



STANDARD SPECIFICATIONS

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CITY OF LIVERMORE

CALIFORNIA

STANDARD SPECIFICATIONS

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CITY OF LIVERMORE
GENERAL CONDITIONS

and

STANDARD
SPECIFICATIONS

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CITY OF LIVERMORE

**STANDARD
SPECIFICATIONS**

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SECTION 011100

SUMMARY OF WORK

1.01 ORDER OF THE WORK

- A. In order to expedite the work and to avoid irreparable damage to, or deterioration of the quality of any portion of the public works improvements, it shall be the responsibility of the DEVELOPER to schedule the major items of construction in the following order:
1. Street excavation and rough grading
 2. Storm and sanitary sewers
 3. Water facilities, and their services
 4. Underground gas, electric, telephone, cable TV
 5. Curb, gutter, sidewalk, driveways, and access ramps
 6. Street sub-base (if required)
 7. Base rock
 8. Paving

1.02 NOTIFICATIONS

- A. For all developments the DEVELOPER shall notify owners of adjacent property and affected utilities when prosecution of the work may affect them. Said notification shall consist of erection of a sign at the main construction site entrance and notices to the adjacent property owners. Guidelines on who to notify, and a sample of approved notification form are available from the Development Section. The sign and notices shall include the name, address, and (local) phone number of the DEVELOPER.
- B. When work is required in any existing street, the CONTRACTOR shall notify all residents 72 hours in advance of all operations. When parked vehicles interfere with the CONTRACTOR'S operations, the CONTRACTOR shall post temporary "NO PARKING" signs maximum 100 feet apart on each side of the street 72 hours prior to the scheduled work day. "No parking" signs shall include the following information: Time(s), day(s), date(s), purpose and the following statement: "Violators will be towed at owner's expense. CVC 22651. For information on towed vehicles phone: 371-4900."
- C. If the work has not commenced during this period, the work shall be rescheduled with five (5) working days advance notice. If the work is not completed by the end of the period covered in the initial notification of the CONTRACTOR shall re-notify all residents of the construction schedule extension. The CONTRACTOR will perform all re-posting of no parking signs and re-notification occasioned by his failure to meet the posted schedule.

1.03 PRE-CONSTRUCTION MEETING

- A. Except for work covered by an Encroachment Permit, a pre-construction meeting is required prior to commencement of any work. The meeting will be held at a mutually agreed time and place which shall be attended by the CITY, the DEVELOPER/DEVELOPERS' ENGINEER or Representative, CONTRACTOR'S Construction Superintendent, Subcontractors (as appropriate), and other governmental or agency representatives as appropriate.
- B. The CONTRACTOR shall bring to the preconstruction meeting 6 copies of each of the following:
1. Tentative construction schedule
 2. Shop drawing/sample/substitute or "or equal" submittal schedule

- C. The purpose of the preconstruction meeting is to designate responsible personnel and establish a working relationship. Matters requiring coordination will be discussed and procedures for handling such matters established.

1.04 MAINTAINING TRAFFIC IN PUBLIC STREETS

- A. The CONTRACTOR'S attention is directed to Sections 7-1.08, 7-1.09, and Section 12 of the CalTrans Standard Specifications. Nothing in these Contract Documents shall be construed as relieving the CONTRACTOR from his responsibility to comply with Sections 7-1.08, 7-1.09 and Section 12 of the Caltrans Standard Specifications.
- B. The CONTRACTOR shall be responsible for providing all flagmen and traffic control in conformance with the current edition of the Caltrans Traffic Manual, and the "Uniform Sign Chart," issued by the Department of Public Works, Division of Highways, and shall furnish, erect, maintain, and remove all necessary signs and devices during the length of the construction. Modifications to the approved traffic control plan, dictated by the field traffic conditions, shall be made immediately by the CONTRACTOR as required by the ENGINEER.
- C. Personal vehicles of the CONTRACTOR'S employees shall not be parked on the traveled way or shoulders within any section closed to the public traffic.
- D. A minimum of one paved traffic lane, not less than 12 feet wide shall be open for use by public traffic in each direction of travel, except that single paved 12 foot wide traffic lane may be used with flagmen for short lengths and short periods of time when specifically allowed by the ENGINEER.
- E. The full width of the traveled way shall be open for use by public traffic as follows unless otherwise approved by the Engineer:
 - 1. On all designated major streets before 9:00 am and after 3:30 pm, Monday through Friday;
 - 2. On all other streets before 7:00 am and after 5:00 pm, Monday through Friday;
 - 3. On all streets regardless of designation all day on Saturday, Sunday, and designated legal holidays; and after 3:30 pm on the day preceding a City designated legal holiday.

END OF SECTION

SECTION 013100

COORDINATION

1.01 GENERAL

- A. The CONTRACTOR shall be responsible for the coordination of all work and the coordination of the work of all subcontractors. The CONTRACTOR shall not delegate coordination to any subcontractor. Coordination, as referred to herein, shall include the establishment of on-site lines of authority and communication. The CONTRACTOR'S onsite supervisory person shall be present at all times when any work is in progress.

1.02 SCHEDULING

- A. The CONTRACTOR shall prepare construction schedules as specified in Section 013300 "Submittals", and all schedule submittals shall conform to the requirements specified therein.

1.03 REQUESTS FOR SUBSTITUTIONS

- A. The CONTRACTOR shall review subcontractor's requests for changes and for substitutions.
- B. All requests or substitutions shall conform to the requirements of Section 013300 "Submittals".

1.04 SUBMITTALS

- A. All submittals to the CITY shall be made by the DEVELOPER.

1.05 COORDINATION OF SUBCONTRACTOR RESPONSIBILITIES

- A. The CONTRACTOR shall be responsible for coordination of the work of each of its subcontractors and suppliers. Special attention is directed to the following obligations of the CONTRACTOR:
 - 1. Verify that subcontractors have obtained permits for inspections.
 - 2. Review all subcontractor shop drawings, product data, and sample submittals for compliance prior to submittal to CITY for review.
 - 3. Maintain onsite documentation and keep current record drawing set at the construction site.

END OF SECTION

SECTION 013300

SUBMITTALS

1.01 GENERAL

- A. General: Whenever submittals are required hereunder, all such submittals shall be submitted to the ENGINEER for review. A Submittal is defined as any drawing, calculation, specification, product data, samples, manuals, requests for substitutes, survey data, record drawings, or similar items.
- B. Submittals Required at the Preconstruction Meeting: At the preconstruction meeting, the CONTRACTOR shall submit the following items:
1. A schedule of work, which shall be based on the following order of work:
 - a. Rough Grading
 - b. Sanitary Sewer
 - c. Storm Drainage
 - d. Water Mains
 - e. Joint Trench
 - f. Subgrade
 - g. Aggregate Subbase
 - h. Concrete Surface Improvements
 - i. Aggregate Base
 - j. Asphalt Concrete Pavement
 - k. Striping, Markings
 - l. Signs
 - m. Monuments
 - n. Fire Hydrants
 - o. Street Lights
 - p. Landscaping
 2. A preliminary schedule of shop drawings, samples, and proposed substitutes or "or equal" submittals.
 3. A list of all permits the CONTRACTOR is required to obtain.
- C. Submittals Required After the Preconstruction Meeting: The CONTRACTOR shall submit to the ENGINEER all proposed substitutes or "or equal" products thirty (30) days prior to use on the work, for review. All such submittals shall be in conformance with the requirements of Paragraphs 1.03 and 1.04 herein.
1. The CONTRACTOR shall submit copies of all required permits prior to starting any work covered by the various permits.
 2. The CONTRACTOR hereby agrees that failure to submit alternative product requests within the stipulated time period shall act as a waiver of any future rights to offer such substitutes, and the CONTRACTOR hereby agrees to provide one of the specified products called for in the Project Specifications or on the DRAWINGS.
 3. The CONTRACTOR shall also submit a copy of the valid trench shoring permit issued by CAL OSHA, if applicable, prior to starting any trenching.

- D. All submittals shall be accompanied by a standard transmittal form or cover letter acceptable to the ENGINEER. Information shall include, but not be limited to, CONTRACTOR'S name and address, project identification, sender's name and phone number, and a summary of the purpose of the transmittal.

1.02 CERTIFICATES OF COMPLIANCE

- A. **Certificates of Compliance:** The CONTRACTOR shall provide Certificates of Compliance for all products and materials proposed to be used. The Certificates of Compliance shall include identification 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.

1.03 SHOP DRAWINGS

- A. Whenever called for in the DRAWINGS, or where required by the ENGINEER, the CONTRACTOR shall furnish to the ENGINEER for review, a minimum of six (6) copies of each shop drawing submittal. The term "Shop Drawings" as used herein shall be understood to include detail design calculations, shop drawings, fabrication and installation drawings, erection drawings, lists, graphs, operating instruction, catalog sheets, data sheets, and similar items. Unless otherwise required, said Shop DRAWINGS shall be submitted to the ENGINEER at a time sufficiently early to allow review of same by the ENGINEER, and to accommodate the anticipated rate of construction progress.
- B. All Shop Drawings shall be accompanied by a standard transmittal form or cover letter approved by the ENGINEER. Any submittal not accompanied by such a form, or where all applicable items on the form are not completed, will not be considered. Incomplete submittals will be returned for re-submittal only if the sender is identified on the form or cover letter.
- C. Normally, a separate transmittal form shall be used for each specific item or class of material or equipment for which a submittal is required. Transmittal of a submittal of various items using a single transmittal form will be permitted only when the items taken together constitute a manufacturer's "package" or are so functionally related that expediency indicates review of the group or package as a whole. A multiple-page submittal shall be collated into sets, and each set shall be stapled or bound, as appropriate, prior to transmittal to the ENGINEER.
- D. Except as may otherwise be provided herein, the ENGINEER will return prints of each submittal to the CONTRACTOR with its comments noted thereon, within 21 calendar days following their receipt by the ENGINEER. It is considered reasonable that the CONTRACTOR shall make a complete and acceptable submittal to the ENGINEER by the second submission of a submittal item. Anything after the initial submittal and first re-submittal for review is defined as EXCESSIVE REVIEW and all costs for EXCESSIVE REVIEW shall be charged to the DEVELOPER. Final acceptance will be withheld until all costs for EXCESSIVE REVIEW are reimbursed to the CITY.
- E. If a submittal is returned to the CONTRACTOR marked "NO EXCEPTIONS TAKEN," formal revision and resubmission of said submittal will NOT be required.
- F. If a submittal is returned to the CONTRACTOR marked "MAKE CORRECTIONS NOTED," a formal revision and resubmission of said submittal will NOT be required.
- G. If a submittal is returned to the CONTRACTOR marked "AMEND - RESUBMIT," the CONTRACTOR shall revise said submittal and shall resubmit a minimum of 6 copies of said revised submittal to the ENGINEER.
- H. If a submittal is returned to the CONTRACTOR marked "REJECTED-RESUBMIT," the

CONTRACTOR shall revise said submittal and shall resubmit a minimum of 6 copies of said revised submittal to ENGINEER.

- I. Fabrication of an item may be commenced only after the ENGINEER has reviewed the pertinent submittals and returned copies to the CONTRACTOR marked either "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED." Corrections indicated on submittals shall be considered as changes necessary to meet the requirements of the Contract Documents.
- J. All CONTRACTOR submittals shall be carefully reviewed by the CONTRACTOR , prior to submittal to the ENGINEER. Each submittal shall be dated, signed, and certified by the CONTRACTOR as being correct and in strict conformance with the Contract Documents. In the case of shop drawings, each sheet shall be so dated, signed, and certified. No consideration for review by the ENGINEER of any CONTRACTOR submittals will be made for any items which have not been so certified by the CONTRACTOR. All non-certified submittals will be returned to the CONTRACTOR without action taken by the ENGINEER, and any delays caused thereby shall be the total responsibility of the CONTRACTOR.
- K. The ENGINEER's review of CONTRACTOR submittals shall not relieve the CONTRACTOR of the entire responsibility for the correctness of details and dimensions. The CONTRACTOR shall assume all responsibility and risk for any misfits due to any errors in CONTRACTOR submittals. The CONTRACTOR shall be responsible for the dimensions and the design of adequate connections and details.

1.04 PROPOSED SUBSTITUTES OR "OR EQUAL" ITEMS

- A. For convenience in designation, any material, product, or equipment to be incorporated may be designated under a brand or trade name or the name of a manufacturer and its catalog information. The use of any substitute material, product, or equipment which is equal in quality and utility and possesses the required characteristics for the purpose intended will be permitted, subject to the following requirements:
 - 1. The burden of proof as to the quality and utility of any such substitute material, product, or equipment shall be upon the CONTRACTOR.
 - 2. The ENGINEER will be the sole judge as to the quality and utility of any such substitute material, product, or equipment and its decision shall be final.
- B. Whenever the name or the name and address of a manufacturer or Supplier is given for a material, product, or equipment, or if any other source of a material, product, or equipment is indicated therefore, such information is given for the convenience of the CONTRACTOR only, and no limit, restriction, or direction is indicated or intended thereby, nor is the accuracy or reliability of such information guaranteed. It shall be the responsibility of the CONTRACTOR to determine the accurate identity and location of any such manufacturer, Supplier, or other source of any material, product, or equipment called for.
- C. The CONTRACTOR may offer any material, product, or equipment which it considers equal to those specified. The CONTRACTOR, at its sole expense, shall furnish data concerning items it has offered as substitute or "or-equal" to those specified. The CONTRACTOR shall provide the data required by the ENGINEER to determine that the quality, strength, physical, chemical, or other characteristics, including durability, finish, efficiency, dimensions, service, and suitability are such that the substitute or "or-equal" item will fulfill its intended function.
- D. Approval by the ENGINEER of a substitute item proposed by the CONTRACTOR shall not relieve

CONTRACTOR of the responsibility for full compliance with the Contract Documents and for adequacy of the substituted item. The CONTRACTOR shall also be responsible for resultant changes and all additional costs which the substitution requires in its work, the work of its subcontractors and of other contractors and shall effect such changes without cost to CITY.

1.05 SAMPLES

- A. Unless otherwise specified, whenever samples are required, the CONTRACTOR shall submit not less than 3 units of each such sample item or material to the ENGINEER for approval at no cost to the CITY.
- B. Samples, as required herein, shall be submitted for approval a minimum of 14 calendar days prior to ordering such material for delivery to the job-site, and shall be submitted in an orderly sequence so that dependent materials or equipment can be assembled for review by the ENGINEER.
- C. All samples shall be individually and indelibly labeled or tagged, indicating thereon all specified physical characteristics and manufacturer's names for identification and submitted to the ENGINEER for review for compliance. Upon receiving approval of the ENGINEER, two sets of the samples will be stamped and dated by the ENGINEER and returned to the CONTRACTOR, one set will be retained by the ENGINEER.
- D. Unless otherwise specified, all colors and textures of specified items will be selected from the manufacturer's standard colors and standard materials, products, or equipment lines.

1.06 ACCEPTANCE FOR MAINTENANCE

- A. Improvements will not be accepted by the CITY for permanent maintenance until the CONTRACTOR-prepared mylar Record DRAWINGS have been delivered to the ENGINEER.

1.07 USE OF PRIVATE PROPERTY

- A. If the CONTRACTOR uses private property for access or construction the CONTRACTOR shall obtain all necessary permits/approvals from the Planning Division and private Owner and submit to the ENGINEER a copy of each agreement executed with the private property owner(s) for access or use of the private property prior to using said private property.

1.08 CUT SHEETS

- A. The CONTRACTOR shall submit to the ENGINEER cut sheets for any major grading work including trenching for dry utilities, water, sanitary sewer line installation, storm drain line installation, and curb and gutter construction, 24 hours prior to start of construction work.

