projects.

L. Any non-metallic pipe shall be provided with a 10 gauge tracing wire.

III. EXECUTION

A. Pressure test piping to 200 P.S.I. with leakage limited to one gallon per hour per 1000 L.F. of installed pipe, (or a drop in pressure of no more than 10% maximum in two hours).

B. All Contractor requests for on site inspections by the campus Fire Marshal to test fire protection systems must allow for a minimum of two working days notice.

C. Thrust blocks shall be neatly formed and inspected by Fire Marshal before backfilling. Use building paper between concrete and fittings.

D. Nuts and bolts of mechanical joints shall be coated for corrosion protection.

02666: DISTRICT HEATING WATER SYSTEM STANDARDS

PART-I GENERAL

1.01 SCOPE

A. This section contains design guidelines pertaining to new connections to the campus district heating water system including the primary / secondary pumping interface required for each building connection. Also included are guidelines for underground hot water piping between buildings.

1.02 RELATED GUIDELINES

A. See Parts 1, 2 , & 3 of these standards for global information regardingdesign process, building requirements, and site requirements.

B. See Section 15010 for General Mechanical Design Guidelines.

C. See Section 15050 for Basic Mechanical Materials and Methods

D. See Section 15400 for Plumbing Design Guidelines

E. See Section 15500 for HVAC Piping

F. See 17920 for Building Management System (Direct Digital Controls).

1.03 DEFINITIONS

A. Primary Heating Water : Primary heating water shall be defined as heating water supplied directly from the campus district heating water mains on the primary side of a building primary / secondary pumping bridge or heat exchanger.

B. Secondary Heating Water: Secondary heating water shall be defined as heating water within a building on the secondary side of a primary / secondary pumping bridge or heat exchanger.

1.04 CAMPUS DISTRICT HEATING WATER SYSTEM

A. Background: The core academic buildings on campus are served by a district heating water system supplied from the Fackler Co-Generation Central Heat Plant. The system was originally designed by Kennedy Engineers and installed in several phases beginning in 1966. Initially it was operated as a high temperature system with the district supply water temperatures ranging up to 360 degrees Fahrenheit. In 1987 co-generation was added to the central heat plant and the system was converted to a low temperature system with supply water temperatures being kept below 250 degrees Fahrenheit. Drawings for the original system and subsequent retrofits are available from the campus archives.

B. Present Operation: The system is currently operated as a variable flow system. System differential pressure is controlled to a constant 20 PSI differential at a point roughly two thirds through the district loop. The interface at each building is either a primary /secondary pumping bridge or a heat exchanger dependent on elevation relative to the Central Heat Plant. Flow through the primary system at each building is controlled by a 2 way control valve which is modulated to maintain the primary return water temperature at a constant 140 degrees Fahrenheit. The primary heating water supply temperature is reset at the central plant based on multiple parameters up to a maximum temperature of 220 degrees Fahrenheit.

C. New Core Academic Buildings: The district heating water system should be used as the primary heat source for space heating and hot water for all new academic buildings constructed in the campus core. Confirm primary heating source for specific new buildings with the University's Representative.

1. Exceptions

a. Domestic & industrial hot water may be heated with hot water heater(s) located at the building when the use is anticipated to be relatively low and when approved by the University's Representative. See Section 15400 for water heater requirements.

b. Space heating for small buildings with space heating loads 500,000 BTUH or less may be accomplished with the primary heat source located at the building when approved by the University's Representative. See Section 15500 for primary heat source requirements.

c. Buildings that have sites remotely located (1,000 feet or more) from the district heating water mains may be accomplished with the primary heat source located at the building when approved by the University's Representative. See Section 15500 for primary heat source requirements.

D. Adding Heating Load: For new buildings to be connected to the district heating system, the anticipated additional heating load should be identified early during preliminary planning. This load should be submitted to the University's Representative for review by the Principal Engineer for Physical Planning and Construction. Improvements to the district system may be required to accommodate the additional heating load.

E. District Heating System Design Requirements

1. General Design Considerations

a. Maximum Working Temperature and Pressure: All portions of the primary heating water system above and below grade shall be designed to accommodate a maximum temperature of 250 degrees Fahrenheit occurring at a pressure of 150 PSI. See section 15500 for the building secondary heating water systems.

b. Ground Water Protection: Below grade piping, vaults, and manholes must be designed to prevent the intrusion of ground water which could saturate the pipe insulation. Flooded manholes and vaults will conduct significant quantities of heat out of the system into the surrounding earth. The outer conduit of conduit piping systems shall be sealed watertight. Seal all penetrations of vaults, manholes, and concrete lined trench watertight. Provide a gravity drain or a sump pump at each vault and manhole.

2. Air Relief:

a. The layout of the underground piping system should be carefully considered so as to minimize the number of system high points where air will be trapped. (Trapped air will decrease system capacity.)

b. Provide manual air reliefs at all system high points. Pipe air relief discharge to a safe location away from the operator. (Note: Steam flashing will occur under some operating conditions.) Air reliefs for the district heating system shall be detailed on the Working Drawings.

c. Wherever site grades allow, slope lateral piping to buildings at a constant slope so that air will migrate either to the district mains or to accessible locations inside the building.

d. Pipe reducers for horizontal pipe shall be eccentric type installed to provide a uniform top of pipe.

