CITY OF LIVERMORE

TECHNICAL SPECIFICATIONS

DIVISION 32 – EXTERIOR IMPROVEMENTS

SECTION 321000

ASPHALT PAVEMENT, BASE AND SURFACE TREATMENTS

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide all materials, equipment, and labor necessary to furnish and construct the roadway structural section, base repair, asphalt overlay, and all appurtenant work, complete in place, as shown on the Drawings and as specified herein.

B. **Work Covered in this Section:**

1. Preparation of Subgrade.
2. Aggregate Subbase.
3. Aggregate Base.
4. Tack Coat.
5. Asphalt Concrete Base Repair.
6. Pavement Crack Sealant.
7. Remove and Replace Traffic Markings.
8. Pavement Grinding.
9. Pavement Pulverization and Reshaping & Compaction of Base Material.
10. Sawcutting.
11. Pavement Reinforcing Fabric.
12. Pavement Reinforcing Mesh
13. Asphalt Concrete Overlay, Utility Cut Pavement Replacement, and Pavement Structural Section.
14. Adjust Iron Castings to Grade.
15. Pavement Flood Testing.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A.	Section 311300	Selective Tree and Vegetation Trimming and Removal.
B.	Section 311316	Root Pruning.
C.	Section 310000	Earthwork.
D.	Section 312300	Utility Earthwork.
E.	Section 333900	Precast Concrete Maintenance Holes.
F.	Section 311723	Traffic Stripes and Pavement Markings.
G.	Section 321300	Concrete Surface Improvements
H.	Section 022100	Monuments.
I.	Section 055000	Miscellaneous Metal Work
J.	Division 1	General Requirements.

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. **State of California (Caltrans) Standards**

1. Standard Specifications:

Section 15	Existing Highway Facilities.
Section 19	Earthwork.
Section 25	Aggregate Subbases.
Section 26	Aggregate Bases.
Section 37	Bituminous Seals.
Section 39	Asphalt Concrete.
Section 42	Groove and Grind Pavement.
Section 84	Traffic Stripes and Pavement Markings.
Section 85	Pavement Markers.
Section 88	Engineering Fabrics.
Section 92	Asphalts.
Section 93	Liquid Asphalts.
Section 94	Asphaltic Emulsions.

B. **Commercial Standards:**

ASTM D 36	Test Method for Softening Point of Bitumen (Ring-and-Ball Apparatus.)
ASTM D 276	Test Method for Melting Point of High Strength Open Fiber Glass Mesh.
ASTM D 1557	Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb (4.54-kg) Rammer and 18-in. (457-mm) Drop.
ASTM D 3407	Methods of Testing Joint Sealants, Hot-Poured, for Concrete and Asphalt Pavements.
G.R.I. GGI-87	Methods of Testing High Strength Open Fiber Glass Mesh for Tensile Strength and Maximum Elongation at Break.
D 5261-92	Method for Determining Minimum Mass/Unit Area of Open Fiber Glass Mesh.

1.4 CONTRACTOR SUBMITTALS

A. **Certificates of Compliance:** Certificates of Compliance shall be provided for all products and materials proposed to be used under this Section.

B. **Delivery Tickets:** For City public works projects, the CONTRACTOR shall provide delivery tickets to the ENGINEER at the time of delivery of each load of product, including aggregate subbase, aggregate base, asphalt concrete, liquid asphalt, sealant, and paving reinforcement fabric. Each delivery ticket shall include or be accompanied by appropriate batch information produced by the batching plant or factory of origin and information stating the mix or model number, total yield in kilograms, liters, or square meters, and time, date, and location of delivery.

1.5 QUALITY ASSURANCE

A. The CITY will employ a testing laboratory to perform all quality assurance testing and inspection testing as may be required by this Section.

B. At the discretion of the ENGINEER the CONTRACTOR shall flood test all asphalt pavement for proper drainage by flooding with water (recycled water when available) in ample quantity to demonstrate the correct shaping of the pavement.

PART 2 -- PRODUCTS

2.1 AGGREGATE SUBBASE

A. Aggregate subbase material shall be the class specified on the Drawings and shall be in conformance with Section 25, "Aggregate Subbases," of the Caltrans Standard Specifications.

2.2 AGGREGATE BASE

A. Aggregate base material shall be Class 2 aggregate base in conformance with Section 26, "Aggregate Bases," of the Caltrans Standard Specifications. All aggregate base used on the work shall conform to the 19 millimeter maximum size gradations.

2.3 TACK COAT OR PAINT BINDER

A. A tack coat or paint binder shall be SS-1 asphalt emulsion in conformance with Section 39, "Asphalt Concrete," of Caltrans Standard Specifications.

B. A tack coat or paint binder to be used with pavement fabric or mesh shall be asphalt grade PG 64-16 in conformance with Section 92, "Asphalts," of the Caltrans Standard Specifications.

2.4 ASPHALT CONCRETE BASE REPAIR

A. Asphalt concrete for base repair shall be Type A for all City streets.

B. The asphalt binder shall be paving asphalt Grade PG 64-10 in conformance with Section 92, "Asphalts," of the Caltrans Standard Specifications.

C. The aggregate shall be 3/4-inch maximum size, medium grading, in conformance with Section 39, "Asphalt Concrete," of the Caltrans Standard Specifications.

2.5 PAVEMENT CRACK SEALANT

A. The pavement crack sealant shall be a modified asphalt composition conforming to the following requirements:

Test	Test Method	Requirements
Softening Point	ASTM D 36	180-degree F. minimum
Core Penetration	ASTM D 3407	30-dmm minimum

at 77-degrees F.		
Resilience at 77-degrees F.	ASTM D 3407	30 percent minimum
Flow	ASTM D 3407	3-mm maximum

B. If asphalt ground rubber is used, the gradation of the asphalt ground rubber shall be such that 100 percent will pass a No. 8 sieve.

C. The material shall be capable of being melted and applied to cracks and joints at temperatures below 400-degrees F. When heated, it shall readily penetrate cracks 1/4-inch wide or wider.

2.6 PAVEMENT REINFORCING FABRIC / CRACK-RETARDING MASTIC MEMBRANE AND PAVEMENT REINFORCING MESH

A. Pavement reinforcing fabric shall be a non-woven material designed as a pavement reinforcing fabric in conformance with Section 88, "Engineering Fabrics," of the Caltrans Standard Specifications.

B. Crack-retarding mastic membrane is intended as a stress relieving interlayer to control development of reflective cracking from occurring in the overlay of isolated areas of moderate to severe surface cracking. It may include an adhesive backing and release liner. Crack-retarding mastic membrane shall be as manufactured by **Pavetech International. - Paveprep, Paveprep SA , and AMOCO Fabrics and Fibers Company - Petrotac or equal.**

C. Pavement reinforcing mesh shall be a high strength glass fiber grid designed for reinforcing wider overlay areas with tensile resistance against pavement fatigue created by higher traffic loading and to prevent reflective cracking by relieving stresses as either an underlayment or an interlayer. It usually requires a self-tacking adhesive for installation or may be specified as a composite with a waterproofing membrane or nonwoven fabric layer.

The pavement reinforcing mesh shall be a knitted, glass fiber strand grid with the following minimum characteristics, or an equal material, as determined and approved by the ENGINEER.

Test	**Test Method**	**Requirements**
Tensile Strength	G.R.I. GG 1-87	560 lbs/in. (100 kN/m) Component strand strength
Elongation at Break	G.R.I. GG 1-87	5 Percent Maximum
Melting Point	ASTM D 276	425 deg.-F (218 deg.-Celsius)
Mass/Unit Area	D 5261-92	11 oz./sq. yd. (370 g/m2)

All values represent certifiable average minimum roll values in the weakest principal direction of the grid. The manufacturer shall supply test data to the ENGINEER for review prior to the start of mesh placement. Data shall be signed by the responsible quality assurance principal at the manufacturing facility and be representative of all of the product used on the project.

2.7 ASPHALT CONCRETE OVERLAY, UTILITY CUT PAVEMENT REPLACEMENT, AND PAVEMENT STRUCTURAL SECTION

A. Asphalt concrete shall be Type A on all City streets.

B. Asphalt concrete shall be placed at the thickness indicated on the Drawings.

C. The asphalt binder shall be paving asphalt grade PG 64-10 in conformance with Section 92, "Asphalts," of the Caltrans Standard Specifications.

D. The aggregate shall be 1/2-inch maximum size, medium grading for overlays and top lift(s) of pavement structural sections in conformance with Section 39, "Asphalt Concrete," of the Caltrans Standard Specifications. The minimum overlay thickness for the top lift shall be 1.5 inches (38 mm). The aggregate shall be 3/4-inch maximum size, medium grading, for the bottom lift(s) of pavement structural sections in conformance with Section 39, "Asphalt Concrete," of the Caltrans Standard Specifications. For pavement structural sections less than 4 inches (102 mm), the aggregate shall be 1/2-inch maximum size, medium grading in accordance with Section 39, “Asphalt Concrete,” of the Caltrans Standard Specifications.

E. Recycled

2.8 FINE ASPHALT CONCRETE PAVING

A. Fine asphalt concrete for patch paving shall be Type B, 3/8-inch maximum size. The asphalt binder shall be paving asphalt grade PG 64-10 in conformance with Section 92, "Asphalts," of the Caltrans Standard Specifications.

2.9 PORTLAND CEMENT CONCRETE

A. Portland Cement Concrete used to adjust utility structure frames and monument frames to grade shall be Class B in conformance with Section 033050, "Utility Cast-in-Place Concrete."

2.10 IRON CASTINGS AND COVERS

A. The CONTRACTOR shall provide new iron castings in accordance with Section 055000 “Miscellaneous Metal Work” and the City Standard Details when required by the ENGINEER.

PART 3 -- EXECUTION

3.1 GENERAL

All work adjacent to existing pavement structural section shall butt up to the full existing structural section. Where the full pavement structural section is not encountered, continue removal of additional pavement structural section until a full pavement structural section is found.

3.2 PUBLIC NOTIFICATION

All homeowners, businesses and public facilities affected by the WORK shall be provided with prior notification of the WORK and necessary parking restrictions, in conformance with Division 1, General Requirements. All notifications shall be provided twice in conformance with the following:

1. A written notification shall be mailed to each affected business/residence a minimum of two weeks prior to commencing the work.

2. Door hangers shall be provided 72 hours prior to commencing work.

The format of the required notifications shall be approved by the Engineer. The CONTRACTOR shall coordinate the notification process and follow up each notification with submittal to the ENGINEER of a signed affidavit confirming time and date of each notification.

3.3 ORDER OF WORK

A. Selective tree and vegetation trimming and/or root pruning operations necessary for work requiring equipment accessibility or installation of improvements shall be completed prior to commencement of that work.

B. All underground utilities shall be installed, inspected and approved, and all backfill and compaction operations shall be completed prior to commencement of pavement structural section construction.

C. Cutting or patching of finished pavement will not be allowed.

3.4 PREPARATION OF SUBGRADE

A. The subgrade shall be prepared in conformance with Section 19, "Earthwork," of the Caltrans Standard Specifications, unless modified by this Section.

B. Subgrade preparation shall extend a minimum of 2 feet beyond all concrete improvements and asphalt paved areas. Unless otherwise recommended in the soils report, the subgrade shall be scarified to a minimum depth of 6 inches below the grading plane, mixed thoroughly and wetted in conformance with ASTM D 1557, or dried as directed by the ENGINEER. The pavement section, the entire area under the curb and gutter, bus turnout area, and the area 2 feet beyond any edge of pavement without abutting concrete improvements shall be thoroughly compacted to not less than 95 percent relative compaction in conformance with ASTM D 1557. Compaction of subgrade under sidewalk, access ramps, driveways, median surfacing and the area 2 feet beyond any concrete improvements shall be thoroughly compacted to not less than 90 percent relative compaction in conformance with ASTM D 1557. The surface of the subgrade after compaction shall be hard, unyielding, uniform, smooth, self-draining, and true to grade and cross-section.

C. All soft material which will not compact readily and all unstable material shall be removed in conformance with the Section entitled "Roadway Excavation," in PART 3 of Section 310000, "Earthwork." All materials for subgrade replacement shall be in conformance with the written recommendations of the Geotechnical Engineer.

D. Subgrade preparation and compaction and determination of subgrade stability shall performed under the observation of the ENGINEER. In no case shall lime or cement treatment be used to stabilize subgrade.

E. Finish subgrade shall be within the tolerances established in Section 19-1.03, "Grade Tolerances," of the Caltrans Standard Specifications.

3.5 AGGREGATE SUBBASE

A. Aggregate subbase shall be spread and compacted in conformance with Section 25, "Aggregate Subbases," of the Caltrans Standard Specifications unless modified by this Section. Finished aggregate subbase shall have a minimum thickness as shown on the Drawings and shall not vary more than 0.08 foot above or below the established grade. The aggregate subbase shall be compacted to 95 percent relative compaction in conformance with ASTM D 1557. The surface of the aggregate subbase after compaction shall be hard, unyielding, uniform, smooth, self-draining, and true to grade and cross-section.

3.6 AGGREGATE BASE

A. Aggregate base shall be spread and compacted in conformance with Section 26, "Aggregate Bases," of the Caltrans Standard Specifications for Class 2 Aggregate Base. Finished aggregate base shall have the minimum thickness as shown on the Drawings and shall not vary more than 0.05 foot above or below the established grade. The aggregate base shall be compacted to 95 percent relative compaction in conformance with ASTM D 1557. The surface of the aggregate base after compaction shall be hard, unyielding, uniform, smooth, self-draining, and true to grade and cross-section.

3.7 TACK COAT

A. The CONTRACTOR shall be responsible for the proper use of tack coats and shall be in conformance with applicable regulatory requirements.

B. Tack Coat or Paint Binder

Prior to placement of asphalt concrete a tack coat or paint binder shall be applied to existing paved and vertical surfaces where new asphalt concrete is to be placed on or against existing pavement at an approximate total rate from 0.02 gallon to 0.10 gallon per square yard to all areas receiving asphalt concrete. The exact rate of application will be determined by the ENGINEER. Care shall be taken to prevent over application of tack coat material onto finish surfaces that will not be in contact with the new asphalt concrete pavement.

3.8 ASPHALT CONCRETE BASE REPAIR

A. Existing failed roadway sections shall be excavated to the limits as marked in the field and/or as shown on the Drawings. During base repair operations streets shall not be closed to traffic, but temporary traffic controls shall be implemented in conformance with the Division 1, General Requirements.

B. The CONTRACTOR shall not excavate more area than he is capable of paving within the same working day. At the end of each working day all open street excavations must be either backfilled and compacted to within one inch below existing finish grade, or covered with steel plating in conformance with Section 312300, “Utility Earthwork” in order to allow use by public traffic.

C. On residential streets, excluding truck routes and bus routes, requiring an asphalt concrete overlay, a minimum depth of 4 inches of pavement structural section shall be cut out, removed and replaced with asphalt concrete. On residential streets, excluding bus routes, not requiring an asphalt concrete overlay a minimum depth of 6 inches of structural pavement section shall be cut out, removed and replaced with asphalt concrete.

On all other streets, including truck routes and bus routes, the depth of removal of the pavement structural section shall be as shown on the Drawings or as determined by the ENGINEER.

Where soft or unsuitable materials are encountered, additional excavation and/or remediation will be required as determined by the ENGINEER.

D. For CITY owned traffic signals where traffic signal detector loops are present, the CONTRACTOR shall notify the ENGINEER a minimum of 48 hours prior to beginning asphalt concrete base repair work. For Caltrans traffic signals the CONTRACTOR shall notify Caltrans in conformance with Caltrans requirements.

E. **Cutting of Existing Pavement Structural Section:** All final cuts in asphalt concrete shall be straight, clean, and vertical for the full depth of the cut. Additional areas shall be cut out when determined by the ENGINEER that the edge of the asphalt concrete pavement to remain is loose, depressed, or potentially unstable. Cutting of the existing pavement structural section shall be done by one of the following options:

1. Longitudinal cuts may be wheel-cut but shall be discontinued if the ENGINEER determines that excessive breakage or deflection of the adjacent pavement to remain is occurring.

2. On streets that are to receive an asphalt concrete overlay as a part of the work a jack-hammer, sawcutter or grinder may be used.

3. All other cuts shall be made by saw-cutting or grinding.

F. The asphalt concrete material removed shall become the property of the CONTRACTOR and shall be disposed of in a legal manner.

G. After removal of the asphalt concrete, the existing base or subgrade shall be shaped to conform to the cross slope or crown of the street, and a minimum of the top 6 inches re-compacted to 95 percent relative compaction in conformance with ASTM D 1557.

H. The vertical edges of the excavated paving repair area shall be treated with a tack coat. Care shall be taken to prevent over application of the tack coat material onto finish surfaces that will not be in contact with the new asphalt concrete pavement.

I. Asphalt concrete for pavement repair sections shall be placed in a minimum of 2 lifts and shall be spread and compacted in the number of layers and thicknesses in conformance with Section 39-6.01, "Spreading and Compacting," of the Caltrans Standard Specifications.

J. The finish grade of the new asphalt concrete pavement shall be flush with the adjacent existing pavement and shall conform to cross slope or crown of the street. Variances of more than zero to 1/8 inch above the existing pavement grade will not be allowed. Asphalt concrete base repairs that are out of tolerance with existing pavement shall be ground down or removed and repaved.

3.9 PAVEMENT CRACK SEALING

A. Prior to overlaying existing pavements, crack sealing operations shall be performed in accordance with the following:

1. Crack sealing shall be performed on all pavement cracks ¼-inch wide or wider. Cracks between a ¼-inch and a ½-inch wide shall be routed to a depth and width of ½-inch prior to sealing.

2. Crack sealing shall be performed after any required pavement repair or grinding operations and prior to placing flexible pavement coatings, pavement reinforcing fabric, or overlay.

3. Immediately prior to performing crack sealing, the cracks shall be cleaned by the use of high-pressure compressed air such that all vegetation, dirt, and other objectionable materials are removed. The compressed air shall be filtered of moisture and oils. Under damp conditions, a hot compressed air lance shall be utilized to dry the cracks as well.

5. Sealant material shall conform to the provisions of PART 2 "Products" of this Section and shall be applied at the temperature and rate recommended by the manufacturer.

6. Sealant shall be applied to a slightly overfilled condition, then struck off with a guide-shoe, plate, or squeegee to produce a band of material 2 inches to 4 inches in width, centered over the crack. On streets to be slurry or seal-coated, strike-off height shall be less than 1/8-inch above the pavement surface.

7. Extensively cracked pavement areas shall not be crack sealed unless specifically directed by the ENGINEER. This is necessary to avoid interference with proper adhesion of the flexible pavement coatings, pavement reinforcing fabric, or overlay, and to avoid subsequent asphalt bleeding on the new surface. Where the ENGINEER determines excessive coating or thickness of pavement crack sealant by the CONTRACTOR, the CONTRACTOR shall perform the necessary pavement base repairs to correct the problem prior to placement of any flexible pavement coating, pavement reinforcing fabric, or overlay.

8. Crack seal areas shall be protected from traffic until the material has sufficiently cured and does not track. Any damage or loss of material from freshly placed crack seal material shall be replaced by the CONTRACTOR .

3.10 REMOVE AND REPLACE TRAFFIC MARKINGS

A. Removal and replacement of existing traffic striping, legends, and pavement markers shall be in conformance with Section 321723, “Traffic Stripes and Pavement Markings.”

B. Removal and replacement of traffic striping, legends, and raised pavement markers shall conform to the following scheduling requirements:

1. Existing traffic striping, legends, and pavement markers shall be completely removed prior to beginning of resurfacing operations. The CONTRACTOR shall then either begin said operations within 24 hours of the removal of the existing delineations or shall replace said delineations with painted markings.

2. Permanent traffic striping, legends, and pavement markers shall be installed no sooner that 2 calendar days nor later than 7 calendar days after the resurfacing has been placed. Raised pavement markers shall be installed no sooner than 7 calendar days no later than 14 calendar days after resurfacing has been placed. Traffic striping, legends, and pavement markers shall be installed in conformance with Section 84, " Traffic Stripes and Pavement Markings," and Section 85, "Pavement Markers," of the Caltrans Standard Specifications. The layout of permanent traffic striping, legends, and pavement markers shall be approved in writing by the ENGINEER prior to installation.

3.11 PAVEMENT GRINDING

A. Grinding necessary to perform edge and transverse pavement conforms shall be performed on all streets to be overlaid and shall be completed in conformance with Section 42-2, “Grinding,” of the Caltrans Standard Specifications and this Section.

B. Grinding at curbs, gutters, valley gutters, and street intersections shall be in conformance with the Drawings and Standard Details. No grinding shall be performed through an intersection if the cross street is also to be overlaid.

C. Damage to detector loops at CITY owned traffic signals shall be reported to the ENGINEER and repaired by the CONTRACTOR at its own expense within 24 hours of disruption of service. If the CONTRACTOR fails to repair damaged loops within the specified time the CITY will repair the damage at the CONTRACTOR'S expense. Damage to detector loops at traffic signals owned by other Agencies shall be repaired in conformance with the appropriate Agency requirements.

D. All materials removed shall become the property of the CONTRACTOR and shall be disposed of in a legal manner. Residue from the grinding operations may be removed from the roadbed by a vacuum sweeper following within 50 feet of the grinding operations. The CONTRACTOR shall be responsible for maintaining the street in a clean condition during the course of the grinding operations. All loose materials shall be removed prior to the application of the tack coat.

E. Areas that cannot be reached with the grinding machine shall be jack-hammered or otherwise removed by hand.

F. The CONTRACTOR shall place temporary asphalt concrete ramps at all grinding limits which abut remaining asphalt pavement surfaces. Temporary asphalt concrete ramps shall be in place the same day as the grinding operation.

G. Temporary asphalt concrete ramps shall be a minimum of 5 feet in length, extending the entire width of the affected travelway, and shall be sufficiently compacted so as not to deform or ravel.

H. The CONTRACTOR shall maintain temporary asphalt concrete ramps to the satisfaction of the ENGINEER and shall completely remove them prior to the application of tack coat.

3.12 SAWCUTTING FOR ROADWAY WIDENING

A. When removing asphalt pavement in connection with roadway widening the existing asphalt pavement shall be sawcut with a power driven asphalt saw to provide a smooth joint for the new pavement. The CONTRACTOR shall sawcut the pavement before any pavement excavation to avoid damage to the pavement section to remain.

3.13 PAVEMENT PULVERIZATION AND RESHAPING & COMPACTION OF BASE MATERIAL

A. On public works projects when specifically required on the Drawings, the CONTRACTOR shall pulverize the existing pavement to the limits shown on the Drawings, or as otherwise directed by the ENGINEER, using specialized mechanized equipment capable of pulverizing asphalt concrete into a uniform gradation of not more than 1-1/2 inch maximum size. The equipment shall also be capable of capturing and containing airborne dust particles in an appropriate manner as to conform to the dust abatement requirements of the Specifications.

B. The CONTRACTOR shall pulverize the existing pavement until the maximum size of the asphalt concrete is not more than 1-1/4 to 1-1/2 inches and mix it with the underlying top two inches of base material.

C. The CONTRACTOR shall reshape and compact the combined mixture as a new base for the thickness of asphalt concrete shown on the Drawings. The street section shall be reshaped to a cross-slope of 2.0% minimum to 5.0% maximum as approved by the ENGINEER. The CONTRACTOR shall compact the base to a minimum relative compaction of 95% with a two-axle steel drum roller weighing not less than eight tons nor more than ten tons. Compaction will be determined from a moisture-density curve performed on the mixed material to determine the optimum moisture for compaction.

D. Should pulverization operations produce an excess of material which cannot be reshaped and compacted to meet the necessary cross-slope, the excess material shall become the property of the CONTRACTOR and shall be disposed of in a legal manner.

E. The CONTRACTOR shall be responsible for maintaining the street in a clean condition during the course of the pulverization operations. Surrounding traffic and pedestrian areas shall be swept and maintained free of loose material and debris at all times and residue from the pulverization operations shall be removed from the surrounding improvements by the end of the work day.

F. Areas that cannot be reached with the pulverization machine shall be jack-hammered or otherwise removed by hand.

G. Pulverization operations shall not precede pavement overlay operations by more than three calendar days, unless otherwise approved in writing by the ENGINEER.

H. The CONTRACTOR shall place temporary asphalt concrete ramps at all pulverization limits which are to conform to remaining asphalt pavement surfaces. Temporary asphalt concrete ramps shall be in place the same day as the pulverization operation.

I. Temporary asphalt concrete ramps shall be a minimum of 5 feet in length, extending the entire width of the affected travelway, and shall be sufficiently compacted so as not to deform or ravel.

J. The CONTRACTOR shall maintain temporary asphalt concrete ramps to the satisfaction of the ENGINEER and shall completely remove them prior to the application of tack coat.

3.14 PAVEMENT REINFORCING FABRIC / CRACK-RETARDING MASTIC MEMBRANE

A. Placement of pavement reinforcing fabric and mastic membrane, including application of tack coat shall be in conformance with Section 39-4, "Subgrade, Prime Coat, Paint Binder (Tack Coat), and Pavement Reinforcing Fabric," and Section 88, "Engineering Fabrics," of the Caltrans Standard Specifications and this Section.

B. Prior to placement of tack coat, fabric or mastic membrane, the CONTRACTOR shall insure that the existing pavement is clean and free of dirt, water, and vegetation. All cracks shall be cleaned and if necessary, sealed in conformance with this Section. Care shall be taken to prevent the application of tack coat material to surfaces that will not be in contact with the new asphalt concrete pavement.

C. Placement of pavement reinforcing mesh shall be in conformance with the manufacturer's recommendations as approved by the ENGINEER and this Section. The surface temperature before laying the mesh shall be between 40 degrees F (5 degrees C) and 140 degrees F (60 degrees C.)

D. Prior to placing pavement reinforcing mesh, the existing pavement shall be cleaned to provide an adequate surface for the adhesion of the mesh to the satisfaction of the ENGINEER and/or manufacturer's representative. The pavement shall be cleaned by sweeping or vacuuming and be free of oil, vegetation, sand, dirt, water, gravel, debris, paint, pavement markers, striping, or rubber, including loose aggregate and fines from level course or finish paving operations.

   All cracks shall be cleaned, and if necessary, sealed in conformance with this Section. For direct application of pavement reinforcing mesh on an existing pavement, cracks ¼-inch and larger shall be filled with crack sealer per this Section. Potholes shall be dug out and filled with hot mix to provide a level surface. Areas with uneven surfaces and/or extensive cracking shall require a leveling course as determined by the ENGINEER.

E. Tack Coat shall be applied by a suitably metered truck with all spray heads adequately adjusted to lay down an even coat. Tack coating for pavement reinforcing fabric or mastic membrane shall be applied per the manufacturer's recommendations. Mastic membrane with self-adhesive backing may be used without tack coat in accordance with the manufacturer's recommendations. Tack coating is not usually required for pavement reinforcing mesh and shall only be applied when recommended by the manufacturer for the specific work. In this application, emulsion type tack coating must be cured before placement of the reinforcing mesh.

F. Fabric placement equipment shall be mechanized and shall be capable of handling full rolls of material and of laying the fabric without forming excessive wrinkles and/or folds in conformance with the manufacturer's recommendations for installation. Manually laying the fabric shall only be allowed in small areas not practical for mechanical equipment.

G. Mesh laid by mechanical means or by hand must be under sufficient tension to eliminate ripples. Should ripples occur, these must be removed by pulling the grid tight or in extreme cases, by cutting to the manufacturer's recommendations and lying it flat. Transverse joints shall be lapped in the direction of the paver by a minimum of 4 inches. Longitudinal joints shall be 1-2 inches overlapped.

H. Fabric or mesh shall not be placed within the grinding limits unless placed on a level course first or as otherwise directed by the ENGINEER. Normally mesh placement shall end one foot before the grind at pavement conforms and one foot before vertical butt transitions.

I. Mastic membrane shall be rolled with a static drum roller or rubber tire pneumatic roller or as recommended by the manufacturer.

J. Pavement reinforcing mesh shall be rolled with a rubber coated roller or pneumatic tire roller, to activate the self-adhesive. Tires must be clean to avoid pick up of the mesh. A pneumatic tire roller or tractor installer with pneumatic tire roller assembly shall adhere the mesh to the surface. A vehicle

with rubber tires may be used to adhere reinforcing mesh to existing surface if approved by the manufacturer. The CONTRACTOR shall not pave if adequate adhesion is not achieved first.

K. The CONTRACTOR shall neatly cut the reinforcing material around all utility structures and monuments prior to placing pavement overlay.

L. Construction and emergency vehicles may run across the reinforcing material after being rolled with the insurance that precautions are taken to avoid damage caused by turning and braking. The material must also be kept clean of mud, dust and debris. Damaged sections shall be removed and patched to the manufacturer's printed recommendations, taking care to completely cover the damaged area.

M. In areas of localized bleeding of tack coat through the fabric, the CONTRACTOR shall spread asphalt concrete over the area to prevent pick-up or lifting of the fabric.

N. The CONTRACTOR shall not place more fabric, mastic or mesh than can be covered with a minimum of 1-1/2 inches of hot asphalt concrete mix and compacted on the same working day.

O. All Pavement fabric, mastic, or mesh shall be stored, as per the manufacturer's recommendations, in a dry covered condition free from dust, dirt, and moisture.

3.15 ASPHALT CONCRETE OVERLAY OR PAVEMENT STRUCTURAL SECTION

A. Surface preparation for asphalt concrete overlay on existing asphalt concrete surfaces shall include removal of all traffic striping and legends, raised pavement markers, and all grinding, patching, and sweeping.

B. Application of a prime coat and/or tack coat shall not occur until all surface preparation has been performed.

C. Asphalt concrete shall be spread and compacted on the prepared base or existing asphalt concrete in conformance with the lines, grades and dimensions shown on the Drawings and in conformance with Section 39, "Asphalt Concrete," of the Caltrans Standard Specifications.

D. Spreading and compaction equipment and methods shall be in conformance with Sections 39-5,, "Spreading and Compacting Equipment," and 39-6, "Spreading and Compacting," of the Caltrans Standard Specifications and this Section. The ENGINEER may, at its option, call for continuous and/or random testing of asphalt concrete compaction. Asphalt concrete shall not be placed or stockpiled in windrows when the underlying layer or surface is frozen, or when, in the opinion of the ENGINEER, weather conditions will prevent the proper handling, finishing, or compaction of the asphalt concrete.

Spreading by use of motor graders will not be allowed unless approved in writing by the ENGINEER.

E. The finished grade shall be flush with the adjacent existing pavement, shall conform to the cross slope or crown of the street, and shall be within the tolerances of the "straightedge" test as defined in Section 39-6.03, "Compacting," of the Caltrans Standard Specifications. The CONTRACTOR shall be responsible for all damage to fresh surfacing until it is ready for use by public traffic. Damaged areas shall be repaired to the satisfaction of the ENGINEER.