1.09 STREET LIGHT WIRING PLAN

- A. The CONTRACTOR shall submit an acceptable street light wiring plan, indicating the wiring run, and the location of the power source, for review by the ENGINEER prior to starting installation of any street lights.

1.10 STREET TREE REMOVAL

- A. The CONTRACTOR shall give the ENGINEER 10 calendar days notice prior to removal of any street tree designated for removal on the Approved Construction DRAWINGS. Whenever it is determined by the CITY that a street tree must be removed, the ENGINEER must post the tree

under the provisions of Chapter 12.20 of the Livermore Municipal Code.

1.11 GRADING

- A. The CONTRACTOR shall notify the ENGINEER two (2) working days prior to starting ANY grading on the site.

END OF SECTION

SECTION 014200

REFERENCE STANDARDS

1.01 GENERAL

- A. Titles of Sections and Paragraphs: Captions accompanying specification sections and paragraphs are for convenience of reference only, and do not form a part of the Specifications.
- B. Applicable Publications: Whenever in these specifications references are made to published specifications, codes, standards, or other requirements, it shall be understood that wherever no date is specified, only the latest specifications, standards, or requirements of the respective issuing agencies which have been published as of the date of CITY approval of the Construction Drawings or issuance of an Encroachment Permit, shall apply; except to the extent that said standards or requirements may be in conflict with applicable laws, ordinances, or governing codes. No requirements set forth herein or shown on the Drawings shall be waived because of any provision of, or omission from, said standards or requirements.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Without limiting the general provisions of other portions of the specifications, all work specified herein shall conform to or exceed the requirements of all applicable codes and the applicable requirements of the following documents to the extent that the provisions of such documents are not in conflict with the requirements of these Specifications nor the applicable codes.
- B. References herein to codes shall mean the following listed codes, the editions as adopted by the City of Livermore, including all addenda, modifications, amendments, or other lawful changes thereto:
 - 1. Uniform Building Code, published by the International Conference of Building Officials (ICBO).
 - 2. Uniform Plumbing Code, published by the International Association of Plumbing and Mechanical Officials (IAPMO).
 - 3. Uniform Mechanical Code, published by the International Conference of Building Officials (ICBO).
 - 4. National Electric Code, published by the National Fire Protection Association (NFPA).
 - 5. Uniform Fire Code, published by the International Conference of Building Officials (ICBO).
 - 6. California Code of Regulations; Title 8 Industrial Relations, Title 19 Public Safety, Title 24 Building Standards, and California Labor Code.
 - 7. Reference proper ADA Codes
 - 8. Livermore Municipal Code .
 - 9. Livermore Zoning Ordinance.
 - 10. Specific Plans
- C. In case of conflict between codes, reference standards, drawings and the other Contract Documents, the most stringent requirements shall govern. All conflicts shall be brought to the attention of the ENGINEER for clarification and directions prior to ordering or providing any materials or labor.

- D. References herein or on the Drawings to "State Standard Specifications" or "Standard Specifications" shall mean the Standard Specifications current edition as adopted by the State of California, Department of Transportation ("Caltrans").
- E. References herein or on the Drawings to "Livermore Standard Specifications" or "CITY Standard Specifications" shall mean the City of Livermore Standard Specifications, current edition or as specified on the Approved Construction Drawings.
- F. References herein or on the Drawings to "State Standard Plans" or "Standard Plans" shall mean the Standard Plans, current edition as adopted by the State of California, Department of Transportation ("Caltrans").
- G. References herein or on the Drawings to "Livermore Standard Details", "CITY Standard Details" or "Standard Details" shall mean the City of Livermore, Standard Details, current edition or as specified on the Approved Construction Drawings.
- H. References herein or on the Drawings to "Cal-OSHA" shall mean State of California, Department of Industrial Relations, General Industry, Electrical and Construction Safety Orders, as amended to Date, and all changes and amendments thereto which are effective as of the date of construction.
- I. References herein or on the Drawings to "OSHA Standards" shall mean Title 29, Part 1910, Occupational Safety and Health Standards, Code of Federal Regulations (OSHA), including all changes and amendments thereto.

END OF SECTION

SECTION 014213

ABBREVIATIONS

1.01 GENERAL

- A. Whenever in these Specifications references are made to the standards, specifications, or other published data of the various national, regional, or local organizations, such organizations may be referred to by their acronym or abbreviation only. As a guide to the user of these specifications, the following acronyms or abbreviations which may appear in these specifications shall have the meanings indicated herein.

1.02 ABBREVIATIONS AND ACRONYMS

AAMA	Architectural Aluminum Manufacturer's Association
AAR	Association of American Railroads
AASHTO	American Association of State Highway and Transportation Officials
AATCC	American Association of Textile Chemists and Colorists
ACI	American Concrete Institute
AFBMA	Anti-Friction Bearing Manufacturer's Association., Inc.
AGA	American Gas Association
AGC	Associated General Contractors
AGMA	American Gear Manufacturer's Association
AHAM	Association of Home Appliance Manufacturer's
AI	The Asphalt Institute
AIA	American Institute of Architects
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
AMCA	Air Moving and Conditioning Association
ANS	American Nuclear Society
ANSI	American National Standards Institute, Inc.
APA	American Plywood Association
API	American Petroleum Institute
APWA	American Public Works Association
ASA	Acoustical Society of America
ASAE	American Society of Agriculture Engineers
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
ASLE	American Society of Lubricating Engineers
ASME	American Society of Mechanical Engineers
ASQC	American Society for Quality Control
ASSE	American Society of Sanitary Engineers
ASTM	American Society for Testing and Materials
AWPA	American Wood Preservers Association
AWPI	American Wood Preservers Institute
AWS	American Welding Society
AWWA	American Water Works Association
BBC	Basic Building Code, Building Officials and Code Administrators International
BHMA	Builders Hardware Manufacturer's Association
CALOSHA	California Occupational Safety and Health Administration
CALTRANS	State of California Department of Transportation
CBM	Certified Ballast Manufacturer's
CEMA	Conveyors Equipment Manufacturer's Association
CGA	Compressed Gas Association
CLPCA	California Lathing & Plastering Contractors Assn
CLFMI	Chain Link Fence Manufacturer's Institute

CMA	Concrete Masonry Association
CRSI	Concrete Reinforcing Steel Institute
DCDMA	Diamond Core Drill Manufacturer's Association
EIA	Electronic Industries Association
ETL	Electrical Test Laboratories
IAPMO	International Association of Plumbing and Mechanical Officials
ICBO	International Conference of Building Officials
IEEE	Institute of Electrical and Electronics Engineers
IES	Illuminating Engineering Society
IME	Institute of Makers of Explosives
IP	Institute of Petroleum (London)
IPC	Institute of Printed Circuits
IPCEA	Insulated Power Cable Engineers Association
ISA	Instrument Society of America
ISO	International Organization for Standardization
ITE	Institute of Traffic Engineers
MBMA	Metal Building Manufacturer's Association
MPTA	Mechanical Power Transmission of Association
MTI	Marine Testing Institute
NAAM	National Assn of Architectural Metal Manufacturer's
NACE	National Association of Corrosion Engineers
NBS	National Bureau of Standards
NCCLS	National Committee for Clinical Laboratory Standards
NEC	National Electrical Code
NEMA	National Electrical Manufacturer's Association
NFPA	National Fire Protection Association
NFPA	National Forest Products Association
NGLI	National Lubricating Grease Institute
NMA	National Microfilm Association
NWMA	National Woodwork Manufacturer's Association
OSHA	Occupational Safety and Health Administration (Federal)
PCA	Portland Cement Association
RIS	Redwood Inspection Service
RVIA	Recreational Vehicle Industry Association
RWMA	Resistance Welder Manufacturer's Association
SAE	Society of Automotive Engineers
SAMA	Scientific Apparatus Maker Association
SIS	Swedish Standards Association
SMA	Screen Manufacturer's Association
SMACCNA	Sheet Metal and Air Conditioning Contractors National Association
SPR	Simplified Practice Recommendation
SSBC	Southern Standard Building Code, Southern Building Code Congress
SSPC	Steel Structures Painting Council
SSPWC	Standard Specifications for Public Works Construction
TAPPI	Technical Assn of the Pulp and Paper Industry
TFI	The Fertilizer Institute
UBC	Uniform Building Code
UL	Underwriters Laboratories, Inc.
USA	Underground Service Alert
WCLIB	West Coast Lumber Inspection Bureau
WCRSI	Western Concrete Reinforcing Steel Institute
WIC	Woodwork Institute of California
WRI	Wire Reinforcement Institute, Inc.
WWPA	Western Wood Products Association

END OF SECTION

SECTION 014500

QUALITY CONTROL

1.01 SITE INVESTIGATION AND CONTROL

- A. The CONTRACTOR shall verify all dimensions in the field and shall check all field conditions continuously during construction. The CONTRACTOR shall be solely responsible for any inaccuracies built into the WORK.
- B. The CONTRACTOR shall inspect related and appurtenant work and shall report in writing to the ENGINEER, any conditions which will prevent proper completion of the WORK. Any work required due to unsuitable conditions shall be done by the CONTRACTOR at its sole cost and expense.

1.02 INSPECTION OF THE WORK

- A. General: The WORK shall be conducted under the general observation of the ENGINEER and shall be subject to inspection by the ENGINEER to assure strict compliance with the requirements of the Contract Documents.
- B. The presence of the ENGINEER, or its representative, shall not relieve the CONTRACTOR of the responsibility for the proper execution of the WORK in accordance with all requirements of the Contract Documents. Compliance is distinctly a duty of the CONTRACTOR, and said duty shall not be avoided by any act or omission on the part of the ENGINEER.
- C. All materials and articles furnished by the CONTRACTOR shall be subject to rigid inspection, and no material or articles shall be used until it has been inspected and reviewed for compliance by the ENGINEER.
- D. Inspection at Place of Manufacture: Unless otherwise specified, all products, materials, and equipment shall be subject to inspection by the ENGINEER at the place of manufacture.
- E. The presence of the ENGINEER at the place of manufacture however, shall not relieve the CONTRACTOR of the responsibility for furnishing products, materials, and equipment which comply with all requirements of the Contract Documents.
- F. At all times during construction, the CONTRACTOR shall prevent the formation of any airborne dust nuisance. If the CONTRACTOR fails to comply within 2 hours of notification, the CITY will issue a "STOP WORK ORDER".

1.03 SAMPLING AND TESTING

- A. Sampling and testing for quality control is the sole responsibility of the CONTRACTOR. The CITY reserves the right to reject any products or materials found to be in non-compliance under quality assurance.
- B. Unless otherwise specified, all sampling and testing shall be in accordance with the methods prescribed in the current standards of the ASTM or other specified published standards, as applicable to the class and nature of the article or materials considered.
- C. Any waiver by the CITY of any specific testing or other quality assurance measures, whether or not such waiver is accompanied by a guarantee of substantial performance as a relief from the specified testing or other quality assurance requirements as originally specified, and whether or not such guarantee is accompanied by a "performance bond" to assure execution of any

necessary corrective or remedial WORK, shall not be construed as a waiver of any prescriptive or performance requirements of the Contract Documents. A "performance bond" as used herein is a separate bond in addition to the Performance Bond required in the Subdivision Agreement.

- D. Notwithstanding the existence of such waiver, and in addition to any testing and inspection performed by any other inspector on behalf of the CITY or any other public agency having jurisdiction, the ENGINEER shall have the right to make independent investigations and tests, and failure of any portion of the WORK to meet any of the requirements of the Contract Documents, shall be reasonable cause for the ENGINEER to require the removal or correction and reconstruction of any such work in accordance with the General Conditions for Development.

1.04 TIME OF INSPECTIONS AND TESTS

- A. Required samples and test specimens shall be furnished by the CONTRACTOR and prepared for testing in ample time for the completion of the necessary tests and analyses before the subject materials or articles are to be used. The CONTRACTOR shall furnish all required test specimens at its own expense. Except as otherwise provided performance of the required initial test and first test will be by the CITY, and all costs therefor will be borne by the CITY; except, that the cost of any test after the first re-test, which shows unsatisfactory results shall be borne by the CONTRACTOR.
- B. Whenever the CONTRACTOR is ready to backfill, bury, cast in concrete, or otherwise cover or make inaccessible any work, the CONTRACTOR shall notify the ENGINEER not less than 24 hours in advance of beginning any such work. Failure of the CONTRACTOR to notify the ENGINEER at least 24 hours in advance of any such inspections shall be reasonable cause for the CONTRACTOR's work to be delayed in order for inspections and any remedial or corrective work required, and all costs of such delays, including its impact or effect upon other portions of the WORK shall be borne by the CONTRACTOR.

END OF SECTION

SECTION 015100

TEMPORARY UTILITIES

1.01 CONSTRUCTION WATER

- A. General: Construction water will be available and may be purchased from the City of Livermore, located at 1052 S. Livermore Ave., Livermore, CA 94550, or from the California Water Service Company, located at 195 South "N" Street, Livermore, CA 94550. The CONTRACTOR will also be required to apply for and furnish a deposit for use of the construction water meters (potable or recycled). The CONTRACTOR shall provide all facilities necessary to convey the water from the designated source to the points of use in accordance with the requirements of the Contract Documents
- B. Per the Stage 2 Drought Mandatory Conservation Measures adopted by the City Council, recycled water must be used for all construction water. The CONTRACTOR shall contact the City of Livermore Water Resources Division for all permits required for use of recycled water.
- C. The CONTRACTOR shall be solely responsible for the adequate functioning of its water supply system and shall be solely liable for any claims arising from the use of same, including discharge or waste of water therefrom.
- D. Where recycled water is used, CONTRACTOR shall post notices conspicuously throughout the site warning the CONTRACTOR'S personnel that recycled water is in use.
- E. Fire Hydrant Water Connections: The CONTRACTOR shall not make connection to, or draw water from, any fire hydrant without first obtaining permission of the CITY or other authority having jurisdiction over the use of said fire hydrant and from the agency owning the affected water system. For each such connection made, the CONTRACTOR shall first attach to the fire hydrant a valve and a construction meter, supplied by the CITY or said other authority and agency.
- F. Pipeline Water Connections: The CONTRACTOR shall not make connection to, or draw water from, any pipeline without first obtaining permission of the ENGINEER or California Water Service Company or other authority having jurisdiction over the use of said pipeline and from the agency owning the affected water system. For each such connection made, the CONTRACTOR shall first attach to the pipeline a valve and a construction meter, supplied by the CITY or said other authority and agency. A certified approved backflow device is to be used for this purpose.
- G. Removal of Water Connections: Before final acceptance of the WORK on the project, all temporary connections and piping installed by the CONTRACTOR shall be entirely removed, and all affected improvements shall be restored to their original condition, or better, to the satisfaction of ENGINEER, the CITY, and/or other agency owning the affected utility.

END OF SECTION

SECTION 015500

SITE ACCESS AND STORAGE

1.01 MAINTAINING TRAFFIC

- A. The CONTRACTOR shall be responsible for providing adequate traffic control in conformance with the requirements of the "Manual of Traffic Controls for Construction and Maintenance Work Zones," Current Edition, as Published by the State of California Department of Transportation.
- B. Traffic Control: For the protection of traffic in public or private streets and ways, the CONTRACTOR shall provide, place, and maintain all necessary barricades, traffic cones, warning signs, lights, and other safety devices in accordance with the requirements of the "Manual of Traffic Controls for Construction and Maintenance Work Zones," Current Edition, published by the State of California, Department of Transportation and the Drawings, if applicable.
- C. If closure of any street is necessary during construction, the CONTRACTOR shall submit a formal application and complete detour plan for a street closure to the CITY and/or other authority having jurisdiction at least 30 days prior to the needed street closure in order for the CITY and other agency having jurisdiction to review the application. The detour plan shall include all necessary signing and detour requirements, shall be signed and stamped by a registered professional engineer, and shall be a scaled design on 24" x 36" sheets.