3. Drain Down:

a. Provide means for draining down lateral piping to buildings either at the building or adjacent to the isolation valves at the district mains depending on grade. All system low spots shall be provided with a valved drain leg equipped with a capped hose connection fitting.

4. Building Interface:

a. The building interface for buildings with the lowest point of the heating system occurring at elevation 775 feet and higher (Thimann Laboratory basement and higher) shall be by primary / secondary pump bridge.

b. The building interface for buildings with the lowest point of the heating system occurring lower than elevation 775 feet (lower than Thimann Laboratory basement) shall be by plate and frame heat exchanger. The heat exchanges shall be rated for 300 psi primary/secondary pressure differential.

c. Color Coding: Primary heating water piping inside buildings shall be color coded red and labeled for flow direction.

d. 2-Way Control Valve: Provide a 2 way modulated automatic control valve on the primary heating water return piping at each building to control the flow of primary heating water. Provide DDC control of the valve from the campus central energy management system (see Section 17920). Select the valve to be capable of full shut off against a differential pressure of 50 PSI. Call out the valve Cv on the drawings. For buildings with primary / secondary pumping, select the valve Cv to provide a 5 PSI pressure drop at design flow rate. For buildings with a heat exchanger, select the valve Cv to provide a pressure drop equal to the pressure drop through the heat exchanger at design flow. Provide DDC sequence of operation to control primary heating water return to a constant set point of 140 degrees.

e. BTU Meter: Provide a BTU meter on the primary heating water loop at each building. Interface the BTU meter with the campus central energy management system and provide the following information: primary heating water flow rate, primary heating water supply temperature, primary heating water return temperature, instantaneous energy use rate (BTU/Hr). Totaled energy use (BTU's).

f. Balancing Valve: Provide a balancing valve with flow measuring capabilities as detailed to throttle the maximum primary heating water flow rate. Balance the primary heating water flow to design flow rate while verifying that the 2 way automatic control valve is full open, and that the pressure differential at the system mains is being controlled to constant 20 PSI by the campus energy management system.

g. Expansion Tank: For buildings with primary / secondary pumping, select the heating water expansion tank to accommodate the pipe volume of the laterals to the building, as well as the pipe volume within the building. Oversize the building expansion tank to provide for a minimum future increase in system pipe volume of 20 per cent.

h. Makeup Water: For buildings with primary / secondary pumping, make up water is not required for the building heating water system. Make up water will be provided from the Central Heat Plant via the system mains.

i. Water Treatment: For buildings with primary / secondary pumping, a water treatment chemical pot feeder is not required for the building heating water system. Chemical treatment will be provided from the Central Heat Plant via the system mains.

5. Primary Heating Water Pipe Sizing: Primary heating water piping shall be sized based on the following criteria:

a. Size to accommodate the pressure drop through all primary loop components based on the design flow rate plus 50 per cent. Design flow rate shall be based on the assumption of an 80 degree Fahrenheit temperature differential between primary heating water supply and return. Pressure differential at the system mains shall be assumed to be 20 PSI for buildings above Kerr Hall. For Buildings below Kerr Hall, assume a pressure differential of 15 PSI at the system mains.

b. In no case shall primary heating water piping be sized with a velocity greater than 6 feet per second based on the design flow rate plus 50 per cent.

c. The minimum size for primary heating water piping laterals from the system mains to a building shall be 2-1/2 inches. Supply and return piping may be reduced in size once inside the building.

6. Connection to Existing District Heating Water Mains:

a. The points of connection to the existing district heating water mains shall be verified with the University's Representative taking into account: the additional heating load to be imposed on the system, accessibility, and pipe anchoring considerations.

b. Most of the existing heating water manholes were constructed with piping provisions to accommodate future building connections. Connection to the existing mains inside an existing manhole is usually the best option when available.

c. Connections to existing heating water mains shall be detailed on the working Drawings. The Design Professional shall be responsible for verifying the probable existing conditions at the intended points of connection by referring to the campus archive drawings and field verifying accessible points of the system. Consult with the University's Representative in cases where as-built conditions are critical such as close proximity to the footing of a future building.

d. New connections to the existing heating water mains shall be made by welded in T fittings or weld-o-lets. Penetration of the existing pipe wall shall be drilled, sawcut, or ground followed by reaming, so as to produce a smooth surface with minimal flow restriction. Use of cutting torches to penetrate the existing pipe walls will not be allowed. Within the contract documents (division 1) call out coordination of the heating system drain down to allow for welding as an activity to be listed on the schedule.