F. Asphalt concrete for new pavement structural sections shall be placed in a minimum of 2 lifts and shall be spread and compacted in the number of layers and thicknesses in conformance with Section 39-6.01, "Spreading and Compacting," of the Caltrans Standard Specifications.

G. The depositing, distribution, and spreading of each lift of the asphalt concrete shall be accomplished in a single, continuous operation.

H. All utility structures and monuments shall be marked for reference in at least 2 directions by the CONTRACTOR prior to placing the asphalt concrete. Said reference marking shall be made using a temporary removable water based marking chalk. The CONTRACTOR shall be responsible for the complete removal of all such reference markings after the completion of raising utility structures and monuments to grade.

I. Fog sealing of new asphalt concrete structural sections will not be allowed.

3.16 ASPHALT CONCRETE UTILITY CUT PAVEMENT REPLACEMENT

A. **Preparation of Existing Asphalt Concrete Pavement:** The existing asphalt concrete pavement shall be sawcut 12 inches past the edge of the trench to provide a smooth joint for the new pavement. The CONTRACTOR may sawcut the pavement before excavating the trench to facilitate the removal of the pavement. In addition the CONTRACTOR shall sawcut and remove any irregular or damaged pavement along the open trench as directed by the ENGINEER before placing new asphalt concrete pavement.

B. Placement of asphalt concrete shall be in conformance with this Section, except that the number of layers and thicknesses shall be as shown on the Drawings.

3.17 ADJUST IRON CASTINGS TO GRADE

A. All Iron Castings shall be set to finish grade after placing the asphalt concrete. The adjustment of structures and monuments to grade shall be in conformance with Section 15-2, "Miscellaneous Highway Facilities," of the Caltrans Standard Specifications and this Section.

B. Adjustment rings will not be allowed.

C. When streets are overlayed unless deemed unsuitable by the ENGINEER, existing frames and covers shall be salvaged and re-used. All iron castings damaged during construction shall be replaced by the CONTRACTOR with new iron castings at the CONTRACTOR'S expense. Replacement iron castings for CITY utility structures shall be replaced in conformance with the appropriate technical section. Replacement iron castings for other Agency utility structures shall be replaced in conformance with the appropriate Agency requirements.

D. All water valve covers shall be exposed on the same day in which they are covered by resurfacing operations.

E. All maintenance hole covers shall be raised no later than 5 working days after resurfacing is placed, and shall be patch-paved with asphalt concrete within 5 working days after being raised.

F. Tops of frames shall be set within to zero to 1/8-inch above finish grade. Frames which do not meet this tolerance shall be re-adjusted by the CONTRACTOR at its own expense.

G. After adjusting frames CONTRACTOR shall insure all covers are removable and seat properly when replaced. For new iron castings the new covers shall not rock.

H. Hand mixing of concrete for use in raising iron castings to grade will be allowed. Concrete shall be placed and thoroughly consolidated in conformance with Section 321300, Concrete Surface Improvements..

I. Asphalt concrete patch paving shall be fine asphalt concrete placed over a tack coat. Patch paving may be placed by hand using a vibratory plate compactor or roller in conformance with this Section.

3.18 PAVEMENT FLOOD TESTING

A. Flood testing of asphalt pavement must be made prior to the placement of striping and legends. The ENGINEER must be present to witness the flood tests. The CONTRACTOR shall notify the ENGINEER a minimum of 3 working days prior to the flood test.

B. The CONTRACTOR shall repair any areas which are damaged or in which excessive ponding occurs. Excessive ponding is defined as areas in which water stands more than 3/16-inch in depth. Any areas requiring remedial overlay shall be prepared by grinding the pertinent area as defined by the ENGINEER and placing fine asphalt concrete patch mix over a tack coat. The corrective work shall be done prior to the placement of striping and legends.

- END OF SECTION -

SECTION 321200 FLEXIBLE PAVEMENT COATINGS

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide all materials, equipment and labor necessary to furnish and construct the flexible pavement coatings and all appurtenant work, complete in place, as shown on the Drawings and as specified herein.

B. Work Specified in this Section:

1. Preparation and cleaning of pavement.
2. Pavement Crack Sealant
3. Application of oil spot sealer to areas of fuel, oil and grease stains.
4. Application of polymer or latex modified emulsified asphalt slurry seal.
5. Application of chip seal.
6. Application of micro-surfacing.
7. Application of bond coat and pavement overcoat.
8. Pavement sweeping and clean-up of jobsite.

C. As referenced in these specifications and on the plans, the term “cape seal” is defined as the application of a chip seal seal followed by the application of the specified bituminous seal, such as a slurry seal or micro-surfacing.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A.	Section 311300	Selective Tree and Vegetation Trimming and Removal.
B.	Section 321000	Asphalt Pavement, Base, and Surface Treatments.
C.	Section 311723	Traffic Stripes and Pavement Markings.
D.	Division 1	General Requirements.

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. **State of California (Caltrans) Standards:**

1. Standard Specifications:

Section 5	Control of Work.
Section 6	Control of Materials.
Section 37	Bituminous Seals.
Section 94	Asphaltic Emulsions.

B. **Commercial Standards:**

ISSA A105 (revised 2005)	International Slurry Surfacing Association. Recommended Performance Guidelines For Emulsified Asphalt Slurry Seal.
ISSA A143	International Slurry Surfacing Association.

(revised 2005) Recommended Performance Guidelines For Polymer-Modified Micro-surfacing

1.4 CONTRACTOR SUBMITTALS

A. The CONTRACTOR shall provide the ENGINEER with Certificates of Compliance and sample materials for all products and materials proposed to be used under this Section.

B. The Certificates of Compliance shall identify the name of the material, material source, name of the supplier, project name and the segment of the WORK where the material represented by the sample is to be used.

C. At least 7 working days prior to beginning pavement slurry sealing operations, the CONTRACTOR shall provide the ENGINEER with signed original laboratory reports for the mix designs which covers the specific materials to be used, per the requirements of Section 37-2.03, "Mix Design," of the Caltrans Standard Specifications and this Section.

D. At least 7 working days prior to beginning polymer modified asphalt scrub seal or micro-surfacing operations, the CONTRACTOR shall provide the ENGINEER with signed original laboratory reports for the mix designs which covers the specific materials to be used, per the requirements of this Section.

E. The CONTRACTOR shall provide the ENGINEER with weigh tags and quantities for all materials delivered to the job site, including aggregate, asphaltic emulsion and any additives.

F. For the slurry seal, the chip seal, and the micro-surfacing, the CONTRACTOR shall include the proposed source of aggregate in the mix design laboratory report and a material sample for the ENGINEER'S review. In addition, the CONTRACTOR shall submit a list of three (3) projects on which the proposed aggregate was used and has demonstrated a history of holding a dark coloration.

1.5 QUALITY ASSURANCE

A. For slurry seal, the above mix design reports shall be performed by a certified testing laboratory capable of performing the applicable ISSA tests indicated in Section 37-2.03, "Mix Design," of the Caltrans Standard Specifications and this Section. For micro-surfacing, mix design reports shall conform to the requirements of this Section and the contractor shall obtain a letter of certification from the manufacturer of the specified emulsion, polymer, and recycling agent and submit to the City for approval. The latex certification shall be submitted from a laboratory with IAS, ISO 17085 accreditation.

B. The above mix design reports shall also indicate the proposed source, type and coloration of the proposed aggregate and samples of the aggregate shall be submitted by the CONTRACTOR for the ENGINEER'S review prior to use.

C. The ENGINEER will employ a certified testing laboratory to perform additional quality assurance tests and inspections as may be required by this Section.

D. A change in either aggregate or emulsion during the course of the WORK will require submittal and approval of a new mix design and aggregate samples. Substituted materials shall not be used until the mix design and materials are reviewed by the ENGINEER. Random samples of materials and mixes will be taken by the ENGINEER during operations for further analysis and testing.

E. Once the emulsified asphalt slurry seal materials and proportions to be used are reviewed by the ENGINEER, no substitution of other materials will be permitted unless the materials proposed for

substitution are first tested and a laboratory report is submitted for the substituted design as specified above and the mix design of those materials is reviewed by the ENGINEER.

1.6 QUALITY CONTROL

A. The CONTRACTOR shall comply with Section 6, "Control of Materials," of the State Standard Specifications and this Section.

B. Materials to be incorporated into the WORK shall be new and unused unless otherwise approved. In case a reference is not clear as to which of several available grades is desired, the highest quality material shall be used.

C. Materials or equipment not conforming to the requirements of this Section shall be considered as defective and shall be removed from the site of the WORK unless otherwise permitted by the ENGINEER. No rejected materials or equipment, the defects of which have subsequently been corrected, shall be used until inspected and reviewed by the ENGINEER.

D. The CONTRACTOR shall permit the ENGINEER to take samples of the aggregate and asphalt emulsion used in the WORK at the ENGINEER'S discretion. Gradation and sand equivalent tests may be run on the aggregate and residual asphalt tests on the emulsion. The ENGINEER will compare the test results with this Section and notify the CONTRACTOR immediately if any test fails to meet specifications.

E. If any two successive tests fail on the stockpile material, the WORK shall be stopped. Before WORK can continue, the CONTRACTOR shall, at his own expense, be responsible for proving to the satisfaction of the ENGINEER that the conditions have been corrected.

F. If any two successive tests fail on the mix from the same mixer-spreader machine, the use of the machine shall be suspended. It shall be the responsibility of the CONTRACTOR, at his own expense, to prove to the ENGINEER that the problems have been corrected and that the equipment is working properly before it will be allowed for use again on the WORK.

G. All WORK will be done by persons experienced in the specific work, under competent supervision, and in a manner to the ENGINEER'S complete satisfaction as specified in Section 5-1.06, "Superintendence," and Section 5-1.12, "Character of Workman," of the Caltrans Standard Specifications.

H. The CONTRACTOR shall furnish all tools and equipment and employ sufficient trained personnel to operate all equipment and perform all handwork efficiently and skillfully.

PART 2 -- PRODUCTS

2.1 POLYMER OR LATEX MODIFIED EMULSIFIED ASPHALT SLURRY SEAL

A. Immediately prior to mixing, the slurry seal shall consist of a mixture of asphaltic emulsion, aggregate, water and additives (as required) in conformance with Section 37-2 of the Caltrans Standard Specifications and modified as follows:

1. Asphaltic emulsion shall be a polymer or latex modified quick setting, cationic type, in conformance with the requirements for PMCQS1h or LMCQS1h grade of Section 94, "Asphaltic Emulsions," of the State Standard Specifications, except that the test requirements for cement mixing and settlement shall not apply.

2. Aggregate for the slurry seal shall be in conformance with Section 37-2.02C, "Aggregate," of the Caltrans Standard Specifications for a Type II mix. The use of crushed granite or other light grey-colored aggregate will not be allowed. The aggregate shall consist of an aggregate or

combination of aggregates dark in color and nature that shall be produced by crushing rock. All materials shall be free from vegetable matter and other deleterious substances, oversized particles and caked lumps.

3. Water shall be potable, and free from harmful, soluble salts.

4. Chemical retardant may be added up to one percent of dry weight of the aggregate to insure proper workability while not adversely affecting the seal.

2.2 CHIP SEAL

A. Chip Seal shall conform to the requirements of Section 37-1, “Seal Coats” and Section 94, “Asphaltic Emulsions” of the Caltrans Standard Specifications.

1. Asphaltic emulsion shall be polymer modified, rapid setting, grade PMCRS-2h.

2. Aggregate gradation shall conform to medium gradation, 3/8” x No. 6.

2.3 OIL SPOT SEALER

A. Oil spot sealer shall consist of "OverKote" Oil Spot Seal manufactured by Reed & Graham, Inc., or equal, conforming to the following specifications:

1. A commercial grade, quick drying, latex emulsion sealer which shall have suitable additives to coat and promote adhesion of the flexible pavement coating to oil, grease and gasoline stained pavement.

2.4 PAVEMENT CRACK SEALANT

A. Pavement crack sealant shall be in accordance with PART 2 – “Products” of Section 321000 “Asphalt Pavement, Base and Surface Treatments.”

2.4 BOND COAT

A. The bond coat shall consist of a tack coat mixture of emulsified asphalt binder and water mixed and applied uniformly to the entire surface where specified. The design mix shall conform to the Caltrans Standard Specifications and the following requirements:

1. Asphaltic Emulsion shall be in conformance with the requirements for SS1h grade of Section 94, “Asphaltic Emulsions,” of the Caltrans Standard Specifications, except that the test requirements for cement mixing and settlement shall not apply.

2. Water shall be potable and free from harmful soluble salts.

2.5 ASPHALT PAVEMENT OVERCOAT

A. The asphalt pavement overcoat shall consist of a cold applied composition of asphaltic emulsion mixed with aggregate, polymer and water conforming to the following requirements and applied after the bond coat has dried:

1. Asphaltic Emulsion shall conform to the specifications for SS1h grade per Section 94, “Asphaltic Emulsions,” of the Caltrans Standard Specifications,:

except in Tables 1 and 2, the values for penetration at 25 degrees C for tests on residue from distillation must be from 20 to 60. You may use clay-stabilized emulsion with a solids content not less than 45 percent by weight.

2. Aggregate – 100% of aggregate for the overcoat mixture shall be pass the No. 16 sieve and be composed of clean, hard, durable, uncoated particles, free from lumps of clay or organic matter. The use of crushed granite or other white or light gray-colored sand or aggregate shall not be allowed.

3. Water – Water shall be potable and free from harmful soluble salts.

4. Polymer – Polymer must be either neoprene, ethylene or vinyl acetate, or a blend of butadiene and styrene.

2.6 MICRO-SURFACING

A. Micro-surfacing shall consist of a polymer modified, cationic micro-surfacing emulsion (MSE), water and additives, mineral filler, and aggregate in accordance with the following requirements:

1. Micro-surfacing emulsion (MSE)
   a. Micro-surfacing emulsion (MSE) shall be homogenous. The polymer shall be milled or blended into the asphalt or blended into the emulsifier solution prior to the emulsification process. The MSE shall contain a minimum of three (3%) percent polymer solids based on mass of MSE residual asphalt.

   b. The MSE shall conform to the following requirements:

Test	Test Method	Requirement
Viscosity @ 25°C, SSF	AASHTO T 59	15-90 sec
Sieve Test, max.	AASHTO T 59	0.30%
Settlement, 5 days, max.	ASTM D 244	5%
Storage Stability, 1 day, max.	AASHTO T 59	1%
Residue by Evaporation, min.	California Test 331	62%

Tests on Residue from Evaporation Test:

Test	Test Method	Requirement
G* @ 20ºC, 10 rad/sec, MPa	AASHTO TP 5	Report Only
Penetration @ 25ºC	AASHTO T 49	40-90
Phase Angle @ 50°C, 10 rad/sec, PA (max) - PA base	AASHTO TP 5	Report Only
Softening Point, min.	AASHTO T 53	57ºC
Stiffness @ -12°C, MPa, and M-value	AASHTO TP 1	Report Only

2. Water and additives: Water shall be of such quality that the asphalt will not separate from the MSE before the micro-surfacing is placed on the pavement. If necessary for workability, additives that will not adversely affect the micro-surfacing product may be used.

3. Mineral filler shall be Portland cement or hydrated lime that is free of lumps. Portland cement shall be either Type I, Type II, Type III or a combination thereof. The type of mineral filler shall be determined by the Contractor based on laboratory mix designs. The mineral filler will be considered part of the aggregate gradation requirement.

4. Aggregate

   a. The aggregate used for micro-surfacing shall be Type II or Type III as shown on the plans. The material shall be free from vegetation matter and other deleterious substances.

Aggregate shall be free of lumps and oversize particles. *One hundred (100%) percent of the parent aggregate shall be larger than the largest stone in the gradation to be used.*

b. Aggregate shall conform to the grading and quality requirements prior to the addition of the MSE. If aggregates are blended, each component aggregate shall conform to the Sand Equivalent and Durability Index requirements.

c. The percentage composition by mass of aggregate, including mineral filler, shall conform to the grading requirements as per Caltrans Specification Section 37-2.02C.

d. The aggregate, excluding mineral filler, shall conform to the following quality requirements:

Test	California Test	Requirement
Sand Equivalent, min.	217	65
Durability Index, min.	229	55
Percentage of Crushed Particles, min.[1]	205	100%
Los Angeles Rattler Loss at 500 Rev., max.[2]	211	35%

Notes:

1. California Test 205, Section D, is amended to read: "Any particle having 2 or more freshly, mechanically fractured faces shall be considered a crushed particle."
2. California Test 211, Los Angeles Rattler, shall be performed on the parent aggregate before crushing.

e. Aggregate shall be free from vegetable matter and other deleterious substances, oversized particles and caked lumps. The use of crushed granite or other light grey-colored aggregate will not be allowed. The aggregate shall consist of an aggregate or combination of aggregates dark in color and nature that shall be produced by crushing rock.

f. If the results of the aggregate grading do not meet the specified gradation, the micro-surfacing represented by the test shall be removed. However, if requested in writing by the Contractor and approved by the Engineer, the micro-surfacing may remain in place and the Contractor shall pay to the City $0.40/SY for the aggregate represented by the tests and left in place. The City may deduct these amounts from any moneys due or to become due the Contractor.

g. If the results of the Sand Equivalent test for aggregate do not meet the specified requirement, the micro-surfacing represented by the test shall be removed. However, if requested in writing by the Contractor and approved by the Engineer, the micro-surfacing may remain in place and the Contractor shall pay to the City $0.40/SY for the aggregate represented by the tests and left in place. The City may deduct these amounts from any moneys due or to become due the Contractor.

h. When the results of both the aggregate grading and the Sand Equivalent tests do not conform to the specified requirements and if the micro-surfacing is allowed to remain in place, both payments to the City shall apply. The City may deduct these amounts from any moneys due or to become due the Contractor.

i. No single aggregate grading or Sand Equivalent test shall represent more than two hundred seventy-five (275) ton or one (1) day's production, whichever is smaller.

5. Micro-surfacing Mix Design-

a. At least ten (10) days before the micro-surfacing placement commences, the Contractor shall submit for approval of the Engineer a laboratory report of tests and a proposed mix design covering the specific materials proposed for use on the project.

b. The percentages of each individual material proposed in the mix design shall be shown in the laboratory report. Adjustments may be required during construction based on field conditions. Individual materials shall be within the following limits:

MSE Residual Asphalt	10% to 15% by dry mass of aggregate
Water and Additives	As needed
Mineral Filler	0% to 3% by dry mass of aggregate

c. The mix design and aggregate tests shall be performed by a laboratory capable of performing the applicable International Slurry Surfacing Association (ISSA) tests. The proposed micro-surfacing mixture shall conform to the specified requirements when tested in conformance with the following tests:

Test	ISSA Test Method	Requirements
Wet Cohesion @ 30 Minute (Set), min. @ 60 Minute (Traffic), max.	TB* 139	 12 kg-cm 20 kg-cm
Excess Asphalt, max.	TB* 109	540 g/m^2
Wet Stripping, min.	TB* 114	90%
Wet Track Abrasion Loss 6-day Soak, max.	TB* 100	 810 g/m^2
Displacement Lateral, max. Specific Gravity After 1000 Cycles of 57 kg, max.	TB* 147A	 5% 2.10
Classification Compatibility, min.	TB* 144	(AAA, BAA) 11 grade points
Mix Time @ 25°C, min.	TB* 113	Controllable to 120 Seconds

TB* = Technical Bulletin

d. The laboratory that performed the tests and designed the mixture shall sign the laboratory report. The report shall show the results of the tests on individual materials and shall compare their values to those required by these Special Provisions. The report shall clearly show the proportions of aggregate, water (minimum and maximum), additive usage, mineral filler (minimum and maximum), and MSE residual asphalt content (minimum and maximum) based on the dry mass of aggregate. The laboratory shall report the quantitative effects of moisture content on the unit mass of the aggregate (bulking effect) in conformance with the requirements of ASTM Designation: C 29M. Previous laboratory reports covering the same materials may be accepted provided the material test reports were completed within the previous twelve (12) months. The mix design shall further show the recommended changes in water, additive, and mineral filler proportions for high temperature weather conditions by reporting proportions of materials required for sixty (60) seconds of mix time with materials heated to 38°C. This 38°C mixing report will not be required for projects requiring nighttime application.

e. The component materials used in the mix design shall be representative of the micro-surfacing materials proposed by the Contractor for use on the project. Once the mix design is approved by the Engineer, no substitution of other material will be permitted unless the materials proposed for substitution are first tested and a laboratory report is submitted for the substituted design in conformance with these Special Provisions. Substituted materials shall not be used until the mix design for those materials has been approved by the Engineer.

PART 3 -- EXECUTION

3.1 ORDER OF WORK

A. All asphalt concrete pavement repairs and adjacent concrete curb and gutter repair operations shall be completed, inspected and reviewed by the ENGINEER prior to installation of the flexible pavement coating.

B. Tree and vegetation trimming and/or removal operations required for equipment accessibility shall be completed by the CONTRACTOR in accordance with Section 311300, "Selective Tree and Vegetation Trimming and Removal," prior to installation of the flexible pavement coating.

C. Prior to applying the flexible pavement coating, all surface preparation, including pavement striping and marking removal, street cleaning and crack sealing operations shall be completed in accordance with this Section, including:

1. All weeds or other vegetation growing through the asphalt concrete shall be removed and all open cracks shall be blown clear of foreign material, including organics, sand, dirt and grease.

2. All pavement surfaces where heavy deposits of grease and oil are encountered shall be cleaned of dirt by scraping, washing with detergent, and rinsing with water. After the spots have dried, the CONTRACTOR shall seal the spots with an oil spot sealant, as specified herein, and allow to dry before application of surface coating.

3. All pavement surfaces where heavy deposits of dirt, sand, clay and other objectionable material are encountered shall be cleaned up by the CONTRACTOR through the use of high pressure blowers, vacuums or sweepers. The third paragraph of Section 37-2.06 of the State Standard Specifications is hereby amended such that the use of flushing as a means to clean the pavement prior to pavement coating placement shall not be allowed.

4. Immediately prior to pavement coating operations, all pavement surfaces shall be cleaned by vacuum sweeping to remove all loose particles of paving, dirt, vegetation and all other extraneous material and debris.

D. The ENGINEER shall review the surface preparation prior to placement of the pavement coating.

3.2 PUBLIC NOTIFICATION

All homeowners, businesses and public facilities affected by the WORK shall be provided with prior notification of the WORK and necessary parking restrictions, in conformance with Division 1, General Requirements. All notifications shall be provided twice in conformance with the following:

1. A written notification shall be mailed to each affected business/residence a minimum of two weeks prior to commencing the work.

2. Door hangers shall be provided 72 hours prior to commencing work.

The format of the required notifications shall be approved by the Engineer. The CONTRACTOR shall coordinate the notification process and follow up each notification with submittal to the ENGINEER of a signed affidavit confirming time and date of each notification.

3.3 TRAFFIC CONTROL

A. The CONTRACTOR shall use suitable measures, including signs, portable barricades, tape and flaggers, as required by this Section and the Division 1, General Requirements to protect the WORK area from damage from all types of vehicular and/or pedestrian traffic. Approval to open WORK areas to traffic does not constitute acceptance of the WORK.

B. In WORK areas which are subject to an increased rate of sharp turning vehicle or twisting tires, additional closure time may be required for a more complete cure of the seal coating to prevent damage to the pavement. Slight tire marks may be evident in these areas after opening but will diminish over time with rolling traffic. If areas should become noticeably rutted, they will be considered as abnormal characteristics of the pavement coating and will not be accepted.

3.4 PROTECTING UTILITY COVERS

A. Immediately prior to commencing pavement coating operations, all metal surface utility and monument covers shall be protected by completely covering the cover with oiled or plastic paper attached appropriately with adhesive, as approved by the ENGINEER. No adhesive or surface seal material will be permitted to cover, seal, or fill the area between the frame and cover of the structure or monument. All covers shall be exposed and cleaned of surface seal material by the end of the same working day.

3.5 OIL SPOT SEALER

A. The CONTRACTOR shall apply oil spot sealer to all street and surfaces where heavy deposits of grease and oil are encountered as part of the surface preparation. Pavement surfaces with heavy deposits of grease and oil shall be prepared by cleaning dirt and deposits off by scraping, washing with detergent and rinsing with water. After the spots have dried, the CONTRACTOR shall seal the spots with an oil spot sealant, as specified herein, and allow to dry before application of the pavement surface coating.

3.6 PAVEMENT CRACK SEALING

A. Crack sealing operations shall be in accordance with PART 3 – “Execution” of Section 321000 “Asphalt Pavement, Base and Surface Treatments.”

3.7 CHIP SEAL

A. Chip Seal shall be applied in accordance with Section 37-1, “Seal Coats” and Section 94 “Asphaltic Emulsions” of the Caltrans Standard Specifications.

3.8 POLYMER MODIFIED EMULSIFIED ASPHALT SLURRY SEAL

A. Proportioning - The slurry seal mixture shall be proportioned in accordance with the requirements of Section 37-2.04 of the Caltrans Standard Specifications, except that the third paragraph of the section shall be amended as follows:

1. Asphaltic emulsion shall be added at the rate of from fifteen to eighteen percent by weight of the dry aggregate. A job mix design shall be submitted by the CONTRACTOR for review by the ENGINEER that conforms to the specifications herein, and is suitable for the traffic, climate and curing conditions associated with the WORK.

2. No change in proportioning of the mix or substitution of materials shall occur without both testing and submittal of a laboratory report, as specified in the Caltrans Standard Specifications and this Section.

B. Mixing - The slurry seal shall be mixed in accordance with the requirements of Section 37-2.05 of the Caltrans Standard Specifications and this Section.

1. The ENGINEER may use the recorders, gauges and measuring facilities of each slurry seal mixer-spreader unit to determine application rates, asphalt emulsion content and additive content of individual loads.

2. The delivery rate of aggregate and emulsion per revolution of the aggregate feeder shall be calibrated at different gate settings for each mixer-spreader truck used on the project.

3. The CONTRACTOR shall check stockpile moisture content regularly and set the mixing equipment accordingly to account for aggregate bulking.

4. Samples of the slurry seal mixture may be taken directly from the mixer-spreader trucks as determined necessary by the ENGINEER. Consistency and residual asphalt content tests may be made by the ENGINEER on the samples and compared to the requirements of this Section. The ENGINEER will notify the CONTRACTOR immediately if any test fails to meet specifications.

C. Spreading Equipment - The slurry seal mixture shall be mixed in continuous pugmill mixers of adequate size and power ***and shall contain reversible motor driven augers like those used for micro-surfacing*** and be uniformly spread by means of a controlled spreader box and in accordance with the requirements of Section 37-2.05 of the Caltrans Standard Specifications and this Section.

1. A minimum of two 7 cubic yard or larger mixer-spreader trucks, in good operating condition, shall be on the job site at all times. Mixer-spreader equipment must be able to negotiate turns in cul-de-sacs on an initial, continuous pass next to the curb.

2. The mixer-spreader trucks shall be equipped with a pressurized water system and nozzle type spray bars to provide a fog spray immediately ahead of the spreader box. The rate of application shall be adjustable and shall cover the entire application surface without flowing or ponding.

3. If required by the ENGINEER, the mixer-spreader equipment shall be inspected and calibrated on a 300-foot test section. The CONTRACTOR shall use this calibration to establish the settings required to obtain the desired application rate for the slurry mix and to correct the proportioning of materials, in accordance with the requirements of this Section.

D. Placing - The slurry seal mixture shall be placed in accordance with the requirements of Section 37-2.06 of the Caltrans Standard Specifications, and this Section.

1. Slurry seal shall not be placed if either the pavement or the air temperature is below 50 degrees F, or when in the opinion of the ENGINEER, road conditions or imminence of inclement weather, are not conducive to successful results.

2. Slurry seal placement shall not begin before 7:00 a.m. and shall be terminated each day in sufficient time so that all streets will be open to traffic by 3:30 p.m.

3. The surface to be slurried shall be lightly pre-dampened with a fog spray of water from the applicator mounted on the mixer-spreader truck as described in "Spreading Equipment," above. The rate of application of the fog spray shall be adjusted to compensate for ambient temperature, and surface texture, and shall cover the entire surface without flowing or ponding.

4. The slurry seal mixture shall be of the desired consistency upon leaving the mixer. No lumping, balling, or unmixed aggregate shall be permitted. A sufficient amount of material shall be carried in all parts of the spreader at all times so that complete coverage is obtained. Overloading of the spreader shall be avoided.

5. The slurry seal mixture shall possess sufficient stability so that premature breaking of the material does not occur in the spreader box. The mixture shall be homogeneous during and following mixing and spreading. It shall be free of excess water and emulsion and free of segregation of the emulsion and aggregate fines from the courser aggregate. Spraying of additional water into the spreader box will not be permitted.

6. No streaks, such as those caused by oversize aggregate, shall be left in the finished surface. If excess oversize aggregate develops the job will be stopped until the CONTRACTOR proves to the ENGINEER that the situation has been corrected. Some situations may require screening the aggregate just prior to loading it into mixer-spreader trucks going from the stockpile area to the lay down operation.

7. The slurry seal machine shall move forward at such a speed that the slurry seal mixture penetrates and substantially fills all surface voids in the existing pavement.

8. The forward speed of the slurry seal spreader shall be maintained so as not to cause corrugations and surface irregularities in the slurry seal.

9. The slurry box squeegees, rubber belting or similar material, shall be flexible enough to wipe the slurry uniformly over the surface of the existing pavement without gouging, scouring or abrading the surface.

10. Slurry seal shall be placed to the limits as shown on the drawings, as marked in the field, and as directed by the ENGINEER. Where recently resurfaced streets intersect with the project limits, slurry material shall be extended to provide a minimum overlap beyond the edge(s) of recent resurfacing, as marked in the field or as directed by the ENGINEER, irrespective of typical project limits.

11. The edges of the slurry seal application on both sides of the street shall be maintained in a neat and uniform line. Along concrete gutters, the slurry seal shall overlap the lip of gutter approximately one (1) inch maximum to seal the joint along the edge of the concrete. No runoff into the gutter will be permitted. Where there is no concrete gutter, the slurry seal shall extend to the limits of the existing asphalt pavement.

12. Areas which cannot be reached with the slurry seal machines shall be surfaced using hand squeegees to provide complete and uniform coverage. The area to be handworked shall be lightly dampened prior to mix placement and the slurry worked immediately. Care shall be exercised to leave no unsightly appearance from handwork. The same type of finish as applied by the spreader box shall be required. Handwork shall be completed during the machine applying process.