1.02 HIGHWAY LIMITATIONS

- A. All hauling by motor vehicles shall be confined to designated truck routes, except where otherwise authorized in writing by the ENGINEER.

1.03 CONTRACTOR'S WORK AND STORAGE AREA

- A. The CONTRACTOR shall make its own arrangements for any necessary off-site storage areas necessary for the proper execution of the Work. Plans shall be submitted to the City's Planning Division for all proposed offsite storage areas in order to obtain any necessary permits. The CONTRACTOR shall obtain all necessary CITY permits for off-site storage and shall submit copies of the owner's written permission for such private property use, and a letter post use from the owner stating that the condition of the property was left to their satisfaction.
- B. The CONTRACTOR will not be allowed use of public street right-of-way or public land for work or storage areas without written approval of the ENGINEER.

1.04 TEMPORARY STREET USE

- A. Street Use: Nothing herein shall be construed to entitle the CONTRACTOR to the exclusive use of any public street, alley, way, or parking area during the performance of the Work hereunder, and it shall so conduct its operations as not to interfere unnecessarily with the authorized work of the CITY, utility companies, or other agencies, or public access in such streets, alleys, ways, or parking areas. The CONTRACTOR shall be responsible for any damage to public facilities in the public right-of-way. Any damage done to these public facilities will be repaired and/or replaced by the CONTRACTOR.

- B. No street shall be closed to the public without first obtaining the permission of the ENGINEER, and other proper governmental authority, where applicable.
- C. Fire hydrants on or adjacent to the WORK shall be kept accessible to fire-fighting equipment at all times.
- D. Temporary provisions shall be made by the CONTRACTOR to assure the use of sidewalks and the proper functioning of all gutters, sewer inlets, and other drainage facilities.
- E. Wherever necessary or required for the convenience of the public or individual residents or business places at street or highway crossings, private driveways, or elsewhere, the CONTRACTOR shall provide suitable temporary bridges or steel plates over unfilled excavations, except in such cases as the CONTRACTOR shall secure the written consent of the individuals or authorities concerned to omit such temporary bridges or steel plates, which written consent shall be delivered to the ENGINEER prior to beginning the excavation. All such bridges or steel plates shall be maintained in service until access is provided across the backfilled excavation.
- F. Temporary bridges or steel plates for street and highway crossings shall conform to the requirements of the authority having jurisdiction in each case, and the CONTRACTOR shall conform to Section 312300-3.13 (steel plate).
- G. No equipment or material left on the street shall block line of site at intersections, or traffic signal and signs.

1.05 ACCESS SECURITY

- A. Where construction site access is directly off of a public street the CONTRACTOR shall be responsible for providing and maintaining adequate fencing, barricades, and/or signs to prevent public access from the public street into the construction site 24-hours a day.

END OF SECTION

SECTION 015526

TEMPORARY TRAFFIC CONTROL SYSTEMS

1.01 THE REQUIREMENT

- A. The CONTRACTOR shall provide all materials, equipment, and labor necessary to furnish, place, and maintain all temporary traffic control systems, including construction and maintenance area traffic control devices and flaggers as required to perform the WORK in accordance with this Section, and all other appurtenant work, complete in place, as shown on the Drawings and as specified herein.
- B. Work Specified in this Section:
 - 1. Review of proposed WORK areas to determine temporary traffic control requirements.
 - 2. Verification of temporary traffic controls with the ENGINEER or appropriate agency prior to implementation.
 - 3. Maintenance of traffic control during the WORK.
 - 4. Monitoring traffic control during the WORK to determine necessary changes required to maintain adequacy.
 - 5. Maintenance of traffic control during non-work hours to maintain adequacy.
 - 6. Removal of temporary traffic control systems after completion of the WORK.
 - 7. Removal of traffic detector loops/detouring vehicles through signalized intersections.
- C. The CONTRACTOR shall comply with Section 7058 of the Business and Professions Code as it applies to establishment of traffic control.

1.02 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. State of California, Department of Transportation (Caltrans) Specifications and Standards:
 - 1. Standard Specifications:

Section 7	Legal Relations and Responsibility
Section 12	Construction Area Traffic Control Devices
 - 2. Standard Plans
 - 3. Traffic Manual, current edition
- B. Commercial Standards:

State of California, Division of Industrial Safety, Department of Industrial Relations:

Safety Orders of the Division of Industrial Safety, Department of Industrial Relations of the State of California, current edition.
- C. State Codes: State of California Business and Professions Code.

1.03 CONTRACTOR SUBMITTALS

- A. In addition to the submittal requirements of Section 011100 "Summary of Work," the CONTRACTOR shall provide the following at the pre-construction conference:

1. A "Letter of Responsibility," on company letterhead, indicating the names and telephone numbers of at least three different persons who shall be available to be contacted in case of emergency at any time during the life of the contract. Said persons must have decision-making authority within the company.
 2. "Traffic Control/Construction Staging Plans" indicating proposed traffic control measures during all stages of the WORK. These plans shall be submitted for review and approval by the ENGINEER in order to determine the CONTRACTOR'S compliance with the requirements of this section.
- B. The CONTRACTOR shall be responsible for submitting separate applications for encroachment permits to the appropriate agencies for WORK or traffic control within areas outside of the jurisdiction of the CITY. The CONTRACTOR shall be responsible for compliance with all traffic control requirements determined necessary by other permitting agencies or other public authorities acting within their jurisdictions.

1.04 PRODUCTS

- A. All construction area stationary and portable sign panels, lights, barricades, and traffic control devices shall be the product of a commercial sign or safety device manufacturer conforming to the requirements of Section 12, "Construction Area Traffic Control Devices," of the Caltrans Standard Specifications, unless otherwise specified in this Section, shown on the Drawings, and/or as directed by the ENGINEER.

1.05 GENERAL

- A. The CONTRACTOR shall provide all appropriate traffic control measures in accordance with this Section prior to start of construction in the public right-of-way or in any area adjacent to the street right of way where public safety is affected.
- B. The CONTRACTOR shall take all necessary precautions for the protection of the WORK and the safety of its employees and the public. Traffic shall be maintained through the construction or maintenance zone in accordance with Sections 7-1.08, 7-1.09 and 12 of the Caltrans Standard Specifications and Sections 011100 "Summary of Work."
- C. Proposed traffic control plans shall be approved by the ENGINEER and any other public agency with jurisdiction over the roadway prior to installation.
- D. All construction area signs, lights, barricades, and traffic control devices shall be furnished, installed, maintained, and removed in conformance with the specifications of the Caltrans Traffic Manual, current edition, as published by the State of California Department of Transportation and Business and Professions Code Section 7058. Additional or alternate signs may only be used when specifically authorized by the ENGINEER.
- E. The CONTRACTOR shall station guards or flaggers and shall conform to such special safety regulations relating to traffic control as may be required by these Technical Specifications, the ENGINEER, or other public authorities acting within their jurisdictions. Section 12-2.02 of the Caltrans Standard Specifications is revised to provide that all flaggers and guards shall be furnished by the CONTRACTOR at its expense.
- F. The CONTRACTOR shall monitor traffic and safety conditions and maintain adequate traffic control measures during both work and non-work hours in order to maintain compliance with the requirements of this Section.

- G. The CONTRACTOR shall conform to all requirements of the current "Safety Orders of the Division of Industrial Safety, Department of Industrial Relations of the State of California."
- H. If a hazardous condition is observed and the CITY notifies the CONTRACTOR either directly or by telephone, the CONTRACTOR shall correct the condition immediately. If the CONTRACTOR fails to correct the hazardous condition immediately, the CITY reserves the right to call in a local contractor to perform the necessary work needed to improve public safety. The cost incurred shall be billed to the DEVELOPER.
- I. All construction area signs, lights, barricades, and temporary traffic control devices shall be completely removed from the roadway when not in use. Locations and methods of storing traffic control equipment adjacent to the roadway between interrupted uses shall require prior approval of the ENGINEER.
- J. The CONTRACTOR shall completely remove all temporary signs, striping and/or delineators and restore the pavement, as necessary, upon removal or relocation of any temporary traffic controls or detours constructed as part of the WORK.
- K. When traffic is detoured to the bicycle/parking lane adjacent to the curb where street tree branches are interfering with vehicular traffic, the CONTRACTOR shall trim the trees in accordance with Section 311300 "Selective Tree and Vegetation Trimming and Removal."
- L. When the construction activity will make any detector loop at a traffic signal inoperative for a period of 72 hours or more, the CONTRACTOR shall provide video detection, or any other similar device which is not installed in the pavement prior to the start of work at his own expense. The CONTRACTOR shall provide a temporary video detection device attached to the traffic signal pole luminaire arm which is wired to the traffic signal controller. The proposed detection device must conform to Section 344100, or as approved by the ENGINEER.

- END OF SECTION -

SECTION 015600

PROTECTION OF EXISTING FACILITIES

1.01 GENERAL

- A. The CONTRACTOR shall protect all existing utilities, trees, shrubbery, landscaping, irrigation facilities, buildings, fences, roadside signs, poles, mailboxes, and all other improvements not designated for removal and shall restore damaged or temporarily relocated utilities and improvements to a condition equal to or better than they were prior to such damage or temporary relocation, all in accordance with requirements of the Contract Documents.
- B. Prior to beginning any work, the CONTRACTOR shall verify the exact locations and depths of all utilities shown and the CONTRACTOR shall make exploratory excavations of all utilities that may interfere with the WORK at CONTRACTOR's sole expense. When such exploratory excavations show the utility location as shown to be in error, the CONTRACTOR shall so notify the ENGINEER.
- C. Private hose bibs and hoses shall not be used for construction unless the CONTRACTOR secures the owner's permission to use same.
- D. All reference markings made by the CONTRACTOR shall be done with water base paint and shall be removed by the CONTRACTOR.

1.02 PROTECTION OF STREET OR ROADWAY SURVEY MARKERS

- A. The CONTRACTOR shall not destroy, remove, or otherwise disturb any existing survey markers or other existing street or roadway markers unless specifically shown on the Drawings. No pavement breaking or excavation shall be started until all survey or other permanent marker points that will be disturbed by the construction operations have been properly referenced for easy and accurate restoration. All survey markers or points disturbed by the CONTRACTOR shall be accurately restored to the satisfaction of the Engineer by the CONTRACTOR at its own expense.

1.03 EXISTING UTILITIES AND IMPROVEMENTS

- A. General: The CONTRACTOR shall protect all Underground Utilities and other improvements which may be impaired during construction operations. It shall be the CONTRACTOR'S responsibility to ascertain the actual location of all existing utilities and other improvements that will be encountered in its construction operations, and to see that such utilities or other improvements are adequately protected from damage due to such operations. The CONTRACTOR shall take all possible precautions for the protection of unforeseen utility lines to provide for uninterrupted service and to provide such special protection as may be necessary. Any damages occurring during construction shall be repaired to pre-existing or better conditions by CONTRACTOR at their own expense.
- B. Utilities to be Moved: In case it shall be necessary to relocate or move the property of any public utility or franchise holder, the CONTRACTOR shall be responsible to contact the appropriate utility or franchise holder and obtain proper permits prior to work?.
- C. Where the proper completion of the WORK requires the temporary or permanent removal and/or relocation of an existing utility or other improvement which is shown, the CONTRACTOR shall remove and, without unnecessary delay, temporarily replace or relocate such utility or the facility at the direction of the affected utility. In all cases of such temporary removal or relocation, restoration to former location shall be accomplished by the CONTRACTOR in a manner that will

restore or replace the utility or improvement as nearly as possible to its former locations and to as good or better condition than found prior to removal.

- D. Underground Utilities: The CONTRACTOR shall notify the appropriate utility or agency for any existing utility lines that are damaged or exposed during construction.
- E. The CONTRACTOR shall keep existing streets free from dust and debris during all phases of construction.

1.04 TREES WITHIN STREET RIGHTS-OF-WAY

- A. General: The CONTRACTOR shall exercise all necessary precautions so as not to damage or destroy any trees or shrubs, including those lying within street rights-of-way, and shall not trim or remove any trees unless such trees have been approved for trimming or removal by the CITY or other jurisdictional agency. Trees and shrubs which are not scheduled for removal shall be protected with temporary fencing placed around their driplines. All existing trees and shrubs which are damaged during construction shall be trimmed or replaced by the CONTRACTOR or a certified tree company to the satisfaction of said CITY and/or other jurisdictional agency. Tree trimming and replacement shall be accomplished in accordance with the requirements of the CITY or other jurisdictional agency.

1.05 NOTIFICATION BY THE CONTRACTOR

- A. The CONTRACTOR shall notify all utilities 48 hours prior to any excavation so that their lines can be marked. Those to be notified include, but are not limited to:
 - 1. Underground Service Alert (USA), 800-227-2600.
- B. Prior to any excavation in the vicinity of any existing underground facilities, including all water, sewer, storm drain, irrigation, gas, petroleum products, or other pipelines; all buried electric power, communications, or television cables; all traffic signal and street lighting facilities; and all roadway and state highway rights-of-way the CONTRACTOR shall notify the respective authorities representing the owners or agencies responsible for such underground facilities 48 hours prior to the day of excavation so that a representative of said owners or agencies can be present during such work if they so desire.

END OF SECTION

SECTION 015700 - SITE PREPARATION

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide all materials, equipment and labor necessary to protect or control traffic, surface drainage, pedestrians, noise, dust and any nuisance conditions created by construction and shall perform all work required to protect existing streets, curbs, gutters, sidewalks, access ramps, driveways, utilities, landscaping, fences and other existing improvements as shown on the Drawings and as specified herein.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 310000 Earthwork.
- B. Section 312300 Utility Earthwork.
- C. Division 1 General Requirements.

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

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

- 1. Standard Specifications.
- 2. Standard Plans.
- 3. Manual of Traffic Controls for Construction and Maintenance Work Zones.
- 4. Traffic Manual.

B. **Commercial Standards:**

- 1. USA/Underground Service Alert.

1.4 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall obtain and submit copies of all permits required by governing agencies prior to any construction.
- B. The CONTRACTOR shall submit to the ENGINEER those drawings required in PART 2 - PRODUCTS of this Section outlining all methods and materials intended to protect existing features and control local conditions prior to construction.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. All products shall conform to State, Federal and local standards as well as manufacturers' printed recommendations.

2.2 SAFETY AND NOISE BARRIERS

- A. If the proximity of existing features will require construction of an appropriate barrier such as temporary fencing, berms, acoustic barriers, or similar facilities the CONTRACTOR shall prepare a

submittal for review to the ENGINEER of drawings that define the proposed safety or noise barriers, including any required signage, prior to beginning any construction.

2.3 TRAFFIC CONTROL

- A. If the proximity of existing streets or access ways will require construction of appropriate safety barriers, flagging, trench plates, temporary lanes, warning signs, lane striping or similar facilities the CONTRACTOR shall prepare a submittal for review to the ENGINEER of drawings that define the proposed traffic control devices prior to beginning any construction. The submittal shall be submitted in accordance with the latest edition of the State of California (Caltrans) Traffic Manual, and Manual of Traffic Controls for Construction and Maintenance Work Zones.

2.4 SURFACE DRAINAGE

- A. If the proximity of existing surface drainage will require construction of appropriate bypass, appropriate bypass, interceptors, or similar facilities the CONTRACTOR shall prepare a submittal for review to the ENGINEER of drawings that define the proposed drainage devices prior to beginning any construction.