Drain down duration should be called out to be as short as possible and should not occur in the heating season. System drain downs shall be coordinated with Physical Plant with a minimum 14 days advance notice.

e. *Provide manual isolation valves at the points of connection of primary heating water laterals to buildings to the district heating water mains. Heating system valves shall not be buried. Provide a concrete vault at the valves with ample space for valve operation and removal of valves. Provide drainage provisions or sump pump to keep the vault clear of water. Isolation valves shall be flanged, steel body, bronze trim with visual status indication.*

f. *The existing mains throughout most of the campus are routed inside a poured in place concrete lined trench with a continuous concrete lid . When making new connections at a point where the concrete trench occurs, (1) Provide for required concrete sawcutting, (2) Provide for re-sealing of concrete trench to prevent water intrusion into the existing concrete lined trench.*

g. *The existing mains throughout most of the campus are insulated with approximately 2" of asbestos containing calcium silicate pipe lagging. Where this occurs, provide notification within the contract documents of the presence of asbestos and include asbestos abatement as a contract requirement. Coordinate this issue with the Executive Architect and the University's Representative.*

h. *Connections to the existing mains shall be designed to accommodate the expansion of the system mains. For this reason new connections should be located adjacent to existing anchors for the systems pipe mains whenever possible. Where this is not practical, calculate the expected expansion of the main and provide a connection design which will accommodate the lateral movement. Connection at the center of an existing expansion loop is often the best alternative option.*

i. *Lateral connections to the existing heating water mains should be made taking into consideration the system point where air relief will occur. If the lateral pipe is connected into the top of main, air relief will need to be provided to accommodate both the lateral and system main. In some cases, it may be beneficial to specify the connections as occurring to the bottom or side of the main to avoid needing to install additional air reliefs.*

j. *Heating water piping shall not be routed under building slabs.*

7. *Acceptable Piping Materials, Primary Heating Hot Water*

a. *Below grade buried: Buried heating water pipe shall be a factory manufactured conduit piping system. Inner carrier pipe shall be schedule 40 black steel with butt welded fittings. Insulation between carrier and conduit pipe shall be 2 inch thick closed cell polyurethane foam. Outer conduit pipe shall be either PVC or filament wound polyester resin composite. Outer conduit system shall be sealed water tight. Outer conduit shall be continued through pipe penetrations of concrete walls with concentric space being sealed water tight by mechanical seals. Provide provisions to accommodate pipe expansion either by expansion loops or specially manufactured elbows . Provide anchoring system where required to control the direction of pipe movement. Acceptable products include: Ricwil Terra-Gard, Perma-Pipe PolyTherm, and equal products from other similar manufacturers. Install in accordance with*

manufacturers directions and UCSC standard detail 2.6-12: Typical Underground Pipe.

b. Above grade and exposed within vaults & manholes: Schedule 40 black steel pipe with butt welded fittings except valves and strainers shall be flanged. Piping and fittings fully insulated with 2 inch thick fiberglass. See section 15500 for additional requirements for above grade HVAC Piping.

8. Testing and Inspection:

a. Primary heating water piping shall be hydrostatically tested at a minimum pressure of 225 PSI for a period not less than 4 hours. Provide slip blinds at valve flanges for valve protection during testing.

b. For buried conduit system piping, the joints for the inner carrier pipe will be left exposed until all testing has been completed.

c. For buried conduit system piping, the outer conduit shall be air tested in accordance with manufacturer's directions.

d. For buried conduit system piping, all testing shall also be in accordance with manufacturer's directions. Consult with the University Representative should the manufacturer's directions conflict with the above.

1.03 UNDERGROUND HOT WATER PIPING BETWEEN BUILDINGS

A. As a general rule for buildings not connected to the campus district heating water system, underground routing of piping for space heating or domestic hot water is not allowed. Primary heating sources should be located in the buildings.

1. Exception

a. Small buildings with relatively small loads may have space heating and domestic hot water provided via underground hot water piping from adjacent buildings when approved by the University's Representative.

B. Acceptable Piping Materials, Hot Water Piping Between Buildings

1. Below grade buried: Buried hot water pipe between buildings and not part of the campus district heating water system shall be a factory manufactured conduit piping system. Inner carrier pipe shall be Type K copper tubing with a factory supplied O-ring coupling system. Fittings shall be wrought copper with joints brazed with 15% silver brazing conforming to AWS classification BCuP-5. Insulation between carrier and conduit pipe shall be minimum 1 inch thick closed cell polyurethane foam. Outer conduit pipe shall be PVC. Outer conduit shall be sealed watertight. Provide provisions to accommodate pipe expansion through the use of expansion loops and elbows. O-ring coupling systems will be allowed to accommodate pipe expansion only when other alternatives are not practical, and must be approved by the University's Representative. Such systems shall not be placed under any concrete slabs, and shall be recorded on as-built drawings. Provide restraint system of thrust blocks and anchors as required for the specific application. Acceptable products include: Ricwil Copper-Gard and equal products from Perma-Pipe or other similar manufacturers. Install in accordance with manufacturer's directions and UCSC standard detail 2.6-12, Typical Underground Pipe.

02667: *DISTRICT COOLING TOWER WATER SYSTEM STANDARDS*

I. GENERAL

A. The campus has a central cooling tower available. Check with Project Manager for available spare capacity.

B. The present central cooling tower, located at the central heating plant, is limited to supplying core area buildings.

C. See also Division 15 for plumbing standards.

II. MATERIALS

A. Acceptable piping materials are:

1. Below Grade: Class 200 AWWA C-900 PVC with bell and spigot joints and cast iron fittings. Specify restraining method: thrust blocks or restrained joints. Restrained joints should be called out for pipe configurations where thrust blocking will be difficult.