13. The CONTRACTOR shall use 15-lb. roofing paper at slurry seal transverse limits and stop/start butt joint conforms to maintain a neat and uniform line and thickness of slurry seal at conforms. The CONTRACTOR shall position the paper to provide a minimum overlap at conforms, avoid double placement of material at stop/start joints, and hold excess slurry for easy removal without spillage.

14. Wherever possible, longitudinal lap joints shall coincide with lane lines or in the center of the lane. In no case will joints be allowed in the normal wheel track of vehicles. Care shall be taken to avoid leaving ridges at the lap joints between adjoining passes.

15. The CONTRACTOR shall not continue to the next street until all handwork has been completed and all excess slurry along gutters, walks and drives has been removed to the satisfaction of the ENGINEER.

16. All excess and unsuitable material within the street right-of-way shall be removed as it develops or no later than the end of each work day.

17. The CONTRACTOR shall not use diesel fuel or solvents of any kind for cleaning tools and equipment in such a manner as to permit spillage of the diesel fuel or solvent.

18. The CONTRACTOR shall be responsible for all damage to the slurry seal coat until it cures. All damaged areas shall be patched or the street re-slurried as directed by the ENGINEER at the CONTRACTOR'S expense.

E. Sweeping - After the slurry seal has cured, the CONTRACTOR shall perform additional sweeping in to remove excess loose material per this Section.

1. The CONTRACTOR shall notify the ENGINEER of its proposed sweeping schedule.

2. The CONTRACTOR shall adjust the sweeping schedule at the discretion of the ENGINEER should unforeseen circumstances arise.

3. Within 4 to 7 calendar days after slurry seal has cured, the CONTRACTOR shall perform an initial sweeping operation on all slurry seal areas to remove excess loose material.

4. Within 10 to 14 calendar days after the slurry seal has cured, the CONTRACTOR shall perform a second sweeping operation on all slurry seal areas to remove excess loose material.

5. The CONTRACTOR shall also perform additional sweeping operations after the second sweeping as determined necessary by the ENGINEER. The CONTRACTOR shall perform the required additional sweeping operations within 48 hours of the ENGINEER'S notification.

3.9 MICRO-SURFACING

A. Mixing and Spreading Equipment:

1. If required by the ENGINEER, the mixer-spreader equipment shall be inspected and calibrated on a 300-foot test section. The CONTRACTOR shall use this calibration to establish the settings required to obtain the desired application rate for the micro-surfacing mix and to correct the proportioning of materials, in accordance with the requirements of this Section.

2. The micro-surfacing shall be mixed in continuous pugmill mixers of adequate size and power for the type of micro-surfacing to be placed. All indicators shall be in working order prior to commencing mixing and spreading operations.

3. Mixer-spreader trucks shall be equipped to proportion the aggregate, water, additives (if used), mineral filler, and MSE by volume. Rotating and reciprocating equipment on mixer-spreader trucks shall be covered with metal guards.

4. The mixer-spreader truck shall not be operated unless low-flow and no-flow devices and revolution counters are in good working condition and functioning and metal guards are in place. The required indicators shall be visible while walking alongside the mixer-spreader truck.

5. Aggregate feeders shall be connected directly to the drive on the emulsion pump. The drive shaft of the aggregate feeder shall be equipped with a revolution counter reading to the nearest one-tenth (1/10) of a revolution.

6. The micro-surfacing mixture shall be spread by means of a spreader box. The spreader box shall be capable of placing the micro-surfacing a minimum of 3.6-m wide and shall prevent the loss of micro-surfacing from the box. Spreader boxes over 2.38-m in application width shall have baffles, reversible motor driven augers or other suitable means to insure uniform application on super-elevated sections and shoulder slopes. Spreader box skids shall be maintained in such manner as to prevent chatter (wash boarding) in the finished mat. The spreader box shall be clean and free of micro-surfacing and MSE at the start of each work shift.

7. The spreader box shall have a series of strike-off devices at the rear of the box. The leading strike-off device shall be fabricated of steel, stiff rubber or other suitable material. The number of strike-off devices shall be determined by the Contractor. The first strike-off device shall be designed to maintain close contact with the pavement during the spreading operations, shall obtain the thickness required, and shall be capable of being adjusted to the various pavement cross sections for application of a uniform micro-surfacing finished surface. The final strike-off device shall be fabricated of flexible material suitable for the intended use and shall be designed and operated to ensure that a uniform texture is achieved in the finished surface of the micro-surfacing. The final strike-off device shall be cleaned daily and changed if problems with longitudinal scouring occur.

8. If there is a grade difference of 1/2" or more between the finish grade of the microsurfacing treatment and the grade of an adjacent existing utility cover, the utility cover shall be raised flush with the finish grade.

B. Proportioning:

1. Aggregate, water, additives (if used), mineral filler, and MSE shall be proportioned by volume utilizing the mix design approved by the Engineer. If more than one kind of aggregate is used, the correct amount of each kind of aggregate to produce the required grading shall be proportioned separately, prior to adding the other materials of the mixture, in a manner that will result in a uniform and homogeneous blend.

2. The aggregate shall be proportioned using a belt feeder operated with an adjustable cutoff gate. The height of the gate opening shall be determinable. The MSE shall be proportioned by a positive displacement pump. Variable rate emulsion pumps, if used, shall be calibrated and used in the pump's calibrated condition in conformance with California Test 109 prior to usage.

3. The delivery rate of aggregate and MSE per revolution of the aggregate feeder shall be calibrated at the appropriate gate settings for each mixer-spreader truck used on the project in conformance with California Test 109.

4. The aggregate belt feeder shall deliver aggregate to the pugmill with such volumetric consistency that the deviation for any individual aggregate delivery rate check-run shall not exceed two (2%) percent of the mathematical average of three (3) runs of at least three (3) ton each. The emulsion pump shall deliver MSE to the pugmill with such volumetric consistency that the deviation for any individual delivery rate check-run shall be within two (2%) percent of the mathematical average of three (3) runs of at least 1135 L each. The water pump shall deliver water to the pugmill with such volumetric consistency that the deviation for any individual delivery rate check-run shall be within two (2%) percent of the mathematical average of three (3) runs of at least 1135 L each.

5. The MSE storage tank shall be located immediately before the emulsion pump and shall be equipped with a device which will automatically shut down the power to the emulsion pump and aggregate belt feeder when the MSE level is lowered to a point where the pump suction line is exposed.

6. A temperature-indicating device shall be installed in the emulsion storage tank at the pump suction level. The device shall indicate the temperature of the MSE and shall be accurate to within 5°C.

7. The belt delivering the aggregate to the pugmill shall be equipped with a device to monitor the depth of aggregate being delivered to the pugmill. The device for monitoring the depth of aggregate shall automatically shut down the power to the aggregate belt feeder whenever the depth of aggregate is less than the target depth of flow. A second device shall be located where the device will monitor the movement of the aggregate belt by detecting revolutions of the belt feeder. The devices for monitoring no flow or belt movement shall automatically shut down the power to the aggregate belt when the aggregate belt movement is interrupted. The device to detect revolutions of the belt feeder will not be required where the aggregate delivery belt is an integral part of the drive chain. To avoid erroneous shutdown by normal fluctuation, a delay of three (3) seconds will be permitted between sensing and shutdown of the operation.

8. The polymer modified emulsified asphalt shall be added at a rate from ten (10%) percent to fifteen (15%) percent by weight of dry aggregate. The exact rate to be determined by the job mix design submitted by the Contractor for approval by the Engineer.

C. Spreading:

1. Micro-Surfacing shall not be applied if either the pavement or air temperature is below 50°F (10°C) and falling, but may be applied when both pavement and air temperatures are above 45°F (7°C) and rising. No Micro-Surfacing shall be applied when there is the possibility that the finished product will freeze within 24 hours.

2. Micro-surfacing shall be spread at a rate of 18-22 pounds of dry aggregate per square yard for Type II aggregate and 25-32 pounds of dry aggregate per square yard for Type III aggregate, or as directed by the Engineer. The completed spread shall be within ten (10%) percent of the specified rate. The micro-surfacing box squeegees, rubber belting or similar material, shall be flexible enough to spread the micro-surfacing uniformly over the surface.

3. The spreader box shall be pulled at a rate NOT GREATER THAN 270 FEET PER MINUTE. Any areas micro-surfaced while the spreader box is exceeding 270 feet per minute will be considered out of Specification and will not be paid for by the City.

4. Each spreader box used on the project shall be equipped with augers to insure uniform application of the micro-surfacing and shall have inboard set skids. A sufficient amount of micro-surfacing shall be carried in all parts of the spreader at all times so that complete coverage is obtained. No lumping, balling, or unmixed aggregate shall be permitted. No streaks such as caused by oversize aggregate shall be left in the finished pavement.

5. No excessive buildup or unsightly appearance shall be permitted on longitudinal or transverse joints. Burlap drags may be used. Approved squeegees shall be used to spread micro-surfacing in areas not accessible to the micro-surfacing mixer/spreader. Longitudinal joints shall correspond with the edges of the final traffic lanes. The Engineer may permit other patterns of longitudinal joints if the patterns will not adversely affect the quality of the finished product.

6. Through traffic lanes shall be spread in full lane widths only. Longitudinal joints common to two (2) traffic lanes shall be butt joints with overlaps not to exceed 76 mm. Building paper shall be placed at the transverse joints to avoid double placement of the micro-surfacing. Other suitable methods to avoid double placement of the micro-surfacing will be allowed. Hand tools shall be available to remove spillage.

7. Micro-surfacing placement shall not begin before 7:00 a.m. and shall be terminated each day in sufficient time so that all streets will be open to traffic by 3:30 p.m.

8. The mixture shall be uniform and homogeneous after placing on the surfacing and shall not show separation of the MSE and aggregate after setting. The completed surface shall be of uniform texture and free from ruts, humps, depressions or irregularities.

9. Adequate means shall be provided to protect the micro-surfacing from damage by traffic until such time that the mixture has cured sufficiently so that the micro-surfacing will not adhere to or be picked up by the tires of vehicles.

10. The Contractor shall submit certified weight tickets for all loads of aggregate delivered to the project site(s). Tickets shall be submitted to the Project Inspector by the end of each day in which a delivery is made. At the end of the project, tickets will be used to calculate the average spread rate of the micro-surfacing. The average spread rate will be calculated by dividing the total pounds of aggregate for the project by the total square yardage of the project. If the average rate is less than the allowable ten (10%) percent variation from the specified spread rate of twenty (20) pounds of dry aggregate per square yard, the Contractor shall pay to the City an amount of reduced compensation. The City may deduct the amount of reduced compensation from any monies due, or that may become due, the Contractor under the contract.

11. The amount of reduced compensation will be calculated using the total square yards of micro-surfacing placed times the contract price per square yard times the reduced compensation factor: The reduced compensation factor shall be equivalent to the percent reduction in rate from the specified rate (for reduction rates in excess of 10%). For example, a reduction rate of 10.1% from the specified 20 lbs./SY would result in a reduced compensation factor of 10.1% or 0.101; likewise, a reduction rate of 11% below the specified 20 lbs. would result in a reduction factor of 11% or 0.11. The reduced compensation factor will be calculated using the following equation:

    1—(calculated lbs. of aggregate per SY / 20 lbs. per SY)= reduction factor

    No reduction factor will be applied to the contract price for reduced spread rates within 10% of the specified rate or for rates which exceed the specified rate.

12. At limits of micro-surfacing (start or finish), a straight line cut-off shall be obtained by laying down a strip of building paper or other approved material. Such paper and any excess micro-surfacing shall be removed by the Contractor after application of the micro-surfacing.

13. Edge limits of the micro-surfacing on both sides of the street shall be maintained in a neat, straight, and uniform line. Micro-surfacing shall extend to the lip of gutter. The micro-surfacing may be allowed to extend onto the gutter pan 1”—2”, but a neat, straight, and uniform line must be maintained. In the event that micro-surfacing extends onto the gutter more than 1”–2” or the micro-surfacing is not in a neat, straight, uniform line, it will be the responsibility of the Contractor to remove all excess micro-surfacing from the gutters using an appropriate method. Any runs or drips that spill on to the concrete gutter surface shall be removed the same day that the spill occurs. At the completion of removal operations, gutters shall be restored to original condition (grey/white concrete finish). All work associated with the removal of micro-surfacing from the gutters will be conducted at the Contractor’s expense.

D. Sweeping:

The micro-surfacing shall be swept approximately twenty-four (24) hours after placement to remove loosened or shed aggregate particles. Thereafter, the micro-surfacing shall be swept, when directed by the Engineer, for up to ten (10) days after placement to remove loosened or shed aggregate particles. Sweeping shall be performed in such a manner that the micro-surfacing will not be damaged.

3.10 BOND COAT AND ASPHALT PAVEMENT OVERCOAT:

A. Proportioning:

1. The bond coat shall consist of a tack coat mixture of one (1) part emulsified asphalt binder (SS1h grade) and four (4) parts water.

2. The asphalt pavement overcoat shall be proportioned, mixed, and applied in a manner that takes into account the surface roughness of the pavement. The proportions of materials and the number of applications required shall be in accordance with those contained in the mix design submittal and the manufacturer's specifications as approved by the Engineer.

B. Mixing:

1. The mixing or agitating equipment utilized by the contractor shall be a tank-type power mixer with a round bottom and shall be a power driven mixer of sufficient capacity to maintain the mineral content of the overcoat in suspension prior to application.

2. The proposed mix design for asphalt pavement overcoat must have the values of the properties shown in the following table:

Asphalt Pavement Overcoat Mix Design Requirements

Property	Test method	Requirement	
		Min	Max
Mass per liter	ASTM D 244	1.1 kg	
Cone penetration, mm	California Test 413	340	700
% Nonvolatile % Nonvolatile soluble in tri-clorethylene	ASTM D 2042[a]	50 10	 35
Wet track abrasion, g/m^2	ASTM D 3910		380
Dried film color		Black	
Viscosity	ASTM D 562	75 KU[b]	

[a] Weigh 10 g of homogenous product into a previously tared, small ointment can. Place in a constant temperature oven at 165 ± 5 °C for 90 ± 3 minutes. Cool, reweigh, and calculate nonvolatile components as a percent of the original weight.

[b] Krebs units

3. Asphalt pavement overcoat must contain a minimum of 2 percent polymer by volume of undiluted asphaltic emulsion.

C. Placing:

1. No asphaltic emulsion products shall be placed when either the pavement or the air temperature is below 60°F, or when in the opinion of the Engineer, pavement conditions or imminence of inclement weather, are not conducive to successful results. Request that the Engineer shut off the irrigation system at least 5 days before placing the overcoat. Do not water plants adjacent to the seal at least 24 hours before and after the overcoat placement.

2. The Contractor shall remove all existing pavement markings and thermoplastic stripes within the limits of the overcoat area as part of the pavement preparation process.

3. The Contractor shall protect all buildings, fences, utility boxes, storm drain grates, and adjacent concrete curbs, gutters, and sidewalks from overspray, spillage, and tracking during application of the bond coat and overcoats.

4. The Contractor shall apply the bond coat over the entire asphalt pavement to be overcoated at a rate of 0.05 to 0.10 gallon per square yard. The bond coat shall be allowed to dry prior to placement of the overcoat. Any pools of wet binder remaining in depressions shall be swept out and allowed to dry before applying the overcoat.

5. Prior to the first application of overcoat in hot weather, the Contractor shall dampen the pavement surface. Any excess water shall be removed to leave the surface only slightly damp prior to application.

6. In general, for the purposes of bidding the project, two (2) or more applications of overcoat mixture are required for the surface roughness with 3 pounds of aggregate and adequate water added per gallon of sealer (not to exceed 15% by volume) to the first application to obtain a semi-fluid consistency, and another application of sealer made without the application of aggregate as necessary to obtain a smooth and uniform surface. The quantity of undiluted sealer to be applied per 1,000 square feet of area shall also be determined in the mix design submittal, but is estimated at a minimum of 30 gallons per 1,000 square feet of area for the purposes of the bid. In the field, the controlling factor shall not be the quantity of sealer used, but that the finished surface shall be smooth and uniform, showing no evidence of course or uneven texture.

7. Add polymer at the job site in the Engineer's presence.

8. If adding water at the job site based on the manufacturer's recommendations for consistency and spreadability, do not exceed 15% by volume of undiluted asphaltic emulsion.

9. The asphalt pavement overcoat shall be applied by the combined use of rubber-faced squeegees and mechanized material spreading equipment or other suitable methods approved by the Engineer. The material should be applied to the area in continuous parallel lines and spread immediately by the use of rubber-faced squeegees and/or mechanized materials spreading equipment. Care shall be taken to avoid leaving ridges at the lap joints between adjoining passes.

10. Asphalt pavement overcoat material shall be placed to the limits as indicated on the plans and as directed by the Engineer. Where curbs and sidewalks exist, the overcoat shall seal the joint between the edge of pavement and the concrete, but shall not overlap onto the concrete. The Contractor shall use 15 lb. roofing paper to start and stop at sidewalks, in order to ensure a straight line conform and hold

excess material for easy removal. The edge limits of the overcoat application shall extend to the existing edges of pavement.

11. All excess and unsuitable materials resulting from the Contractor's operations shall be removed as it develops by the end of each work day.

12. The Contractor shall not use diesel fuel or solvents of any kind for cleaning tools and equipment in such a manner as to permit spillage of the diesel fuel or solvent.

13. Do not allow traffic on the coated surface for at least 24 hours after placement.

14. Do not stripe the parking lot until the surface has dried.

15. The Contractor shall be responsible for all damage to the overcoat until it cures. All damaged areas shall be re-coated as directed by the Engineer at the Contractor's expense.

16. After the pavement overcoat has cured, and during the duration of the contract, the Contractor shall perform additional sweeping in areas of excess raveling, as directed by the Engineer.

- END OF SECTION -

SECTION 321300 - CONCRETE SURFACE IMPROVEMENTS

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide all materials, equipment, and labor to furnish and install all concrete surface improvements including concrete curbs, median curbs, gutters, valley gutters, sidewalks, access ramps, bus turnouts, driveways, median nose surfacing, pads, miscellaneous concrete footings, and all appurtenant work, complete in place, as shown on the Drawings and as specified herein.

B. **Work Covered in this Section:**

1. Subgrade Preparation.
2. Root Pruning.
3. Aggregate Base.
4. Sidewalk Drains.
5. Forms for Concrete.
6. Concrete Reinforcement.
7. Portland Cement Concrete Placement.
8. Expansion Joints.
9. Deep Joints.
10. Score Lines.
11. Curing Compound.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A.	Section 311316	Root Pruning.
B.	Section 310000	Earthwork.
C.	Section 321000	Asphalt Pavement, Base and Surface Treatments.
D.	Section 033050	Utility Cast-in-Place Concrete.
E.	Division 1	General Requirements.

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. **State of California (Caltrans) Standards:**

1. Standards Specifications:

Section 19	Earthwork.
Section 26	Aggregate Bases.
Section 73	Concrete Curbs and Sidewalks.
Section 90	Portland Cement Concrete.

2. Standard Plans

B. **Commercial Standards:**

ASTM A 82	Specification for Steel Wire, Plain, for Concrete Reinforcement.
ASTM A 185	Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
ASTM A 615	Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
ASTM C 143	Test Method for Slump of Hydraulic Cement Concrete.
ASTM C 309	Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
ASTM D 1557	Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb (4.54-kg) Rammer and 18-in. (457-mm) Drop.
ASTM D 1751	Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types.)
ASTM D 1785	Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
ASTM D 2241	Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR-Series.)

1.4 CONTRACTOR SUBMITTALS

A. **Certificates of Compliance:** Certificates of Compliance shall be provided for all products and materials proposed to be used under this Section.

B. **Mix Designs:** A list of pre-approved ready-mix designs is on file in the ENGINEER'S office. If the CONTRACTOR does not use one of the pre-approved designs prior to beginning the concrete work, the CONTRACTOR shall submit to the ENGINEER, for review, preliminary concrete mix designs which shall show the proportions and gradations of all materials proposed for each class and type of concrete specified herein. Each mix design shall be accompanied by a Certificate of Compliance to these specifications.

C. **Delivery Tickets:** The CONTRACTOR shall provide delivery tickets at the time of delivery of each load of concrete. Batch tickets automatically produced by the batching equipment, indicating quantities of each ingredient, shall accompany each delivery ticket. Each delivery ticket shall, in additions, state the mix number, total yield in cubic yards, date, and the time of day, to the nearest minute, corresponding to when the batch was loaded, when it was dispatched, when it arrived at the job, and the time that unloading began.

PART 2 -- PRODUCTS

2.1 AGGREGATE BASE

A. Aggregate base shall be Class 2, 3/4-inch maximum size grading, aggregate base in conformance with Section 26, "Aggregate Bases," of the Caltrans Standard Specifications.

2.2 CONCRETE REINFORCEMENT AND DOWELS

A. Steel bar for concrete reinforcement and dowels shall be deformed billet-steel bars of the size or sizes as specified on the Drawings and shall conform to the requirements of ASTM A 615 for Grade 40 or Grade 60 bars.

B. Steel welded wire fabric for sidewalk drains shall be cold drawn steel welded wire fabric, 6"x6"x 10/10, and shall conform to the requirements of ASTM A 82 for the tie wire and ASTM A 185 for the wire fabric.

C. Tie wire shall be a minimum of 18 gage, black annealed conforming to the requirements of ASTM A 82.

2.3 SIDEWALK DRAINS

A. Pipes for sidewalk drains shall be 3 inch PVC Schedule 40 or PVC SDR 32.5 in conformance with ASTM D 1785 and ASTM D 2241, respectively. Steel welded wire fabric shall be as specified in Section 2.2 above.

2.4 PORTLAND CEMENT CONCRETE

A. Portland cement concrete for curbs, median curbs, gutters, valley gutters, sidewalks, access ramps, bus turnouts, driveways, pads, and miscellaneous concrete footings shall be in conformance with Standard Detail G-6.

B. Concrete shall be Ready-mix of a pre-approved mix design as listed in the ENGINEER'S office.

C. **Admixtures:** All admixtures shall be in conformance with Section 033050, "Utility Cast-in-Place Concrete."

D. **Water-Cement Ratio and Compressive Strength:** The water-cement ratio and compressive strength shall be in conformance with Section 033050, "Utility Cast-in-Place Concrete."

E. Except for miscellaneous concrete footings lampblack shall be added at the rate of 3/4 pound/pint per cubic yard of concrete.

F. Aggregate gradations proposed by the CONTRACTOR shall be within the following percentage passing limits:

Primary Aggregate Nominal Size	*Sieve Sizes*	*Limits of Proposed Gradation*
1-1/2” x 3/4” ……..	1”	19-41
1” x No. 4 ……..	3/4”	52-85
1” x No. 4 ……..	3/8”	15-38
Fine Aggregate ……..	No. 16	55-75
Fine Aggregate ……..	No. 30	34-46
Fine Aggregate ……..	No. 50	16-29

2.5 EXPANSION JOINT MATERIAL

A. Expansion joint material shall be premolded expansion joint filler ¼ inch thick in conformance with ASTM D 1751. Expansion joint material shall be shaped to fit the cross section of the concrete improvements prior to being placed.

2.6 CURING MATERIALS

A. All curing compound shall be of the non-pigmented type in conformance with ASTM C 309, Type 1-D, Class A.

2.7 ACCESS RAMPS

A. Access ramps shall conform to the "Curb Ramp Details" of the Caltrans Standard Plans.

B. Detectable Warning Surfaces shall be manufactured by Armor Tile Tactile Systems, dark gray in color, or approved equal.

PART 3 -- EXECUTION

3.1 SUBGRADE PREPARATION

A. Preparation of subgrade shall be in conformance with Section 310000, "Earthwork," and Section 321000, "Asphalt Pavement, Base and Surface Treatment."

B. Finish subgrade shall be within the tolerances established in Section 19-1, "General," of the Caltrans Standard Specifications.

3.2 SAWCUTTING EXISTING CONCRETE IMPROVEMENTS

A. Where a portion of existing concrete surface improvements is to be removed and replaced, the section to be removed shall be sawcut with an approved concrete saw to a minimum depth of 1-1/2 inches. For sidewalks, access ramps, and driveways the limit of the saw cut shall be at a minimum the first score line beyond the limits of the area to be replaced or as directed by the ENGINEER. For curb and gutter the limit of the sawcut shall be the nearest deep joint or as directed by the ENGINEER.

3.3 ROOT PRUNING

A. Where existing concrete improvement replacement is required due to tree root intrusion the tree roots shall be pruned in conformance with PART 3 - EXECUTION of Section 311316, "Root Pruning."

3.4 AGGREGATE BASE

A. Aggregate base shall be spread and compacted in conformance with PART 3 - EXECUTION of Section 321000, "Asphalt Pavement, Base and Surface Treatments." The aggregate base shall be placed to the depth as shown on the Drawings.

3.5 FORMS FOR CONCRETE

A. No forms shall be placed prior to approval of the aggregate base and subbase by the ENGINEER.

B. All concrete surface improvements may be placed by slip form paver, and curb and gutter may be placed by extrusion machine.

3.6 CONCRETE REINFORCEMENT

A. Concrete reinforcement and dowels shall be placed at the location as shown on the Drawings. Installation of concrete reinforcement and dowels shall be in conformance with Section 033050, "Utility Cast-in-Place Concrete."

3.7 SIDEWALK DRAINS

A. Pipe for sidewalk drains shall be placed and installed as specified on the Drawings.

3.8 PORTLAND CEMENT CONCRETE

A. No concrete for concrete surface improvements shall be placed until the subgrade, aggregate base, forms and reinforcement, and sidewalk drains have been approved by the ENGINEER.

B. Concrete curbs, gutters, valley gutters, sidewalks, access ramps, bus turnouts, driveways, and miscellaneous concrete footings shall be constructed in conformance with Section 73, "Concrete Curbs and Sidewalks," of the Caltrans Standard Specifications, except that hand mixing of Portland cement concrete for use in concrete surface improvements will not be allowed, and except as modified in this Section.

C. Concrete surface improvements shall not exceed the tolerances established in Section 73, "Concrete Curbs and Sidewalks," of the Caltrans Standard Specifications.

D. When a truck mixer or agitator is used for transporting concrete to the delivery point, discharge shall be completed within 1-1/2 hours, or before 250 revolutions of the drum or blades, whichever comes first, after the introduction of the cement to the aggregates. Under conditions contributing to quick stiffening of the concrete, or when the temperature of the concrete is 85° F., or above, a time less than 1-1/2 hours may be required.

E. All existing square formed steel tube sign posts shall be protected prior to pouring concrete around the post such that no concrete will leak inside the post.

3.9 JOINTS

A. **Expansion Joints:** Expansion joints shall be placed at 200-foot spacings and at all changes in horizontal alignment.

B. **Deep joints:** Deep joints shall be placed at all driveway edges and at 10 foot spacing. Depth of deep joint shall be 3/4-inch.

C. **Score lines:** Score lines shall be placed transversely at 5-foot spacing between deep joints, longitudinally along back of curb, and longitudinally at mid-point on sidewalks over 8 feet in width.

D. When replacing concrete improvements score lines and deep joints shall match existing score line and deep joint spacing.

3.10 CONCRETE FINISH

A. All concrete surface improvements, except access ramps and miscellaneous concrete footings, shall have a soft broom finish. Access ramp surface finish shall conform to the "Curb Ramp Details" of the CalTrans Standard Plans.

B. Miscellaneous concrete footings shall be sloped to provide drainage away from the post/pipe.

3.11 CURING

A. All exposed surfaces of Portland cement concrete shall be cured in conformance with the manufacturer's printed recommendations.

- END OF SECTION -

SECTION 321400 - INTERLOCKING PRECAST CONCRETE PAVERS

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide all materials, equipment and labor necessary to furnish and place all interlocking precast concrete pavers, which may include but is not necessarily limited to, preparation of subgrade, aggregate base, sand leveling bed, interlocking precast concrete pavers, edge restraints and all appurtenant work, complete in place as shown on the Drawings and as specified herein.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A.	Section 310000	Earthwork.
B.	Section 321000	Asphalt Pavement, Base and Surface Treatments.
C.	Division 1	General Requirements.

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. **State of California (Caltrans) Standards:**

1. Standard Specifications:

Section 26	Aggregate Bases.

B. **Commercial Standards:**

ASTM C 33	Specifications for Concrete Aggregates
ASTM C 140	Specification for Sampling and Testing Concrete Masonry Units
ASTM C 150	Specifications for Portland Cement

1.4 CONTRACTOR SUBMITTALS

A. **Certificates of Compliance:** Certificates of Compliance shall be provided for all products and materials proposed to be used under this Section.

B. Manufacturer's product data showing size, shape, pattern and color of interlocking precast concrete pavers shall be submitted to the Engineer for approval.

C. If requested, samples showing colors of interlocking precast concrete pavers shall be submitted to the Engineer for approval.

1.5 DELIVERY, STORAGE AND HANDLING

A. Interlocking precast concrete pavers shall be delivered and unloaded at jobsite on pallets and bound in such a manner that no damage occurs to the product during shipping, handling, unloading and storage at the job-site all in accordance with the manufacturer's recommendations.

1.6 QUALITY ASSURANCE

A. Interlocking precast concrete pavers shall be installed by a licensed specialty contractor.

B. The final surface elevations shall not deviate more than 3/8-inch under a 10 foot long straight edge.

PART 2 -- PRODUCTS

2.1 AGGREGATE BASE

A. Aggregate base shall be class 2, 19 millimeter maximum size grading, aggregate base in conformance with Section 26, "Aggregate Bases," of the Caltrans Standard Specifications. Aggregate base to be treated with a granular pre-emergent herbicide such as **Treflan, Ronstar, Tristar or equal**.

2.2 SAND LEVELING BED

A. The sand leveling bed shall be clean, non-plastic and free from deleterious or foreign matter. The sand shall be a concrete sand and conform to the fine aggregate grading requirements of ASTM C 33.

2.3 INTERLOCKING PRECAST CONCRETE PAVERS

A. Materials used to manufacture interlocking precast concrete pavers shall conform to the following:

1. Portland Cement shall be in conformance with ASTM C 150.

2. Aggregates shall conform to ASTM C 33. No expanded shale or lightweight aggregate will be allowed.

B. Interlocking precast concrete pavers shall have a minimum compressive strength of 8000 psi in accordance with ASTM C 140.

2.4 EDGE RESTRAINTS

A. Edge restraints used to restrain precast concrete pavers shall be either an aluminum or polyvinyl chloride (PVC) edge restraint system with steel spikes such as **PAVE EDGE PVC** rigid and/or flexible edging as manufactured by **PAVE TECH, INC**., or a “L-shaped” aluminum paving restraint system such as **PermaLoc Structur Edge Aluminum Restraint** or equal.

B. Spikes used for anchoring shall be 3/8-inch diameter steel spikes as supplied by the manufacturer.

C. PVC edge restraints shall be connected by 3/4-inch diameter PVC pipe as supplied by the manufacturer.

D. Aluminum edge restraints shall have a minimum 3/16-inch by 1-5/8 inch edge with a black duraflex (acrylic paint) electrostatically applied baked on paint.