PART 3 -- EXECUTION

3.1 SITE INSPECTION

- A. Prior to moving onto the project site the CONTRACTOR shall visit and inspect the site conditions and review maps of the existing site and facilities delineating existing utilities, property and right-of-way lines.

3.2 SITE MOBILIZATION

- A. All safety, noise, traffic, drainage control and other features required for construction shall be established at the site prior to any construction.
- B. The CONTRACTOR shall notify and coordinate the utility location services of all agency utilities affected by the construction work. In addition, the Underground Services Alert (USA) organization shall be used to locate and mark underground utility locations prior to construction in each affected area.

3.3 SITE ACCESS

- A. The CONTRACTOR shall install any necessary access to the site, including barrier facilities to be installed at the beginning of construction to prohibit entry of unauthorized persons.

3.4 SITE CLEARING, GRUBBING, AND STRIPPING

- A. All clearing, grubbing and stripping shall be in accordance with Section 310000, "Earthwork," and Section 312300, "Utility Earthwork."

3.5 OVEREXCAVATION, REGRADING, AND BACKFILL

- A. All over excavation, regrading and backfill shall be in accordance with Section 310000, "Earthwork," and Section 312300, "Utility Earthwork."

- END OF SECTION -

SECTION 015713

TEMPORARY EROSION CONTROL

1.01 GENERAL

- A. Temporary erosion control shall consist of, but not be limited to, constructing such facilities and taking such measures as are necessary to prevent, control, and abate water, mud, construction materials, hazardous materials and erosion damage to public and private property as a result of the CONTRACTOR'S operations.
- B. Conformance with the requirements of this section shall in no way relieve the CONTRACTOR from the CONTRACTOR'S responsibilities, as provided in Section 7-1.01G, "Water Pollution," Section 7-1.11, "Preservation of Property," of the Caltrans Standard Specifications, and National Pollutant Discharge Elimination System (NPDES) General Permit for Storm Water Discharges Associated with Construction Activity (General Permit) of the California Regional Water Quality Control Board.
- C. Construction vehicles and equipment entering existing paved areas shall be free of mud, silt and other debris during all phases of work. No mud, silt and other debris shall be tracked on paved surfaces. If such materials are tracked on the streets or other paved areas both public and private, the CONTRACTOR shall immediately remove these materials prior to these materials entering into the storm drain system.
- D. Stockpiling of materials on the street will not be allowed unless otherwise approved by the ENGINEER. The CONTRACTOR shall cover with plastic any construction or excavated materials between October 15th and April 15th which may possibly erode and enter the storm drain system of paved streets or other paved areas both public and private. Stockpiling of dirt on paved areas will not be allowed.
- E. The CONTRACTOR shall sweep the work area as necessary to meet all NPDES requirements and shall clean up the work site daily before leaving the site.
- F. A Storm Water Pollution Prevention Plan (SWPPP) is required for the project, The CONTRACTOR shall be responsible for obtaining a SWPPP permit (should we call out how??) and throughout the duration of the project for installing, constructing, inspecting and maintaining the control measures included in the SWPPP and any amendments thereto and for removing and disposing of temporary control measures.
- G. By October 15th of each year the temporary erosion control features as are necessary to prevent damage during forthcoming winter season shall be constructed and functioning. If the earthwork in any area has not progressed to a point where any part of the facilities on the temporary erosion control plans for that area can be constructed, the CONTRACTOR shall construct such supplementary temporary erosion control facilities as are necessary to protect adjacent private and public property.

Temporary erosion control measures shall include, but not be limited to, the following:

1. The CONTRACTOR shall conduct operations in such a manner that storm runoff will be contained within the site or channeled into the storm drain system which serves the runoff area. Storm runoff from one area shall not be allowed to divert to another runoff area.
2. Storm drain systems, toe of slope drains, and outlet structures shall be constructed and operating prior to commencing, or concurrently with placing an embankment.

Temporary downdrains, drainage structures, and other devices shall be provided to channel storm runoff water into the respective permanent storm drain systems during construction. Mud and silt shall be settled out of the storm runoff before the runoff enters the storm drain system.

3. Embankment areas, while being brought up to grade and during periods of completion prior to final roadbed construction, shall be protected by various measures to eliminate erosion and the siltation of downstream facilities and adjacent areas. These measures may include, but shall not be limited to: temporary downdrains, either in the form of pipes or paved ditches with protected outfall areas; graded berms around areas to eliminate erosion of embankment slopes by surface runoff; confined ponding areas to desilt runoff; and temporary check dams in toe of slope ditches to desilt runoff.
4. Excavation areas, while being brought to grade, shall be protected from erosion and the resulting siltation of downstream facilities and adjacent areas by use of various temporary erosion control measures. These measures may include, but shall not be limited to: check dams; confined ponding areas to desilt the runoff; and protection, such as sandbags around inlets which have not been brought up to grade.
5. Contour graded areas shall be protected against erosion and the resulting siltation of downstream facilities and adjacent areas during grading operations. Various measures may include, but shall not be limited to: the use of graded contour berms to control sheet flow; supplemental grading of large areas around temporary or unfinished inlet structures to provide desilting basins; and temporary ditch paving.
6. From October 15th to April 15th:
 - A. During embankment construction, an earth berm or appropriate grading to direct drainage away from the edge of the top of the embankment shall be constructed and maintained on those embankments where earthwork operations are not in progress.
 - B. Special attention will be required to protect areas, which have been cleared, and grubbed prior to excavation or embankment operations, and which are subject to runoff during the period from October 15th to April 15th. Temporary measures may include, but shall not be limited to: temporary desilting basins; contour graded ditches; temporary paved and unpaved ditches; and filter fabric fences to contain silt and sediment from runoff.
 - C. After each storm, desilting basins shall be checked against their design capacity and if necessary, silt and sediment shall be removed to restore capacity.

1.02 INSPECTION AND MAINTENANCE

- A. To ensure the proper implementation and functioning of temporary erosion control measures, the CONTRACTOR shall regularly inspect and maintain the construction site for the control measures identified in the Storm Water Pollution Prevention Plan (SWPPP). The CONTRACTOR shall identify corrective actions and time frames to address any damaged measures or reinstate any measures that have been discontinued.
- B. During the winter season defined as between October 15th to April 15th, inspections of the construction site shall be conducted by the CONTRACTOR to identify deficient measures, as follows:
 1. Prior to a predicted storm;

2. After all precipitation which causes runoff capable of carrying sediment from the construction site;
3. At 24 hours intervals during extended precipitation events; and
4. Routinely, on a minimum twice monthly basis.

If the CONTRACTOR identifies a deficiency in the deployment or functioning of an identified control measure, the deficiency shall be corrected in a timely manner. If the ENGINEER identifies a deficiency in the deployment or functioning of an identified control measure, the CONTRACTOR will be notified in writing and the deficiencies shall be corrected by the CONTRACTOR in a timely manner. Upon failure of the CONTRACTOR to remedy the defect as specified within 4 hours after notification by the ENGINEER, the CITY may order that such work be done by others, and all costs therefore shall be charged to the CONTRACTOR

END OF SECTION

SECTION 015719

TEMPORARY ENVIRONMENTAL CONTROLS

ADD A PARAGRAPH referencing any Project level environmental mitigations

1.01 DUST ABATEMENT

- A. The CONTRACTOR shall furnish all labor, equipment, and means required and shall carry out effective measures at all times during construction to prevent its operation from producing any airborne dust nuisance and dust in amounts damaging to property, cultivated vegetation, or domestic animals, or causing a nuisance to persons living in or occupying buildings in the vicinity all in conformance with Section 10, "Dust Control", and Section 18, "Dust Palliative" of the Caltrans Standard Specifications. The CONTRACTOR shall be responsible for any damage resulting from any dust originating from its operations. The dust abatement measures shall be continued until the CONTRACTOR is relieved of further responsibility by the ENGINEER.
- B. Reclaimed water, as specified in Section 015100, "Temporary Utilities" must be used when available for CONTRACTOR's use for dust abatement.
- C. Upon failure of the CONTRACTOR to remove the dust nuisance as specified in Paragraph A within 2 hours after notification by the ENGINEER, the CITY may order that such work be done by others, and all costs therefore shall be charged to the CONTRACTOR.

1.02 RUBBISH CONTROL

- A. During the progress of the Work, the CONTRACTOR shall not allow any rubbish or construction debris to blow or travel off the construction site. The CONTRACTOR shall keep all public streets and roads free from mud, dirt, rubbish, and unnecessary obstructions resulting from its operations. Disposal of all rubbish and surplus materials shall be in accordance with local codes and ordinances governing locations and methods of disposal, and in conformance with all applicable laws and regulations.

1.03 SANITATION

- A. The CONTRACTOR shall insure that adequate existing sanitation facilities are available or the CONTRACTOR shall provide and maintain adequate sanitation facilities. All wastes and refuse from sanitary facilities provided by the CONTRACTOR or organic material wastes from any other source related to the CONTRACTOR'S operations shall be disposed of away from the site in accordance with all laws and regulations pertaining thereto. Sanitation facilities will not be allowed in public street rights-of-way or in public lands. If more than four sanitation facilities are being used on a particular site, the CONTRACTOR shall locate these facilities no closer than 100' from existing residential units.

1.04 CHEMICALS

- A. All chemicals used during project construction whether defoliant, soil sterilant, herbicide, pesticide, disinfectant, polymer, reactant or of other classification, shall show approval of either the U.S. Environmental Protection Agency or the U.S. Department of Agriculture. Use of all such chemicals and disposal of residues shall be in strict accordance with the printed instructions of

the manufacturer.

1.05 CULTURAL RESOURCES

- A. The CONTRACTOR'S attention is directed to the National Historic Preservation Act of 1966 (16 U.S.C. 470 and 36 CFR 800) which provides for the preservation of potential historical architectural, archaeological, or cultural resources (hereinafter called "cultural resources").
- B. The CONTRACTOR shall perform remediation in conformance with the requirements of the National Historic Preservation Act of 1966 as it relates to the preservation of cultural resources.
- C. In the event potential cultural resources are discovered during subsurface excavations in the public street right-of-way or on public lands, the CONTRACTOR shall immediately cease all operations and shall immediately notify the ENGINEER.
 - 1. The CONTRACTOR shall be responsible for hiring a qualified archaeologist to assess the value of such potential cultural resources and make a recommendation to the State Historic Preservation Board Cultural Resources Officer.
 - 2. The CONTRACTOR shall obtain all necessary permits from the CITY Historic Preservation Committee.
- D. If the archaeologist determines that the potential find is a bona fide cultural resource, at the direction of the State Water Resources Control Board Cultural Resources Officer, the CONTRACTOR shall suspend work at the location of the find.

1.06 CONSTRUCTION NOISE

The CONTRACTOR shall be advised that the operation of any noise creating blower, power fan, or internal combustion engine which causes noise due to the explosion of operating gases or fluids is prohibited, unless the noise from such blower or fan is muffled and such noise in such a manner so as not to be plainly audible at a distance of either 75 feet from the source of the noise, or between the hours of 6:00 p.m. Saturday to 7:00 a.m. Monday; 8:00 p.m. to 7:00 a.m. on Monday, Tuesday, Wednesday and Thursday; 8:00 p.m. Friday to 9:00 a.m. on Saturday or at all on city-observed holidays. The operation between the hours of 6:00 p.m. Saturday to 7:00 a.m. Monday; 8:00 p.m. to 7:00 a.m. on Monday, Tuesday, Wednesday and Thursdays; 8:00 p.m. Friday to 9:00 a.m. Saturday or at all on city-observed holidays of any pile driver, steam shovel, pneumatic hammer, derrick, steam, electric hoist, sandblaster or other equipment used in construction, demolition or other repair work, the use of which is attended by loud or unusual noise, is prohibited.

In addition, to the above noise requirements, the CONTRACTOR shall comply with all other requirements of Chapter 9.36 "Noise" of the Livermore Municipal Code.

END OF SECTION

SECTION 016600

MATERIALS AND EQUIPMENT

1.01 SALVAGE OF EXISTING FACILITIES

- A. Any existing public or CITY facilities to be removed as directed by the ENGINEER shall be salvaged by the CONTRACTOR and delivered to the CITY facility as directed by the ENGINEER.
- B. The CONTRACTOR shall carefully remove, in a manner to prevent damage, any and all materials and equipment specifically designated by the ENGINEER to be removed and salvaged.
- C. Any items damaged during the removal, storage, or handling as a result of carelessness, negligence, or improper procedures shall be replaced by the CONTRACTOR with corresponding items of equal or greater value.
- D. The CONTRACTOR may at its option and on approval of the CITY furnish and install new items in lieu of those indicated to be salvaged or reused, in which case the original items shall become the property of the CONTRACTOR and shall be removed from the site after completion of the WORK. The cost of substituting new items in lieu of salvaged or revised items, at the CONTRACTOR'S option, shall be the responsibility of the CONTRACTOR.
- E. Existing materials and equipment removed by the CONTRACTOR shall not be reused in the WORK, except where otherwise called for in the contract documents.

END OF SECTION

SECTION 017123

FIELD ENGINEERING

1.01 SUMMARY

- A. The CONTRACTOR shall lay out and install all construction to lines and grades in accordance with the Drawings.
- B. The CONTRACTOR shall be responsible for setting and maintaining all field engineering, establishing lines and grades, and for the accuracy of the stake information. All horizontal and vertical stake datum shall agree with the Drawings.

END OF SECTION

SECTION 017700

PROJECT CLOSEOUT

1.01 GENERAL

A. ALL construction shall meet the City Occupancy Requirements prior to any building occupancy. City occupancy requirements include, but are not limited to, the following:

1. All underground facilities
2. Buildings
2. Asphalt concrete pavement
3. Portland cement concrete improvements which may include, but not limited to: curb; gutter; sidewalk, driveways, and access ramps
4. Finish grading within the street right-of-way
5. Street name signs
6. Traffic regulatory signs, striping, and markings
7. Street lights and signals installed and energized
8. Fire hydrants installed and accepted
9. All potential hazards removed within the street right-of-way
10. Street, and sidewalks and driveways cleaned
11. Water meters and boxes installed
12. Sanitary sewers cleaned out
13. Street trees installed *
14. All training on equipment or systems satisfactorily completed
15. All conditions of approval complied with

* The CONTRACTOR may provide a tree bond in order to receive occupancy.

1.02 FINAL CLEANUP

A. The CONTRACTOR shall promptly remove all rubbish, debris, unused materials, concrete forms, construction equipment, and temporary structures and facilities used during construction. Final acceptance of the WORK by the CITY will be withheld until the CONTRACTOR has satisfactorily complied with the foregoing requirements for final cleanup of the project site.

1.03 FINAL SUBMITTALS

A. The CONTRACTOR, prior to final acceptance, shall submit the following items to the ENGINEER:

1. Written guarantees or warranties
2. Record drawings as specified in Section 013300 "Submittals."
3. Completed Pavement Management Form
4. Maintenance stock items, including special parts; spare parts; special tools
5. Signed-off permits and/or certificates of inspection and acceptance by local governing agencies having jurisdiction
6. Releases from all parties who are entitled to claims against the subject project, property, or improvement pursuant to the provisions of law.

END OF SECTION

CITY OF LIVERMORE
TECHNICAL SPECIFICATIONS

DIVISION 2 – EXISTING CONDITIONS

SECTION 022100 - MONUMENTS

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide all materials, equipment, and labor necessary to furnish and install cast-in-place Portland Cement Concrete survey monuments and all appurtenant work, complete in place, as shown on the Drawings and as specified herein.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 312300 Utility Earthwork.
- B. Section 321000 Asphalt Pavement, Base and Surface Treatments.
- C. Section 321300 Concrete Surface Improvements
- D. Section 033050 Utility Cast-in-Place Concrete.
- E. Division 1 General Requirements. Section 15600 Paragraph 1.02
PROTECTION OF STREET OR ROADWAY SURVEY MARKERS

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards:

- ASTM A 48 Specification for Gray Iron Castings.