B. Provide sectionalizing valves *at all branch connections*.

C. *Cooling towers shall have epoxy coated basins.*

III. EXECUTION (not used)

SECTION 02685: *UNDERGROUND GAS DISTRIBUTION SYSTEM STANDARDS*

I. GENERAL

A. UCSC owns and maintains the underground natural gas distribution systems throughout the campus. Gas distribution pressure is 10 PSI. The campus also has a 60 PSI distribution system, for use by the Co-Generation plant only.

B. Gas Systems shall be designed in accordance with the Uniform Fire Code with California Amendments and NFPA- 54.

C. Provide a gas regulator (provide 7" w.c. or higher pressure depending on the equipment needs. e.g. emergency generator) and meter at each new building (See Section 15400).

D. For new buildings to be connected to the campus natural gas system, the anticipated additional gas demand should be identified early during preliminary planning. This anticipated gas demand should be submitted to the Principal Engineer for UCSC Physical Planning and Construction. Improvements to the campus system may be required to accommodate the additional demand. The Principal Engineer shall identify a suitable point of connection to the campus system and what system improvements may be necessary to accommodate the new building.

E. Qualifications- Contractor shall be manufacturer certified for performing fusion splices of polyethylene gas piping.

F. New services connected to 60 PSI gas system (for use by the Co-Generation Plant only) must be installed with a double regulator station.

G. See also Section 15400 for additional plumbing standards.

II. MATERIALS

A. The existing campus gas distribution system is coated steel piping protected from electrolysis by a low voltage cathodic protection system. *Except for minimal quantities required to make connections to existing steel gas mains, no further additions of steel pipe will be made to the system so as not to stress the existing cathodic protection system. All additions to the existing system shall be with AGA approved fusion welded polyethylene gas piping (Phillips Drisco Pipe, Nypac or equal) Any breaks in the existing steel piping shall be bridged to maintain cathodic protection.*

B. As a precaution against damage from future trenching all underground gas piping shall be installed at a minimum depth of 30 inches. Underground gas piping installations shall include: a sand backfill, tracer wire, and detectable warning tape as called out in UCSC standard detail 2.6-12, Typical Underground Pipe.

C. Where underground steel pipe is required to be used for connecting into existing steel mains, all joints shall be welded, except at valves, which shall be flanged. Where not factory coated, steel pipe shall be primed and wrapped with 2 overlapping layers of 10 mil tape.

D. *Provide underground gas sectionalizing valves at all underground branch connections.* Valves shall be steel body, lubricated plug type with a minimum working pressure equal to 200 P.S.I. *(Homestead, Rockwell or equal).* Valves shall have 2" square operating nut and extensions shall be provided as required to bring the operating nut *and grease fitting* within 6" of the top of

the valve box. Valves shall be lubricated before they are put into service. *(Install per UCSC standard detail; 2.6-2, Gas Branch Main and Valve Installation)*

E. *Provide each valve with a valve box and extension to final grade. Valve boxes shall be pre-cast concrete with a triangular cast iron traffic cover marked "GAS". (Brooks 4-TT or equal).*

F. Provide AGA approved factory fabricated transition riser between below grade polyethylene piping and above grade steel piping. (Wayne Manufacturing Anodeless Riser, or equal). Field fabricated risers of wrapped or coated steel pipe will not be allowed.

G. Meters reading in cubic feet of gas per hour and provided shall be provided for the following building classifications. *Meters shall be bellows type by Singer or American.*

1. Academic Buildings
2. Housing
3. Food Service
4. Other areas as determined for specific projects.

III. EXECUTION

A. Pressure test pipe with air to 100 P.S.I.G. for 4 hours minimum.

SECTION 02720: STORM DRAINAGE SYSTEM STANDARDS

I. GENERAL

A. Provide positive surface drainage away from buildings 2.5% minimum to a collector, landscaped area or disbursement system (location to be approved by geotechnical engineer). Ponding anywhere on the site will not be acceptable (except as necessary for storm water management, the location for which must be reviewed by the geotechnical consultant). A water test is required to check for positive drainage. Water may not drain across walks and paths

B. Design piping systems to a 10-year storm frequency.

C. The storm drainage system shall be properly coordinated with surrounding campus terrain and improvements to ensure that run-off does not cause damage to adjoining area. Storm drains and culverts shall have a minimum diameter of 8 inches. Inlets shall be hydraulically designed to admit design quantities.

D. Minimum grades for surface drainage shall be 1.5% for paved gutters and small paved ditches, 2.5% for small unlined ditches, 2% for area drainage of paved surfaces and 2.5% for area drainage of unpaved yard areas.

E. The natural gradients of the existing terrain shall be retained with a minimum of cutting required. Cut and fill slopes shall not exceed 2:1, unless it can be demonstrated that a steeper slope will not result in increased erosion.

F. Underground storm drainage collection and disposal systems shall be designed to provide a minimum flow velocity of 3.0 fps when flowing ½ full.

G. Design gravity pipes to flow 90% full, without surcharge.

H. Provide 12” deep sediment trap in bottom of drain inlets and catch basins where necessary to provide water quality. University Representative to approve each location.

I. Catch basins to be minimum 24" wide to allow cleanout. Provide ADA compliant grates in walking areas.

J. Where new development drains to existing outfalls, existing outfalls shall be upgraded as necessary to extend to toe of slope and provide energy dissipation.