2.5 MASONRY TYPE SAND

A. Masonry type sand shall be a clean non-plastic and free from deleterious or foreign matter, containing at least 30 percent of 1/8-inch particles.

PART 3 -- EXECUTION

3.1 SUBGRADE PREPARATION

A. Preparation of subgrade shall be in conformance with Section 310000 "Earthwork" and Section 321000 "Asphalt Pavement, Base and Surface Treatment."

3.2 AGGREGATE BASE

A. Aggregate base shall be spread and compacted in conformance with Part 3- “Execution” of Section 321000 "Asphalt Pavement, Base and Surface Treatments." The aggregate base shall be placed to the depth as shown on the Drawings.

3.3 SAND LEVELING BED

A. Sand shall be spread evenly over the area to be paved to produce a 1-inch thick leveling bed when the interlocking precast concrete pavers have been placed and vibrated.

B. The CONTRACTOR shall provide the proper level of sand such that the final elevation of the interlocking precast concrete pavers allow proper drainage across the adjacent hardsurfacing.

3.4 INTERLOCKING PRECAST CONCRETE PAVERS

A. The pavers shall be clean and free of foreign material before installation.

B. The pavers shall be placed in the approved pattern as shown on the Drawings.

C. The CONTRACTOR shall place the pavers in such a manner that the desired pattern is maintained and the joints between the pavers are nominally 1/8-inch with no individual gap exceeding 1/4-inch. String lines shall be used to hold pattern lines true.

D. The CONTRACTOR shall fill the gaps at the edges of the paved area with standard pavers or with standard pavers cut to fit. Standard pavers shall be cut with a double-bladed splitter or masonry saw to produce a clean edge to the surface of the paver.

E. The pavers shall be vibrated in the sand leveling bed using a vibrator capable of 3,000 to 5,000 pounds compaction force to vibrate the pavers into the sand.

F. The CONTRACTOR shall vibrate the pavers until the joints between the pavers are full of sand within 1/8-inch from the top of the pavers.

G. After vibration, clean masonry type sand shall be spread over the paver surface, allowed to dry, and vibrated into the joints with additional vibrator passes and sweeping so as to completely fill the joints.

H. All surplus material shall be swept from the surface and disposed of upon completion of work.

3.5 EDGE RESTRAINTS

A. PVC flexible edging shall be used for all curves and radiuses. PVC rigid edging shall be used on straight areas.

B. L-shaped aluminum edge restraints shall be installed facing the precast concrete pavers.

C. Steel spikes for edge restraints shall be anchored at a maximum of 12-inches on center.

- END OF SECTION -

SECTION 321723 - TRAFFIC STRIPES AND PAVEMENT MARKINGS

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide all materials, equipment, and labor necessary to furnish and place all traffic stripes and pavement markings, which may include but is not necessarily limited to, removal of any existing striping, legends, and pavement markers; repair of damaged pavement; placement of pavement markers; placement of both thermoplastic and painted striping and marking; and all other appurtenant work, complete in place, as shown on the Drawings and as specified herein.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 321000 — Asphalt Pavement, Base, and Surface Treatments.

B. Division 1 — General Requirements.

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. **Federal Specifications and Standards:**

United States Department of Transportation, Manual of Uniform Traffic Control Devices

B. **State of California (Caltrans) Standards:**

1. Standard Specifications:

Section 15	Existing Highway Facilities.
Section 84	Traffic Stripes and Pavement Markings.
Section 85	Pavement Markers.
Section 94	Asphalt Emulsions.

2. Standard Plans.

3. Traffic Manual.

1.4 CONTRACTOR SUBMITTALS

A. **Certificates of Compliance:** Certificates of Compliance shall be provided for all products and materials proposed to be used under this Section.

PART 2 -- PRODUCTS

2.1 TRAFFIC STRIPES AND PAVEMENT MARKINGS

A. **General:** Unless otherwise noted on the Drawings, all permanent traffic stripes and pavement markings shall be thermoplastic and/or pavement markers.

B. **Thermoplastic:** Thermoplastic for traffic stripes and pavement markings shall conform to Section 84-2, "Thermoplastic Traffic Stripes and Pavement Markings," of the Caltrans Standard Specifications.

When thermoplastic marking is applied within a crosswalk or a bike lane, the following composition shall be used with a maximum thickness of 0.12 inches (3.0 mm):

Binder	**20% (18% min)**
Glass Beads	**20% (15% min)**
TiO_2 Pigment	**10% (7% min)**
Filler	**35% (37% max)**
Cullet	**15 % (10% min)**

The crushed glass cullet in such mixture shall be produced from cullet of clear glass, with a maximum size of 850 micrometers (100% passing by weight) and a minimum size of 425 micrometers (0-5%% passing by weight). The skid resistance shall be a minimum of 55 BPN.

C. **Paint:** Paint for traffic stripes and pavement markings shall conform to Section 84-3, "Painted Traffic Stripes and Pavement Markings," of the Caltrans Standard Specifications.

D. **Pavement markers:** Pavement markers shall conform to Section 85, "Pavement Markers," of the Caltrans Standard Specifications and as specified herein. Fire Hydrant markers shall be two-way, reflective blue markers.

E. **Pavement arrows:** Type II and III pavement arrows shall be installed on streets with speed limits of 45 mph or greater. Type I(10), IV, VII, and VIII pavement arrows shall be installed on all other streets.

2.2 ADHESIVE

A. Adhesive shall be the hot melt bituminous type conforming to Section 85, "Pavement Markers," of the Caltrans Standard Specifications.

PART 3 -- EXECUTION

3.1 GENERAL

A. Centerline and lane lines shall be re-established the same day as they are removed by the use of temporary reflective markers placed at 24-foot maximum spacing.

B. Stop bars, crosswalks, advanced school crossing legends and arrows, shall be re-established the same day as they are removed using paint or traffic tape and shall match the width, size, and color as the removed markings unless otherwise shown on the Drawings.

C. Temporary traffic stripes and pavement markings placed on the finish lift of asphalt concrete shall be made with temporary traffic tape. Temporary traffic stripes and pavement markings placed on sub-lifts of asphalt concrete may be made with paint or traffic tape. Traffic tape will not be placed on slurry seal surfaces.

3.2 REMOVE EXISTING TRAFFIC STRIPES AND PAVEMENT MARKINGS

A. All removed traffic stripes and pavement markings and excess material shall become the property of the CONTRACTOR and shall be disposed of in a legal and proper manner. Removal and disposal of existing traffic markings and excess material shall conform to Section 15, "Existing Highway Facilities," of the Caltrans Standard Specifications and as specified herein.

B. The CONTRACTOR shall conduct his work so as not to damage existing pavement and public improvements to remain. Any resultant damage determined to be excessive by the ENGINEER shall be repaired in kind by the CONTRACTOR at its sole expense.

C. Damage to the pavement resulting from removal of pavement markers shall be considered as any depression more than 1/4-inch deep and shall be repaired by the CONTRACTOR by filling the depression with hot melt bituminous adhesive to the satisfaction of the ENGINEER.

D. Where blast cleaning is used for the removal of traffic stripes and pavement markings or objectionable material, the residue including dust shall be removed immediately after contact between the sand and the surface being treated. Such removal shall be by a vacuum attachment operating concurrently with the blast cleaning operation.

E. Where removal of traffic stripes and pavement markings is done by grinding or sandblasting methods, the effected pavement surface shall be completely covered by applying asphaltic emulsion conforming to Section 94 of Caltrans Standard Specifications.

F. All reference markings made by the CONTRACTOR shall be done with spray chalk.

G. All temporary traffic stripes and pavement markings shall be removed by the CONTRACTOR on the same day as placement of the permanent striping and markings.

3.3 TRAFFIC STRIPES AND PAVEMENT MARKINGS INSTALLATION

A. Placement of all traffic stripes and pavement markings shall be in conformance with Section 84, "Traffic Stripes and Pavement Markings," and Section 85, "Pavement Markers" of the Caltrans Standard Specifications, referenced Plans of the Caltrans Standard Plans, as shown on the Drawings and as specified herein.

B. All layouts must be inspected and approved by the ENGINEER prior to permanent placement of the traffic stripes and pavement markings. The CONTRACTOR shall notify the ENGINEER no later than 48 hours prior to the start of the scheduled placement.

C. Any overlap, dripping, or tracking of fresh thermoplastic or paint onto unmarked surfacing shall be removed to the satisfaction of the ENGINEER.

D. Thermoplastic and paint shall be placed as close as possible to existing utility structure and monument frames and covers without covering them.

E. The CONTRACTOR shall protect all fresh thermoplastic and paint and shall repair or replace all damage to traffic stripes and pavement markings caused by his failure to do so at its own expense.

F. All traffic stripes and pavement markings, new or existing, within or adjacent to the WORK limits which become defaced or damaged during the CONTRACTOR'S operations shall be replaced by the CONTRACTOR at its expense concurrently with other traffic marking operations in the immediate area. The ENGINEER shall be the sole judge as to which stripes or legends are defaced or damaged.

G. Fire hydrant markers shall be installed at all fire hydrant locations as shown on the Drawings.

- END OF SECTION -

SECTION 323113 - CHAIN LINK FENCES AND GATES

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide all materials, equipment, and labor necessary to furnish and install chain link fencing and gates, and all appurtenant work, complete in place, as shown on the Drawings and as specified herein.

B. Where the WORK requires temporary removal and replacement of existing fences, the fences shall match the adjacent fence.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A.	Section 321300	Concrete Surface Improvements
B.	Section 033050	Utility Cast-in-Place Concrete.
C.	Division 1	General Requirements.

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. **State of California (CALTRANS) Standards:**

1. Standard Specifications:

Section 80	Fences.

B. **Commercial Standards:**

ASTM F668	Standard Specification for Poly (Vinyl Chloride)(PVC) - Coated Steel Chain Link Fence

1.4 CONTRACTOR SUBMITTALS

A. **Certificates of Compliance:** Certificates of Compliance shall be provided for all products and materials proposed to be used under this Section.

B. Product data sheets for gates, typical fence construction, and fence corner construction shall be submitted to the ENGINEER for review prior to fabrication and construction.

PART 2 -- PRODUCTS

2.1 GENERAL

A. Fencing shall be 3 feet or 6 feet high, unless otherwise specified on the Drawings. All fencing materials shall be hot-dip galvanized after fabrication. All materials and components shall be new, first quality items specifically manufactured for the intended application. All fencing shall be vinyl coated steel chain link fabric.

B. All galvanized fence material shall be galvanized in accordance with Section 80-4, "Chain Link Fence," of the Caltrans Standard Specifications. All steel parts shall be hot-dipped galvanized prior to vinyl coating.

2.2 MATERIALS

A. Fence fabric without slats shall be No. 11 gage galvanized steel wire, 2 inch mesh. Fence fabric with slats shall be a No. 9 gage galvanized steel wire, 2-inch mesh. The fabric shall have a knuckled finish on the top and bottom edge.

B. Fabric ties shall be galvanized steel wire of the same gage as fence fabric, spaced 14 inches apart on posts. Aluminum ties will not be permitted. A continuous No. 7 gage galvanized steel tension wire shall be interlaced with the fabric or attached to the fabric with clips along the extreme top and bottom of the fence.

C. Posts shall be one-piece without circumferential welds, and shall be:

1. Line Posts:

a. Fence With Slats - Posts shall be 2 inch Schedule 40 pipe, 3.65 lb./ft.

b. Fence Without Slats - Posts shall be 1-1/2 inch Schedule 40 pipe, 2.72 lb./ft.

2. End and Corner Posts:

a. Fence With Slats - Posts shall be 2-1/2 inch Schedule 40 pipe, 5.79 lb./ft.

b. Fence Without Slats - Posts shall be 2-inch Schedule 40 pipe, 3.65 lb./ft.

3. Gate posts shall ~~be 3-1/2 inch~~ Schedule 40 pipe, with a diameter in accordance with the manufacturer's recommendation based on gate width.

D. Braces shall be 1-1/4 inch Schedule 40 pipe, 2.27 lb./ft.

E. Truss Rod and turn buckle shall be in conformance with Section 80-4, "Chain Link Fence," of the Caltrans Standard Specifications.

F. Fence stretcher bars shall be 1/4-inch by 3/4-inch galvanized steel bars, and steel bands for fastening stretcher bars to the posts shall be 1/8-inch by 3/4-inch.

G. Nuts, bolts and screws shall be of steel, hot-dipped galvanized after fabrication, minimum size 3/8-inch diameter.

H. Fence swing gate frames shall be constructed of 1-1/2 inch Schedule 40 pipe, minimum, and shall be fabricated by welding with all welds ground smooth prior to hot-dip galvanizing. Each gate leaf shall be provided with at least one diagonal brace. Frames shall be galvanized after fabrication. Galvanized malleable iron fittings for latching the gate shall be provided. Swing gates shall be hung by at least 2 steel or malleable iron hinges not less than 3 inches in width. Fabric shall match the fabric used in the fence. Each pair of gates shall be provided with a heavy drop rod latch assembly with a locking device for a padlock.

I. Fence sliding gates shall be track guided cantilever type. They shall be engineered and designed special for opening size and opening directions. Their construction shall be similar to that specified for swing gates. The gate components shall be engineered for proper piping and bracing size, and shall be provided complete with all necessary operating hardware including, but not necessarily limited to the following: tracks, supports, brackets, guides, heavy duty rollers with roller or ball bearings, and finish hardware. They shall be engineered for not less than a wind load of 25 lb./sq. ft. and maximum deflection of 1/160 of the full span with a 200-pound live load at the free end. The completed, welded, gate frame units and any ungalvanized hardware shall be hot-dip galvanized after fabrication. The cantilever gates shall have a free clear space under them of not less than 4 inches.

J. Concrete shall be a Class C in conformance with City Standard Detail G-6..

K. Slats shall be high density polyethylene blend, UV stabilized wide slat resistant to chemicals, salt & petroleum products, 3/8-inch by 2-1/2 inch. Unless otherwise specified, the color shall be Redwood.

L. Vinyl coated steel chain link fabric shall be No. 11 gauge steel wire, 2-inch mesh in accordance with ASTM F668, Class 2B. The color shall be as specified on the drawings.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. All earth, brush, or other obstructions which interfere with the proper alignment of construction of fences and gates shall be removed and disposed of at the expense of the CONTRACTOR.

B. Fence line posts shall be spaced at not more than 10-foot intervals, measured from center to center of the posts and measured generally parallel to the ground slope. Line posts shall be set plumb and shall be centered in 12 inch diameter concrete footings extending 39 inches into the ground.

C. Fence end posts and corner posts shall be set plumb, and shall be centered in 12 inch diameter concrete footings extending 39 inches into the ground.

D. Gate posts shall be provided with a concrete footing in accordance with the manufacturer's printed recommendation.

E. Where a horizontal fence alignment angle is 15 degrees or more corner posts shall be installed in lieu of line posts.

F. Bracing shall be provided at all end, gate, and corner posts, the latter in both directions. Horizontal brace rails shall be set 6 inches below top of fence fabric running from the corner, end, or gate post to first line post. Diagonal tension members shall connect tautly between posts below horizontal braces.

G. Fence corner posts shall be installed in lieu of line posts at intervals not exceeding 500 feet and shall be braced horizontally in both directions.

H. The fabric shall be fastened on the side of the posts as shown or as designated by the ENGINEER. The fabric shall be stretched and securely fastened to the posts, and between the posts the fabric shall be fastened to the top and bottom tension wires and the truss rod. The truss rod shall be stretched tight with turnbuckles at the end and corner posts.

I. The fabric shall be fastened to the end, corner, and gate posts with stretcher bars and stretcher bar bands spaced at approximately 14 inches on line posts and at approximately 18 inches on tension wires.

J. Concrete for footings shall be placed immediately after mixing in a manner such that there will be no concentration of the large aggregates. The concrete shall be consolidated by tamping or vibrating in an approved manner. Concrete for footings may be placed without forms, providing the ground is firm enough to permit excavation to neat line dimensions. Prior to placing the concrete, the earth around

the hole shall be thoroughly moistened. The concrete shall completely fill the hole and top surfaces of the concrete shall be crowned and sloped away from the post to shed water and shall have a neat appearance. Not less than 7 days shall elapse after placing the concrete footings before the fence fabric is fastened to the posts.

K. Any galvanized coating damaged during construction of the fencing and gates shall be repaired by application of molten **Galvo-Weld; Galvinox; or equal.**

- END OF SECTION -

SECTION 328000 IRRIGATION SYSTEMS

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall furnish all materials, equipment and labor necessary to complete all irrigation systems and related WORK as shown on the Drawings and/or as specified herein.

B. The Plans indicate the general arrangement of piping and equipment, but do not necessarily indicate all offsets, fittings and accessories that may be required. The CONTRACTOR shall furnish any incidental materials and labor not specifically called for but required to provide an irrigation system which will operate efficiently and provide adequate coverage.

C. Work Covered in this Section:

1. Selecting appropriate and acceptable irrigation system materials and accessories.
2. Installing a functional and complete irrigation system with electronic controller which complies with the City's Water Efficient Landscape Ordinance.
3. Testing an irrigation system to assure compliance with all applicable codes, standards and recommendations.
4. Establishing and setting appropriate and acceptable run-times for each station on the irrigation controller.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A.	Section 01330	Submittals
B.	Section 312300	Utility Earthwork
C.	Section 331102	PVC Pressure Pipe
D.	Section 329119	Landscape Grading
E.	Section 329300	Landscape Planting
F.	Section 329305	Landscape and Irrigation Maintenance
G.	Section 330526	Piping Identification Systems
H.	Section 331200	Miscellaneous Piping, Valves, Fittings, and Appurtenances
I.	Section 331233	Water Meters
J.	Section 331213	Backflow Prevention Assemblies
K.	Division 1	General Requirements

1.3 REFERENCE SPECIFICATIONS. CODES, AND STANDARDS

A. **Federal Specifications and Standards:**

NEC	National Electric Code
AASHTO	American Association of State Highway and Transportation Officials

B. **State of California (Caltrans) Standards:**

1. Standard Specifications: Section 20-5 Irrigation Systems

C. **Commercial Standards:**

ASTM D 1785	Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
ASTM D 2241	Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
ASTM D 2464	Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
ASTM D 2466	Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
ASTM D 2467	Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
ASTM D 2564	Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.
ASTM D 2737	Standard Specification for Polyethylene (PE) Plastic Tubing.
ASTM D 2855	Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
ASTM F 656	Specification for Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings.
UL	Underwriters' Laboratories Inc.
NSF	National Sanitation Foundation

B. **Reference:**

City of Livermore Water Efficient Landscape Ordinance, Ordinance Number 1399, adopted by the City Council on December 21, 1992 (Municipal Code §13.25).

1.4 CONTRACTOR SUBMITTALS

A. Submittals shall be provided by the CONTRACTOR as required by this Section and in accordance with Section 01330 "Submittals."

B. The CONTRACTOR shall retain all manufacturer documentation and warranty information accompanying the installed equipment. Said documentation and warranty information shall be submitted to the ENGINEER upon request, but not later than the date when the installation is complete.

C. If the CONTRACTOR wishes to substitute the materials, products, or manufacturers' explicitly listed in these specifications, a list of the proposed substitutions along with the corresponding manufacturer documentation and warranty information shall be submitted to the ENGINEER at least thirty (30) days before beginning work covered by this Section. Substitute materials will be acceptable only if the CONTRACTOR demonstrates that the substitutions are equal to the

specified products. An equal product must be consistent in quality and features when compared to the specified product, must be compatible with the CITY'S existing system and inventory of replacement parts, and must have the same or better manufacturers' warranty.

D. Upon request of the ENGINEER, but not later than the date of the final review, the CONTRACTOR shall submit to the ENGINEER a complete set of "As-Built" record plans which accurately depict all changes noted on the job-site plan set. Said record plans shall be submitted on reproducible mylar or sepialar prints made from the original planting and irrigation plans. In addition, the CONTRACTOR shall submit one complete reduced set of record irrigation plans printed on 11-inch by 17-inch white paper. The plant establishment period described in Section 329305 "Landscape and Irrigation Maintenance" will not commence until all changes have been accurately drafted onto the record plans, and these plans have been submitted and accepted by the ENGINEER.

1.5 QUALITY ASSURANCE

A. The CONTRACTOR shall schedule all reviews by the ENGINEER of the irrigation installation and system testing at least twenty-four (24) hours prior to the anticipated review.

B. The CONTRACTOR shall request a review by the ENGINEER at the following points in the progress of the irrigation system installation:

1. Before backfilling any segment of pipe, swing joint, valve, electrical conduit/conductor, grade level enclosure, or other irrigation system component, the ENGINEER shall review the parts and their assembly to assure conformance with the Drawings, the Plans and with this Section.

2. After backfilling the main-line pipe and all appurtenant valves, the CONTRACTOR shall demonstrate that the main-line is pressure-tight by performing the following **Hydrostatic Test:**

   After thoroughly flushing the pipe network, the CONTRACTOR shall slowly fill the system with water. All air shall be purged from the system before all remote control valves are closed. All in-line isolation valves shall be open during the hydrostatic test, unless otherwise authorized by the ENGINEER. The hydrostatic test shall consist of charging the system to a static gauge pressure of 125 pounds per square inch (psi). The system shall be capable of maintaining the static pressure with not more than a 5 psi loss for a period not less than 1 hour, or as otherwise directed by the ENGINEER. If leaks appear during the test, the leaks shall be repaired, and then the flushing and hydrostatic test shall be repeated.

3. After the planting is complete, and after the sprinklers and other irrigation components are installed, the ENGINEER shall review the entire irrigation system for leaks, for proper performance, and for conformance with the Plans and Drawings. The CONTRACTOR shall demonstrate that the irrigation system functions properly and provides complete coverage in all planting areas. Any leaks which appear during the review shall be promptly repaired. For areas with rotors or spray heads, the system shall provide head-to-head coverage. Any deficiencies discovered by the ENGINEER shall be promptly corrected.

4. For reviews during the plant establishment period, see Section 329305 "Landscape and Irrigation Maintenance."

1.6 QUALITY CONTROL

A. During the course of the work, the CONTRACTOR shall comply with all applicable Federal, State, and City of Livermore regulations, and of those from other agencies having jurisdiction over the work.

B. The CONTRACTOR shall be responsible for any hazards created in the public right-of-way or any damage to private property caused by leaks, overspray, or other problems associated with the irrigation system during its installation and throughout the plant establishment period.

C. The CONTRACTOR shall assure that all open excavations are properly protected during all phases of the irrigation system installation. No soil shall be stockpiled in an area which may impede the safe passage of pedestrians or vehicles, including street and sidewalk areas which are open to the public.

D. The CONTRACTOR shall maintain one complete set of the irrigation plans for the project at the job-site. In the event any portion of the work is not installed as indicated on the plans, said changes shall be accurately noted and drafted onto the job-site plan set. The CONTRACTOR shall make neat, legible annotations thereon daily as the WORK proceeds, showing all changes including the exact locations, sizes and types of equipment actually installed. This job-site plan set shall be available at all times for review by the ENGINEER.

E. The CONTRACTOR shall be responsible for any damage to the irrigation system which occurs before or during the plant establishment period.

PART 2 -- PRODUCTS

2.1 GENERAL

All irrigation system components shall be new and without flaws or defects.

2.2 CENTRALIZED IRRIGATION SYSTEM

A. **Controller:** The standard centralized irrigation system controller shall be the ***Rainmaster*® Evolution™ DX2 Central Control System**. The controller must support two-way remote communication, and must be upgradeable to interface either by radio, or by hard-wired connection with the *Rainmaster*® Evolution™ DX2 Central Control System computer terminal currently utilized by the CITY. The controller shall have enough stations to control all valves indicated on the Plans including those designated for future extensions, plus a minimum of two spare stations.

B. **Cabinet:** The cabinet for the centralized irrigation system controller and components shall be a vandal and weather-resistant stainless steel pedestal cabinet with integral locking mechanism. The finish is to be reviewed and approved by the ENGINEER. The cabinet shall fully enclose all controller components, accessories and terminal connections. For irrigation systems which utilize reclaimed water, an adhesive-backed sticker with purple background and white letters shall be placed on the inside cabinet door in accordance with Section 330526. The CONTRACTOR shall provide one of the following cabinets:

1. **V.I.T. Products, Inc., Strong Box® Model SB-16SS.**

2. ***Rainmaster*® Evolution™ stainless steel pedestal enclosure.**

3. Approved equal.

C. **Communication Accessories:** The centralized irrigation system controller must be equipped with the following communication accessories capable of remote data transmitted with the *Rainmaster*® Evolution™ DX2 Central Control System:

1. **Radio:** For radio communication, the controller unit shall be specified with an integral radio communication circuit board (***Rainmaster*® DX-RF**). In addition, a compatible accessory antenna shall be provided to transmit the remote data to the base receiver at the City of

Livermore Maintenance Service Center. Selection of an appropriate antenna will depend on whether clear radio reception can be established between the location of the antenna and the location of the base receiver. The CONTRACTOR shall provide the appropriate antenna as follows:

a. For line of sight radio communication, provide a low-profile dome antenna mounted on the side of the controller cabinet, as shown on the Drawings. The dome antenna shall be a ***Rainmaster*® EV-ANT-FD,** or approved equal.

b. For non-line of sight radio communication, provide a high-gain antenna installed as shown on the Drawings. The high-gain antenna shall be a ***Rainmaster*® EV-ANT-F,** or approved equal. If clear reception cannot be established using the high-gain antenna alone, the CONTRACTOR shall also install a ***Rainmaster*® EV-RF-RPTR** Remote Network Repeater Station at an appropriate off-site location in the public right-of-way or landscape easement area.

D. **Remote Control:** The standard remote control shall be a ***Rainmaster*® PROMAX Remote Assembly (PMR)**, receiver unit mounted permanently inside the controller cabinet. The CONTRACTOR shall also permanently mount a ***Rainmaster*® Antenna**, or approved equal, antenna on the controller cabinet for communication between the receiver unit and the City's remote transmitter.

E. **Master Control Valve:** The standard Master Control Valve shall be a ***Superior* 3100.2100** series brass valve, or approved equal, installed as shown on the Drawings.

F. **Flow Sensor:** The standard flow sensor shall be a ***Rainmaster*® EV-FM**, or approved equal, installed as shown on the Drawings. An equal product must be compatible with the controller provided. The electrical cable used to connect the flow sensor to the controller shall be a ***Rainmaster*® EV-CAB-COMM**, or approved equal.

2.3 STANDARD CONTROLLER

A. **Controller:** The standard irrigation controller for use where a centralized irrigation system controller is not required shall be a ***Rainmaster*®** or approved equal. The controller shall have enough stations to control all valves indicated on the Plans including those designated for future extensions, plus a minimum of two spare stations.

B. **Cabinet:** The cabinet for the standard irrigation controller and components shall be a vandal- and weather-resistant, stainless steel pedestal cabinet with integral locking mechanism. The cabinet shall be a dark forest green in the South Livermore Valley Plan area. The cabinet shall fully enclose all controller components, accessories, and terminal connections. For irrigation systems which utilize reclaimed water, an adhesive-backed sticker with purple background and white letters shall be placed on the cabinet door which reads "CAUTION: RECLAIMED WATER - DO NOT DRINK" printed in both English and Spanish. The CONTRACTOR shall provide one of the following cabinets:

1. **V.I.T. Products, Inc., Strong Box® Model SB-18SS** with a **PED-18SS** pedestal.

2. Approved equal.

2.4 ELECTRICAL COMPONENTS

A. **General:** All electrical components shall be UL listed, and installed according to NEC, PG&E, and/or CITY regulations, and manufacturer recommendations.

B. **Electrical Service:**

1. The raceway of electrical conduits for the electrical service between the service point of connection and the controller shall conform to Section 344100 “Traffic Signals and Lighting Systems,” except that the minimum conduit size shall be 3/4-inch diameter. The maximum number of bends for this service shall be no greater than 360 degrees.

2. All electrical service conductors shall be copper AWG size 10 or larger, **Type TW** or **THW**, with a temperature rating of 60 degrees C or higher, unless otherwise noted on the plans. Wire splices shall only occur in approved grade level enclosures with UL listed water-proof connectors, or in a weather-tight junction box inside the controller cabinet.

3. The electrical receptacle installed inside the controller cabinet shall have ground fault circuit interrupter (GFCI) protection.

C. **Low Voltage Control Circuits:**

1. All low voltage control circuit conductors shall be copper AWG size 14 **Type UF**, or larger. The common wire for the low voltage circuit shall be AWG size 12. The CONTRACTOR shall provide one spare AWG size 12 or larger wire for every six valves used in the system which extends parallel to the entire length of common wire as a spare and coil an extra 24” of the spare wire into each remote control valve box. The insulation jacket color for each wire shall be as follows:

   a. Control wires (+) shall be red.
   b. Common wire (-) shall be white.
   c. Spare wire shall be any color other than red, black, or white.

2. Low voltage wire splices shall be assembled using a ***3M*** **Direct Bury Splice Kit** The ***3M*** **DBY** kit shall be used for up to two AWG size 12 wires. The ***3M*** **DBR** kit shall be used for up to three AWG size 10 wires. Wire splices shall only occur in grade level enclosures. If an intermediate splice is required, the CONTRACTOR shall locate the splice inside a grade level enclosure, as described in the “Grade Level Enclosure” section of this section.

2.5 WATER METERS AND BACKFLOW PREVENTION DEVICES

A. **Water Meters:** Water meters for irrigation systems shall be provided in accordance with Section 331233 “Water Meters.” All irrigation equipment must be connected to a water meter installed exclusively for landscaping purposes. No portion of the irrigation system may be connected to a water meter utilized for domestic use. In addition, the irrigation systems for median island landscaping shall be connected to a water meter provided exclusively for the median island(s), unless otherwise approved by the ENGINEER.

B. **Backflow Prevention Assemblies:** Backflow prevention assemblies for irrigation system shall be provided in accordance with Section 331213 “Backflow Prevention Assemblies and Pressure Reducing Valves.”

2.6 VALVES

A. **Remote Control Valves:** The standard remote control valve shall be a ***Rain Bird*®** **EFB-CP** series brass valve, or approved equal. If the design flow rate is less than 10 gallons per minute, the standard remote control valve shall be a ***Rain Bird*®** **PEB** series glass-filled nylon valve, or approved equal. If the design flow rate is less than 3 gallons per minute, or for <u>all</u> drip irrigation systems, the CONTRACTOR shall provide a *Rain Bird*® PEB series valve and an upstream ***Rain Bird*®** **RBY** series in line wye filter with 200-mesh replaceable filter, or approved equal. For drip systems <u>without</u> pressure-compensating emitters, the CONTRACTOR shall also provide ***Rain Bird*®** **EFB-CP-PRS-B** pressure reducing valve or approved equal.