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 FRAME AND COVER

- A. Monument frame and covers shall be grey iron castings conforming to ASTM A 48, Class 30. Monument cover shall be marked "Monument." Each cover shall be ground or otherwise finished so that it will fit in its frame without rocking. Monument frame and cover shall be **Christy G05 TBOX, Monroe #9279, or equal.**

2.2 BRONZE SURVEY MARKER

- A. Bronze survey markers shall be a 2-1/2 inch domed disk with stem and appropriate survey information as specified on the Drawings.

2.3 FORMING TUBE

- A. Tubes for forming portland cement concrete collar and monument shall be a non-metallic type of the size and dimensions shown on the Drawings.

2.4 PORTLAND CEMENT CONCRETE

- A. Portland Cement Concrete for collars and footings shall be Class C in conformance with Section 033050, "Utility Cast-in-Place Concrete."

2.5 ASPHALT CONCRETE PAVEMENT

- A. Asphalt concrete for monuments shall be in conformance with "Fine Asphalt Concrete Paving" in PART 2 – "Products" of Section 321000, "Asphalt Pavement, Base and Surface Treatments."

2.6 DRAIN ROCK

- A. Drain rock material shall be in conformance with Permeable Material, Class 1 or 2, in PART 2 – "Products" of Section 312300, "Utility Earthwork."

PART 3 -- EXECUTION

3.1 GENERAL

- A. Monuments shall not be installed until the asphalt concrete pavement has been completed. Monuments shall be installed at the locations shown on the Drawings.
- B. Concrete, form tube, bronze survey marker, frame and cover, and asphalt concrete shall be installed as shown on the Drawings.

3.2 PORTLAND CEMENT CONCRETE

- A. Hand mixing of the Portland Cement Concrete for use in constructing monuments will be allowed.
- B. All portland cement concrete shall be placed and thoroughly consolidated.

3.3 ASPHALT CONCRETE PAVEMENT

- A. Asphalt concrete for pavement shall be placed in conformance with PART 3 – "Execution" of Section 321000, "Asphalt Pavement, Base and Surface Treatments."

3.4 DRAIN ROCK

- A. Drain rock material shall be installed in conformance with Section 312300, "Utility Earthwork"...

- END OF SECTION -

SECTION 024100 - DEMOLITION

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide all materials, equipment and labor necessary to perform and complete all demolition work shown on the Drawings and as specified herein. This includes, but is not necessarily limited to, such items as demolition, removal, recycling and disposal of asphalt concrete, miscellaneous concrete, vegetation and all other structures, or features as required.
- B. Manufactured articles, materials, equipment, and accessories shall be demolished in accordance with the manufacturer's printed specifications and recommendations, and industry standards, unless otherwise shown or specified.
- C. Hazardous materials shall be handled, removed and disposed of in accordance with all regulatory agency requirements.
- D. Building utilities shall be disconnected, removed, capped and identified in accordance with the appropriate agency requirements.
- E. The CONTRACTOR shall coordinate with the CITY for demolition permits required by the CITY and with all other regulatory agencies and utility companies.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 312300 Utility Earthwork.
- B. Division 1 General Requirements.

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. The demolition and sealing of wells, septic tanks and underground tanks shall be in accordance with regulatory agency requirements. The CONTRACTOR shall obtain all required permits and file all required reports.

CONTRACTOR shall meet all requirements of the City's LMC Section 15.28 Construction Demolition Debris Ordinance which requires that 50% of all demolition debris be diverted.

B. **Commercial Standards:**

- 1. USA Underground Service Alert.

1.4 CONTRACTOR SUBMITTALS

- A. **Demolition Schedule:** The CONTRACTOR shall submit a complete coordination schedule for demolition work including shut-off and continuation of utility services prior to start of the work. The schedule shall indicate proposed methods and operations of facility demolition, and provide a detailed sequence of demolition and removal work to ensure uninterrupted operation of occupied areas.
- B. CONTRACTOR submit a Waste Management Plan identifying how that diversion will be met.
- C. The CONTRACTOR shall provide copies of written agreements from private land owner's, landfill operators, or other agencies accepting disposal of any demolished material prior to any work.

1.5 JOB CONDITIONS

- A. **Condition of Facilities:** The CITY assumes no responsibility for actual condition of facilities to be demolished. The CONTRACTOR shall visit the site and inspect the existing facilities.

PART 2 -- PRODUCTS (Not Used)

PART 3 -- EXECUTION

3.1 OCCUPANCY AND POLLUTION CONTROL

- A. Water sprinkling, temporary enclosures, chutes and other suitable methods shall be used to limit dust and dirt rising and scattering in the air. The CONTRACTOR shall comply with all government regulations pertaining to environmental protection.
- B. Water shall not be used in a manner that creates hazardous or objectionable conditions such as ice, flooding, or pollution.

3.2 PROTECTION

- A. Safe passage of persons around area of demolition shall be provided in accordance with all safety and regulatory requirements. Operations shall be conducted to prevent damage to adjacent buildings, structures, other facilities, people and property.
- B. Interior and exterior shoring, bracing, or supports shall be provided to prevent movement, settlement or collapse of structures to be demolished and to adjacent facilities to remain.
- C. Existing landscaping materials, structures, and appurtenances which are not to be demolished shall be protected and maintained and replaced if damaged.
- D. The CONTRACTOR shall protect and maintain conduits, drains, sewers, pipes and wires that are not to be demolished.

3.3 SMALL STRUCTURE DEMOLITION

- A. Small structures may be removed intact when acceptable to the ENGINEER and approved by the City Building Official.
- B. Demolition shall proceed in a systematic manner, typically from top of structure to ground.
- C. Concrete and masonry shall be demolished in small sections.

3.4 BELOW-GRADE DEMOLITION

- A. Footings, foundation walls, below-grade construction and concrete slabs on grade including utility lines shall be demolished and removed to a depth which will not interfere with new construction but shall not be less than 12 inches below existing ground surface or future ground surface, whichever is lower.
- B. Below-grade areas and voids resulting from demolition of structures shall be completely filled.
- C. All fill and compaction shall be in accordance with Section 312300, "Utility Earthwork."
- D. All fill and compaction surfaces shall be graded to meet adjacent contours and to provide flow to surface drainage structures, or as shown on the Drawings.
- E. Where installation of new utilities requires partial removal or demolition of an existing utility, the existing utility shall be removed to sound material. Pipes to be demolished that require no future connection shall be removed to the extent required and sealed and capped. Sanitary sewer laterals shall be removed as required and a new sewer clean out shall be installed in accordance with the

Standard Specifications and Details. Pipes to be demolished that require a connection shall be removed to the extent required to install the new connection. Pipe sections shall be removed either by sawcutting, removing a complete pipe section to an existing joint, or other adequate means which results in a clean joint acceptable to the ENGINEER..

- F. The CONTRACTOR shall demolish and seal all wells, septic tanks and underground tanks in accordance with applicable regulatory agency requirements and permits.
- G. Joint domestic/fire service laterals shall be abandoned as follows:
 - 1. The Blow Off Assembly shall be removed and capped underground.
 - 2. At the connection to the main the existing lateral valve shall be removed and a blind flange shall be installed on the tee at the main. The lateral pipe shall be abandoned in place by capping both ends of the lateral pipe.
 - 3. The existing structural section of the roadway shall be replaced in kind in accordance with the City Standard specifications.

3.5 AT GRADE DEMOLITION

- A. All asphalt concrete and all portland cement concrete curbs, gutters, sidewalks, access ramps and driveways shall be saw-cut at the nearest scoreline or deep joint and removed entirely to the saw-cut limits. Where adjacent pavement or concrete is broken or deteriorated sufficiently to prohibit a sound replacement the entire deteriorated section shall be removed to the limits determined by the ENGINEER.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

- A. Demolition and removal of debris shall be conducted to ensure minimum interference with roads, streets, walks and other adjacent occupied or used facilities which shall not be closed or obstructed without permission from the CITY. Alternate routes shall be provided around closed or obstructed traffic ways.
- B. Site debris, rubbish and other materials resulting from demolition operations shall become the property of the CONTRACTOR and shall be removed by the CONTRACTOR at the CONTRACTOR's expense to a suitable site. The proper and legal disposal of demolished materials shall be the responsibility of the CONTRACTOR.

3.7 PATCHING AND REPAIRING

- A. The CONTRACTOR shall provide patching, replacing, repairing and refinishing of damaged areas or damaged adjacent facilities involved in the demolition. New concrete shall match the existing adjacent surfaces, in kind or of better quality, to the satisfaction of the ENGINEER, at no cost to the CITY or to the owners of the facilities.

3.8 CLEANUP

- A. During and upon completion of work the CONTRACTOR shall promptly remove unused tools and equipment, surplus materials, rubbish, debris and dust and shall leave areas affected by work in a clean, approved condition.
- B. The CONTRACTOR shall clean adjacent structures and facilities of dust, dirt and debris caused by demolition, as directed by the ENGINEER or governing authorities, and return adjacent areas to condition existing prior to start of work.
- C. The CONTRACTOR shall clean and sweep daily all street and roads affected by its operation.

- END OF SECTION -

CITY OF LIVERMORE
TECHNICAL SPECIFICATIONS

DIVISION 3 – CONCRETE

SECTION 033050 - UTILITY CAST-IN-PLACE CONCRETE

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide all materials, equipment and labor necessary to furnish and place ready-mix cast-in-place concrete, and shall form, mix, place, consolidate, finish, cure, repair and perform all appurtenant work necessary to produce finished concrete complete in place as shown on the Drawings and as specified herein.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 331102 PVC Pressure Pipe
Section 331104 Steel Pipe - Mortar-Lined and Mortar-Coated
Section 331219 Fire Hydrants
Section 333900 Precast Concrete Maintenance Holes
Section 328000 Irrigation Systems
Section 034800 Precast Concrete Vaults, Utility Boxes, and Storm Water Field Drop Inlets
Section 321300 Concrete Surface Improvements.
- B. Section 036000 Grout.
Section 055900 Ductile Iron Pipe
- C. Division 1 General Requirements.

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Federal Specifications and Standards:

- PS 1 U.S. Product Standard for Concrete Forms, Class I.
- PS 20 U.S. Product Standard for American Softwood Lumber.
- UU-B-790A Building Paper, Vegetable Fiber (Kraft, Waterproofed, Water
(Int. Amd.) Repellant and Fire Resistant).

B. State of California (Caltrans) Standards:

1. Standard Specifications:

- Section 51 Concrete Structures.
- Section 52 Reinforcement.
- Section 73 Concrete Curbs and Sidewalks.

C. Commercial Standards:

- ACI 301 Specifications for Structural Concrete for Buildings.
- ACI 315 Details and Detailing of Concrete Reinforcement.
- ACI 318 Building Code Requirements for Reinforced Concrete.

ACI 347	Recommended Practice for Concrete Formwork.
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 31	Practice for Making and Curing Concrete Test Specimens in the Field.
ASTM C 33	Specification for Concrete Aggregates.
ASTM C 39	Test Method for Compressive Strength of Cylindrical Concrete Specimens.
ASTM C 94	Specification for Ready-Mixed Concrete.
ASTM C 143	Test Method for Slump of Hydraulic Cement Concrete.
ASTM C 150	Specification for Portland Cement.
ASTM C 309	Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
ASTM C 494	Specification for Chemical Admixtures for Concrete.
ASTM C 1077	Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation.
ASTM D 1751	Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).
AWS D1.4	Structural Welding Code - Reinforcing Steel.
CRSI MSP-1	Concrete Reinforcing Steel Institute Manual of Standard Practice.
UBC	Uniform Building Code.

1.4 CONTRACTOR SUBMITTALS

- A. **Certificate 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 are 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. Each delivery ticket shall be accompanied by batch tickets automatically produced by the batching equipment, indicating quantities of each ingredient. Each delivery ticket shall, in addition, 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.

1.5 CONSTRUCTION TOLERANCES

- A. The CONTRACTOR shall set and maintain concrete forms and perform finishing operations so as to ensure that the completed WORK is within the tolerances shown on the Drawing and as specified herein. Surface defects and irregularities are defined as finishes and are to be distinguished from tolerances. Permissible deviations for cast-in-place concrete structures shall not exceed $\pm 1/4$ -inch.

PART 2 -- PRODUCTS

2.1 FORM AND FALSEWORK MATERIALS

- A. Except as otherwise expressly accepted by the ENGINEER, all lumber brought on the job site for use as forms, shoring, or bracing shall be new material.
- B. Materials for concrete forms, formwork and falsework shall conform to the following requirements:
1. Lumber shall be Douglas Fir or Southern Pine, construction grade or better, in conformance with U.S. Product Standard PS 20.
 2. Plywood for concrete formwork shall be new, waterproof, synthetic resin bonded, exterior type Douglas Fir or Southern Pine plywood manufactured especially for concrete formwork and shall conform to the requirements of PS 1 for Concrete Forms, Class I, and shall be edge sealed.
 3. Form materials shall be metal, wood, plywood, or other approved material that will not adversely affect the concrete and will facilitate placement of concrete to the shape, form, line and grade shown. Metal forms shall be an approved type that will accomplish such results.

2.2 FORM TIES

- A. Form ties shall be provided with a plastic cone or other suitable means for forming a conical hole to insure that the form tie may be broken off back of the face of the concrete. The maximum diameter of removable cones for rod ties, or of other removable form-tie fasteners having a circular cross-section, shall not exceed 1-1/2 inches; and all such fasteners shall be such as to leave holes of regular shape for reaming. Form Ties shall be **Burke Penta-Tie System, Richmond Snap-Tys, or equal.**

2.3 REINFORCEMENT STEEL

- A. **General:** All reinforcement steel for all cast-in-place reinforced concrete construction shall conform to the following requirements:
1. Bar reinforcement shall conform to ASTM A 615 for Grade 60 Billet Steel Reinforcement with supplementary requirement S-1, or as otherwise shown.
 2. Welded wire fabric reinforcement shall conform to ASTM A 185 and the details shown.
- B. **Accessories:**
1. Accessories shall include all necessary chairs, slab bolsters, concrete blocks, tie wires, dips, supports, spacers and other devices to position reinforcement during concrete placement. Wire bar supports shall be CRSI Class 1 for maximum protection with a 1/8 inch minimum thickness of plastic coating which extends at least 1/2 inch from the concrete surface. Plastic shall be gray in color.

2. Concrete blocks (dobies), used to support and position reinforcement steel, shall have the same or higher compressive strength as specified for the concrete in which it is located. Wire ties shall be embedded in concrete block bar supports.

2.4 CONCRETE MATERIALS

- A. Ready-mix concrete shall conform to the requirements of ASTM C 94.
- B. **Admixtures:** Admixtures shall be used in accordance with manufacturer's printed recommendations.
 1. **Calcium Chloride:** Calcium chloride will not be permitted to be used in concrete, unless specifically approved by the ENGINEER.

2.5 CURING MATERIALS

- A. Materials for curing concrete shall be in conformance with Section 321300, "Concrete Surface Improvements."

2.6 DESIGN

- A. **Concrete Design Requirements:**
 1. **General:** A list of pre-approved ready-mix designs are on file in the ENGINEER'S office. Any other mix design must be approved by the ENGINEER. Concrete shall be composed of cement, admixtures, aggregates and water. These materials shall be of the qualities specified. In general, the mix shall be designed to produce a concrete capable of being deposited so as to obtain maximum density and minimum shrinkage and, where deposited in forms, to have good consolidation properties and maximum smoothness of surface. The proportions shall be changed whenever necessary or desirable to meet the required results at no additional cost to the CITY. All changes shall be subject to review by the ENGINEER.
 2. **Compressive Strength and Cement Content:** The minimum compressive strength and cement content of concrete shall be not less than that specified in the following tabulation.