K. All new storm drain inlets and catch basins to be labeled to indicate prohibition of illegal discharge. Coordinate with University Representative.

L. Refer to Erosion and Sediment Control Standards For Projects Under One Acre, Stormwater Management Plan, LRDP and LRDP EIR.(Locations in Table of Contents)

II. POST-CONSTRUCTION REQUIREMENTS

A. All projects including new development or redevelopment projects that create and/or replace impervious surface are required to comply with UCSC Post-Construction Requirements as outlined below.

B. All projects that create and/or replace ≥ 500sf < 2500sf of impervious surface must implement at least the following design strategies throughout the Project site (a storm water memo documenting compliance must be provided at 100% Design Development):

i) Limit disturbance of natural drainage features
ii) Minimize compaction of highly permeable soils
iii) Limit clearing and grading of native vegetation at the site to the minimum area needed to build the project, allow access, and provide fire protection
iv) Minimize impervious surfaces by concentrating improvements on the least-sensitive portions of the site, while leaving the remaining land in a natural undisturbed state
v) Minimize stormwater runoff by implementing one or more of the following site design measures:
(1) Direct roof runoff into cisterns or rain barrels for reuse
(2) Direct roof runoff onto vegetated areas safely away from building foundations and footings, consistent with California building code
(3) Direct runoff from sidewalks, walkways, and/or patios onto vegetated areas safely away from building foundations and footings, consistent with California building code
(4) Direct runoff from driveways and/or uncovered parking lots onto vegetated areas safely away from building foundations and footings, consistent with California building code
(5) Construct bike lanes, driveways, uncovered parking lots, sidewalks, walkways, and patios with permeable surfaces

C. For all projects that create and/or replace ≥ 2500sf of impervious surface see Campus Standards Appendix C for Post-Construction Requirements.

III. MATERIALS

A. Acceptable piping materials are:

1. PVC drain pipe. Minimum grade: ASTM, SDR 35. For pipe sizes smaller than 12 inch diameter. This includes perforated drain piping behind retaining walls.
2. Corrugated metal pipe (CMP): acceptable but not desirable; will not be approved in main campus area. Review application with project manager.
3. Reinforced concrete pipe (RCP). 12 inch diameter and over.

B. Gravity flow piping serving manholes can be:

1. Reinforced concrete pipe
2. Cast iron soil pipe.
3. PVC pipe (minimum grade, ASTM D3034, SDR 35)

C. Pressurized or pumped piping serving manholes can be:

1. Schedule 40 (minimum) P.V.C. pipe with solvent weld joints.

SECTION 02730: SANITARY SEWERAGE SYSTEM STANDARDS

I. GENERAL

A. Minimum pipe slope shall be 2%.

O. B. Manhole spacings at 300 L.F. max. or less as required.

II. MATERIALS

A. Acceptable piping materials are:

1. Vitrified clay pipe with bell and spigot joints.
2. Concrete lined cast iron.
3. PVC Pipe: ASTM D3034, SDR 35 with elastomeric gasketed joints conforming to ASTM D3212

B. All science buildings shall have an acid resistant sewer and be neutralized prior to connection to the sanitary system.

III. EXECUTION

A. Pressure test sewer piping to 5 P.S.I.G. with air for 15 minutes, 1/2 lb. maximum pressure drop.

SECTION 02780: UNDERGROUND CONDUIT STANDARDS

See Section 16100 for requirements.

Refer to Part III Site Requirements, and Specification Section 01530 Tree Protection, for other requirements affecting underground conduit.

SECTION 02800: SITE IMPROVEMENTS STANDARDS

I. GENERAL

A. Refer to Part III and Specification Section 01530 Tree Protection, for other requirements .

B. Refer to Part VI of this Handbook for details of standard bicycle hitching posts, bollards, *lockboxes*, fencing, and other standard items.

C. Refer to the "Campus Signing Program, UCSC" publication, available from the Archives and Drafting Unit of the UCSC Office of Physical Planning and Construction, when site or road signs are required as part of a project. Additions to the Program may be found in later projects. See UCSC File Nos. 8920, 3000-45, 2600-50.

D. *Standards for pressure treatment at wood retaining walls, posts, and header boards: Refer to Section 06100.*

II. MATERIALS (not used)

III. EXECUTION (not used)

SECTION 02810: IRRIGATION STANDARDS

I. GENERAL

A. Provide water meters (separate from any building water) at all irrigation system lines. *For drip systems, specify low water meter. Provide electronic flow sensor at point of connection for system* . Note: Some small projects or additions to existing systems may not require separate meters. Verify with Project Manager.

D. Low precipitation rate systems shall be used where possible.

E. Irrigation systems shall comply with state and local codes and regulations, e.g. AB325.

F. Refer to Part III and Specification Section 01530 for other requirements .

II. MATERIALS

A. Pipe and Fittings:

1. Live main water lines and all sprinkler laterals shall be virgin polyvinyl chloride #1120-1220, 315 P.S.I. or Sch. 40, N.S.F. approved with primed and heavy bodied solvent welded

2. Preferred drip system configuration is rigid PVC pipe and PVC risers with bubblers installed inside plant watering basins. Also acceptable are drip system laterals of black polyethylene tubing, ASTM standard or better, with STD polyethylene drip tubing compression type fittings.