B. **Quick-Coupling Valves:** The standard non-potable, quick-coupling valve shall be a ***Rain Bird*® 44NP** series valve with locking purple rubber cover, or approved equal.

C. **Ball Valves:** The standard ball valve shall be a ***KBI*®** (King Bros. Industries) **Tru-Union lo-torque valve**. For remote control valve or main-line isolation valve installations, the CONTRACTOR may utilize a ball valve with integral union to eliminate the required threaded coupling and separate union shown on the Drawings.

2.7 ROTORS, SPRAY HEADS, AND TREE BUBBLERS

A. **Rotors:** The standard rotor shall be a ***Hunter*®–I-20** series sprinkler with integral check valve, a ***Hunter*® PGP** series sprinkler with integral check valve, or approved equal. The CONTRACTOR shall install nozzles with the appropriate radius, arc and trajectory for each application. The ENGINEER reserves the right to require a change in nozzles, if the change improves the distribution of irrigation water. For irrigation systems which utilize reclaimed water, all rotors shall be equipped with purple nozzle caps.

B. **Spray Heads:** The standard spray head shall be a ***Rain Bird*® 1800-SAM** series sprinkler with integral check valve, or approved equal. Spray heads shall be specified with the appropriate pop-up height, radius, arc, and trajectory for each application. The ENGINEER reserves the right to require a change in pop-up height or nozzles, of the change improves the distribution of irrigation water. For irrigation systems which utilize reclaimed water, all spray heads shall be equipped with ***Rain Bird*® 1800 NP**, or approved equal, purple plastic snap-on covers which read "DO NOT DRINK" printed in both English and Spanish. As an alternative, the CONTRACTOR may use nozzles with purple identification caps.

C. **Tree Bubblers:** The standard tree bubbler shall be a ***Rain Bird*® 1400** series pressure-compensating full-circle bubbler, or approved equal. The CONTRACTOR shall provide bubblers with the appropriate trickle pattern for each application.

D. Riser-mounted impact heads are not allowed for ornamental landscaped areas without special approval of the ENGINEER.

E. All Irrigation components are to operate according to manufacturer's specifications.

2.8 DRIP IRRIGATION COMPONENTS

A. **Drip Emitters:** The standard drip emitter shall be a ***Rain Bird*® Xeri-Bird™ XBD** series, or approved equal, multi-outlet pressure-compensating emission device.

B. **Drip Tubing:** The distribution tubing shall be continuous 1/4-inch diameter flexible vinyl tubing designed for use with the specified drip emitters.

C. **Insect Plugs:** The standard distribution tubing insect plug shall be a ***Rain Bird*® DBC** series diffuser bug cap, or approved equal.

D. **Drip Stakes:** The standard distribution tubing stake shall be a ***Rain Bird*® TS** series plastic stake, or approved equal.

E. **Pressure Gauge:** On the downstream side of the remote control valve or in-line pressure regulator, the CONTRACTOR shall provide a pressure gauge. The pressure gauge case and window shall be manufactured of polycarbonate resin. The gauge shall be 1-1/2 inches in diameter, shall be calibrated from 0 to 60 pounds per square inch in 2-pound increments and shall have a black aluminum pointer.

2.9 OTHER PROPRIETARY IRRIGATION COMPONENTS OR SYSTEMS

A. With the approval of the ENGINEER, the irrigation system may be designed using proprietary irrigation components in lieu of the products specified and shown on the Drawings. It will be the CONTRACTOR'S responsibility to demonstrate that the proprietary component or system functions as well as or better than a system designed using specified products.

B. If a system utilizing proprietary components is approved for use by the ENGINEER, the Plans shall include all applicable installation details and specifications published by the manufacturer. In addition, the CONTRACTOR shall submit manufacturer documentation and warranty information to the ENGINEER prior to installation.

2.10 GRADE LEVEL ENCLOSURES

A. **Valve Enclosures:** The standard grade-level enclosure for irrigation valves located outside of hardsurfaced areas shall be a ***Carson-Brooks*** green plastic enclosure or purple plastic enclosure (Reclaimed Water Systems) with bolt-down lid, or approved equal.

1. For standard remote control valves, the CONTRACTOR shall provide a rectangular box sized to accommodate all valve components, but not smaller than a ***Carson-Brooks*** **Model 1419-12.**

2. For standard quick-coupling valves and standard ball valves in remote control valve assemblies, the CONTRACTOR shall provide a circular box not smaller than a ***Carson-Brooks*** **Model 910.**

3. For standard ball valves, the CONTRACTOR shall provide a rectangular box sized to allow easy access to the shut-off lever, but not smaller than a ***Carson-Brooks*** **Model 1419-12.**

B. **Emitter Enclosures:** The standard grade-level enclosure for drip emitters shall be a ***Rain Bird®*** **SEB-6X,** or approved equal, plastic circular enclosure designed to accommodate the specified emitter.

C. **Intermediate Wire Splices:** The standard grade level enclosure for intermediate wire splices located outside of hardsurfaced areas shall be a circular box not smaller than a ***Carson-Brooks*** **Model 910**, or approved equal.

D. If the ENGINEER authorizes a grade level enclosure within a hardsurfaced area, the CONTRACTOR shall provide a precast concrete utility box manufactured by ***Christy, Associated Concrete***, or equal with a shape and size comparable to the plastic enclosures described above. The lid for the precast concrete utility box shall support any expected loading condition and shall have text which reads "Irrigation."

E. The 6-inch layer of Class 2 permeable material shown on the Drawings to be placed in the bottom of each grade level enclosure, shall be the material defined in Section 312300 "Utility Earthwork."

2.11 PIPES, SLEEVES, AND FITTINGS

A. **Pipes:** The standard irrigation pipe material shall be Class 12454-B PVC pipe conforming to ASTM D 1784. All pipe material shall be NSF listed, except pipe used for systems which utilize reclaimed water. The standard pipe segment length shall be 20 feet. The standard pipe design shall be as follows:

1. For 1/2-inch to 2-inch nominal pipe diameter, the CONTRACTOR shall provide solvent-weld Schedule 40 or threaded Schedule 80 PVC 1120 conforming to ASTM D 1785.

2. For 2-1/2-inch to 4-inch nominal pipe diameter, the CONTRACTOR shall provide IPS size SDR 13.5 315 PSI PVC 1120 conforming to ASTM D 2241.

3. For nominal pipe diameters greater than 4-inch, the CONTRACTOR shall provide AWWA C900 pipe in accordance with Section 331102 "PVC Pressure Pipe," except that Pressure Class 100, DR 25 may be used, if appropriate for potable water systems.

4. For systems which utilize reclaimed water, the CONTRACTOR shall substitute ***PWPipe*®** **PWPurple Plus, Alertline, Purple Save Pipe as manufactured by J-M Manufacturing Company, Inc.,** or approved equal, pipe for all materials listed above.

5. For system requiring flexible pipe, CONTRACTOR shall use 1/2" or 3/4" IPS Flex Tubing. CONTRACTOR shall use primer and glue approved for IPS Flex Tubing. Weld-On 2795 glue for IPS Flex Tubing, or approved equal.

B. Each length of pipe shall be marked with the nominal diameter in inches, the Schedule or SDR designation, the ASTM D 1784 cell classification and the manufacturer's name and code.

C. If a pipe segment must pass beneath a hardsurfaced area, the CONTRACTOR shall enclose said pipe within a Schedule 40 PVC sleeve which is at least two pipe sizes larger than the enclosed pipe, and shall install a color coded warning tape placed over the sleeve in accordance with Section 330526 "Piping Identification Systems."

D. **Slip Fittings:** All solvent-weld PVC pipe fittings shall conform to ASTM D 2466 for Schedule 40 slip fittings, or ASTM D 2467 for Schedule 80 slip fittings.

E. **Threaded Fittings:** All threaded PVC pipe fittings shall conform to ASTM D 2464 for Schedule 80 threaded fittings. Flex Risers shall be manufactured from a corded rubber hose material permanently fastened to Schedule 80 threaded male adapters on each end.

F. All irrigation mains shall be continuously marked in conformance with the appropriate ASTM and the requirements of Section 330526, "Piping Identification Systems."

2.12 SOLVENT CEMENTS AND PIPE THREAD COMPOUNDS

A. **Solvent Cements:** All solvent-weld PVC pipe material and slip fittings shall be joined using a solvent cement conforming to ASTM D 2564. The CONTRACTOR shall use a regular-bodied cement to join pipes with nominal diameters from 1/2-inch to 2-inches, and a medium-bodied cement to join pipes larger than 2-inches. In addition, for all solvent-weld pipes which will serve as main-lines, or for those pipes with nominal diameters larger than 2-inches, the CONTRACTOR shall first apply a primer conforming to ASTM F 656 before applying the cement.

B. **Pipe Thread Compounds:** All threaded PVC pipe material and fittings shall be assembled using a pipe thread compound or Teflon tape designed to provide a leak-proof pressure-tight seal by filling voids between threads.

2.13 BACKFILL

A. Irrigation trenches which run through planting areas shall be backfilled using Native material, as defined in Section 312300 "Utility Earthwork."

B. The sand backfill indicated on the Drawings for irrigation mainline and electrical trenches shall conform to Sand as defined in Section 312300 "Utility Earthwork."

C. For irrigation pipes which extend in sleeves through hardsurfaced areas, the trenches shall be backfilled in conformance with Section 312300 "Utility Earthwork."

PART 3 -- EXECUTION

3.1 GENERAL:

A. All irrigation system components shall be installed in accordance with this Section, with the Drawings, with the manufacturer's recommendations, and with established industry standards. The CONTRACTOR shall do nothing which may jeopardize any manufacturer warranty.

3.2 POINTS-OF-CONNECTION

A. Before beginning work on the irrigation system installation, the CONTRACTOR shall locate all points-of-connection, both for the water supply, and for the electrical service to the controller. The points-of-connection shall conform to the following requirements:

1. **Water Supply:** All irrigation piping must be connected to a metered water service installed exclusively for landscaping purposes, and in accordance with standards established by the *City of Livermore Water Department*, or *California Water Service Company* (depending on franchise area). In addition, the irrigation systems for median island landscaping shall be connected to a water meter provided exclusively for the median island(s), unless otherwise approved by the ENGINEER. The CONTRACTOR shall install a backflow prevention device in accordance with Section 331213 "Backflow Prevention Assemblies" immediately downstream of the meter.

2. **Electrical Service:** The point of connection to the electrical system must be acceptable to both PG&E and the ENGINEER. The CONTRACTOR shall adhere to all regulations established by PG&E when connecting the controller to the secondary electrical service.

B. If work on either the water service or electrical service point-of-connection requires an existing service to be shut-off, the CONTRACTOR shall coordinate said shut-off with the ENGINEER. At no time shall the period of the shut-off extend more than 24-hours, unless specifically authorized by the ENGINEER. If a shut-off of more than 24-hours is authorized, the CONTRACTOR shall provide irrigation water by some other means to all affected plants, even if the areas are being maintained by CITY staff. Said watering shall be performed as often as necessary to maintain healthy plant growth throughout the duration of the shut-off.

3.3 VERIFYING WATER PRESSURE

A. After locating the water service points-of-connection, the CONTRACTOR shall determine whether the water pressure at this point is within 5 pounds per square inch (psi) of the design pressure indicated on the Plans. If the pressure is more than 5 psi higher or lower than the design pressure, the CONTRACTOR shall notify the ENGINEER of this determination.

B. At the ENGINEER'S discretion, it may be necessary to amend the irrigation design to account for the actual measured water pressure. No work shall proceed until the ENGINEER is satisfied that the design pressure and actual pressure are within a reasonable tolerance.

3.4 SLEEVES BENEATH HARDSURFACING

A. Irrigation pipes and controller wires which must pass beneath hardsurfaced areas or through concrete or masonry walls/foundations shall be placed inside sleeves. The ends of each sleeve shall extend a minimum of 12-inches beyond the limit of the hardsurfacing material, unless otherwise authorized by the ENGINEER. Seal the open ends of the sleeve using expandable foam. Sleeves are to be no less than 2 times the diameter than the pipe it contains.

B. All sleeves shall have a color codes warning tape placed over the sleeve in accordance with Section 330526 "Piping Identification Systems." In addition, the CONTRACTOR shall stamp an "I"

on the top-of-curb or sidewalk above the location of the sleeve so the ends can be found in the future.

C. Sleeves and the required warning tape above each sleeve must be installed before any hardsurfacing or bedding materials are installed. Boring beneath hardsurfacing to install sleeves after the hardsurfacing materials are placed is not allowed without special approval from the ENGINEER.

D. Sleeves shall be installed without bends or angled fittings to allow for future removal and replacement of the contained pipe or wire.

3.5 SYSTEM LAYOUT

A. The controller shall be located where its view from the road will be obscured by the plant materials, but where accessibility for maintenance and programming is not obstructed. Controllers shall not be located in median islands, unless specifically authorized by the ENGINEER. In addition, the controller shall be installed in a location where the cabinet does not obstruct a driver's line-of-sight as defined by AASHTO Sight Distance criteria.

B. For centralized irrigation systems, the following criteria apply:

1. For systems utilizing radio communication, the antenna location is best determined by testing several locations at the site until optimum reception between the antenna and the receiver unit is achieved. The receiver unit is permanently installed at the City of Livermore Maintenance Service Center, 3500 Robertson Park Road. If clear reception cannot be achieved, the CONTRACTOR shall either install a remote network repeater station, or make provisions for hardwired or telephone communication.

2. If a high-gain antenna is utilized, the antenna and controller shall be positioned such that the length of data transmission cable which extends between the two components does not exceed the maximum length of cable available from the manufacturer. A 30-foot cable length is standard.

3. The flow sensor and master control valve shall be located not more than 1,500-feet from the controller.

C. The backflow prevention assembly, if required, shall be installed in a location where the insulated above-ground assembly enclosure does not obstruct a driver's line-of-sight as defined by AASHTO Sight Distance criteria.

D. Irrigation pipes and control wiring shall be placed in planting areas. The CONTRACTOR'S layout shall minimize the length of pipe or control wire passing beneath hardsurfacing materials inside sleeves. For clarity, the plans may show the mainlines or laterals schematically (i.e., superimposed over sidewalks or streets) rather than in their actual intended location. In such cases, the pipes shall be placed in the nearest appropriate unsurfaced area or planting bed.

E. The CONTRACTOR shall locate remote control valve and other mainline valve enclosures within planting areas. Valve enclosures shall not be installed in hardsurfaced areas without the prior approval of the ENGINEER.

3.6 TRENCHING

A. Trenching for buried irrigation system components shall conform to Section 312300 "Utility Earthwork," except as amended herein.

B. Trenches for irrigation pipe, fittings, and electrical conduits shall be free of jagged rubble, large rocks, or other sharp objects which may puncture or cause adverse stresses on the buried features during or after backfill.

C. Trenches for irrigation piping shall be of sufficient width to accommodate pipe laid in a serpentine alignment.

D. Where trenching for new irrigation facilities is performed in areas planted with existing trees, shrubs, or other significant landscape features, the trenching alignment shall be adjusted as necessary to avoid damage to the root systems of these existing features. If the trenching will pass through areas which contain existing groundcover plantings or turf, all disturbed areas shall be restored to their original condition after backfill.

E. If an existing irrigation facility or other underground utility or structure is damaged, broken, or severed during the trenching operation, the CONTRACTOR shall repair said facility to a standard equal to or better than the original construction.

3.7 INSTALLING IRRIGATION PIPES AND CONTROL WIRES

A. Irrigation pipes shall be installed according to the following criteria:

1. Before assembly, all pipe shall be stored with the ends of the pipe wrapped, or with the pipe segments elevated above the ground surface to keep dirt and other debris out of the pipe.

2. If the pipe is brittle or sun-bleached when delivered to the site, it shall be replaced.

3. Parallel pipes may be placed in a common trench, provided that a minimum horizontal clearance of 3-inches is maintained between the buried pipes. No pipe shall be installed parallel to and directly over another pipe.

4. At pipe crossings, the crossing angle shall be approximately perpendicular, but not less than 45 degrees. A minimum of 3-inches vertical clearance shall be maintained between crossing pipes. If a change in pipe elevation is necessary at a crossing to maintain the required vertical clearance, said change shall be accomplished using an offset constructed of 45 degree fittings.

5. All pipe shall be cut straight and true. After cutting, the cut end shall be reamed-out to the full inside diameter of the pipe, and all burrs shall be removed. The CONTRACTOR shall use caution to assure that the cuttings and burrs do not fall inside the pipe during assembly.

6. All irrigation pipe shall be installed in a serpentine alignment to allow for thermal expansion and contraction.

7. Mainline pipes with rubber gasket joints shall be installed in accordance with Section 331102 “PVC Pressure Pipe,” with concrete thrust blocks at every change in pipe direction.

8. Prior to installation of remote control valves, irrigation system shall be thoroughly flushed to the ENGINEERS satisfaction.

B. Irrigation fittings shall be installed according to the following criteria:

1. All solvent-weld PVC pipe shall be assembled in accordance with ASTM D 2855 “Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings.” The CONTRACTOR shall use a regular-bodied solvent cement to join pipes with nominal diameters from 1/2-inch to 2-inches, and a medium-bodied cement to join pipes larger than 2-inches. In addition, for all solvent-weld pipes which will serve as main-lines, or for those

pipes with nominal diameters larger than 2-inches, the CONTRACTOR shall first apply a primer to the fitting and end of pipe before applying the cement and assembling the joint.

2. All threaded PVC pipe shall be assembled using pipe thread compound or Teflon tape, except that Teflon tape shall not be applied to the threads which will receive the spray head, rotor, or emitter. If Teflon tape is used, no more than three wraps shall be applied to each fitting.

C. Control Wires shall be installed according to the following criteria:

1. Control wires shall only be spliced inside grade level enclosures. Said splices shall be assembled using a water-proof manufactured wire splice system in accordance with the manufacturer's instructions.

2. When possible, the CONTRACTOR shall install wiring in the same trench as the irrigation mainline. If wiring is not installed in the same trench as the irrigation mainline, a tracer wire shall be placed next to the mainline terminating in splice boxes.

3. Each bundle of control wires to be buried shall be gathered and taped at an interval not exceeding 10 feet. The bundle shall than be taped to the top of the irrigation mainline. Standard electrical tape shall be used to bundle the wires and to affix the bundle to the irrigation main.

4. All low-voltage control wires shall have a 24-inch length of excess wire coiled inside each remote control valve enclosure.

5. The CONTRACTOR shall install one spare control wire for every 6 valves. The spare control wire is to extend parallel the entire length of the common wire. The insulation jacket color for the spare shall be any color other than red, black, or white.

3.8 INSTALLING VALVES AND GRADE-LEVEL ENCLOSURES

A. Master control valves shall be installed downstream of, and as close as possible to, the backflow prevention device, or to the water meter for systems which require no backflow prevention device. The irrigation main-line between the meter and the master control valve shall have no intermediate branch connections installed which could allow flow to bypass the master control valve.

B. Remote control valves shall be installed according to the following criteria:

1. Only one remote control valve assembly shall be installed inside each grade level enclosure.

2. The size of the remote control valve shall match the line-size of the irrigation pipe which it controls. All accessory components and fittings shown on the Drawings as integral parts of the remote control valve assembly shall be the same line-size as the valve.

3. Each valve assembly shall have unions installed on both ends to allow for future removal of the assembly for maintenance or replacement, as shown on the Drawings.

4. The bottom of the remote control valve assembly shall be fully supported by Class 2 permeable material placed inside the grade-level enclosure.

C. Quick coupling valves shall be installed such that their spacing throughout the planting area does not exceed 200 feet.

D. Ball valves shall be installed according to the following criteria:

1. Ball valves shall be installed at intervals not to exceed 500-feet along the length of each irrigation mainline, and at the upstream end of each mainline which passes beneath a hardsurfaced area inside a sleeve.

2. If an irrigation mainline will be extended to serve a future landscaped area, the mainline shall terminate with a line-size ball valve installed inside a grade-level enclosure.

3. Line size ball valves shall be installed on both sides of sleeve before the irrigation main line passes through any sleeve passing under the street, as directed by the ENGINEER.

E. Grade level enclosures shall be installed according to the following criteria:

1. Locate plastic grade level enclosures not closer than 12 inches (measured at the top) from the edge of any hardsurfacing material, building, wall, header board, or other structure. When two or more enclosures are installed side by side, the CONTRACTOR shall provide at least 12-inches of separation between each enclosure (measured at the top).

2. The lid for each plastic grade level enclosure shall be identified by permanently inscribing the following information onto the top of the lid:

   a. Station number and controller designation (multiple controllers only) for remote control valves.
   b. "MV" for master control valves.
   c. "FS" for flow sensors.
   d. "BV" for ball valves.
   e. "QC" for quick coupling valves.
   f. "SB" for wire splices.

3. If a precast concrete grade level enclosure is used to enclose irrigation or electrical components, the lid shall be set flush with the surrounding hardsurfacing material, and shall be designed to support any expected loading condition. In addition, the lid shall have text which reads "Irrigation."

3.9 ASSEMBLING RISERS, ROTORS, SPRAY HEADS, BUBBLERS, AND EMITTERS

A. **General:** Before any risers, heads, or emitters are installed, the CONTRACTOR shall thoroughly flush the entire main-line pipe network and laterals with clean water and then perform the hydrostatic test described in this section. No risers or heads shall be installed until the ENGINEER is satisfied that the mainline and laterals are adequately flushed and pressure-tight.

B. Rotors and Spray Heads shall be installed according to the following criteria:

1. The riser assemblies for all rotors and spray heads shall be installed with triple-swing joints as indicated on the Drawings. Said triple-swing assemblies shall allow for both horizontal and vertical adjustment of each head without leaking.

2. Before installing each head, the CONTRACTOR shall confirm whether the specified pop-up height, radius, arc and trajectory are appropriate given the site conditions and proposed layout of the plant materials. If a deviation from the Plan is necessary to achieve adequate irrigation coverage, said deviation shall be authorized by the ENGINEER, then executed by the CONTRACTOR at no additional cost to the CITY.

3. The heads shall be positioned such that the spray from each head reaches the closest surrounding head, thus providing "head-to-head" coverage. The CONTRACTOR shall make adjustments or add additional heads, if necessary, to achieve head-to-head coverage in all areas irrigated by rotors or spray heads.

4. Rotors and spray heads shall be placed not closer than 3-inches from the edge of a hardsurfacing material, wall, or foundation to allow access for edging equipment.

5. All heads shall be set perpendicular to the finish grade, including those in sloping areas. The trajectory of each head shall be adjusted by selecting an appropriate pop-up height and nozzle trajectory rather than by tilting the head.

6. Heads shall be set flush with the finish grade elevation of the mowed surface for turf areas, or set slightly above the finish grade elevation in groundcover or mulch areas, per the manufacturer's recommendations.

C. Bubblers shall be installed according to the following criteria:

1. Tree bubblers shall operate on a separate dedicated controller station to allow the bubblers to function even when other stations are shut-off. This will allow the valves for shrubs, groundcover, and/or turf to be shut-off during drought conditions without compromising the survival of the trees.

2. Each bubbler shall be installed within the limits of the plant pit.

3. For street trees along the frontage of a private residential, commercial, or industrial parcel, the bubbler shall be connected to and controlled by the private on-site irrigation system.

4. On slopes, bubblers shall be installed on the uphill side of the tree well.

D. Emitters shall be installed according to the following criteria:

1. Emitters and associated accessories shall be installed as shown on the Drawings and in accordance with the manufacturer's recommendations.

2. The end of each emitter tube with insect plug shall be positioned at the edge of the root ball to encourage peripheral root growth.

3.10 BACKFILL

A. Trench backfill shall be placed in accordance with Section 312300 "Utility Earthwork" and per the Drawings. The CONTRACTOR shall use care in placing backfill to prevent damaging or distorting the buried features.

B. The CONTRACTOR shall exercise care during the compaction of trench backfill material to avoid compacting the soil within the drip-line of existing trees or other significant landscape features scheduled to remain.

C. Trench shall be thoroughly consolidated. If trench settlement occurs within the landscaped area, the CONTRACTOR shall place and add backfill material in the ruts or depressions until a uniform consolidated surface is achieved.

3.11 INSTALLING AND PROGRAMMING THE CONTROLLER

A. **Controller Installation:**

1. The controller shall be installed as shown on the Drawings and in accordance with the manufacturer's recommendations and instructions.

2. All communication and electrical service wires shall be installed inside UL listed Schedule 40 conduit. The cumulative change in conduit direction by use of elbow fittings shall not exceed 360 degrees for any conduit run.

3. For the controller's electrical service connection, the CONTRACTOR shall install a 5-amp in-line fuse on the hot leg of the service, in accordance with Section 034105 "Traffic Signals and Lighting Systems." Said fuse shall be located inside a precast concrete grade level enclosure with a lid marked "Irrigation." The grade level enclosure for the fuse shall be positioned immediately adjacent to the secondary splice box designated by PG&E at the point-of-connection. The service conductors shall run inside a conduit from the grade level enclosure to the controller cabinet (direct burial wire is not allowed).

4. If the distance between the grade level enclosure and the controller cabinet exceeds 250-feet, the CONTRACTOR shall install intermediate grade level enclosures to accommodate wire splices for the electrical service conductors at a spacing not to exceed 250-feet.

5. If a centralized irrigation system controller with radio communication capability is utilized, the CONTRACTOR shall work with the ENGINEER to determine an antenna location which results in clear radio reception between the antenna and the CITY'S base receiver. No components shall be permanently installed until this determination is made.

6. The CONTRACTOR shall connect the low-voltage control wires to the controller in a sequential arrangement according to the station numbers shown on the Plans.

B. **Controller Programming:**

1. The CONTRACTOR shall utilize the irrigation schedule provided on the Plans when programming the controller. Run-times and frequency of watering for each station shall be programmed according to appropriate evapotranspiration rates for each month within the Livermore area.

2. The total amount of water applied to the landscaped area shall not exceed the Maximum Applied Water Allowance, as calculated by the irrigation designer in accordance with the City's Water Efficient Landscape Ordinance. A Landscape Irrigation Audit may be required in accordance with the State of California Landscape Management Program if the monthly water usage exceeds the Maximum Applied Water Allowance by 20% or more.

3. The controller shall be programmed to operate all stations during non-daylight hours, unless otherwise authorized by the ENGINEER.

3.12 OPERATING THE SYSTEM

A. When complete, the irrigation system shall deliver water at a rate which is compatible with the needs of the plant materials and with the infiltration rate of the soil. The system shall be adjusted by the CONTRACTOR to eliminate overspray or runoff during normal operation. Repeat cycles shall be programmed if the runoff problems cannot be corrected by other adjustments.

B. The CONTRACTOR shall establish accounts with all applicable utility companies to provide services for the irrigation system. The ENGINEER will assign addresses for all services upon request of the DEVELOPER or CONTRACTOR. Said services may include water and electrical. Said accounts shall be paid by the CONTRACTOR until completion of the Plant Establishment Period, as described in Section 329305 "Landscape and Irrigation Maintenance."

C. For centralized irrigation systems, the CONTRACTOR shall assure that the controller properly transmits and received data from the CITY'S base receiver unit.

- END OF SECTION -

SECTION 329113 - LANDSCAPE SOIL PREPARATION

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall furnish all materials, equipment, and labor necessary to complete all landscape soil preparation and related work as shown on the Drawings and/or as specified herein.

B. Work Covered in this Section:

1. Sampling and analyzing soil to determine the landscape compatibility and horticultural properties.

2. Amending and placing top-soil.

3. Furnishing and using fertilizers and herbicides.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A.	Section 015700	Site Preparation
B.	Section 329119	Landscape Grading
C.	Section 329300	Landscape Planting
D.	Division 1	General Requirements

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. **Commercial Standards:**

1. OSHA Standards.

1.4 CONTRACTOR SUBMITTALS

A. Soil quality varies significantly in the City of Livermore. Boron levels, for example, range from the tolerable to the extreme (less than 1 part-per-million, up to 16 parts-per-million). A complete landscape compatibility/horticultural report, per the following description is therefore required before grading operations begin. The CONTRACTOR shall submit a horticultural report with recommendations for all areas to be landscaped.

B. The landscape compatibility/horticultural report shall be prepared by a soil testing laboratory with a minimum of three years experience performing analyses for ornamental landscaping as described below.

C. The landscape compatibility/horticultural analysis shall conform to the following minimum criteria:

1. The landscape compatibility/horticultural report shall be submitted to the ENGINEER concurrently with the landscaping plans for the project, and shall be accompanied by a statement from the Landscape Architect that the proposed plant list is in accordance with the report recommendations and with the intent of these Standard Specifications.

2. The results of the horticultural analysis shall be presented in a report which shall include recommendations for soil amendments, fertilization, drainage, tolerant plant materials, and

other necessary measures to assure a successful landscape design. The depth of the water table, if known, shall be included in the report.

3. A minimum of two representative composite soil samples shall be analyzed for landscaped areas with less than 100,000 square feet. Additional tests will be required according to the following criteria:

    a. For areas larger than 100,000 square feet, one additional sample shall be analyzed for each additional 50,000 square feet of landscaped area.

    b. If the total length of the landscaped area, measured longitudinally, exceeds 2,500 linear feet (i.e. for median strips or backing lot treatments), one representative composite sample shall be analyzed for each 2,500 linear feet segment.

    c. For multiple, discontinuous landscaped areas within one project, one representative composite sample shall be analyzed for each distinct area, if the areas are separated by more than 2,500-feet.

    d. If different soil textures or colors are discovered while sampling, a representative sample from each discovered soil type shall be analyzed.

    e. Analyze one representative sample for every 3,000 cubic yards of import soil.

4. Each composite sample shall be a mixture of 10 or more sub-samples taken from the rooting depths of the proposed plantings. Typical rooting depths are as follows:

    a. Turf and herbaceous groundcovers: 0 to 6"
    b. Shrubs: 0 to 18"
    c. Trees: 0 to 12" and 13" to 36" (obtain one sub-sample from each depth)

5. Additional samples shall be analyzed if different soil textures or colors are exposed during mass grading operations, at the discretion of the ENGINEER.

6. Samples shall not contain any plant or organic material from the soil surface.

7. Samples should be gathered with a tube which removes a core of soil from the surface to the lower rooting depths. If a shovel is used, a vertical 1" slice should be taken from the side of the hole.

8. Each soil sample shall be analyzed to determine its soil chemistry including all of the following:

    a. Alkalinity or acidity (pH).
    b. Fertility.
    c. Landscape compatibility.
    d. Soil classification and particle size.
    e. Percolation or infiltration rate.
    f. Boron content.
    g. Salinity including Electrical Conductivity (ECE) and Sodium Absorption Ratio (SAR).
    h. Any calcareous or chlorosis condition.
    i. Any other condition deemed important by the horticulturalist, or requested by the ENGINEER.