Class of Concrete Min. 28-Day Compressive Strength (psi)	Caltrans Class	Aggregate Size	Minimum Cement per cu yard (pounds)
3000	2	1 inch x No. 4	590
3000	3	1 inch x No. 4	505
2000	4	1 inch x No. 4	420
3500	1	1 inch x No. 4	675

The CONTRACTOR is cautioned that the limiting parameters specified above are NOT a mix design. Additional cement or water reducing agent may be required to achieve workability demanded by the CONTRACTOR'S construction methods and aggregates. The CONTRACTOR is responsible for any costs associated with furnishing concrete with the required workability.

3. **Cement:** Type II cement is acceptable for all cast-in-place concrete.

2.7 CONSISTENCY

- A. The consistency of the concrete in successive batches shall be determined by slump tests in accordance with ASTM C 143. Unless otherwise specified the slump for all concrete shall be in accordance with the City's Standard Detail G-6.
- B. Retempering of concrete will not be permitted.

2.8 MIXING AND TRANSPORTING

- A. Mixing and transporting shall be in conformance with Section 321300 "Concrete Surface Improvements" City Standard Specifications. All concrete shall be mixed in mechanically operated mixers.
- B. Ready-mixed concrete shall meet the requirements as to materials, batching, mixing, transporting and placing as specified herein and in accordance with ASTM C 94, including the supplementary requirements specified herein.
- C. Ready-mixed concrete shall be delivered to the site of the work, and discharge shall be completed within one and one-half hours after the addition of the cement to the aggregates or before the drum has been revolved 250 revolutions, whichever is first.
- D. Truck mixers shall be equipped with electrically-actuated counters by which the number of revolutions of the drum or blades may be readily verified. The counter shall be of the resettable, recording type, and shall be mounted in the driver's cab. The counters shall be actuated at the time of starting mixers at mixing speeds.
- E. Each batch of concrete shall be mixed in a truck mixer for not less than 70 revolutions of the drum or blades at the rate of rotation designated by the manufacturer of equipment. Additional mixing, if any, shall be at the speed designated by the manufacturer of the equipment as agitating speed. All materials including mixing water shall be in the mixer drum before actuating the revolution counter for determining the number of revolution of mixing.
- F. Each batch of ready-mixed concrete delivered at the job site shall be accompanied by a delivery ticket furnished to the ENGINEER.
- G. The use of non-agitating equipment for transporting ready-mixed concrete will be allowed only with written approval of the ENGINEER.

PART 3 -- EXECUTION

3.1 GENERAL

- A. All cast-in-place concrete shall be constructed in accordance with the Drawings.

3.2 GENERAL FORMWORK REQUIREMENTS

- A. Forms to confine the concrete and shape it to the required lines shall be used wherever necessary. The CONTRACTOR shall assume full responsibility for the adequate design of all forms, and any forms which are unsafe or inadequate in any respect shall promptly be removed from the WORK and replaced at the CONTRACTOR'S expense. All design, construction, maintenance, preparation and removal of forms shall be in conformance with Section 51-1.05, "Forms," of the Caltrans Standard Specifications; ACI 347; and the requirements specified herein.

- B. All forms shall be true in every respect to the required shape and size, shall conform to the established alignment and grade, and shall be of sufficient strength and rigidity to maintain their position and shape under the loads and operations incident to placing and vibrating the concrete.

3.3 REINFORCEMENT

- A. **General:** All reinforcement steel, welded wire fabric and other appurtenances shall be fabricated and placed in accordance with the requirements of the Uniform Building Code, the Drawings and the supplementary requirements specified herein.

- B. **Fabrication:**

- 1. General: Reinforcement steel shall be accurately formed to the dimensions and shapes shown, and the fabricating details shall be prepared in accordance with ACI 315 and ACI 318, except as modified by the Drawings.
- 2. Bending or Straightening: Reinforcement shall not be straightened or rebent in a manner which will injure the material.

- C. **Placing:**

- 1. Reinforcement steel shall be accurately positioned as shown, and shall be supported and wired together to prevent displacement, using annealed iron wire ties or suitable clips at intersections.
- 2. Tie wires shall be bent away from the forms in order to provide the specified concrete coverage.
- 3. Unless otherwise specified, reinforcement placing tolerances shall be within the limits specified in Section 7.5 of ACI 318 except where in conflict with the requirements of the Uniform Building Code.
- 4. The minimum spacing requirements of ACI 318 shall be followed for all reinforcing steel.
- 5. Welded wire fabric placed over the ground shall be supported on wired concrete blocks (dobies) spaced not more than 3 feet on centers in any direction. The construction practice of placing welded wire fabric on the ground and hooking into place in the freshly placed concrete will not be allowed.

- D. **Splicing:**

- 1. General: Reinforcement bar splices shall be of the character acceptable to the ENGINEER.
- 2. Splices of Reinforcement:
 - a. The length of lap for reinforcement bars, unless otherwise shown, shall be in accordance with ACI 318.
 - b. Laps of welded wire fabric shall be in accordance with the ACI 318. Adjoining sheets shall be securely tied together with No. 14 tie wire, one tie for each 2 running feet. Wires shall be staggered and tied in such a manner that they cannot slip.

- E. **Cleaning and Protection:**

- 1. The surfaces of all reinforcement steel and other metalwork to be in contact with concrete shall be thoroughly cleaned of all dirt, grease, loose scale and rust, grout, mortar and other foreign

substances immediately before the concrete is placed. Where there is delay in depositing concrete, reinforcing shall be reinspected and, if necessary, recleaned.

3.4 PREPARATION OF SURFACES FOR PLACING CONCRETE

- A. **General:** Earth surfaces shall be thoroughly wetted by sprinkling, prior to the placing of any concrete, and these surfaces shall be kept moist by frequent sprinkling up to the time of placing concrete thereon. The surface shall be free from standing water, mud and debris at the time of placing concrete.
- B. **Joints in Concrete:** Hardened concrete surfaces upon or against which concrete is to be placed, are defined as construction joints. The surfaces of horizontal joints shall be given a compacted, roughened surface to a minimum 1/4-inch amplitude for good bond. Before new concrete is placed, the joint surfaces shall be cleaned of all laitance, loose or defective concrete and foreign material. Any water shall be removed from the surface of construction joints before the new concrete is placed.
- C. **Placing Interruptions:** Interruptions in placing concrete will not be allowed without the written approval of the ENGINEER. The CONTRACTOR shall submit its purposed method of joint construction to the ENGINEER for review. When interruption of concrete placement operations has been approved the working face shall be given a shape by the use of forms or other means, that will secure proper union with subsequent work.
- D. **Embedded Items:** All reinforcement, anchor bolts, sleeves, inserts and similar items shall be set and secured in the forms where shown on the Drawings or by shop drawings and shall be acceptable to the ENGINEER before any concrete is placed. Accuracy of placement is the responsibility of the CONTRACTOR.
- E. No concrete shall be placed in any structure until all water entering the space to be filled with concrete has been properly cut off or has been diverted by pipes, or other means, and carried out of the forms, clear of the work. No concrete shall be deposited underwater nor shall the CONTRACTOR allow still water to rise on any concrete until the concrete has attained its initial set. Water shall not be permitted to flow over the surface of any concrete in such manner and at such velocity as will injure the surface finish of the concrete. Pumping or other necessary dewatering operations for removing ground water, shall be the responsibility of CONTRACTOR.
- F. Anchor bolts shall be accurately set and shall be maintained in position by templates while being embedded in concrete.

3.5 PLACING

- A. **General:** Placing of concrete shall conform to the applicable requirements of Section 51-1.09, "Placing Concrete," of the Caltrans Standard Specifications and the requirements of this Section.
- B. **Non-Conforming Work or Materials:** All concrete which does not conform to the requirements of this Section shall be removed from the work.
- C. **Placement in Wall Forms:**
 - 1. Concrete shall not be dropped through reinforcement steel into any deep form. In such cases, hoppers and, if necessary, vertical ducts of canvas, rubber or metal shall be used for placing concrete. In no case shall the free fall of concrete exceed 4 feet below the ends of ducts, chutes or buggies. Concrete in forms shall be deposited in uniform horizontal layers not deeper than 2 feet and care shall be taken to avoid inclined layers. Each layer shall be placed while the previous layer is still soft.

2. The surface of the concrete shall be level whenever a run of concrete is stopped.

- D. **Temperature of Concrete:** The temperature of concrete when it is being placed shall be in conformance with Section 321300 "Concrete Surface Improvements" City Standard Specifications.

3.6 PUMPING OF CONCRETE

- A. **General:** If the pumped concrete does not produce satisfactory end results as determined by the ENGINEER, the CONTRACTOR shall discontinue the pumping operation and proceed with the placing of concrete using conventional methods.

3.7 CONSOLIDATION

- A. As concrete is placed in the forms or in excavations, it shall be thoroughly settled and compacted in general conformance with Section 51-1.09, "Placing Concrete," of the Caltrans Standard Specifications.

3.8 FINISHING CONCRETE SURFACES

- A. **General:** Exposed surfaces shall be free from fins, bulges, ridges, offsets, honeycombing, or roughness of any kind, and shall present a finished, smooth, continuous hard surface.
- B. **Formed Surfaces:** No treatment is required after form removal except for curing, repair of defective concrete and treatment of surface defects.
- C. **Unformed Surfaces:** After proper and adequate vibration and tamping, all exposed un-formed surfaces of pads, slabs and floors, shall be brought to a uniform surface with suitable tools. The finish for all unformed concrete surfaces shall be a soft broom finish.

3.9 CURING

- A. **General:** All exposed concrete top surfaces of pads, shall be cured in conformance with Section 321300, "Concrete Surface Improvements."

3.10 PROTECTION

- A. The CONTRACTOR shall protect all concrete against injury until final acceptance by the CITY.
- B. Holes left by form-tying and other minor imperfections as defined herein shall be repaired in an approved manner with cement grout in conformance with Section 036000, "Grout."

- END OF SECTION -

SECTION 033055 - CAST-IN-PLACE CONCRETE PIPE

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide all materials, equipment and labor necessary to furnish and install all cast-in-place concrete pipe and all appurtenant work, complete and operable, including all connections as shown on the Drawings and as specified herein.
- B. The minimum internal diameter for cast-in-place concrete pipe shall be 36 inches.
- C. Cast-in-place concrete pipe will not be allowed in areas with less than 3 feet of cover from finished grade to top of pipe.
- D. Cast-in-place concrete pipe will not be allowed in the existing or future public road right-of-way.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 312300 Utility Earthwork.
- B. Section 330130 Sanitary Sewer and Storm Drain Leakage Testing.
- C. Section 333900 Precast Concrete Maintenance Holes.
- D. Section 321300 Concrete Surface Improvements
- E. Section 033050 Utility Cast-in-Place Concrete.
- F. Section 034800 Precast Concrete Vaults, Utility Boxes, and Storm Water Field Drop Inlets.
- G. Section 331100 Piping, General.
- H. Division 1 General Requirements.

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

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

1. Standard Specifications:

Section 63 Cast-In-Place Concrete Pipe.

B. **Commercial Standards:**

ACI 301 Specifications for Structural Concrete for Buildings.

ACI 347 Recommended Practice for Concrete Formwork.

ASTM C 31 Practice for Making and Curing Concrete Test Specimens in the Field.

ASTM C 39 Test Method for Compressive Strength of Cylindrical Concrete Specimens.

ASTM C 94	Specification for Ready-Mixed Concrete.
ASTM C 143	Test Method for Slump of Hydraulic Cement Concrete.
ASTM C 150	Specification for Portland Cement.
ASTM C 260	Specification for Air-Entraining Admixtures for Concrete.
ASTM C 309	Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
ASTM C 494	Specification for Chemical Admixtures for Concrete.
ASTM C 1077	Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation.
UBC	Uniform Building Code.

1.4 CONTRACTOR SUBMITTALS

- A. **Certificates of Compliance:** Certificates of Compliance shall be provided for all products and materials proposed to be used in this Section.
- B. The CONTRACTOR shall submit to the ENGINEER for review the mix design for the portland cement concrete. Cast-in-place concrete pipe shall not be placed until this mix design has been reviewed and accepted by the ENGINEER.
- C. **Delivery Tickets:** The CONTRACTOR shall provide delivery tickets at the time of delivery of each load of concrete. Each delivery ticket shall be accompanied by batch tickets automatically produced by the batching equipment, indicating quantities of each ingredient. Each delivery ticket shall, in addition, 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.

1.5 QUALITY ASSURANCE

- A. When required, the CITY will employ a testing laboratory to take core samples from the cast-in-place pipe to check for obvious segregation of aggregate, rock pockets, blisters, voids, honeycomb or inadequate wall thickness.
- B. After core samples and measurements for wall thickness have been taken by the CITY, the CONTRACTOR shall patch all holes.
- C. Cast-in-place concrete pipe may be rejected based on the conditions outlined in Section 63-1.05 "Construction" of the Caltrans Standard Specifications.

PART 2 -- PRODUCTS

2.1 CAST-IN-PLACE CONCRETE

- A. Cast-in-place concrete shall be constructed of Class 1 Portland cement concrete conforming to the provisions in Section 321300 "Concrete Surface Improvements" of the City Standard Specifications. Cement shall conform to ASTM C150, Type II.
- B. Ready-mix concrete shall conform to the requirements of ASTM C 94.

2.2 AGGREGATE

- A. The combined aggregates for concrete used shall conform to the grading limits for a one inch maximum size specified in Section 321300 "Concrete Surface Improvements" of the City Standard Specifications.

2.3 ADMIXTURES

- A. Admixtures shall be used in accordance with manufacturer's printed recommendations.
 - 1. **Calcium Chloride:** Calcium chloride will not be permitted to be used in concrete, unless specifically approved by the ENGINEER.
 - 2. **Mineral:** Shall be combined with cement to make cementitious material in accordance with Caltrans Specifications Section 90, Portland Cement Concrete, 90-4.08 "Required Use of Mineral Admixtures".

2.4 CONSTRUCTION JOINTS

- A. The rebar for use in construction joints shall be in conformance with Section 63-1.05, "Construction" of the Caltrans Standard Specifications.

2.5 CURING COMPOUND/WATERPROOF MEMBRANE

- A. Curing compound and waterproof membrane shall be in conformance with Section 321300 "Concrete Surface Improvements" of the City Standard Specifications.

2.6 CONSISTENCY

- A. The consistency of the concrete in successive batches shall be determined by slump tests in accordance with ASTM C 143. The slump shall be 2 inches +/- one inch.
- B. Retempering of concrete will not be permitted.

2.7 MIXING AND TRANSPORTING

- A. Mixing and transporting shall be in conformance with Section 321300 "Concrete Surface Improvements" of the City Standard Specifications. All concrete shall be mixed in mechanically operated mixers.
- B. Ready-mixed concrete shall meet the requirements as to materials, batching, mixing, transporting, and placing as specified herein and in accordance with ASTM C 94, including the supplementary requirements specified herein.
- C. Ready-mixed concrete shall be delivered to the site of the work, and discharge shall be completed within one and one-half hours after the addition of the cement to the aggregates or before the drum has been revolved 250 revolutions, whichever is first.
- D. Truck mixers shall be equipped with electrically-actuated counters by which the number of revolutions of the drum or blades may be readily verified. The counter shall be of the resettable, recording type, and shall be mounted in the driver's cab. The counters shall be actuated at the time of starting mixers at mixing speeds.
- E. Each batch of concrete shall be mixed in a truck mixer for not less than 70 revolutions of the drum or blades at the rate of rotation designated by the manufacturer of equipment. Additional mixing, if any, shall be at the speed designated by the manufacturer of the equipment as agitating speed. All

materials including mixing water shall be in the mixer drum before actuating the revolution counter for determining the number of revolution of mixing.