3. Drip micro tubing shall be installed into lateral with transfer barb of appropriate size.

4. Threaded PVC pipe and nipples shall be SCH. 80 or galvanized pipe. All threaded fittings and nipples shall be wrapped with Teflon tape prior to assembly.

5. Risers shall be SCH. 80 PVC and wrapped with Teflon tape prior to assembly.

B. Backflow preventive device shall be an approved, above-ground reduced pressure principle backflow prevention assembly equipped with resilient seated *ball* valves. (See Section 02665 for approved list.)

C. *All manual shut off and isolation valves shall be ball type.*

D. Pressure regulator valve (PRV) shall be diaphragm type with union, Watts U5B series, Wilkins 600 PRV, or equal. *Smaller PRV's (2" and less) shall be installed on the riser of the backflow prevention assembly. Larger PRV's shall be installed in a valve box.*

E. *Controller shall be RainMaster Evolution Satellite Assembly DX3. The University has an existing network enabling commmunication with the RainMaster Evolution Satellite system, therefore, no substitution shall be permitted unless proposed controller has all of following features without exception:*
1. Communication compatible with RainMaster Evolution Central Control Software.
2. Single manufacturer's system including controller, satellite main board, pre-wired.
3. Controller shall be capable of providing malfunction warnings on both irregular current and flow levels.
4. Controller shall be capable of monitoring moisture and flow readings.

5. *Controller shall be compatible with radio, telephone, and hardwire communication.*
6. *Controller shall have programmable rain shutoff capability as well as the ability to monitor/read flow.*
7. *Controller shall have dedicated outputs for two (2) normally closed master valves, one (1) normally open master valve, one (1) pump and auxiliary 24 VAC.*
8. *Basic operation features shall be accessible via remote control.*
9. *Unit shall have built in remote control jack.*
10. *If mounted in an enclosure, unit must be UL approved.*
11. *Solid state. microprocessor-based; capable of fully automatic, semi-automatic or manual operation.*
12. *Programming: 6-48 stations, 12 programs; individual station programming option, 8 start times and non volatile memory.*
13. *Programmable water window.*
14. *Program review capability.*
15. *Field wire condition detection.*
16. *Water budgeting: 0-999 percent.*
17. *Standby watering schedule.*
18. *High and Low flow levels, programmable and monitored.*
19. *Water use review, prior month, current month.*
20. *Controller shall be equipped with appropriate interface board for radio communication and installed antenna.*

F. Flow sensor Shall be Rainmaster EVFM-PXX (no known compatible), where XX designates pipe size appropriate for system capacity. Flow meter shall be installed with a straight length of pipe at least 10 times the pipe diameter upstream of the flow sensor and at least 5 times the pipe diameter on the downstream side of the flow sensor. Flow sensor shall be connected to controller clock with RainMaster EV-CAB-SEN cable or equivalent. For drip systems, specify low flow water meter.

G. Sprinkler heads:

1. Lawn:

Small lawn areas	4" to 6" lawn pop-up Rainbird 1800 series Toro 570C w/ check valve, or equal
Medium range areas	gear driven pop-up Hunter PGP series, or equal
Large turf areas	gear driven pop-up Hunter "I" series, or equal.

All lawn heads shall be installed with a swing joint assembly and check valves on heads located on sloped areas.

2. Shrub:

a. 12" High Pop-up, Rainbird 1812 series, Toro 570 series, or equal.

b. Plastic shrub nozzles on 1/2" Schedule 80 risers may be used in areas away from paths, walks, drives, etc.

c. All shrub heads shall be installed with a swing joint assembly.

3. Drip:

Emitters shall be *cleanable*: *Hardi DBK*, Salco, Pepco, Vortex, or equal, of appropriate size and flow installed with micro tubing.

H. Quick coupler valves shall be of the one piece, double lug. l" type and installed on galvanized swing joint assembly. QCV shall have a concrete sprinkler block installed. *QC is to be fastened to 30" #3 rebar with two 2" diameter screw worm clamps.* Buckner 2500, Rainbird, or equal. QCV keys shall accompany every four QCV. Provide Sprinkler collar: Christy Block # M30SBA, Brooks #1-59, or equal.

I. Remote control valves shall be brass, 24 volts, electrically operated, normally closed type, *contamination proof, self flushing*, installed with union in valve box. Rainbird EFB series, Buckner, or equal.

J. Master valve shall be installed at the point of connection before the flow sensor. Master valve shall be brass normally open electric diaphragm valve.

K. Manual control valve shall be angle type with union and cross handle (anti-syphon shall be specified on drawings). MCV shall be installed inside valve box with stem and cross handle not more than 6" from the top of box. Champion 300 series, Buckner 2200 w/ union, or equal.