9. For landscaped and hard-surfacing areas, the CONTRACTOR shall submit a pre-emergent herbicide for approval by the ENGINEER.

D. The CONTRACTOR shall submit to the ENGINEER a written certification stating the quantity, type, composition, weight, and origin of all amendments and chemicals delivered to the site for soil preparation work.

1.5 STOCKPILED MATERIAL

A. Areas to receive landscaping shall not have stockpiled materials placed on them for long periods of time to avoid compaction of landscaped areas. If landscaped areas are over compacted by stockpiled materials, the area shall be cross-ripped and scarified as described in PART 3 of these specifications.

1.6 QUALITY ASSURANCE

A. The CONTRACTOR shall, upon request of the ENGINEER, produce records to verify the ordering and delivery of specified quantities and types of material.

PART 2 -- PRODUCTS

2.1 TOPSOIL

A. An 8-inch minimum layer of clean topsoil shall be provided in all planting areas. Topsoil shall consist of a fertile, friable soil of a loamy character containing an amount of organic matter which is normal to the area before the addition of humus or soil amendments. It shall be free of any refuse, heavy or stiff clay, hard dirt clods, stones larger than 1-1/2 inches in any dimension, roots larger than 3/4-inch in diameter, litter, and other deleterious materials. In addition, the soil shall be free of noxious weeds, Bermuda grass, nut grass or other invasive wildland pest plant material, toxic amounts of boron, acid or alkaline chemicals, and shall be capable of sustaining healthy plant life.

B. Site strippings may be stockpiled and then used as topsoil, provided the material conforms to the above criteria.

C. If import topsoil is used, it shall be certified by the soil testing laboratory to be physically and chemically appropriate for sustaining plant life, and for mixing with the underlying native soil.

2.2 SOIL AMENDMENTS

A. The CONTRACTOR shall amend the topsoil in accordance with the recommendations of the landscape compatibility/horticultural report, and as specified on the plans. If the plans are in conflict with the landscape compatibility/horticultural report, the report shall govern.

B. Where such products are appropriate and available, the CONTRACTOR shall use recycled products as soil amendments. Recycled products include composted sewage sludge, composted yard debris, or rice hulls, for example.

C. The CONTRACTOR shall submit a certification describing the quantity, type, composition, weight, and origin of all amendments. Amendments shall not be delivered to the site without the approval of the ENGINEER.

D. Submittals of composted sewage sludge must be accompanied by a certification that the amendment meets all applicable State and Federal guidelines for beneficial reuse of sewage residuals. Submittals of composted materials must include certification that manufacturing procedures involve temperatures and detention times which effectively inactivate weed seeds and other deleterious organisms or materials.

E. Rice hull compost shall not contain living vegetation, dirt or other objectionable material, pathogenic viruses, fly larvae, insecticides, herbicides, fungicides or poisonous chemicals that would inhibit plant growth.

2.3 COMMERCIAL FERTILIZER

A. All fertilizers shall be commercially processed and shall conform to the requirements of the agricultural laws and regulations applicable in the State of California.

B. The CONTRACTOR shall adhere to the recommendations of the horticultural report and of the manufacturer when selecting the appropriate fertilizer for each landscape area.

C. Unless otherwise specified, the fertilizer shall be a long-term, slow-release, water-insoluble, nitrogen-based product.

D. The fertilizer shall be in pelleted, granular, or tablet form and shall have the chemical composition clearly marked on the packaging material for inspection by the ENGINEER. The packaging must list the relative amounts of the three major macro-nutrients--nitrogen (N), phosphorus (P), and potassium (K)--as percentages of the total weight. If other macro-nutrients (e.g. magnesium, sulfur, calcium) or micro-nutrients (e.g. chlorine, iron, boron, manganese) are included in a fertilizer, these must also be listed on the packaging. The fertilizer packaging must also indicate whether the product is "fast-release" or "slow-release."

2.4 PRE-EMERGENT HERBICIDES

A. Unless otherwise specified on the plans, a broad spectrum pre-emergent herbicide shall be used. The herbicide must be registered for use in the State of California. Care shall be taken in selecting the appropriate pre-emergent herbicide because the effectiveness of these products is determined by site-specific conditions.

PART 3 -- EXECUTION

3.1 CLEARING

A. All landscaped areas shall be cleared and graded in accordance with Section 015700 "Site Preparation" and Section 329119 "Landscape Grading."

B. In all areas to be planted, remove and properly dispose of all rocks and paving materials over 1-1/2 inch in any dimension, and all weeds, debris, and other deleterious or noxious material, as described above.

3.2 SOIL PREPARATION

A. If in-place soils are to be amended to create the topsoil layer, the in-place soils within the areas to be planted shall be cross-ripped and scarified to a minimum depth of 8-inches prior to the addition of amendments and fertilizers.

B. If import soil is used for topsoil, the underlying sub-soil shall be cross-ripped and scarified to a minimum depth of 8-inches before topsoil is placed. The import soil shall then be incorporated (i.e. mixed) with the sub-soil so that there is a gradual change from sub-soil to topsoil, rather than a sharp break.

C. Following the ripping and scarifying operation, all areas to be planted shall be tilled to break down clods, to expose deleterious material to be removed, and to incorporate soil amendments and/or commercial fertilizer. Amendments and fertilizers shall be evenly distributed and incorporated throughout the topsoil layer.

D. The CONTRACTOR shall use the soil amendments and/or commercial fertilizer specified in the landscape compatibility/horticultural report or shown on the plans. The CONTRACTOR shall adhere to all agricultural laws and regulations applicable in the State of California and the manufacturer's safety recommendations when using agricultural chemicals.

E. The tilling operation shall be performed until the ripped and scarified soil is in a loose condition and the amendments and fertilizers are thoroughly mixed.

F. The outer limits of the areas to be cultivated shall extend a minimum of 12-inches beyond the outer row of plants requiring cultivation, unless otherwise stated on the Plans.

G. The use of rubber tired equipment will be permitted for cultivating operations provided the equipment used completely eradicates any compaction caused by the tires. Rubber tired equipment will not be allowed on cultivated areas after cultivation.

H. Grading work shall not be performed when the moisture content of the soil is such that excessive compaction will occur, or when the soil is so dry that clods will not break readily or dust will form in the air. Apply water as required to prevent the formation of an airborne dust nuisance and to provide ideal soil moisture content for tilling.

3.3 PESTICIDE/HERBICIDE APPLICATION

A. Apply pre-emergent herbicide in accordance with the manufacturer's recommendations for all tree ring, ground cover, and shrub bed areas. The CONTRACTOR shall adhere to all agricultural laws and regulations applicable in the State of California and the manufacturer's safety recommendations when using agricultural chemicals.

B. The pre-emergent herbicide shall be applied before mulch is placed.

C. The CONTRACTOR shall use care in applying the pre-emergent herbicide to avoid damaging any existing trees or other landscape features scheduled to remain. Herbicide shall not be applied during windy conditions to avoid spray drift.

- END OF SECTION -

SECTION 329119 - LANDSCAPE GRADING

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall furnish all materials, equipment, and labor necessary to complete all landscape grading and related work as shown on the Drawings and/or as specified herein.

B. Work Covered in this Section:

1. Establishing Finish Grades and Contours in Landscaped Areas.

2. Protecting Existing Trees and/or Other Vegetation.

3. Protecting Landscape Slopes from Erosion and Denudation.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A.	Section 024100	Demolition
B.	Section 015700	Site Preparation
C.	Section 311300	Selective Tree and Vegetation Trimming and Removal
D.	Section 311316	Root Pruning
E.	Section 310000	Earthwork
F.	Section 329113	Landscape Soil Preparation
G.	Division 1	General Requirements

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. **Commercial Standards**:

1. USA (Underground Service Alert)

B. **Reference:**

ASTM D 1557	Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb. (4.54-kg) Rammer and 18" (457-mm) Drop
ASTM D 2992	Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	Test Methods for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)

1.4 CONTRACTOR SUBMITTALS

A. The CONTRACTOR or DEVELOPER shall submit copies of a supervising arborist's certification from the Western Chapter of the International Society of Arboriculture if landscape grading work will be performed in areas where trees or other plant materials exist which are scheduled to remain as part of the landscaping design. Said certification shall be submitted to the ENGINEER prior to performing any work.

B. The CONTRACTOR or DEVELOPER shall submit copies of the recommendations prepared by the certified Arborist to the ENGINEER prior to performing any work.

C. The CONTRACTOR shall submit manufacturer product information for the erosion control netting to be used on 3:1 or steeper slopes.

D. See Section 329113 "Landscape Soil Preparation" for the submittal requirements related to the landscape compatibility/horticultural report.

1.5 QUALITY ASSURANCE

A. All compaction testing will be performed by a testing laboratory of the CITY'S choice and at the CITY'S expense, except as otherwise noted in this Section.

B. Where soil material is required to be compacted to a percentage of relative compaction, the maximum density at optimum moisture content will be determined in conformance with ASTM D 1557. Field density in-place and moisture content tests may be performed in conformance with ASTM D 2992 and ASTM D 3017, respectively, or by such other means acceptable to the ENGINEER.

C. If the tested materials show non-compliance with the required relative compaction, the CONTRACTOR shall accomplish such remedy as may be required to ensure compliance.

D. The CITY will pay the cost of the first test and one re-test. Subsequent re-testing after the first re-test to show compliance shall be at the CONTRACTOR'S expense.

1.6 QUALITY CONTROL

A. The CONTRACTOR shall notify Underground Service Alert (USA) and all affected utility companies, per Section 01560 "Protection of Existing Facilities," before performing grading or excavation work in areas which contain existing underground utilities. The utilities marked by each service provider shall be protected by the CONTRACTOR during the grading or excavation work, or repaired at the CONTRACTOR'S expense, if damaged.

B. The DEVELOPER or CONTRACTOR will be held responsible to replace or repair any damage to public or private property which occurs as a result of the landscape grading operations.

C. Subgrades and finished grades for the landscaped areas may vary within a tolerance of one-tenth of a foot (0.1') from the finished grade elevations shown on the plans, provided no drainage pockets or depressions result.

D. All bench marks, monuments, and other reference points set by a Professional Land Surveyor for the benefit of the CONTRACTOR shall be carefully protected during grading operations and, if disturbed or removed prematurely, shall be replaced as directed by the ENGINEER at the CONTRACTOR'S sole expense.

E. All landscape grading work performed in and around areas with existing trees or other plants shall be performed in accordance with the recommendations of an arborist certified by the Western Chapter of the International Society of Arboriculture.

F. If the CONTRACTOR, while performing the landscape grading work, endangers the survival of an existing designated tree or other significant landscape feature which is scheduled to remain, the ENGINEER shall have the authority to require the CONTRACTOR to perform additional work in an effort to mitigate the damage and to increase the likelihood of recovery, subject to the following:

1. If, in the opinion of the ENGINEER, the death of the tree or other landscape feature is likely, the CONTRACTOR shall completely remove the feature in conformance with Section 311300 "Selective Tree and Vegetation Trimming and Removal."

2. If a tree is removed, the minimum tree replacement ratio will be determined by the Planning Division based on the size, location, and significance of the removed feature. In no case shall the replacement ratio be less than five-to-one for a replacement tree of equivalent size, character, and species.

3. If a five-to-one replacement is not practical due to site constraints, or other extenuating circumstances, the ENGINEER may allow replacement with 24"-box size trees or equivalent orchard dug tree of equivalent species at a replacement ratio less than five-to-one (five new trees for each removed tree). All costs associated with the above work shall be incurred by the CONTRACTOR.

G. For grading during the rainy season which normally extends from October 15th to April 15th, the CONTRACTOR shall implement appropriate erosion and sediment control measures, as regulated by the *Regional Water Quality Control Board*, to prevent sediment-laden storm runoff from discharging into the public storm drain system. Said erosion control measures must remain in place during the rainy season, or until all landscaping improvements are installed and accepted by the ENGINEER.

H. The CONTRACTOR shall control airborne dust and dirt while performing the grading work so as not to create a nuisance. All air-quality regulations promulgated by the Bay Area Air Quality Management District or other regulatory agency must be adhered to at all times, or the CONTRACTOR may be subject to fine or penalty.

PART 2 -- PRODUCTS

2.1 SUITABLE FILL MATERIAL

A. Native fill material, including strippings, shall be free of any refuse, heavy or stiff clay, hard dirt clods, stones larger than 1-1/2 inches in size, and roots larger than 3/4 inch in diameter. In addition, the strippings shall be free of boron greater than 1 part-per-million (ppm), noxious weeds, Bermuda grass, nut grass, or other invasive wildland pest plant.

B. Import fill shall conform to the requirements of Section 310000 "Earthwork." Prior to the placement of import fill, the ENGINEER shall be notified of the source of materials. It shall be the DEVELOPER'S or CONTRACTOR'S responsibility to demonstrate the suitability of all import soil for landscape plantings. If required by the ENGINEER, a landscape compatibility/ horticultural report shall be prepared and submitted, per Section 329113 "Landscape Soil Preparation." The import fill shall also be free of the deleterious materials noted above.

C. Top-soil shall conform to the requirements of Section 329113 "Landscape Soil Preparation."

D. Any earthwork quantity data listed on the plans is for the CONTRACTOR'S convenience only. All grading shall conform to the contours shown on the plans, and within the tolerances listed in the Section. If any discrepancies arise between such listed quantities and the contours shown on the plans, the contours shall govern.

PART 3 -- EXECUTION

3.1 SITE CLEARING, GRUBBING, AND STRIPPING

A. The area to be landscaped shall be cleared, grubbed, and stripped in conformance with Section 024100, "Demolition," Section 015700 "Site Preparation" and Section 310000 "Earthwork," except as amended herein.

B. Any existing surface vegetation or weeds which are not classified as either noxious or an invasive wildland pest plant shall be incorporated into the soil to a depth of 8 inches by discing in two perpendicular directions. Where the height of the growth interferes with proper discing, the growth shall first be cut-out and the cuttings removed.

3.2 PRESERVATION OF EXISTING VEGETATION OR OTHER FEATURES

A. Prior to any grading work, the CONTRACTOR shall identify an area surrounding each designated existing tree or other vegetative feature where no grading is allowed. This area will normally be defined as the area within the dripline, although it may be extended beyond the dripline if recommended by the Arborist.

B. The CONTRACTOR shall install safety fencing which completely surrounds the area identified above to protect each existing tree or other vegetative feature from damage, and to ensure that the soil within the dripline is not compacted. The safety fencing shall be an orange high-density polyethylene netting with a minimum installed height of 4-feet. The safety fencing shall be fastened to iron "T" posts driven into the ground, and shall remain in place until all grading work is complete. No materials or equipment shall be stored within this fenced area.

C. The crowns and roots of existing trees and/or other vegetative features shall be pruned in conformance with Section 311300 "Selective Tree and Vegetative Trimming and Removal," and with Section 311316 "Root Pruning," or as further recommended by the Arborist to eliminate diseased or dead wood, and to provide adequate clearance for construction equipment.

D. The CONTRACTOR shall place a 4-inch deep layer of wood chip mulch within the fenced area described above to help minimize soil compaction and/or denudation, and to moderate surface soil temperatures. Chips from the pruning operation can be used for mulch, if desired.

E. The CONTRACTOR shall irrigate the area within the dripline of each existing tree or other landscape feature as recommended by the Arborist. If an irrigation system is used, the heads, pipes, and hose shall remain atop the surface of the ground. No trenching or other excavation will be allowed within the fenced area without the prior authorization of the ENGINEER.

3.3 PREPARATION FOR FILL MATERIAL

A. Before placing any fill material, the CONTRACTOR shall assure that all landscape areas to receive fill have a firm, unyielding surface. Saturated soils which deform easily under load shall be either removed and replaced, or ripped, air-dried, and recompacted until a stable surface is achieved.

B. The CONTRACTOR shall remove and legally dispose of any soil within the planting areas which has been contaminated with portland cement, petroleum products, or other non-compatible chemicals or substances.

C. All excess soil and spoils, including native material deemed unsuitable by the ENGINEER, shall be removed from the site and properly disposed of.

3.4 PLACEMENT AND COMPACTION OF FILL

A. Grading equipment shall be suitable for the work to be done and shall be well maintained and safe. Equipment operators and workmen shall be skilled in grading operations and shall be supervised by a competent superintendent.

B. All landscape grading, including the establishment of subgrade elevations for landscape hardsurfacing, shall be controlled by enough intermediate grade stakes as may be necessary to achieve the slopes, contours, and finished grade elevations shown on the plans.

C. All landscape areas shall be moisture-conditioned and brought up to grade in lifts or horizontal layers not exceeding 8 inches. The final lift shall be topsoil which conforms to Section 329113 "Landscape Soil Preparation."

D. The ENGINEER may perform compaction tests on each layer of fill to assure adequate compaction throughout the landscape area. If the compaction is not satisfactory, the CONTRACTOR shall recompact each deficient area as necessary to achieve the compaction requirements specified below:

1. For all lifts except the final top-soil lift, the density shall be not less than 90 percent relative compaction as determined by ASTM D1557.

2. The final 8 inch topsoil lift shall be compacted to between 80 and 85 percent relative compaction.

E. No fill shall be placed during weather conditions which will alter the moisture content of the fill materials sufficiently to make adequate compaction improbable. After placing operations have been stopped because of adverse weather conditions, no additional fill material shall be placed until the last layer compacted conforms to the required compaction.

3.5 FINISH GRADING AND PROTECTION OF SLOPES

A. After all hardsurfacing features, utility vaults and splice boxes, and other improvements within the landscaped areas are installed, the surfaces of earth mounds and planting areas shall be graded and shaped by blading, dragging, and other appropriate means. Finished surfaces shall be uniform and true to the slopes and grades indicated on the plans. Finish grade of planting areas shall conform to the following criteria:

1. All areas shall slope away from the foundations of any building, sound wall, retaining wall, bridge abutment, pier footing or other structure within or contiguous to the landscaped area. All areas shall also slope away from the crown of any existing tree.

2. The final contours shall not obstruct natural storm runoff, unless a surface swale or underground storm drain system is provided. Every effort shall be made to assure that all landscaped areas freely drain to the City's storm drain system without ponding or promoting erosion.

3. All rill and gully erosion scars shall be repaired to the satisfaction of the ENGINEER.

4. All angular grade transitions shall be rounded off, including top and toe of slopes.

5. To accommodate the mulch or sod, the soil grade shall be set either 3 inches for mulch, or 1 inch for sod, below the surface of sidewalks, curbs, hardsurfaced areas, header boards, utility vaults or splice boxes, or other features within or contiguous to the landscaped areas. The finish grade after the mulch or sod is installed shall then be flush with the hardscape features or utility enclosures.

6. All cut or fill shall be flush with the adjoining grade in a firm, unyielding position with no visible grade differential.

7. For slopes adjacent to sidewalks, the toe of slope shall be located no closer than 3' from the edge of sidewalk. The area between the toe of slope and sidewalk shall have a 2% slope.

C. All contour slopes in landscape areas shall be graded to conform to the following criteria:

1. The maximum allowable slope in groundcover/shrub areas is 3:1 (3 horizontal to 1 vertical), unless otherwise approved by the ENGINEER.

2. The maximum allowable slope in turf areas is 4:1 (4 horizontal to 1 vertical).

3. The minimum allowable slope in groundcover/shrub or turf is 2% (50 horizontal to 1 vertical).

4. The minimum allowable slope in hardsurfacing areas is 2% (50 horizontal to 1 vertical).

5. All landscaped areas shall slope away from building foundations, or other similar structures, at a minimum allowable slope of 2% (50 horizontal to 1 vertical).

D. After fill material has been placed and compacted to the satisfaction of the ENGINEER, all sloping landscape areas shall be roughened before planting takes place. Surface roughening can be accomplished by one of the following means:

1. Trackwalking can be performed by driving a bulldozer or other track-mounted tractor up and down perpendicular to the slope. The tractor will leave a pattern of tread imprints parallel to the slope contours.

2. A serrated wing blade attached to the side of a bulldozer can be used to roughen small cut and fill slopes. A depth of 2" to 4" shall be loosened if this method is employed.

3. Roughening can be accomplished using hand tools such as picks or rakes, provided a 2" to 4" loosened depth is achieved throughout.

E. For 3:1 or steeper slopes, an erosion control netting made from woven coir or jute fiber twine shall be installed over the entire sloped area to stabilize the surface and protect against erosion. The edges of each net shall be anchored to the ground surface as recommended by the manufacturer. For slopes subject to high-velocity storm runoff, a product designed specifically for this use shall be employed, as approved by the ENGINEER.

F. At the completion of grading work, the site shall be left in a clean and finished condition conforming to the plans.

- END OF SECTION -

SECTION 329300 LANDSCAPE PLANTING

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall furnish all materials, equipment, and labor to complete all planting and related work as shown on the Drawings and/or as specified herein.

B. **Work Covered in this Section:**

1. Selecting appropriate and acceptable plant materials and accessories which comply with the City of Livermore Water Efficient Landscape Ordinance.
2. Installing root barriers and water barriers.
3. Planting trees, shrubs, groundcover, and/or turf.
4. Placing mulch in landscape areas.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A.	Section 01330	Submittals
B.	Section 312300	Utility Earthwork
C.	Section 328000	Irrigation Systems
D.	Section 329119	Landscape Grading
E.	Section 329113	Landscape Soil Preparation
F.	Section 329305	Landscape and Irrigation Maintenance
G.	Division 1	General Requirements

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Federal Specifications and Standards:

AASHTO	American Association of State Highway and Transportation Officials

B. State of California (Caltrans) Standards:

1.	Standard Specifications	Section 20-4 Highway Planting

C. Commercial Standards:

ANSI Z60.1	An Annotated Checklist of Woody Ornamental Plants of California, Oregon, & Washington
ASTM A-48	Standard Specification for Gray Iron Castings

D. Reference:

City of Livermore Water Efficient Landscape Ordinance, Ordinance Number 1399, adopted by the City Council on December 21, 1992 (Municipal Code §13.25).

Plants for California Landscapes: A Catalog of Drought-Tolerant Plants, published by the California Department of Water Resources.

Water Wise Gardening, published by East Bay Municipal Utility District (EBMUD).

A Success List of Water-Conserving Plants, published by the Saratoga Horticultural Foundation.

Select California Native Plants, published by the Saratoga Horticultural Foundation.

1.4 CONTRACTOR SUBMITTALS

A. Submittals shall be provided by the CONTRACTOR as required by this Section, and in accordance with Section 01330 "Submittals."

B. Submit to the ENGINEER certificates of inspection required by law for transportation of plant materials to the site. Clearance from the County Agricultural Commissioner, as required by law, shall be obtained before trees or other plant materials are delivered from outside Alameda County.

C. The CONTRACTOR shall, upon request of the ENGINEER, produce records to verify the ordering and delivery of specified quantities and types of plant material for each project.

D. If turf is specified, the CONTRACTOR shall submit the seed mixture for the proposed sod. The ENGINEER must approve the seed mixture before sod is ordered.

E. If turf block is shown on the Plans, the CONTRACTOR shall submit manufacturer information for the proposed turf block product to the ENGINEER for approval.

F. If the CONTRACTOR wishes to substitute plants for those indicated on the Plans, a list of the proposed substitutions shall be submitted to the ENGINEER at least thirty (30) days before beginning work covered by this Section.

G. If tree grates are shown on the Drawings, the CONTRACTOR shall submit manufacturer's information for the proposed grate products to the ENGINEER for approval.

1.5 QUALITY ASSURANCE

A. All trees and other plant materials shall comply with Federal and State laws requiring inspection for plant diseases and pest infestations. Inspection certificates required by law shall accompany each shipment of plant material. Clearance from the County Agricultural Commissioner, as required by law, shall be obtained before trees or other plant materials are delivered from outside Alameda County.

B. The CONTRACTOR shall schedule all reviews by the ENGINEER of planting materials and work at least twenty-four (24) hours prior to the anticipated review.

C. The CONTRACTOR shall request a review by the ENGINEER at the following points in the progress of the landscape planting work:

1. At the time when the locations of all trees and shrubs (5-gallon size or larger) are flagged in the planting areas, the ENGINEER will review the plant locations for required clearances to

utilities and structures, for intersection line-of-sight criteria established by AASHTO, and for conformance with the Plans.

2. Upon delivery of plant materials, the ENGINEER will review all trees, shrubs, groundcover plantings, and/or selected sod rolls for conformance to the criteria listed below. The plants to be reviewed shall be set out in their containers or arranged in such a way as to allow access to all sides of each plant for inspection, and shall not be planted until the ENGINEER has approved their quality, health, and vigor.

3. Notwithstanding routine inspections during the course of the work, the ENGINEER will, upon completion, review all trees, shrubs, groundcover, and/or sod to confirm whether the plant materials and accessories were installed in accordance with the Drawings, or whether any damage to the plants occurred during planting. If the plant materials are found to be acceptable, the plant establishment period will commence, as described in Section 329305, "Landscape and Irrigation Maintenance." If unacceptable plant materials are identified, they shall be promptly removed, disposed of, and replaced by the CONTRACTOR at no cost to the City.

D. The ENGINEER reserves the right to inspect trees, shrubs, groundcover, and turf for size and condition of root systems, for injuries and latent defects, for disease or infestation, and for any other unsatisfactory or defective condition. This inspection may occur at any time during the progress of the work, or during the plant establishment period.

1.6 QUALITY CONTROL

A. Planting shall be performed by a CONTRACTOR licensed to perform landscape work who employs personnel familiar with planting procedures. All work shall be performed under the supervision of a knowledgeable, qualified planting foreman.

PART 2 -- PRODUCTS

2.1 PLANT MATERIALS

A. General:

1. All plant materials shown on the Plans shall be specified by both the Common Name and the Scientific Name (genus, species and cultivar), and by container size. Plant varieties, quantities, and container sizes are regulated by the City of Livermore Water Efficient Landscape Ordinance, and by the DESIGN REVIEW process of the City of Livermore Planning Department.

2. The quality and size of all plant material shall conform to the State of California Grading Code of Nursery Stock. Only No. 1 grade nursery grown stock shall be provided.

3. The CONTRACTOR shall furnish the quantities and sizes of plant material necessary to complete the work shown. If a plant list is included on the Plans, and the quantities of plant materials shown on the plant list is in conflict with the symbols shown on the Plans, the symbols shall govern.

4. Plant material selection shall comply with any special recommendations given in the Landscape Compatibility/Horticultural Report.

5. Plant materials shall be delivered with tags or stakes identifying each plant species.

6. All plant materials shall be free from insects, diseases, and/or fungi which may threaten their survival, or which will require costly treatment or maintenance to contain.

7. All plant materials shall be free of dead branches and dead branch tips, and shall have foliage of normal density, size, and color in order to be considered vigorous and thriving.

8. The use of drought-tolerant plants is strongly encouraged by the ENGINEER, if compatible with the site conditions.

B. Trees:

1. The following minimum container sizes shall be provided, unless otherwise approved by the ENGINEER:

   a. Street trees shall be 24"-box size, except that homeowners may select a 15-gallon size as a replacement tree for a street tree which has died.
   b. Accent trees for backing lot areas, median islands, and recreational parks shall be 24" box size as shown on the drawings, or as otherwise required by DESIGN REVIEW.
   c. The ENGINEER encourages the use of bare root or balled and burlaped plants of equivalent trunk caliper and species as replacements for specified container plants.
   d. A tree of similar species, size, and character may be required to replace an existing tree damaged or threatened by the negligent work of the CONTRACTOR. See Section 329119 "Landscape Grading" for additional information.

2. PROPER IDENTIFICATION/COMPLIANCE

A. All trees shall be true to name as ordered or shown on the planting plans and shall be labeled individually or in groups by species and cultivar (where appropriate). All trees shall comply with federal and state laws and regulations requiring inspection for plant disease, pests and weeds. Inspection certificates required by law shall accompany each shipment of plants. Clearance from the County Agricultural Commissioner, if required, shall be obtained before planting trees originating outside the county in which they are to be planted. Even though trees may conform to county, state, and federal laws, the buyer may impose additional requirements.

3. TREE CHARACTERISTICS AT THE TIME OF SALE OR DELIVERY

A. Tree health

As typical for the species/cultivar, trees shall be healthy and vigorous, as indicated by:

- foliar crown density
- length of shoot growth (throughout crown)
- size, color and appearance of leaves
- uniform distribution of roots in the container media
- appearance of roots
- absence of twig and/or branch dieback
- relative freedom from insects and diseases

Note: some of these characteristics cannot be used to determine the health of deciduous trees during the dormant season.

B. Crown

1. Form: Trees shall have a symmetrical form as typical for the species/cultivar and growth form.

a) Central Leader: Trees shall have a single, relatively straight central leader and tapered trunk, free of codominant stems and vigorous, upright branches that complete with the central leader. Preferably, the central leader should not have been headed. However, in cases where the original leader has been removed, an upright branch at least ½ (one-half) the diameter of the original leader just below the pruning point shall be present. Note: This section applies to single trunk trees grown with normal straightness, as typically used for street or landscape planting. This specification does not apply to plants that have been specifically cultured in the nursery or selected for unusual or unique shape, such as contorted forms, topiary forms, espalier forms, multi-stem, or clump forms.

b) Potential Main Branches: Branches shall be distributed radially around and vertically along the trunk, forming a generally symmetrical crown typical for the species.

1. Potential main branches shall be evenly spaced and have appropriate space between them.

2. Branches shall be no larger than 2/3 (two thirds) the diameter of the trunk, measured 1" (one inch) above the branch.

3. The attachment of scaffold branches shall be free of included bark.

c) Temporary Branches: Unless otherwise specified, small "temporary" branches should be present along the lower trunk below the first potential permanent branch, particularly for trees less than 1-1/2" (one and one-half inches) in trunk diameter. Temporary branches should be distributed around and vertically along the lower trunk. They should be no greater than 3/8" (three-eights inch) in diameter, and no greater than ½ (one-half) the diameter of the trunk at the point of attachment. Heading of temporary branches is usually necessary to limit their growth.

C. Trunk

1. Trunk diameter and taper shall be sufficient so that the tree will remain vertical without the support of a nursery stake.

2. The trunk shall be free of wounds (except properly-made pruning cuts), sunburned areas, conks (fungal fruiting-bodies), wood cracks, bleeding areas, signs of boring insects, galls, cankers and/or lesions.

3. Trunk diameter at 6" (six inches) above the soil surface shall be within the diameter range shown for each container size below:

Container	Soil Volume*	Trunk Diameter (in.)	Soil level from Container Top
5 gallon	0.6	0.5” to 0.75”	1.25” to 2”
15 gallon	3.3	0.75” to 1.5”	1.75” to 2.75”
24 inch box	10.5	1.5” to 2.5”	2.25” to 3”

*Approximate soil volume in gallons

D. Roots

1. The trunk, root collar (root crown) and large roots shall be free of circling and/or kinked roots. Soil removal near the root collar may be necessary in order to verify that circling and/or kinked roots are not present.