- F. Each batch of ready-mixed concrete delivered at the job site shall be accompanied by a delivery ticket furnished to the ENGINEER.
- G. The use of non-agitating equipment for transporting ready-mixed concrete will be allowed only with written approval of the ENGINEER.

PART 3 -- EXECUTION

3.1 GENERAL

- A. Cast-in-place concrete pipe shall be in conformance with Section 63, "Cast-in-place Concrete Pipe," of the Caltrans Standard Specifications and as specified herein.

3.2 EARTHWORK

- A. Earthwork shall be in conformance with Section 63-1.04, "Earthwork" of the Caltrans Standard Specifications and as modified by this Section.
- B. When rock is encountered in the trench, it shall be removed to a minimum depth of 6 inches below the bottom of the pipe and backfilled and compacted with suitable bedding material in conformance with Section 312300, "Utility Earthwork."
- C. The trench shall be excavated and backfilled in conformance with Section 312300, "Utility Earthwork."

3.3 CAST-IN-PLACE CONCRETE

- A. The concrete shall be placed in conformance with Section 63-1.05, "Construction" of the Caltrans Standard Specifications and as specified herein.
- B. The minimum wall thickness for the pipe shall be as specified in Section 63-1.02, "Materials" of the Caltrans Standard Specifications.
- C. If construction of the pipe stops short of a manhole, the resulting construction joint must be reinforced with a concrete collar. The end of the pipe shall be left rough with a slope of approximately 45 degrees. The concrete collar shall be monolithically poured and must extend a minimum of one foot beyond each side of the joint and must be of a minimum thickness not less than 1-1/2 times the wall thickness. The concrete collar must completely encircle the pipe.
- D. Variations from the nominal internal diameter shall not exceed 1/32 inch per diameter inch.
- E. Concrete shall not be placed when the air temperature in the vicinity of the WORK exceeds 90 degrees Fahrenheit.

3.4 CURING

- A. Curing and protecting cast-in-place concrete pipe shall be in conformance with Section 63-1.06, "Curing and Protecting Concrete" of the Caltrans Standard Specifications.

3.5 TESTING

- A. Testing shall conform to the requirements of Section 330130, "Sanitary Sewer and Storm Drain System Leakage Testing."

- END OF SECTION -

SECTION 033500 - TEXTURED CONCRETE PAVING

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide all materials, equipment, and labor necessary to furnish and place all textured concrete paving which may include but is not necessarily limited to, preparation of subgrade, aggregate base, reinforcement, concrete, colored hardener, colored curing compound, acrylic sealer, special imprinting tools 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 310000 Earthwork.
- B. Section 321000 Asphalt Pavement, Base and Surface Treatments.
- C. Section 321300 Concrete Surface Improvements.
- 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. Standard Specifications:

- Section 19 Earthwork.
- Section 26 Aggregate Bases.

B. **Commercial Standards:**

- ASTM C 33 Specifications for Concrete Aggregates.
- ASTM C 150 Specifications for Portland Cement.
- ASTM C 260 Specification for Air-Entraining Admixtures for Concrete.
- ASTM C 309 Specifications for Liquid Membrane-Forming Compounds for Curing Concrete.
- ASTM C 494 Specification for Chemical Admixtures for Concrete.
- ASTM D 1751 Specifications for Preformed Expansion Joint Filter for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).

1.4 CONTRACTOR SUBMITALS

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

- B. If requested, the CONTRACTOR shall provide a 2-foot by 2-foot square shop sample to be approved by the Engineer prior to start of construction.

1.5 QUALITY ASSURANCE

- A. Textured concrete paving shall be installed by a licensed specialty CONTRACTOR.
- B. All work shall comply with the current specifications and quality standards issued by the manufacturer.

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 REINFORCEMENT AND DOWELS

- A. Steel bar for textured concrete paving reinforcement and dowels shall be deformed billet-steel bars of the size or sizes as specified on the Drawings and shall be in conformance with PART 2 - PRODUCTS of Section 321300, "Concrete Surface Improvements."

2.3 PORTLAND CEMENT CONCRETE

- A. Portland cement concrete for textured concrete paving shall have a minimum 28 day compressive strength at 3000 psi.
- B. Portland cement shall be Type II cement conforming to ASTM C 150.
- C. Aggregate shall be minus 3/8-inch to 1 inch conforming to ASTM C 33.
- D. When textured concrete paving is installed in the travelway, aggregate shall be minus 1-inch conforming to ASTM C33.
- E. An air-entraining agent conforming with ASTM C 260 and/or a normal set or retarded set water reducing admixture conforming with ASTM C 494 may be used.
- F. Calcium chloride shall not be permitted in the mix.

2.4 EXPANSION JOINT MATERIAL

- A. Expansion joint material shall be premolded expansion joint filler 1/2-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.

2.5 COLOR HARDENER

- A. Color hardener shall be a ready to use, regular grade, dry-shake color hardener and shall be streak-free integregations of pigments, surface conditioning and dispersing agents, and portland cement blended with hard, graded aggregate.

2.6 COLORED CURING COMPOUND

- A. Colored curing compound shall be in conformance with ASTM C 309 and shall conform with all applicable air pollution regulations.

2.7 ACRYLIC SEALER

- A. A colored acrylic sealer may be used in lieu of a colored curing compound in accordance with the manufacturer's recommendations. A clear acrylic sealer may be used if textured concrete paving is multicolored.

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 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 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."

3.4 INSTALLATION OF TEXTURED CONCRETE PAVING

- A. Textured concrete paving shall be installed to the dimensions as shown on the Drawings.
- B. The concrete shall be placed and screeded to the finished grade and floated to a uniform surface in accordance with the manufacturer's recommendations.
- C. The Contractor shall use manufacturer approved imprinting tools to make the desired impression to the surface of the concrete while the concrete is still in the plastic stage of set.

3.5 COLOR HARDENER

- A. Color hardener shall be applied evenly to the concrete surface by the dry-shake method using a minimum of 60 pounds per 100 square feet in accordance with the manufacturer's recommendations.
- B. Color hardener shall be applied in two or more shakes, floated after each and troweled only after the final floating.

3.6 EXPANSION JOINTS/DEEP JOINTS

- A. Expansion joints shall be placed continuously between all textured concrete paving surfaces and concrete surfaces.
- B. Deep joints shall be placed to a depth of 1/4 of the thickness of the textured concrete paving at a minimum spacing equal to 1.5 times the width of the textured concrete paving unless otherwise recommended by the manufacturer.

- END OF SECTION -

**SECTION 034800 - PRECAST CONCRETE VAULTS, UTILITY BOXES,
AND STORM WATER FIELD DROP INLETS**

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide all materials, equipment, and labor necessary to furnish and install all precast items as required, including all appurtenances necessary to make a complete installation as shown on the Drawings and as specified herein.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 033050 Utility Cast-In-Place Concrete.
- B. Section 033500 Grout.
- C. Section 055000 Miscellaneous Metalwork.
- D. Section 330526 Piping Identification Systems.
- E. Division 1 General Requirements.

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. **Commercial Standards:**

- ACI 318 Building Code Requirements for Reinforced Concrete.

1.4 CONTRACTOR SUBMITTALS

A. **Shop Drawings:**

- 1. The CONTRACTOR shall submit Shop Drawings for all specialty precast concrete items. Submitted drawings shall show design criteria, all dimensions, location and type of lifting inserts, and details of reinforcement and joints.
- 2. For all precast items which are manufactured, the CONTRACTOR shall also submit a list of the design criteria and product data sheets used by the manufacturer.

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

1.5 DEFINITIONS

- A. In these Specifications, where the terms "Precast Concrete," "Prefabricated Concrete" and "Precast Concrete Specialties" are used, they shall have equivalent meaning.

PART 2 -- PRODUCTS

2.1 MANUFACTURED ITEMS

A. Miscellaneous Precast Vaults:

1. Vault dimensions shall be as required by the specific installations and shall meet all required clearances.
2. Vaults shall be **Christy, Utility Vault Co. or equal.**
3. The vault frames shall be provided by the vault manufacturer. Vault covers shall be tubular beams as specified and shall conform to Section 055000, "Miscellaneous Metalwork." When leveling bolts are used to set the vault top sections, the CONTRACTOR shall ensure that the load on the vault will be transferred through the mortar to the vault, and will not be carried by the leveling bolts.
4. Where vaults are in areas which may be subjected to vehicular traffic vault, frame and cover shall be designed for HS-20 traffic loading.
5. Vaults larger than 24 inches by 36 inches shall have vault access doors, with hinged meter reading lids when specified, and shall be located as specified or as shown on the Drawings.

B. Utility Boxes:

1. Utility boxes shall be sized as shown on the Drawings or shall meet the minimum clearance requirements as specified or as required for the intended use.
2. Utility boxes shall have covers that are designed by the manufacturer for HS-20 traffic loading in streets and driveways subject to vehicular traffic. The covers shall be embossed "Water," "Sanitary Sewer," or "Recycled" as appropriate. All water meter utility box covers shall have touch read recess holes in the lid.
3. Utility boxes larger than 22 inches by 36 inches shall have two piece steel checker plate lids and shall be located as specified or as shown on the Drawings.
4. Utility boxes shall be as manufactured by **Christy or equal.** The following table lists standard model numbers for Christy:

Service	Christy Box/lid*
a. Water Meters:	
Piston Meter Boxes	
5/8"	B-9/B-9P*
3/4"	B-12/B12P*
1"	B-16/B16P*
1-1/2"	B-36/B36P*
2"	B-36/B-36-61P*
Omni Meter Boxes	
1-1/2"	B-36/B-36P*
2"	B-36/B-36P*
3"	Special design as approved by the City

b. Valve Boxes, Water Line Angle Marker Boxes	G-5/G5C
c. Sampling Station, Blow-Off and Angle Meter Stop Boxes	B-9/B-9*
d. Air Release Valves (1" and 2")*	B-24/B24-D (1" and 2" valves)
e. Sanitary Sewer: Clean Out Boxes	F8/F8*

* Utility boxes located in streets or driveways shall have cast-iron covers. Water meter boxes located in driveways shall have steel checker plate covers with a reading lid. All other utility boxes shall have reinforced concrete covers or polymer concrete covers.

5. Utility boxes in landscape areas, unimproved areas, and field installations shall have bolt or screw down lids or covers.
6. Utility boxes for blow-off valves on pipelines greater than 12" shall be Christy Box/lid B-30/B-30D* or equal and as shown on the DRAWINGS.

C. Storm Water Field Drop Inlets:

1. Frame and grate or cover plate shall be of the same manufacturer as the pre-cast inlet and shall be hot-dip galvanized after fabrication.
2. Precast storm water field drop inlets frame and grate shall be in conformance with Section 055000, "Miscellaneous Metalwork."
3. **Storm water field drop side-opening inlet:** Precast storm water field drop side-opening inlets shall be **Santa Rosa, Type C, or equal**. Frame and grate or cover plate shall be in conformance with Section 055000, "Miscellaneous Metalwork."

2.2 PREFORMED JOINT SEALANT

- A. On vaults the joint sealing compound shall be a preformed, cold- applied, ready to use plastic joint sealing compound **Quick-Seal, Ram-Nek; or equal**.

2.3 NON-SHRINK GROUT

- A. Non-shrink grout shall be as specified in the Section 033500, "Grout."

PART 3 -- EXECUTION

3.1 MANUFACTURED ITEMS

- A. Precast Concrete Vaults, Utility Boxes and Field Storm Water Inlets shall be installed in accordance with the manufacturer's printed recommendations, and as shown on the Drawings.
- B. Connections to precast vaults, utility boxes, and field storm water inlets shall be made by installing pipe sections into the structure wall using non-shrink grout as specified in Section 033500, "Grout." A water stop shall also be installed on all plastic pipes.

- C. All utilities shall be identified as specified in Section 330526, "Piping Identification Systems."
- D. Construction grade redwood shims and one-piece boards shall be installed as shown on the Drawings.

- END OF SECTION -

SECTION 036000 - GROUT

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide all materials, equipment, and labor necessary to furnish and place grout and shall form, mix, place, cure, repair, finish, and do all other work as necessary to produce finished grout as shown on the Drawings and as specified herein.
- B. The following types of grout shall be covered in this Section:
 - 1. Non-Shrink Grout: Non-Shrink grout is to be used unless another type is specifically referenced or as shown on the Drawings.
 - 2. Epoxy Grout
 - 3. Cement Grout
- C. Cement grout for pressure grouting around steel casing pipes shall be in conformance with Section 330523, "Steel Casing Boring and Jacking."

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 330523 Steel Casing Boring and Jacking.
- B. Section 033050 Utility Cast-in-Place Concrete.
- C. Division 1 General Requirements.

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Specifications, codes, and standards shall be as specified in Section 033050, "Utility Cast-in-Place Concrete," and as referred to herein.

B. Commercial Standards:

ASTM C 109	Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-In. or 50-mm Cube Specimens).
ASTM C 531	Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, and Monolithic Surfacing.
ASTM C 579	Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, and Monolithic Surfacing.
ASTM C 827	Test Method for Change in Height of Early Ages of Cylindrical Specimens from Cementitious Mixtures.
ASTM D 696	Test Method for Coefficient of Linear Thermal Expansion of Plastics.
CRD-C 621	Corps of Engineers Specification for Non-shrink Grout.

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 PREPACKAGED GROUTS

A. Non-Shrink Grout:

1. Non-shrink grout shall be a prepackaged, inorganic, non-gas-liberating, non-metallic, cement-based grout requiring only the addition of water. Manufacturer's instructions shall be printed on each bag or other container in which the materials are packaged. The specific formulation for each class of non-shrink grout specified herein shall be that recommended by the manufacturer for the particular application.
2. Class A non-shrink grouts shall have a minimum 28-day compressive strength of 5000 psi; shall have no shrinkage (zero percent) and a maximum 4.0 percent expansion in the plastic state when tested in accordance with ASTM C 827; and shall have no shrinkage (zero percent) and a maximum of 0.2-percent expansion in the hardened state when tested in accordance with CRD C 621.
3. Class B non-shrink grouts shall have a minimum 28-day compressive strength of 5000 psi and shall meet the requirements of CRD C 621.
4. Application:
 - a. Class A non-shrink grout shall be used for the repair of all holes and defects in concrete members which are water bearing or in contact with soil or other fill material, grouting under all equipment base plates, and at all locations where grout is specified; except, for those applications for Class B non-shrink grout and epoxy grout specified herein. Class A non-shrink grout may be used in place of Class B non-shrink grout for all applications.
 - b. Class B non-shrink grout shall be used for the repair of all holes and defects in concrete members which are not water-bearing and not in contact with soil or other fill material.

B. Epoxy Grout:

1. Epoxy grout shall be a pourable, non-shrink, 100-percent solids system. The epoxy grout system shall have 3 components: resin, hardener, and specially blended aggregate, all premeasured and prepackaged. The resin component shall not contain any non-reactive diluents. Resins containing butyl glycidyl ether (BGE) or other highly volatile and hazardous reactive diluents are not acceptable. Variation of component ratios is not permitted unless specifically recommended by the manufacturer. Manufacturer's instructions shall be printed on each container in which the materials are packaged.
2. The chemical formulation of the epoxy grout shall be that recommended by the manufacturer for the particular application.
3. The mixed epoxy grout system shall have a minimum working life of 45 minutes at 75 degrees F.
4. The epoxy grout shall develop a compressive strength of 5000 psi in 24 hours and 10,000 psi in 7 days when tested in accordance with ASTM C 579, Method B. There shall be no shrinkage (zero percent) and a maximum 4.0 percent expansion when tested in accordance with ASTM C 827.