L. Irrigation control wire shall be direct burial wire specifically for wiring of underground electrical controls, type UF and UL approved. Wires connecting each solenoid to control panel shall be RED, and all common return wire shall be WHITE. Minimum wire size shall be #14 *and provide 12" minimum extra wire length per connection.* Connections at valves shall be water tight made with Drisplice, Scotchlok sealing packs, or equal. *Provide 3 wires (two of simular color and one white) from irrigation controller to point of connection (POC) for future expansion. Provide an additional continuous #14 wire of different color for back up power to all control valves.*

M. Valve boxes shall be precast concrete with reinforced concrete lids or plastic boxes with lids. Minimum size Christy Utility Box B3, Brooks #3 Series, or equal. *Provide adequate clearance within valve boxes for easy operation of contained equipment. Valve boxes shall be installed on a 6" minimum base of 1" or larger drain rock. Valve boxes shall be traffic rated wherever installed in vehicular traffic areas.*

N. Drip systems shall have an additional PRV (Watts IR 56, Buckner, or equal) and drip filter system with a 150 mesh filter (Amiad 39 series, Ag Products, or equal) installed directly down stream of the remote control valve in a separate valve box.

III. EXECUTION

A. Pressure Test: All mains shall be tested under hydrostatic pressure for four hours at 125 pounds per square inch and be proven watertight. *The University's Representative shall be present for such tests.*

B. Coverage Tests: When the sprinkler system is completed, the Contractor shall perform, in the presence of the Architect, a *uniformity test with water catch cans* to determine if the water coverage of lawn and planting area is complete and adequate. The Contractor shall furnish all materials and perform all work required to correct any inadequacies of coverage disclosed.

C. Tracer Wires:

All live main lines buried under hard surface areas (roads, paths, etc.) shall have a copper tracer wire incorporated in the trench. Remote control valve wiring can act as a tracer in instances where it is included in the main line runs. Pressure lines to quick coupler valves are considered live mains.

D. Minimum Depth:

1. 18 inches over pressure main lines.
2. 12 inches over non-pressure lateral lines supplying oscillating heads, shrub and pop-up heads.
3. 15 inches over lines of rotary pop-up heads.

E. Provide sleeves beneath all paved areas for irrigation piping. Sleeves shall be installed so that all joints occur outside of pavement area.

F. Verify that all irrigation lines are buried deep enough to avoid any damage during subsequent landscaping operations. (such as rototilling, tree planting, etc.)

G Controller enclosure pad (if applicable) shall be poured to include 1" PVC electrical conduit for 120VAC power supply, 1" PVC electrical conduit for phone or radio wires and a PVC electrical conduit sized as needed for master and remote control valve wires. Controller pad shall also be poured to include 5/8" dia. x 8' ground rod terminating inside enclosure and 3" above concrete surface.

H Communications antenna shall be installed in accordance with manufacturer's specifications.

I. Backflow preventive devices: See Part VI for standard installation detail.

SECTION 02830: CHAIN LINK & WIRE FENCES AND GATES STANDARDS

I. GENERAL

A. *Both chain link and welded wire with wood posts are in current use on campus, generally in its less developed areas. Verify with the Project Manager which fence would be appropriate for any particular project.*

II. MATERIALS

A. All chain link fences and gates provided for permanent locations in areas of visual importance shall be vinyl coated (black or dark green). Verify with the Project Manager.

B. Welded wire with wood posts, see standard detail Part VI, 2.8-2.

III. EXECUTION (not used)

SECTION 02900: LANDSCAPING STANDARDS

I. GENERAL

A. Minimum Design Criteria:

Landscape planting design shall consider selection of plant materials that are generally water efficient, resistant to deer browsing, will be easily maintained, and that are appropriate to the surrounding natural environment or site conditions. Ground cover and vegetation shall be designed to minimize erosion. All plantings, trees, lawn and ground covers shall be of varieties having compatible with existing soils. Sizes of plants selected should be adequate to assure their survival; smaller plants are encouraged to maximize adaptability to the site conditions. All plants shall be guaranteed through one growing season.

B. *Refer to Part III of this handbook and Specification Section 01530 for other requirements .*

II. MATERIALS

A. Plants: Plants shall be in accordance with the California State Regulations for Nursery Inspection of Rules and Grading, and shall conform with American Association of Nurserymen Standards, ANSI Z60, in all ways.

1. All plants shall have a normal habit of growth and shall be sound, healthy and vigorous. All plants shall have vigorous and fibrous root systems which are not root bound *and free of root defects*.

2. Plants shall be symmetrical *with proper trunk caliper/taper* and typical for variety and species.

3. Plants shall be nursery grown under climatic conditions similar to those in Santa Cruz County or shall be acclimatized prior to planting.

B. Fertilizers: Appropriate soil tests shall be performed and fertilizers, *amendments*, and application rates shall be recommended based on those tests and other relevant site conditions.

1. *Chemical or organic fertilizers and amendments should not be used when planting California native plants, since they destroy Mycorrhizal Fungi, which are essential to healthy root systems.*

C. Topsoil:

1. Topsoil will be stockpiled on the site for future use.

2. If insufficient topsoil has been stockpiled on the site to complete the work as indicated on the drawings and herein specified, supply import topsoil of sufficient quantity to complete the work.

a. Provide Combination Fertility, Agricultural Suitability, and Particle-Size Test, performed by a soils laboratory approved by the Architect and conforming to the requirements of Section 01400. Services of the laboratory shall be paid for by the Contractor.