2. The tree shall be well rooted in the container. When the trunk is carefully lifted the trunk and root system shall move as one.

3. The top-most roots or root collar shall be within 1" (one inch) above or below the soil surface. The soil level should be within 2" (two inches) of the top of the container. (see table above)

4. When the container is removed, the rootball shall remain intact.

5. The rootball periphery should be free of large circling and bottom-matted roots. The acceptable diameter of circling peripheral roots depends on species and size of rootball. The maximum acceptable size should be indicated for the species (if necessary)

6. On grafted or budded trees, there shall be no suckers from the root stock.

E. Moisture Status

At time of inspection and delivery, the rootball shall be moist throughout, and the tree crown shall show no signs of moisture stress, as indicated by wilt. Roots shall show no signs of being subjected to excess soil moisture conditions, as indicated by root discoloration, distortion, death, or foul odor.

4. INSPECTION/DELIVERY

A. The ENGINEER reserves the right to reject trees that do not meet specifications as set forth in these guidelines or as adopted by the ENGINEER. If a particular defect or sub-standard element or characteristic can be easily corrected, appropriate remedies shall be required. If destructive inspection of rootballs is to be done, the buyer and seller should have a prior agreement as to the time and place of inspection; minimum number and/or percentage of a species (cultivar) and as to who is financially responsible for the inspected trees. The CONTRACTOR shall coordinate with the ENGINEER on how many days notification are needed prior to delivery.

C. **Shrubs:**

1. The minimum container size for shrubs shall be 5-gallon or 1-gallon as approved by DESIGN REVIEW.

2. Physical criteria:
   a. Each shrub must stand upright without support.
   b. All container shrubs shall be free of girdling roots, defined as those roots greater than 1/8-inch diameter circling the periphery of the root ball. The top of the root ball shall be free of "knees" (roots) protruding above the soil, and the bottom shall be free of matted roots.

D. **Groundcover** shall be grown in a nursery under climatic conditions similar to those in the locality of the project.

E. **Turf** shall be sod propagated from 100% dwarf fescue *(festuca)*, with the exact seed mixture approved by the ENGINEER prior to delivery. Turf propagated from seed at the site is not allowed for ornamental landscapes unless specifically approved by the ENGINEER.

F. **Substitutions** will not be allowed unless specifically authorized by the ENGINEER, and unless the substitution is consistent with the DESIGN REVIEW approval. If a substitution is desired, the CONTRACTOR shall submit, in writing, proof that a specified material is unavailable along with a list of proposed substitutions. The proposed substitutions must be the nearest equivalent size and variety of the unavailable material, and must be compatible with the site conditions and proposed improvements. Significant changes in a previously approved landscape theme will require DESIGN REVIEW or City Council approval, as coordinated by the City of Livermore Planning Division. Minor changes to the previously approved landscape theme may be approved as coordinated by the City of Livermore Planning Division.

2.3 MULCH

A. Unless otherwise specified on the Plans, all landscaped areas, excluding turf areas and plant pit areas, shall have a 3-inch layer of mulch placed atop the finish grade. The mulch shall consist of wood chips, tree bark, shredded bark (commonly know as "Gorilla Hair"), or cobble. The type of mulch specified on the Plans shall be used. The mulch shall conform to the following criteria:

1. Wood chips shall be manufactured from clean wood. The particle size of the chips shall be between 1/2-inch and 3-inches in length, and not less than 3/8-inch in width and 1/16-inch in thickness. At least 85 percent, by volume, of wood chips shall conform to the sizes specified.

2. Tree bark shall have a particle size between 1/2-inch and 1-1/2 inches and shall be free of salt and foreign materials such as clods, coarse objects, sticks, rocks, weeds or weed seeds.

3. Shredded bark (Gorilla Hair) shall be a mixture of shredded bark and wood, and shall have a particle size between 1/8-inch and 1/2 inches in thickness and 1-inch to 8-inches in length. The mulch shall be free of salt and deleterious materials such as weed seeds, dirt clods, and rocks. At least 75 percent, by volume, of the material shall conform to the sizes specified.

4. Cobble for tree wells or median islands, if indicated on the Plans or Drawings, shall be well-rounded river run stone with a generally consistent color and shape. The size of each cobble shall vary from between 4-inches and 6-inches in diameter. Each cobble shall be clean and free of foreign material when placed.

2.4 ACCESSORIES

A. **Root Barriers** shall be provided for all trees within 5-feet of any hardsurfacing material (i.e. sidewalks, curb & gutter, decorative paving, etc.). The root barrier shall be fabricated from a high density and high impact plastic such as polyvinyl chloride (PVC), acrylonitrile-butadiene-styrene (ABS), polystyrene, polypropylene, or polyethylene, and shall have a minimum thickness of 0.06-inches. The ENGINEER encourages the use of products which contain post-consumer recycled plastic. The barrier shall have 1/2-inch to 3/4-inch high raised vertical ribs on the inner surface spaced not more than 8-inches apart to discourage circling roots. If segmented panels are used, each panel shall be permanently interlocked to the adjacent panels to form a continuous linear or cylindrical barrier.

B. **Water Barriers** shall be provided continuously along the back of curbs which separate landscaped areas from hardsurfacing areas (e.g. along median curbs with landscaping, along standard curb & gutter with park strips areas, etc.). A water barrier is not required along the back of deep median curbs which extend to below subgrade elevation. The water barriers shall be fabricated from a smooth high density plastic such as polyethylene or polypropylene, and shall have a minimum

thickness of 0.03-inches and a minimum panel width of 24-inches. The ENGINEER encourages the use of products which contain post-consumer recycled plastic.

C. **Tree Grates** shall be provided for all trees planted in tree wells placed in 10-foot wide commercial sidewalks within the Downtown Commercial Core (DCC) district, the Outer Core Area (OCA) district, the Central Business (CB) district, or the Neighborhood Commercial (CN) district as defined in the City of Livermore Zoning Ordinance, or as otherwise required by DESIGN REVIEW, by City Council, or by the ENGINEER. Tree grates and frames shall be fabricated from cast iron which conforms to ASTM A-48 Class No. 35 or better as manufactured **by Urban Accessories Inc. Kiva Series Model**, **Ironsmith Model No. M4804, Olympian** or approved equal. All castings shall be true to pattern, and all component parts shall fit together properly. The castings shall be free from blowholes, pores, and shrinkage distortion. They shall be smooth and well-cleaned by shotblasting, and shall be furnished without paint or primer. The pattern of grating shall contain radial spokes with circumferential rings, allowing expansion of the tree opening as the tree trunk grows larger.

D. **Staking** for all trees shall be provided as follows:

1. Stakes shall be 2-inch diameter by 8-feet long logdepole pine with a 6-inch long conical point on the buried end, and a chamfered end on top to reduce splitting during installation. Stakes shall be pressure-treated in conformance with the American Wood Preserver Association's (APW) standards using copper naphthenate or similar material. Stakes shall be free of splits and knots.

2. Rubber ties shall be fabricated from recycled corded tires 18-inches to 24-inches in length and 1-inch minimum in width. The ties shall be fastened to the stakes using galvanized roofing nails or galvanized wood screws.

3. Guy wires will not be allowed unless specifically approved by the ENGINEER.

E. **Turf Block** shall be provided for all groundcover or turf areas which must support vehicle loads. Turf Block shall be either a manufactured plastic or a precast concrete product, as approved by the ENGINEER, with a grid or honeycomb pattern of web elements designed to support the weight of the design vehicle while preventing soil compaction of the planting area. The turf block shall allow plant material to propagate in the cell spaces between the webs.

PART 3 -- EXECUTION

3.1 GENERAL REQUIREMENTS

A. The following work must be complete prior to any landscape planting described in this Section:
1. Underground utility work.
2. Irrigation Systems per Section 328000.
3. Landscape Grading per Section 329119.
4. Landscape Soil Preparation per Section 329113.
5. Hardsurfacing improvements including sidewalks, decorative paving, drainage swales and curb & gutter, lighting, fencing, etc.

B. Prior to excavating plant pits, confirm the location of all underground joint trench facilities, sewer mains or laterals, water mains or services, storm drain pipes or sidewalk drains, and other utilities, and take proper precautions so as not to damage or disturb such improvements during the course of the work. If a conflict exists between the existing improvements and the specified plant pit locations, promptly notify the ENGINEER. Where such obstructions cannot be removed, the plant

locations may be adjusted, if approved by the ENGINEER. The CONTRACTOR shall remain responsible for the repair of any damaged utilities caused by negligence during planting operations.

3.2 PREPARATION FOR PLANTING

A. Protect and maintain all plant material delivered to the site according to accepted horticultural practices. Proper maintenance between delivery and planting shall include regular watering and any necessary pruning, as well as protection from animals, wind, excessive sun exposure, and vandals.

B. To protect the irrigation system and other underground improvements from damage, the CONTRACTOR shall flag all irrigation heads, grade level enclosures and sleeves, communication conduits, and other similar structures before beginning work under this Section.

C. Before planting, the CONTRACTOR shall install the following accessories, as shown on the Drawings:

1. **Root barriers** shall be installed with their top edges set just above grade (*not buried*), or as recommended by the manufacturer.

2. **Water barriers** shall be positioned vertically along the back-of-curb, extending from finish grade to 6-inches below the subgrade elevation, as indicated on the Drawings.

3.3 PLANTING OF TREES, SHRUBS, GROUNDCOVER, AND TURF

A. Planting may occur during winter months only if the weather conditions do not adversely affect the materials or the soil condition.

B. The ENGINEER may make adjustments in the location of plants in order to maintain the minimum clearances shown on the Drawings, or to mitigate an unforeseen conflict. In no case shall the CONTRACTOR locate shrubs closer than 2-feet and trees closer than 4-feet to hardsurfacing or structures. All trees within 5-feet of a hardsurfaced area shall be installed with root barriers.

C. At street intersections, driveways, and roadway curves, trees and shrubs shall not be planted in areas where the mature height of the plant will obstruct a driver's line-of-sight as defined by AASHTO Sight Distance criteria.

D. Plant holes shall be dimensioned as shown on the Drawings, and shall be roughly cylindrical. The walls and bottoms of plant holes, including those drilled with a power auger shall be scarified.

E. If existing tree roots over 1-inch diameter are severed while excavating the plant pits, the severed faces of the roots shall be cut cleanly with a sharp axe or saw, and then thoroughly coated with emulsified asphalt made especially for use on cut or damaged plant tissues. If the exposed roots cannot be treated immediately, they shall be covered with wet burlap to prevent them from drying out. See Section 02235 "Selective Tree and Vegetation Trimming and Removal" for additional requirements.

F. Plants shall not be handled by stems, trunks, or tops, but only by the container. If damage occurs as a result of the careless handling of a plant, the ENGINEER shall have the authority to reject said plant, and require the CONTRACTOR to provide a replacement at the CONTRACTOR'S expense.

G. Plants shall be carefully removed from containers. All tin containers, other than knockout cans, shall be cut on two sides to facilitate removal of plants with as little disturbance as possible to the root ball. Cans shall be cut with can cutters or similar equipment. In no case shall cans be broken open with an axe, mattock, or other inappropriate tool.

H. If plants do not have young feeder roots which are creamy in color and visible at the edge of the container, the CONTRACTOR shall loosen the roots by cutting in a few places to encourage new feeder root development around the perimeter of the rootball.

I. Shrubs and trees shall have their parent trunks set true and plumb in a vertical position. The top of the plant ball shall be set approximately 1-inch above the finish grade of the planting area. The CONTRACTOR will be held responsible for any settling which occurs, and shall raise and replant any plant whose crown settles below the finish grade.

J. Soil excavated from the plant pits, if suitable as topsoil as defined in Section 329113 "Landscape Soil Preparation," may be re-used for planting backfill. If unsuitable soil is encountered while excavating the plant pits, such soil shall be removed from the site, and a sufficient amount of approved topsoil for installing the plant material shall be provided. If soil amendments and/or fertilizer is required per the landscape compatibility/horticultural report, then these materials shall be incorporated before backfill is placed.

K. The CONTRACTOR shall place backfill in the plant hole after setting the plant in place and assuring that the trunk is plumb. After bringing the backfill level with the surrounding grade, the CONTRACTOR shall tamp the backfill around the root ball and water thoroughly. If the soil within the plant pit settles, then additional backfill shall be placed.

L. Immediately after planting, remove the nursery stake (*if any*) and securely stake and tie all trees in accordance with the Drawings. Tree stakes shall be installed on the westerly or windward side of the tree for single-stake configurations, or parallel to the curb line for double-stake configurations. Install each tie in a figure "8" pattern with a loop large enough to allow for two years' growth.

M. Except where a plant is in a turf area, or where a single plant space is otherwise edged, the CONTRACTOR shall form a berm or ridge of soil in a neat circle at the drip-line of each tree and shrub, to retain irrigation water.

N. Remove turf in a 36-inch diameter area around all trees planted in turf.

O. Water each tree or shrub thoroughly during planting and immediately after backfilling, and water again after basin has been constructed.

P. If ruts or depressions appear in the turf area after sod has been placed, said depressions shall be filled with top soil so that the finish surface of the turf is uniform throughout.

Q. Groundcover plants shall be planted in a triangular pattern at a spacing not to exceed that shown on the Drawings.

3.4 POST PLANTING PROCEDURES

A. After planting, the CONTRACTOR shall install any accessories shown on the Drawings, including tree stakes, perforated pipe aerators, and/or tree grates. The following conditions apply to the installation of these accessories:

1. **Tree stakes** shall be installed with their top ends set below the lowest scaffold branch of the tree.

2. **Tree Grates** shall be installed flush with the surrounding sidewalk or hardsurfacing material.

B. After the pre-emergent herbicide is applied, a 3-inch thick layer of mulch shall be placed in all landscape areas. The mulch shall not be placed in the plant pits, or in contact with the parent trunk of any tree, shrub, or groundcover plant, unless otherwise specified.

C. Following planting and initial watering, the CONTRACTOR shall water all plants and planted areas as necessary to keep the ground moist from the surface to well below the root systems. The foliage of trees, shrubs, or groundcover shall not be wetted when exposed to the hot sun.

D. The Contractor shall protect all plants and planted areas against trespassing, theft, and damage during the plant establishment period. If any plants are injured, removed, or destroyed, they shall be treated or replaced as required by the ENGINEER at no cost to the CITY.

E. Maintenance of all plant material during the plant establishment period shall be performed by the CONTRACTOR per Section 329305 "Landscape and Irrigation Maintenance."

END OF SECTION

SECTION 329302 ENGINEERED (STRUCTURAL) SOIL

PART 1 - GENERAL

1.01 CONTRACT DOCUMENTS:

The General Conditions and all other Contract Documents for this project are complementary and applicable to this section of the Specifications.

1.02 SCOPE OF WORK:

A. The work of this section consists of preparing, placing and compacting Engineered Soil Mix on a prepared subgrade for the purpose of compaction capability of 95% and to provide ample space in which tree roots will successfully grow. The engineered soil mix shall be as manufactured by TMT Enterprises, Inc. 1996 Old Oakland Road, San Jose, California. 1 (408) 432-9040 or approved equal licensed by Amereq, Inc. to distribute Engineered Soil according to the Cornell University patent. Engineered Soil shall include, but not be limited to, the following specifications:

1. Labor, equipment, and materials necessary for the preparation and installation of engineered soil.

PART 2 – MATERIALS AND MIXING

2.01 MATERIALS

A. Crushed Granite Stone: Crushed granite stone shall be ¾-inchto 1-½-inch crushed granite quarry rock of angular, sharp texture. ASHTO #4. Stone shall be clean, sharp and free of other stone other than granite. Stone shall be angular in shape with a maximum average length, width and depth ration of 2:1:1. Stones with visible fracture lines will be rejected. Stones shall have a pH between 6.0 and 7.0, and soluble salt levels less than 300 ppm.

B. Clay Loam Soil: Clay loam soil to conform to Section 10-2.02 Topsoil with the following revised requirements:

1. Gradation Limits: Coarse Sand: 10 to 15 percent; Medium Sand: 15 to 20 percent; Fine Sand 0 to 5 percent. Clay: 27 to 35 percent and Silt 25 to 35 percent.
2. Chemistry Limits: pH between 5.5 and 7.0, and soluble salt levels less than 300 ppm.

C. Hydrogel: Hydrogel shall be a cross linked potassium copolymer hydrogel as manufactured by Gelscape by Amereq, Inc., Conger NY 10920 or Broadleaf P4 1041 W. 18th Street #A103, Costa Mesa, California 92627, 1 (800) 628-7374.

D. Filter Fabric: Filter fabric shall be a non-woven continuous filament polyester fabric. Weight 4.0 oz per square yard, min. Grab strength 100 lb. Water flow rate

105 gpm/sq.ft. Delivered in 15 foot wide roles minimum. Geolon N 40 as manufactured by Nicolon Corp., Valparaiso, Florida or approved equal.

E. Suppliers for Engineered Soil: All engineered soil mixing shall be performed by an agreed upon supplier using appropriate soil measuring, mixing and shredding equipment of sufficient capacity and capability to assure proper quality control and consistent mix rations. No mixing of engineered soil mix at the project site shall be permitted. Mix suppliers include: TMT Enterprises, 1 (408) 432-9040 or approved equal licensed by Amereq, Inc., to distribute Engineered Soil according to the Cornell University patent.

Mix supplier shall have available at the mixing site, sufficient equipment, instrumentation including qualified technicians to determine the weights and water content of the mix components immediately prior to the mixing procedure.

The contractor shall monitor these critical elements throughout the mixing process to provide adequate quality control. The supplier shall maintain a quality control log of material weight, water content and mix proportions for every 15 tons of material mixed. Maintain adequate moisture content during the mixing process. Soil and mix components shall easily shred and break down without clumping. Soil clods shall easily break down into a fine crumbly texture.

Soil shall not be overly wet or dry. The supplier shall measure and monitor the amount of soil moisture at the mixing site periodically during the mixing process.

2.02 MIXING

A. Mix Component Testing & Submittals: Submit crush granite stone and clay loam soil tests analysis reports from an approved testing laboratory. The testing laboratory shall have a minimum of 5 years experience with the test protocols of the United States Golf Association - Green Section. Test soil and stone separately. Contractor shall submit the test results and samples for approval.

Provide particle size analysis of the clay loam soil using the following gradient chart of mineral content:

Designation	**Size in mm**
Coarse Sand	0.5mm - 1mm
Medium Sand	0.25mm - 0.5mm
Fine Sand	0.1mm - 0.25mm
Very Fine Sand	0.05mm - 0.1mm
Silt	0.002mm - 0.5mm
Clay	Minus 0.002mm

Provide a chemical analysis including pH, percent organic content by weight, nutrient levels including nitrogen, phosphorus and potassium and soluble salt in ppm.

Test analysis should include recommendations to alter soil fertility including fertilizers or pH adjustment required for healthy plant growth. Fertility amendment recommendations shall include amounts and type of amendments.

B. Mix Proportions**:** Approved proportion of materials in Engineered Soil shall be as follows:

Component	**by units of weight**	**by percentage**
Crushed Granite Stone	100 dry weight	70.97% - 74.97%
Clay Loam Soil	18 - 21 dry weight	25% - 29%
Hydrogel	0.03 dry weight	0.03%
Water	10 ± (includes water in other ingredients)	
Other Amendments	As recommended by test analysis	

During compaction, too much soil will separate stones and remove air spaces - too little soil will not provide adequate soil retention.

C. Approved Mix(es) and Production Quality Control: Based on samples and test analysis, the Engineer and the Contractor will jointly determine the ratio of components to meet required test results for drainage, compaction and any project specific requirements. More than one mix ratio may be required to satisfy project specific requirement. Submit the labeled samples of the test mixes with the test results. The Engineer may request additional Engineered Soil test mix samples to be tested in the event that further refinement of the mix is necessary.

All tests will be performed with the sample compacted to 45 foot pounds at 40 cm of moisture retention where applicable.

All tests will be at the expense of the Contractor. If the test results of any Engineered Soil fail to meet the mix criteria, the mix ratio shall be adjusted and the mix retested.

The ratio of the approved mix(es) shall be used as the standard(s) for the prepared Engineered Soil. After the mix(es) has been approved and during the mixing process, the Contractor shall take two - one cubic foot quality control samples per 400 cubic yards of production from the final Engineered Soil. The samples shall be taken at random from locations in the numbered stockpiles or during production. Each sample shall be tested for comparison to the approved mix for particle size analysis and chemical analysis with results submitted for review and approval.

In the event that the quality control samples vary significantly from the approved Engineered sample, as determined by the Engineer, the Contractor shall remix and retest any lot of soil that fails to meet the correct analysis making adjustments to the mixing ratios and procedures to achieve the approved consistency.

D. Mixing Protocol: Spread the crushed stone on a paved surface to maximum depth of 6 inches. Mix the Hydrogel and sufficient water into a slurry and spray over the crushed stone. After the stone is uniformly wetted by the slurry, spread clay loam evenly over the crushed stone. Spray the remaining water over the soil and mix with a loader of other device until the mix obtains an even consistency. Do not over mix or over wet. If the mix begins to form balls or pellets of soil around the aggregate, discard the batch. Any palletized soil will be rejected.

Structural Soil Mix may alternatively be mixed in a commercial pug mill or other equipment approved by the Engineer.

Mixing should include any required soil amendments to alter soil fertility including fertilizers or pH adjustment.

After completion of the mixing and prior to installation, protect the Engineered Soil stockpile(s) from rain and mix separation through erosion and excessive vibration during handling and placement. Cover the stockpile at all times with plastic sheeting.

Contractor shall procure sufficient quantities of Engineered Soil in advance of the time needed at the job site to allow adequate time for final quality control testing as required by the progress of work. Engineered Soil shall be stored in piles no larger than 400 cubic yards and each pile shall be numbered for identification and quality control purposes. Storage piles shall be protected from drying out, rain and erosion by covering with plastic sheeting.

E. Delivery, Storage and Handling: Prior to any delivery of Engineered Soil, Contractor shall hold a preconstruction meeting with the Engineer, mixers and operators and submit a logistics plan to discuss schedules, methods and techniques for mixing, delivery and installation of the material.

Do not deliver or place soils in wet, muddy or frozen conditions. Materials shall be delivered at or near optimum compaction moisture content as determined by ASTM D 698 (AASHTO T99). Do not deliver or place materials in an excessively moist condition (beyond 2% above optimum compaction moisture content as determined by ASTM D698 (AASHTO T99). Protect Engineered Soil from drying out, absorbing excess water and from erosion at all times. Do not store materials unprotected from large rainfall events. Do not allow excess water to enter site prior to compaction. If water is introduced into material after grading, allow material to drain or aerate to optimum compaction moisture content. Engineered Soil stored longer than 2 days shall be inspected for water content, rehydrated and remixed as required to meet optimum compaction moisture content.

3.01 INSTALLATION

A. Site Preparation: Do not proceed with installation of Engineered Soil material until all subsurface drain lines, walls, curb footings, irrigation lines and utility work in the area have been installed. For site elements dependent upon Engineered Soil for foundation support, postpone installation until immediately after the

installation of Engineered Soil. All subsurface drainage systems shall be operational prior to the installation of Engineered Soils.

Excavate and compact the proposed subgrades to depths, slopes and widths as shown on the drawings. Maintain all required angles of repose of the adjacent materials as shown on the drawings. Do not over excavate compacted subgrades of adjacent pavement or structures. Confirm that the subgrade is at the proper elevation and compacted as required. Subgrade elevations shall slope parallel to the finish grade or toward subsurface drain lines.

Excavate existing native soil so that the finish grade of the bottom of the structural soil will be the same depth as shown on the drawings.

Clean the excavation of all construction debris, trash, rubble and any foreign materials. In the event that fuels, oils, concrete washout silts or other material harmful to plants have been spilled into the subgrade material, excavate the soil sufficiently to remove the harmful material. Fill any over-excavation with approved fill and compact to the required subgrade compaction.

Protect adjacent walls, walks and utilities from damage or staining by soil. Clean up all trash and any soil or dirt spilled on any paved surface at the end of each working day. Any damage to the paving or architectural work caused by the installation of Engineered Soil shall be repaired or replaced by the Contractor at no additional cost. Maintain silt and sediment control devices, and provide adequate methods to assure that trucks and other equipment do not track soil from the site.

B. Installation of Engineered Soil: Install Engineered Soil in 6-inch lifts and compact every 12 inches to 18 inches as required. Compact all materials to 95 percent peak dry density as defined by ASTM D698 (standard AASHTO compaction curve AASHTO T99). Hand tamp as necessary to protect utilities, irrigation lines and other subsurface features. Compaction testing procedures and equipment shall be calibrated for non-cohesive soils. No compaction shall occur when moisture content exceeds maximum as listed therein. Delay compaction 24 hours if moisture content exceeds maximum allowable and protect Engineered Soil during delays in compaction with plastic or plywood as directed by the Engineer.

The Engineered Soil Mix shall be able to maintain drainage of water at 0.75 inches per hour after completion of compaction. Test the completed installation with a minimum of one random percolation test per 300 square feet of areas as follows. Dig a hole in the compacted Engineered Soil 10 inches in diameter and 10 inches deep. Fill with water and let drain completely. Immediately refill with water and time the rate of fall of the water in the hole. The water shall recede at a minimum rate of 0.75 inches per hour. All testing shall be done in the presence of the Engineer. In the event that the installation fails to percolate at the required rate, the soil in the area shall be re-tested to determine if it meets the particle size distribution specified. Material that does not meet the specifications shall be removed at no extra cost to the City.

Bring Engineered Soil to finished grades as shown on the drawings. Immediately protect the Engineered Soil material from contamination by toxic materials, trash, debris, water containing cement, clay, silt or materials that will alter the particle size distribution of the mix. After the Engineered Soil is installed, do not significantly delay, schedule or phase the progress or installation of the next layer of paving and planting above/in the Engineered Soil.

The Engineer may periodically check the material being delivered and installed at the site for color and texture consistency with the approved sample provided by the Contractor as part of the submittal for Engineered Soil. In the event that the installed material varies significantly from the approved sample, the Engineer may request that the Contractor test the installed Engineered Soil. Any soil that varies significantly from the approved testing results, as determined by the Engineer, shall be removed and new Engineered Soil installed that meets these specifications.

C. Fine Grading: After the initial placement and rough grading of the Engineered Soil but prior to the start of fine grading, the Contractor shall request review of the rough grading by the Engineer. The Contractor shall set sufficient grade stakes for checking the finished grades. Adjust the finish grades to meet field conditions as directed. Provide smooth transitions between slopes of different gradients and direction. Fill all dips and remove any bumps in the overall plane of the slope. The tolerance for dips and bumps in Engineered Soil areas shall be a 3-inch deviation from the plane in 10 feet. All fine grading shall be inspected and approved by the Engineer prior to the installation of other items to be placed on the Engineered Soil.

D. Installation of Filter Fabric: After the installation is completed and reviewed by the Engineer, install Filter Fabric on top of all Engineered Soil in all areas that will be located below paving. Cut off excess fabric at the edge of the Engineered Soil.

.E. Clean Up: Upon completion of Engineered Soil installation, clean areas. Remove excess fill soils, mix stockpiles and legally dispose of all waste materials, trash and debris. Sweep, do not wash, all paving and other exposed surfaces of dirt and mud until final paving has been installed over the mix. Avoid washing the area until all paving has been completed.

F. Procedure for Installation of Trees: After installation of the Engineered Soil and Filter Fabric is complete and adjacent pavement has cured and been approved by the Engineer, street trees can be installed. Do not excavate planting holes until irrigation and drainage systems are tested and approved by Engineer. Locate planting holes in the center of the tree well as shown on plans bringing any conflict with underground utility lines to the attention of the Engineer. Excavate holes to diameter and depth as shown on plans. Avoid over excavating or contaminating Engineered Soil with native soil. Stockpile excavated Engineered Soil to use as backfill. Cover with plastic to protect stockpile from contamination and drying out. Engineered Soil stockpiled longer than 2 days shall be inspected for water content, rehydrated and remixed as required to meet optimum compaction moisture content.

Prior to planting, test drainage of plant pits by filling with water twice in succession. Conditions permitting retention of water in tree pits for more than 12 hours shall be brought to the attention of the Engineer. Handle the tree carefully, set the rootball on the bottom of the pit and center it in the tree well opening in the sidewalk. Backfill with Engineered Soil Mix and settle with watering. Raise rootballs that settle below accepted finish grade as shown on the drawings. Neatly trim the filter fabric to allow for the installation of the tree in the designated tree wells. Maintain the filter fabric continuously under paved surfaces.

- END OF SECTION -

SECTION 329305 - LANDSCAPE AND IRRIGATION MAINTENANCE

PART 1-- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide all materials, equipment, and labor necessary during the plant establishment and maintenance period to complete all maintenance and related work on the installed landscaping and irrigation system as shown on the Drawings and as specified herein.

B. **Work Covered in the Section:**

1. Maintaining trees, shrubs, groundcover, and/or turf in a healthful, vigorous condition through proper and routine watering, pruning and care.
2. Promoting proper establishment of trees, shrubs, groundcover, and turf through regular maintenance which may include correcting drainage or settlement problems, protecting root systems, weeding, straightening trees, pruning for safe traffic sight distance, and adjusting planting stakes and ties.
3. Analyzing plant problems and applying correct types and rates of fertilizers, insecticides, fungicides, and herbicides in accordance with the regulations of the Alameda County Agricultural Commissioner.
4. Providing professional pest control as outlined herein, including vector and rodent control.
5. Maintaining, reporting, and correcting any non-functioning feature or inefficient operation of the automatic irrigation system or associated backflow prevention assemblies.
6. Performing routine general maintenance and clean-up of the landscaped, open space, and/or park areas, including litter and trash removal, and repair of any damage resulting from vandalism, graffiti, or natural cause.
7. Replacing and re-establishing any tree, shrub, groundcover plant, and/or turf area which is found to be in an unhealthful or dying condition, or which has been stolen or vandalized.
8. Performing weed abatement or other required maintenance in open space or riparian areas.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A.	Section 311300	Selective Tree and Vegetation Trimming and Removal
B.	Section 311316	Root Pruning
C.	Section 328000	Irrigation Systems
D.	Section 329119	Landscape Grading
E.	Section 329113	Landscape Soil Preparation
F.	Section 329300	Landscape Planting
G.	Section 331213	Backflow Prevention Assemblies and Pressure Reducing Valves
H.	Division 1	General Requirements

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. **Federal Specifications and Standards:**

AASHTO	American Association of State Highway and Transportation Officials
ANSI A300-1995	Tree, Shrub and other woody plant maintenance, standard practice

B. **State of California (Caltrans) Standards:**

1. Standard Specifications	Section 20-4 Highway Planting

C. **City of Livermore:**

Municipal Code §9.36.040	Noise from Blowers, Fans, and Combustion Engines
Municipal Code §13.25	Water Efficient Landscape Ordinance, Ordinance Number 1399, adopted by the City Council on December 21, 1992

D. **Reference:**

State of California Department of Pesticide Regulations

State of California Department of Industrial Relations Director's List of Hazardous Substances

Construction Safety Orders of the State of California

Alameda County Agricultural Commission Regulations

International Society of Arboriculture (ISA)

1.4 CONTRACTOR SUBMITTALS

A. At the time of landscape planting, the CONTRACTOR shall submit to the ENGINEER the following:

1. Submit a schedule of proposed routine maintenance activities, including irrigation, fertilization, and plant maintenance during the plant establishment and maintenance periods.

2. Submit a weekly mowing and maintenance schedule to the ENGINEER for each landscaped area. The ENGINEER shall be notified prior to any changes in the weekly schedule.

3. Submit the names, phone numbers, and addresses of contact persons and alternates who shall be responsible for the care of the landscaping and irrigation system during the maintenance period, and who are capable of responding to the ENGINEER'S concerns on short notice.

B. If the CONTRACTOR wishes to substitute different replacement plants for those indicated on the Drawings, a list of the proposed substitutions shall be submitted to the ENGINEER at least thirty days prior to the proposed date of replacement. Substitutions are subject to the approval of the ENGINEER, and/or the Design Review Committee process administered by the City of Livermore Planning Division.

C. The CONTRACTOR shall submit to the ENGINEER a certificate of inspection, as required by law, for transportation of any replacement plant materials to the site. Clearance from the County Agricultural Commissioner, as required by law, shall be obtained before trees or plant materials are delivered from outside Alameda County.

D. If the ENGINEER determines that additional soil samples need to be analyzed to investigate a potential soil-related plant problem, the DEVELOPER or CONTRACTOR shall instruct a qualified soil testing laboratory to analyze additional samples in accordance with Section 329113 "Landscape Soil

Preparation." The results and recommendations of the analysis, including the formulation and rate of application for agricultural chemicals, shall be submitted to the ENGINEER for approval prior to application.

1.5 QUALITY ASSURANCE

A. All of the landscaped areas will be reviewed on a regular basis by the ENGINEER. A report may be prepared by the ENGINEER after each inspection detailing the condition of the trees, shrubs, turf, groundcovers, and the general appearance of the site. If the ENGINEER, during routine inspection, determines that the landscaped area has not been maintained according to these specifications, the Plant Establishment Period will stop, and a notice describing the deficiencies will be forwarded to the CONTRACTOR. The CONTRACTOR shall promptly correct all noted deficiencies. The Plant Establishment Period will not commence again until the ENGINEER is satisfied that all deficiencies have been corrected. It is the CONTRACTOR'S responsibility to notify the ENGINEER as soon as the CONTRACTOR encounters problems with plant materials and the general appearance of the site.

1.6 QUALITY CONTROL

A. All maintenance work performed per this Section shall be performed by a CONTRACTOR licensed to perform landscape maintenance work who employs personnel familiar with irrigation and plant material maintenance. All work shall be performed under the supervision of a person who is knowledgeable about the CITY'S maintenance requirements and standards, who can effectively communicate with the ENGINEER.

B. It shall be the CONTRACTOR'S responsibility to maintain all of the landscaped areas in a condition that is acceptable to the ENGINEER, and in a manner which is consistent with accepted horticultural practice.

C. All plants which die, which become damaged or diseased, or which are stolen shall be replaced by the CONTRACTOR at the CONTRACTOR'S expense. Replacements shall be new container plants of equivalent size and species as compared to the dead, damaged, or missing plants. The replacements shall be installed within fourteen calendar days from the date when the problem is discovered.

D. The CONTRACTOR'S foreman and employees shall have sufficient knowledge of the project, of the Drawings, and of these specifications so that the work can be performed in a manner consistent with these specifications.

PART 2 -- PRODUCTS

2.1 GENERAL

A. All materials shall be provided by the CONTRACTOR, including any necessary replacement plants or irrigation parts.

2.2 EQUIPMENT

A. Any piece of maintenance equipment which utilizes an internal combustion engine shall be equipped with a muffler. The CONTRACTOR shall refrain from using noise-producing equipment between the hours of 11:00 pm and 7:00 am per Municipal Code 9.36.040.

2.3 UTILITY SERVICES

A. All utility company bills associated with the landscaping or irrigation system shall be paid by the DEVELOPER or CONTRACTOR until the maintenance responsibility is transferred to the City at the end of the plant establishment and maintenance period. It shall be the DEVELOPER'S or

CONTRACTOR'S responsibility to notify the appropriate utility company of the transfer of billing accounts upon acceptance of the landscape improvements by the ENGINEER.

1. **Water:** The CONTRACTOR shall establish accounts with either *City of Livermore Water Department* or *California Water Service Company* (depending on franchise area) for each water meter supplying irrigation water to the landscaped areas.

2. **Electricity:** The CONTRACTOR shall establish accounts with PG&E for each electrical meter installed for the controller and/or any landscaping, security, or monument lighting within the public right-of-way or public landscape easement area.

3. **Telephone:** If a centralized irrigation system controller with telephone communication circuit board is provided the final telephone service connection will be made by the City prior to the end of the maintenance period.

2.4 FERTILIZER

A. Agricultural chemicals shall bear the manufacturer's label and guaranteed analysis, and shall be subject to the ENGINEER'S review before application.

B. The CONTRACTOR shall furnish a complete fertilizer conforming to the landscape compatibility/horticultural report submitted for the project, as described in Section 329113 "Landscape Soil Preparation." Said fertilizer shall furnish the required percentages of macro- and micro-nutrients to keep turf, trees, shrubs, and other plant materials in a healthful and vigorous condition.

2.5 INSECTICIDES, FUNGICIDES, HERBICIDES AND RODENTICIDES

A. Insecticides, fungicides, herbicides, and rodenticides shall be consistent with the recommendations included in the horticultural/landscape compatibility report prepared in accordance with Section 329113 "Landscape Soil Preparation" and shall follow the pesticide control advisor's written recommendations as well as meeting the requirements on the label, and shall be supplied in the original manufacturer's containers with complete application and emergency care instructions.

B. A Material Safety Data Sheet (MSDS) shall accompany any substance which is listed on the State of California Department of Industrial Relations Director's List of Hazardous Substances. The MSDS for each substance shall be available at all times to any worker who uses the substance during the course of the work.

2.6 TREE STAKES, TREE TIES, AND OTHER ACCESSORIES

A. Tree stakes, tree ties, and other accessories shall be consistent with Section 329300 "Landscape Planting," and shall be consistent with the materials existing at the site.

2.7 IRRIGATION COMPONENTS

A. All irrigation components shall be consistent with Section 328000 "Irrigation Systems," and shall be consistent with the materials existing at the site.

PART 3 -- EXECUTION

3.1 PLANT ESTABLISHMENT AND MAINTENANCE PERIOD

A. The CONTRACTOR shall provide maintenance of all landscaping areas and irrigation systems for a period not less than 120 calendar days. Said period will begin upon notification from the ENGINEER that the plant establishment and maintenance period has formally commenced.

B. In order for the plant establishment and maintenance period to commence, the ENGINEER must be satisfied that all landscape and irrigation work has been performed in accordance with these Specifications, with the Drawings, and with the project plans. The ENGINEER will confirm compliance during a walk-through arranged by the CONTRACTOR at the completion of the installation. All deficiencies noted by the ENGINEER during the walk-through must be corrected before the plant establishment period can commence.

C. After the plant establishment period begins, the CONTRACTOR shall perform all maintenance work described in this section or required by the ENGINEER. If the CONTRACTOR fails to perform the maintenance work to the satisfaction of the ENGINEER, the plant establishment and maintenance period may be suspended by the ENGINEER until strict compliance is demonstrated.

D. Approximately 30 calendar days before the plant establishment and maintenance period is scheduled to end, the CONTRACTOR shall request a courtesy walk-through with the ENGINEER. The ENGINEER will again review the health of the plant materials, the operation of the irrigation system, and the condition of the site. During this walk-through, the CONTRACTOR shall prepare written notes of any deficiencies discovered by the ENGINEER. A copy of these notes shall be provided to the ENGINEER upon request. The CONTRACTOR shall then promptly correct all noted deficiencies.

E. On or about the date when the plant establishment and maintenance period is scheduled to end, the CONTRACTOR shall request a final walk-through with the ENGINEER. All deficiencies noted during the courtesy walk-through must be resolved to the satisfaction of the ENGINEER before the final walk-through will be scheduled. If, during the final walk-through, new deficiencies are discovered, the ENGINEER will prepare a final *Punch List*. Said list will then be forwarded to the CONTRACTOR, and will serve as the final list of deficiencies which must be resolved prior to acceptance.

F. Since ornamental landscapes require an intensive program of regular maintenance, the CONTRACTOR'S failure to promptly correct one deficiency may result in other more significant and costly deficiencies (e.g. failure to repair a broken irrigation head may result in the loss of plant material). As such, the CONTRACTOR will remain responsible for the condition of the entire landscaped area until final acceptance is granted by the ENGINEER. The ENGINEER reserves the right to amend the *Punch List* and to extend the plant establishment and maintenance period if the CONTRACTOR fails to promptly correct noted deficiencies.

G. Upon written acceptance of the landscaped area for permanent maintenance by the CITY, the CONTRACTOR shall notify all utility companies supplying services to the site that the maintenance obligation has been assumed by the City of Livermore as stated in UTILITY SERVICES in PART 2 - PRODUCTS of this Section. It shall be the CONTRACTOR'S responsibility to initiate the transfer of billing accounts to the CITY'S name after acceptance has been granted.

3.2 GENERAL MAINTENANCE PROCEDURES

A. **General:** The CONTRACTOR shall provide, until final acceptance of the project, regular maintenance of all plants and planted areas in a healthful, thriving condition in accordance with accepted horticultural practices and ISA Pruning standards. Maintenance operations shall include watering, weeding, replanting, fertilizing, clearing debris, and any other operations necessary to maintain plant health and vigor, including treatment for fungus, diseases, insect pests, weeds, or rodents.

B. **Protection:** The CONTRACTOR shall protect all plants and other landscaping improvements including existing landscaping against trespass, vandalism, and theft. Said protection shall be provided from the time the improvements are installed until the conclusion of the plant establishment and maintenance period. If any plants or other improvements are damaged, vandalized, or stolen, they shall be repaired or replaced as required by the ENGINEER. Any necessary temporary

safeguards or barriers shall be provided by the CONTRACTOR, and removed when no longer needed.

C. **Pest Control:**

1. The CONTRACTOR shall act as or coordinate with a licensed specialist to identify any pest management problems which may arise in the landscaped area. The specialist shall be familiar with various integrated pest management (IPM) programs. The CONTRACTOR may be required to develop an IPM plan to effectively eradicate any diseases or pest problems which develop during the plant establishment and maintenance period. The development and execution of the IPM program shall be the responsibility of the CONTRACTOR.

2. The noxious weed, disease, and pest control methods may include any combination of the following:

   A. Pre-emergent herbicide application
   B. Post-emergent herbicide application
   C. Mechanical cultivation and disposal
   D. Weeding or mowing
   E. Chemical growth regulators
   F. Tree injection
   G. Aquatic herbicide application
   H. Trap and release techniques
   I. Poison baiting
   J. Debris or food source removal
   K. Water jetting.
   L. Insecticide, fungicide, rodenticide or other
   M. Pesticide application
   N. Verdant and/or dormant spraying
   O. Repeated control methods as necessary
   P. The use of insect predators
   Q. Any other procedure recommended by the arborist, pest control advisor, or required by the ENGINEER.

3. If requested by the ENGINEER, the CONTRACTOR shall provide a copy of any spray report showing details of areas, times, chemicals and rates of application.

4. Under no circumstances shall agricultural chemicals be allowed to contaminate any open waterways or storm drain networks. The application rates shall not exceed the manufacturer's recommendations or be applied in a manner inconsistent with the label or pest control advisor's written recommendations, and any spilled material shall be cleaned-up immediately and completely.

D. **Manual weeding** shall be performed in conjunction with chemical weed control methods. The CONTRACTOR shall remove both the root system of the weed, and the exposed growth. A trowel or small hand shovel shall be used to loosen the soil prior to removal of each weed. The CONTRACTOR shall exercise caution when working in areas with buried drip irrigation systems to prevent the drip tubing from becoming damaged or severed. The presence of weeds that have gone into flower and seed will be grounds for suspension of the plant establishment and maintenance period until the ENGINEER is assured that the weed problem has been brought under control.

E. **Pruning** shall be performed in strict accordance with ISA standards.

3.3 TREE MAINTENANCE

A. A complete and balanced pruning program shall be provided for all trees. Trees shall be pruned to accentuate their natural form by properly selecting and developing permanent scaffold branches that are smaller in diameter than the trunk or branch on which they are growing. All dead, damaged, diseased, crossing, rubbing, or otherwise unhealthy plant parts shall be removed. Tree crowns shall be thinned if they become too heavy to be self-supporting, or if they are susceptible to wind or storm damage. The CONTRACTOR shall maintain a 12-inch minimum radius clearance measured from the face of the tree trunk.

B. All trees shall be inspected by the CONTRACTOR after every wind or rain storm to determine if any damage has occurred. Broken branches shall be pruned, and stakes shall be straightened and adjusted as necessary so that the tree trunk is in a plumb, vertical position.

C. Except for Birches, Alders and Maple trees, broad-leaf evergreen trees may be pruned and thinned throughout the year, whereas deciduous trees shall be pruned only if required to correct vandalism damage, wind damage, or disease. Prune and shape all trees to avoid future problems of height, spread or wind damage and so that the natural appearance will be enhanced.

D. If a conifer tree loses its terminal leader, a new leader shall be pruned and trained. Under no circumstances shall any conifer tree be topped or pruned into an unnatural shape.

E. Recognized horticultural practices shall be followed when pruning trees, including the use of appropriate tools. Plant parts shall be cut flush to the branch collar. Birches, alders, maples and pines shall not be pruned until after June 1st. Any debris generated during pruning operations shall be collected and disposed of by the CONTRACTOR.

F. All cuts shall be made with a clean, even cut at the branch collar ring adjacent to the nearest bud or other branch. On large limbs, initial cuts shall be made using the three-cut system outwards from final cut to avoid excessive weight and bark tearing. No wound sealers shall be used unless approved by the ENGINEER.

G. The CONTRACTOR shall trim any "suckers" and water shoots which appear around the base of the parent trunk, and shall treat the cuts with a growth regulator/sealer as specified in PART 2 - PRODUCTS of Section 311300.

H. Trees planted in the median island which are within 300-feet of a street intersection shall be pruned to prevent line-of-sight obstructions for vehicle traffic. The CONTRACTOR shall provide a minimum of 8-feet of vertical clear space measured from the top of curb to the lowest scaffold branch. In addition, the CONTRACTOR shall prune trees to maintain the sight clearance for all traffic and guide directional signs.

I. Trees planted adjacent to walking surfaces shall be pruned to raise the lower branches above head height wherever the branches overhang the walking surface.

J. Trees planted beneath overhead utility wires shall be pruned as necessary to prevent the branches from interfering with the suspended wires.

K. The CONTRACTOR shall spray trees for diseases and insects if these problems become apparent, or if directed by the ENGINEER.

L. Tree stakes shall be maintained in a vertical position, and in good repair. Ties shall be checked periodically, and all worn or broken ties shall be replaced. If ties become tight or begin to interfere with proper tree growth, they shall be adjusted.

M. The CONTRACTOR may remove staking which is no longer needed by trees with sufficient trunk caliper, upon approval of the ENGINEER.

3.4 SHRUB MAINTENANCE

A. The CONTRACTOR shall provide a complete and horticulturally correct shrub pruning program. A combination of shearing and selective hand pruning shall be performed. When shrubs are sheared, the CONTRACTOR shall also perform selective hand pruning to regenerate new branches, eliminate dense plant crowns, and to encourage the development of balanced foliage. When planted in masses, shrubs shall be allowed to grow together to fill the bed. Shearing shall only be done to maintain a neat, uniform appearance and to keep shrubs growing within their intended space.

B. Shrubs within median islands or at intersection corners shall be pruned to prevent driver sight obstructions within the safe sight distance zone defined by AASHTO Sight Distance criteria. In general, shrubs shall be allowed to grow no higher than 30-inches above the top of curb within the area designated as the sight distance zone, although a lesser height may be required at certain locations.

C. The foliage of shrubs planted along sidewalks, curbs, or other hardsurfaced areas shall be pruned back to maintain a 6-inch minimum clearance measured from the edge of the hardsurfacing. In median islands, it is especially important to keep the maintenance band area clear of overgrown foliage to provide safe refuge for maintenance workers from approaching vehicles.

D. The foliage of shrubs planted adjacent to fences, buildings, walls, pedestal-type utility enclosures, or other vertical elements shall be periodically pruned-back such that the branches do not rub on or become entangled in the feature, except that a clear path to the feature shall be provided if access is necessary (e.g. a path to the door of a pedestal-type utility enclosure shall be maintained at all times).

E. Shearing of hedge shrubs shall be performed in an even, uniform manner. Care shall be exercised so that gaps or holes do not develop as a result of poor shearing practices. Large heavy stems shall be selectively removed to encourage foliar growth inside the branch network.

F. All trimmings generated during pruning operations shall be disposed of by the CONTRACTOR on the day of pruning.

3.5 GROUNDCOVER AND PERENNIAL MAINTENANCE

A. The need for groundcover mowing will be determined by the ENGINEER. Groundcovers such as Baccharis, Baccaris, cotoneaster, Hedera Helix and Hypericum shall be mowed or sheared in the Spring. Groundcovers such as Myoprum, Star Jasmine and Vinca shall be mowed or sheared in the Summer. Material may be pruned by hand or by mechanical means. Removal of thick, woody stems when the plant is dormant may also be necessary. All debris shall be disposed of by the CONTRACTOR.

B. All groundcover plantings shall be trimmed back from hardsurfacing materials, header boards, shrubs, trees and utility enclosures. All groundcover areas shall be edged using a power edger or other appropriate tool. Upon completion of the edging operation, the groundcover edge shall be set back approximately 1/2 inch from the edge of the hardsurfacing. All clippings or displaced soil shall be removed and/or swept into the groundcover area when edging is complete.

C. The CONTRACTOR shall provide regular maintenance of all seasonal and perennial flower beds. This includes the removal of all spent blooms and dead plant material. Beds shall also be regularly weeded. At the end of each season, perennials shall be cut back to ground level after the foliage has died back. All annual flowers shall be removed once damaged by frost. The flower beds shall then be raked level, and all debris removed and disposed of by the CONTRACTOR. All annual flower beds shall be replanted in the Spring, if required by the ENGINEER.

3.6 TURF MAINTENANCE

A. **General:** Turf, as an important aesthetic component of ornamental landscapes, requires a program of intensive care, performed on a routine basis. An acceptable maintenance program will yield turf with a consistently green appearance which is predominantly free of weeds and voids.

B. **Mowing Operations** shall be performed according to the following criteria:

1. The CONTRACTOR shall not mow, walk, or use any piece of equipment within the turf areas when frost is present as this may result in damage to the plant tissues.

2. The CONTRACTOR shall refrain from mowing if the turf is saturated with water, or if standing water is present. Before mowing, the CONTRACTOR shall walk over the areas to be mowed, removing all litter, bottles, rocks and other deleterious materials.. If water puddles under the feet when walking, then mowing within the saturated areas shall be postponed until the excess water has drained, infiltrated, or evaporated.

3. The mowing equipment shall be adjusted to cut the turf growth to approximately 2-1/2 to 3 inches above finish grade during the growing season, and 1-1/2 to 2 inches during the winter months. The CONTRACTOR shall use care to avoid scalping the turf. Not more than 1/3 of the blade shall be removed during each mow.

4. Mowing is to be performed as needed from December through March, and at least weekly from April through November.

5. If a mulching-type mower is utilized, then the clippings can remain as dropped by the mower, provided they are spread evenly throughout the turf area. If a mulching mower is not utilized, then a mower which captures the clippings shall be used, or alternatively the CONTRACTOR can rake-up the clippings and remove them from the job site the same day.

6. The CONTRACTOR shall use caution when mowing over existing grade-level enclosures, utility vaults, irrigation heads, or other features and plants within the turf area. If said features become damaged by the mower, the CONTRACTOR shall promptly repair the damage to the satisfaction of the ENGINEER.

7. If voids or depressions are discovered in the turf area when mowing, said voids or depressions shall be filled with top-soil and/or plugged with sod to create a uniform, even finish surface.

C. **Mowing Equipment** shall be selected according to the following criteria:

1. Tractor mowing will only be permitted in turf areas which are predominantly open and flat. Tractor mowing will not be permitted in narrow turf areas or in turf areas heavily planted with trees or other obstacles. The authorization of the ENGINEER shall be obtained prior to utilizing a tractor mower in any turf area.

2. When conditions allow the use of tractor mowing equipment, the mowing pattern or direction shall be alternated from week to week.

3. Areas which are prone to scalping shall be mowed using walk-behind mowers.

D. **Line Trimming** shall be performed according to the following criteria:

1. Line trimming equipment shall be utilized for turf areas inaccessible to tractor or walk-behind mowers. The line trimming equipment shall cut the grass blades to approximately the same elevation as that achieved by the mower. The clippings shall be raked-up and removed, or evenly spread. The CONTRACTOR shall use care to avoid damaging tree trunks, shrubs, or other landscape or site features while operating the line trimmer.

2. The CONTRACTOR shall cut the turf back away from rotors, spray heads, and grade-level enclosures as required to keep the features exposed and fully operational.

E. **Edging** shall be performed as follows:

1. The interface between turf areas and hardsurfaced areas shall be edged using a power edger or other appropriate tool. Upon completion of the edging operation, the turf edge shall be set back approximately 1/2 inch from the edge of the hardsurfacing. All clippings or displaced soil shall be swept into the turf area when edging is complete.

2. All trees growing within turf areas shall have a circular area centered around the tree trunk which is free of turf and weeds. The turf edge of said area shall be not greater than 2-inches in height, and shall be maintained using edging or line trimming equipment. Any soil displaced during the edging operation shall be evenly spread onto the turf. The edged ring shall be circular in shape with an equal radius on all sides of the tree. The diameter of the ring shall be between 3-feet and 6-feet depending on the trunk diameter as determined by the ENGINEER.

3. Edging shall be performed as part of the routine mowing schedule.

4. The CONTRACTOR shall use care to protect pedestrians and vehicles within or adjacent to the hardsurfaced area during the edging operation.

F. **Core Aeration** shall be performed during the months of March, June, and October, if required by the ENGINEER. All irrigation heads, grade-level enclosures, and other features within the turf area shall be flagged or staked prior to aeration. The CONTRACTOR shall utilize a coring tine device to perform the aeration. Multiple passes may be required to ensure that tine holes are no more than 2-1/2 inches apart. Tines shall sink at least 3-1/2 inches below finish grade. Damage to any grade-level feature which results from the core aeration operation shall be repaired by the CONTRACTOR at no cost to the City.

G. Supplemental turf fertilization shall be performed with a long-term slow release water insoluble nitrogen as approved by the ENGINEER.

3.7 GENERAL MAINTENANCE AND CLEAN UP

A. Cleanup shall be performed by the CONTRACTOR, and shall include the pick-up of scattered trash, the emptying of all refuse containers, and the removal of all leaves, branches, excess soil, empty plant containers, grass cuttings, weeds, or any other debris that may accumulate at the site.

B. The CONTRACTOR shall promptly remove graffiti from any surface within the landscaped area. Said surfaces may include sound walls, controller cabinets, monument signs, benches, play equipment, light fixtures, etc. The CONTRACTOR shall notify the Livermore Police Department if a graffiti problem persists.

C. Any playground or park site which has play equipment, benches, or other recreational features shall be inspected on a weekly basis by the CONTRACTOR. If damage or wear is discovered, the CONTRACTOR shall immediately repair said feature in accordance with the manufacturer's recommendations and Federal guidelines, using parts supplied by or approved by the manufacturer.

D. All planted areas, including lawns, groundcover areas, areas around shrubs and trees, adjacent paved areas, areas next to buildings, next to buildings, fences, benches, sidewalks, curbs, and gutters shall be kept free from weeds, litter, rocks, glass, and debris.

E. All cracks or joints in sidewalks, curbs, street gutters, and other hardsurfaced areas shall be treated with a herbicide if weeds begin to propagate in the cracks.

F. Bark, sand, and gravel areas shall be raked as required to keep them level and free of foreign material. The sand within a play equipment area shall be raked level not less than once a week.

G. Sidewalks and other hardsurfaced areas shall be kept swept free of any sediment, sand, gravel, or mulch that might be washed onto such areas from adjacent landscape slopes.

3.8 GRADING MAINTENANCE

A. If the root ball of any plant settles below the level indicated on the drawings, said plant shall be raised and replanted to the proper elevation.

B. Depressions shall be filled with top soil as necessary to achieve a uniform surface.

C. Swales shall be repaired, regraded, replanted, or otherwise improved as necessary to provide adequate drainage of all areas.

D. Gully or rill erosion scars shall be regraded or repaired as required by the ENGINEER. Any displaced mulch or soil shall be replaced as necessary. The ENGINEER may require that the area be regraded to eliminate a concentrated flow condition resulting in storm run-off scour.

E. The watering basin surrounding each plant pit shall be repaired as necessary to assure proper irrigation of each plant. Water basins in the turf area will not be permitted.

3.9 WEED ABATEMENT

A. The CONTRACTOR shall be responsible for abating weeds and other naturally occurring vegetation in open space or riparian areas within the project site. The work shall be performed as required by the Fire Marshal of the Livermore-Pleasanton Fire Department or the ENGINEER, and in accordance with this section. The weed abatement operation shall be performed in a manner which eliminates the fire hazard associated with dry weeds, and which reduces any visual blight.

B. The weed abatement operation may be performed with any of the following equipment according to the following criteria. The CONTRACTOR shall use care when performing work adjacent to existing trees to avoid damaging any surface roots.

1. A rotary mower can be used provided the blade removes the vegetation to within 2 inches of the finish grade. The mower must capture all clippings so they can be removed from the site.

2. A discing attachment towed behind a tractor may be used provided the resulting surface area has at least 50% exposed soil when the discing is complete. No weeds shall remain in a vertical position after the discing wheels pass.

3. A rototiller may be used provided the resulting surface area has at least 50% exposed soil when the operation is complete. No weeds shall remain in a vertical position after the rototiller passes.

4. Pesticide application with a dissicant is allowable with the approval of the ENGINEER.

C. The CONTRACTOR shall carry a 4A:40BC or larger fire extinguisher on the tractor, or within convenient reach, at all times during the weed abatement operation. The CONTRACTOR shall recognize that dry grasses pose a significant fire hazard from late Spring to early Winter, and should therefore use all necessary precautions to assure that no fires are ignited during the weed abatement operation.

D. The CONTRACTOR shall remove from the site all miscellaneous debris or rubbish discovered during the weed abatement operation.

3.10 IRRIGATION SYSTEM MAINTENANCE

A. **General:**

1. It is the CITY'S objective to actively pursue water conservation within publicly-owned landscape areas. The CONTRACTOR can expect the administration of this irrigation specification to be closely monitored. Implementation of the Water Conservation Program will be carried out as stated in the City's Water Efficient Landscape Ordinance.

2. The CONTRACTOR shall have full responsibility to ensure watering requirements are met within each landscaped area. The CONTRACTOR shall be capable of performing repairs, installations and modifications to the existing irrigation system to adequately irrigate all landscaped areas.

3. If any part of the irrigation system is vandalized or stolen, the CONTRACTOR shall immediately repair or replace the affected component. If the component cannot be repaired immediately, the CONTRACTOR shall initiate a program of manual watering for all affected areas until the system is fully functional or install a loaner unit. All irrigation items stolen or vandalized shall be reported to the ENGINEER.

B. **Maintenance and repair:**

1. As part of the maintenance obligation, the CONTRACTOR shall regularly inspect the operation of the complete irrigation system, including periodic manual checks of the operation of each station. If a damaged component is discovered, the CONTRACTOR shall promptly repair the damage using replacement parts which are compatible with the original parts.

2. All rotors and spray heads shall operate efficiently and without obstruction. The pop-up extension shall glide smoothly to a fully extended position when in operation, and shall retract completely when the watering cycle ends. The nozzles shall spray with the proper arc and trajectory, and the orifice shall remain unobstructed. The screen within each head shall be periodically cleaned. Replacement parts shall be compatible with the existing equipment, and shall be installed in accordance with the manufacturer's recommendations.

3. If required by the ENGINEER, the rotor or spray head at the end of the lateral line for each station shall be removed so the system can be flushed with water. Said flushing shall be performed until the water flows clean. The rotor or spray head shall then be carefully reinstalled.

4. All remote control valves shall close consistently and completely at the conclusion of each station cycle. Main-line irrigation leaks shall be promptly repaired.

5. The cleaning or replacement of wye filters for the drip system shall be performed periodically by the CONTRACTOR. The system will not be accepted for permanent maintenance until all filters are clean.

6. Any pressure regulators shall be adjusted by the CONTRACTOR to ensure optimum water delivery to the emitters. Any in-line filters shall be cleaned on a quarterly basis.

7. The controller shall be inspected weekly to assure that the system programming is appropriate and efficient. The CONTRACTOR shall replace any controller which does not perform to the manufacturer's specifications.

8. All spray heads, bubblers, emitters, and rotors shall be adjusted to eliminate clogs or over spray onto the streets, walkways, buildings, walls, signs, or other features that may be damaged or stained by irrigation water.

9. The CONTRACTOR shall conduct any necessary backflow prevention assembly testing, as required by Section 331213 “Backflow Prevention Assemblies.”

C. **Watering:**

1. Seasonal programming of the controller shall be performed by the CONTRACTOR according to the schedules shown on the irrigation plans, and per the evapotranspiration rates for different months of the year and the plant’s crop coefficient factor. The time and duration of watering for each station shall be adjusted regularly to account for seasonal temperature and precipitation changes. The irrigation shall be shut-off during weeks of heavy rain, or if the spray may turn to ice on the streets or walkways.

2. Manual watering shall be performed only to supplement the irrigation water provided to particular plants or areas by the automatic irrigation system. Manual watering shall not be performed to disguise a deficiency in the automatic irrigation system. If the automatic irrigation system fails to adequately distribute water to all landscaped areas or plants, the CONTRACTOR shall modify the irrigation system as necessary to achieve complete coverage.

3. Following planting and initial watering, the CONTRACTOR shall assure that the irrigation system provides water for all plants and planted areas as necessary to keep the ground moist from the surface to well below the root systems.

- END OF SECTION -