1. Agricultural Suitability:

Salinity (ECE x 10(3)):	0-2
Sodium (SAR):	0-4
Boron (PPM in Saturated Extract):	0-.7

2. Particle Size

	Minimum	Maximum
Clay and Silt	20%	50%
Fine Sand	30%	40%
Coarse Sand	5%	20%
Gravel (Maximum Aggregate size 3/4")	0%	8%
Decomposed Organic Matter	2%	50%

b. Should the samples not meet all of the standards given above, the soil laboratory may submit in the report what additives should be installed to correct these problems.

c. Soil shall be similar to existing topsoil and the approval of the Architect must be obtained before delivery of topsoil to the site.

D. Herbicides:

1. Any pre-emergent or post-emergent herbicide used for weed control must be approved for use by the Campus Office of Environmental Health and Safety (EH&S).

III. EXECUTION

A. Soil Preparation:

1. Soil Testing

a. A soils test will be executed prior to the planting of any and all plant material. The soils test will be done by the Testing Agency and furnished to the Executive Architect. The location of the soil samples on the site will be determined by the Executive Architect and the Project Manager.

b. The soils test must include existing soils analysis, as well as recommendations for general soil amendments and planting backfill mix.

2. Grades

a. Subgrades for areas to receive topsoil: Subgrades shall be 6 inches below finished grades, plus or minus 1 inch, allowing for 6 inches of topsoil and soil amendments.

b. Grades of planting areas not to receive topsoil shall be established to within 1 inch of finished grade.

3. Soil Loosening

No finish grading or installation of topsoil shall be done until soil loosening has occurred. Soil in all planting areas shall be cultivated to the depths specified below:

a. Subgrade of areas to receive topsoil: 8" deep

b. Areas not to receive topsoil: 8" deep

B. Planting

1. Planting of Trees and Shrubs:

Dig holes for trees twice the diameter of the rootball or natural spread of roots, and provide 6 inches of clearance under the rootball. Similarly dig holes for shrubs and vines a minimum of 6 inches greater than the rootball. Allow minimum of 6 inches under all plant balls. Any tree that can not stand on its own under windy conditions shall be staked. Remove nursery stake and ties. Place two stakes perpendicular to the prevailing wind. Use two broad, flexible ties. Trees requiring staking shall be staked with 2 x 2 x 9' redwood stakes or lodge pole pine tree stakes. Do not put stakes through root ball. Stake all trees according to the "Harris Method". Refer to "Staking Landscape Trees", leaflet 2576, published by The Division of Agricultural Sciences, University of California, 1982. Copies are available at the UCSC Office of Physical Planning & Construction Also see staking detail, Sheet 2.9-1, Part VI of these standards.

C. Soil Conditioning

1. General:

After soil preparation has been completed and high and low spots graded, add soil amendments as indicated and rototill, making repeated passes with the cultivator to the depth specified until the amendments have been thoroughly mixed.

2. Tree and Shrub Planting Holes

a. Planting Holes

1. Locate planting holes per planting plans bringing any conflict with underground utility lines to the attention of the Project Manager.

2. Excavate square holes to the sizes and depths indicated on the drawings.

3. Excavated soil may be spread evenly over shrub beds provided required finished grades are maintained, previously done soil conditioning is not covered, and rocks 2 inches in diameter and debris are removed and disposed of off the site.

4. Scarify the sides and bottom of the holes.

b. Backfilling

1. Backfill the planting holes with the backfill mix amended as per the Soils Analysis to be suitable to the site and the particular planting.

2. Water-settle backfill thoroughly or compact by other approved method prior to planting so plants do not settle.

3. Provide a watering basin berm at all planting holes.

c. Backfill Mix

1. Materials: topsoil with added amendments as recommended by the Soils Analysis.

2. Mixing:

i. Prepare the mix in stockpiles on site; do not mix at each individual planting hole.

ii. Mix thoroughly, leaving no layers of soil amendments or clods of soil.

3. Fertilizer Tablets: *Use Nitrogen Phosphorous Potassium (NPK Tablets). Fertilizer tablets are not recommended in planting holes where California natives are to be planted.*

D. Maintenance

1. Establishing Maintenance Period:

a. As soon as all planting is completed, a planting review to determine the condition of the plantings will be held.

b. Upon approval of the work by the Owner's Representative, the 60 day maintenance period shall begin.

2. Maintenance of Planting:

a. Continuously maintain all plantings in areas included in the contract from the beginning of contract work, during the progress of work, and for a period of 60 days after completion of all work or until final acceptance of all contract work by the Owner, (whichever is later).

b. Scope:

1. New plantings.
2. Existing plantings within the construction area.
3. Continuous operations of watering, weeding, cultivating, mowing, trimming, edging, rolling, fertilizing, insect, pest, fungus, and rodent control, and any other operations to assure good normal growth.

c. Fertilizing:

In addition to fertilizing of trees and shrubs as required, furnish and apply any additional fertilizers necessary to maintain plantings in a healthy, green, vigorous growing condition during the maintenance period.

E. Guarantee

1. All trees, shrubs, groundcovers, and other plant materials shall have a guarantee period which encompasses the replacement of dying, unhealthy, unsightly or non-typical habit plant material from the time of final acceptance for one calendar year.

2. Any trees or other plant materials that die back and lose the form and size originally specified, shall be replaced, even though they have taken root and are growing after the die-back.