5. Application: Epoxy grout shall be used to embed all anchor bolts and reinforcing steel required to be set in grout, and for all other specified applications.

2.2 CEMENT GROUT

- A. **Cement Grout:** Cement grout shall be composed of one part cement, 3 parts sand, and the minimum amount of water necessary to obtain the desired consistency. Where needed to match the color of adjacent concrete, white portland cement shall be blended with regular cement as needed. The minimum compressive strength at 28 days shall be 4000 psi.
- B. Cement shall be as specified in Section 033050, "Utility Cast-in-Place Concrete."

2.3 CONSISTENCY

- A. The consistency of grouts shall be that necessary to completely fill the space to be grouted for the particular application. Dry pack consistency is such that the grout is plastic and moldable but will not flow. Where "dry pack" is specified, it shall mean a grout of that consistency; the type of grout to be used shall be as specified herein for the particular application.

2.4 MEASUREMENT OF INGREDIENTS

- A. Measurements for cement grout shall be made accurately by volume using appropriate containers. Shovel measurement will not be allowed.
- B. Prepackaged grouts shall have ingredients measured by means recommended by the manufacturer.

PART 3 -- EXECUTION

3.1 GENERAL

- A. All surface preparation, curing, and protection of cement grout shall be as specified in Section 033050, "Utility Cast-in-Place Concrete." The finish of the grout surface shall match that of the adjacent concrete.
- B. The manufacturer of Class A non-shrink grout and epoxy grout shall provide on-site technical assistance upon request.
- C. All mixing, surface preparation, handling, placing, consolidation and other means of execution for prepackaged grouts shall be done according to the printed instructions and recommendations of the manufacturer.

3.2 CONSOLIDATION

- A. Grout shall be placed in such a manner, for the consistency necessary for each application, so as to assure that the space to be grouted is completely filled.

- END OF SECTION -

CITY OF LIVERMORE
TECHNICAL SPECIFICATIONS

DIVISION 5 – METALS

SECTION 055000 - MISCELLANEOUS METALWORK

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide, all materials, labor, and equipment necessary to furnish and install miscellaneous metalwork and appurtenances to make a complete installation as shown on the Drawings and as specified herein.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 331219 Fire Hydrants.
- B. Section 333900 Precast Concrete Maintenance Holes.
- C. Section 022100 Monuments.
- D. Section 034800 Precast Concrete Vaults, Utility Boxes, and Storm Water Field Drop Inlets.
- E. Section 099000 Protective Coating.
- F. Section 331200 Miscellaneous Piping, Valve Fittings, and Appurtenances.
- G. Section 330526 Piping Identification Systems.
- H. Division 1 General Requirements.

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Federal Specifications:

QQ-F-461 C (1) Floor Plate, Steel, Rolled.

B. Commercial Standards:

AASHTO Standard Specifications for Highway Bridges.

AISC American Institute of Steel Construction - Specifications, Manuals, Technical and Fabricator Publications, Design Guides.

AISI American Iron and Steel Institute - Documents.

ASTM A 36 Specification for Structural Steel.

ASTM A 48 Specification for Gray Iron Castings.

ASTM A 53 Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.

ASTM A 123 Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

ASTM A 153 Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

ASTM A 307	Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
ASTM A 563	Specification for Carbon and Alloy Steel Nuts.
ASTM A 575	Specifications for Steel Bars, Carbon, Merchant Quality, M-Grades.
ASTM B 98	Specification for Copper-Silicon Alloy Rod, Bar, and Shapes.
ASTM B 438	Specification for Sintered Bronze Bearings (Oil-Impregnated).
ANSI/AWS D1.1	Structural Welding Code - Steel.
NFPA 101	Life Safety Code.
AWS	American Welding Society Handbook.

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 sheets shall be submitted for all products and materials proposed to be used under this section.
- C. **Anchors:** Wherever power-driven pins will be utilized for anchorage or support, complete information describing pin capacity, connections, and proposed use locations shall be furnished to the ENGINEER for review.

PART 2 -- PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. **Standard:** All structural steel shapes, plates, bars, and their products shall conform to the requirements of ASTM A 36.
- B. **Corrosion Protection:** Unless otherwise shown, miscellaneous metalwork of fabricated steel, which will be used in a corrosive environment and/or will be submerged in water/wastewater shall be coated in accordance with Section 099000, "Protective Coating" and shall not be galvanized prior to coating. All other miscellaneous steel metalwork shall be hot-dip galvanized after fabrication as specified herein.

2.2 STORM WATER INLET FRAME AND GRATE

- A. Frames and grates for street curb storm water inlets shall be in conformance with Caltrans Standard Plans D77A and D77B, and shall be Type 600-13 Welded Steel Grate. Frames shall be heavy duty, boltable, HS-20 traffic loading, designed for bicycle use, and hot dip galvanized after fabrication.
- B. Frames and grates for field storm water inlets shall be heavy duty in vehicle traffic areas and light duty for non-traffic areas. Grate shall be boltable to frame and shall be HS-20 traffic loading for heavy duty grates, designed for bicycle use and hot-dip galvanized after fabrication. Frame and grate shall be **Santa Rosa Model 1L, Welded Steel; Christy, U32-71RLD or U32-71RHD; Riveted steel, or equal.**

- C. Frames and grates or cover plates for side opening field storm water inlets shall be steel checker plate, light duty, grate or cover plate shall be bolted to frame, hot dipped galvanized after fabrication, and shall fit Santa Rosa Type C inlet.

2.3 VAULT ACCESS DOORS AND COVERS

- A. **Vault Access Covers:** Vault covers shall be steel checkered plate, 1/4-inch minimum thickness reinforced with steel members for the design load specified. Reinforcing shall be stagger welded to the cover, and the entire assembly shall be hot dip galvanized after fabrication. The top of the cover plate shall be flush with the vault wall. Steel reinforcing members shall be mitered at each end in conformance with the Drawings. Covers and steel reinforcing members shall be designed to fit a preformed recess in the vault casting. Steel checker plate covers shall have lifting holes.

2.4 IRON CASTINGS

- A. Iron castings shall conform to the requirements of ASTM A 48 unless otherwise shown.
- B. Maintenance hole frame and covers shall be in conformance with Section 333900, "Precast Concrete Maintenance Holes."
- C. Monument frames and covers shall be in conformance with Section 022100, "Monuments."
- D. Water frames and valve covers shall be in conformance with Section 034800, "Precast Concrete Vaults, Utility Boxes, and Storm Water Field Drop Inlets."
- E. New frames and covers for utility structures owned by other agencies shall be in conformance with the appropriate agency's requirements.

2.5 SEAT ANGLES, SUPPORTS, AND GUIDES

- A. Seat angle supports, guides, and accessories shall be steel and of a size as shown, and hot-dip galvanized after fabrication.

2.6 BOLTS AND ANCHORS

- A. **Bolts and Nuts**

Standard Service Bolts and Nuts: Except where otherwise shown or specified, all bolts, anchor bolts, nuts and washers, and cap screws shall be steel, galvanized after fabrication as specified herein. Threads on galvanized bolts and nuts shall be formed with suitable taps and dies such that they retain their normal clearance after hot-dip galvanizing. Except as otherwise specified herein, steel for bolts, anchor bolts, nuts and washers, and cap screws shall be in accordance with the requirements of ASTM A 307 Grade A or B, or threaded parts in conformance with the requirements of ASTM A 36.

1. Where required on the Drawings, stainless steel bolts, nuts, and washers shall be provided. Stainless steel bolts, and washers shall be Type 316 stainless steel, ungalvanized.
 2. Fire Hydrant bolts and nuts shall be in conformance with Section 331219, "Fire Hydrants."
- B. **Buried Tie Rods:** Buried tie rods and anchor bolts, and bolts for valve anchor blocks and pipeline thrust restraints shall be of Type 304 stainless steel.

C. **Bolt Requirements:**

1. The bolt and nut material shall be free-cutting steel.
2. The nuts shall be capable of developing the full strength of the bolts. Threads shall be Coarse Thread Series conforming to the requirements of the American Standard for Screw Threads. All bolts and cap screws shall have hexagon heads and nuts shall be Heavy Hexagon Series.
3. The length of all bolts shall be such that after joints are made up, each bolt shall extend through the entire nut, but in no case more than 1/2 inch beyond the nut.

- D. **Expanding-Type Anchors:** Expanding-type anchors if shown or permitted, shall be steel expansion type **Phillips Drill Company "Red Head" anchors, McCulloch Industries "Kwick-Bolt," or equal.** Lead calking anchors will not be allowed. Size shall be as shown. Expansion type anchors shall be galvanized steel. Submerged anchors shall be stainless steel, Type 316.

PART 3 -- EXECUTION

3.1 FABRICATION AND INSTALLATION REQUIREMENTS

- A. **Fabrication and Erection:** Except as otherwise shown, the fabrication and erection of structural steel shall conform to the requirements of the American Institute of Steel Construction "Manual of Steel Construction."

C. **Welding:**

1. **Method:** All welding shall be by the metal-arc method or gas-shielded arc method as described in the American Welding Society's "Welding Handbook" as supplemented by other pertinent standards of the AWS. Qualification of welders shall be in accordance with the AWS Standards governing same.
2. **Quality:** In assembly and during welding, the component parts shall be adequately clamped, supported and restrained to minimize distortion and for control of dimensions. Weld reinforcement shall be as specified by the AWS Code. Upon completion of welding, all weld splatter, flux, slag, and burrs left by attachments shall be removed. Welds shall be repaired to produce a workmanlike appearance, with uniform weld contours and dimensions. All sharp corners of material which is to be painted or coated shall be ground to a minimum of 1/32 inch on the flat.

3.2 GALVANIZING

- A. All structural steel plates shapes, bars and fabricated assemblies required to be galvanized shall, after the steel has been thoroughly cleaned of rust and scale, be galvanized in accordance with the requirements of ASTM A 123. Any galvanized part that becomes warped during the galvanizing operation shall be straightened. Bolts, anchor bolts, nuts and similar threaded fasteners, after being properly cleaned, shall be galvanized in accordance with the requirements of ASTM A 153. Field repairs to galvanizing shall be made using "**Galvinox,**" "**Galvo-Weld,**" **or equal.**

3.3 EXPANDING-TYPE ANCHORS

- A. Drilled anchors shall be installed in strict accordance with the manufacturer's printed instructions. Holes shall be roughened with a brush on a power drill, cleaned and dry. Drilled anchors shall not be installed until the concrete has reached the specified 28-day compressive strength.

3.4 PIPING IDENTIFICATION

- A. All water system items shall be identified in conformance with Section 330526, "Piping Identification Systems."

- END OF SECTION -

SECTION 055900 - DUCTILE IRON PIPE

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide all material, equipment and labor necessary to furnish and install ductile iron pipe and all appurtenant work, complete and operable, including all connections as shown on the Drawings and as specified herein.
- B. All sanitary sewer lines in industrial areas shall be vitrified clay pipe as specified in Section 333106, "Vitrified Clay Pipe."

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 312300 Utility Earthwork.
- B. Section 331300 Pressure Pipeline Testing and Disinfection.
- C. Section 330130 Sanitary Sewer and Storm Drain System Leakage Testing.
- D. Section 333106 Vitrified Clay Pipe.
- E. Section 099000 Protective Coating
- F. Section 331100 Piping, General.
- G. Section 331200 Miscellaneous Piping, Valves, Fittings, and Appurtenances.
- H. Section 331218 Check Valves.
- I. Division 1 General Requirements.

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards:

- AASHTO Specifications for Highway Bridges.
- ANSI/AWWA C104 Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
- ANSI/AWWA C105 Standard for Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquids.
- ANSI/AWWA C110 Standard for Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In., for Water and Other Liquids.
- ANSI/AWWA C111 Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- ANSI/AWWA C115 Standard for Flanged Ductile-Iron Pipe With Threaded Flanges.
- ANSI/AWWA C150 Standard for the Thickness Design of Ductile-Iron Pipe.
- ANSI/AWWA C151 Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids.

ANSI/AWWA C153	Standard for Ductile-Iron Compact Fittings, 3 In. Through 16 In., for Water and Other Liquids.
AWWA C600	Installation of Ductile Iron Water Mains and Their Appurtenances.
ASTM C 150	Specification for Portland Cement.
SSPC	Steel Structures Painting Council.

1.4 CONTRACTOR SUBMITTALS

- A. **Shop Drawings:** The CONTRACTOR shall submit shop drawings of pipe and fittings in accordance with the requirements of the referenced standards and the following supplemental requirements as applicable:
1. Certified dimensional drawings of all valves, fittings, and appurtenances.
 2. For pipe 18 inches in diameter and larger, line layout and marking diagrams which indicate the specific number of each fitting and the location and the direction of each fitting in the completed line. In addition, the line layouts shall include: the pipe station and invert elevation at all changes in grade or horizontal alignment; all elements of deflected joints and fittings, both in horizontal and vertical alignment; and the limits of each reach of restrained joints, or of concrete encasement.
- B. **Certificates of Compliance:** Certificates of Compliance shall be provided for all products and materials proposed to be used under this Section, and the following supplemental requirements:
1. Physical and chemical properties.
 2. Hydrostatic test reports.
- C. All expenses incurred in making samples for certification of tests shall be borne by the CONTRACTOR.

1.5 QUALITY ASSURANCE

- A. **Inspection:** All pipe will be subject to inspection at the place of manufacture in accordance with the provisions of the referenced standards, as supplemented by the requirements herein. The CONTRACTOR shall notify the ENGINEER, in writing, of the manufacturing starting date not less than 14 calendar days prior to the start of any phase of the pipe manufacture.
- B. During the manufacture of the pipe, the ENGINEER shall be given access to all areas where manufacturing is in process and shall be permitted to make all inspections necessary to confirm compliance with the Specifications.
- C. **Tests:** Except as modified herein, all materials used in the manufacture of the pipe shall be tested in accordance with the requirements of the referenced standards as applicable.
- D. The CONTRACTOR shall have said material tests performed at no additional cost to the CITY. The ENGINEER shall have the right to witness all testing provided, that the CONTRACTOR'S schedule is not delayed for the convenience of the ENGINEER.
- E. In addition to those tests specifically required, the ENGINEER may request additional samples of any material including lining and coating samples for testing by the CITY. The additional samples shall be furnished at no additional cost to the CITY.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Mortar, coal tar coated or polyethylene encased ductile iron pipe shall conform to ANSI/AWWA C104, and ANSI/AWWA C105, subject to the following supplemental requirements: 1) the pipe shall be of the diameter and class shown on the Drawings, 2) the pipe shall be furnished complete with rubber gaskets; and 3) all specials and fittings shall be provided as required.
- B. Ductile iron lining options are as follows:
 - 1. Potable Water - Mortar, Type II.
 - 2. Recycled Water - Mortar, Type V.
 - 3. Storm Drains - No liner
 - 4. Sanitary Sewer – Mortar, Type V.
- C. **Marking:** The CONTRACTOR shall legibly mark specials 18 inches in diameter and larger in accordance with the laying schedule and marking diagram. All fittings shall be marked at each end with top field centerline.
- D. **Handling and Storage:** The pipe shall be handled by devices in conformance with the manufacturer's printed recommendations and acceptable to the ENGINEER, designed and constructed to prevent damage to the pipe lining and coating. The use of equipment which might injure the pipe lining and coating will not be allowed. Stockpiled pipe shall be suitably supported and shall be secured to prevent accidental rolling. All other pipe handling equipment and methods shall be in conformance with the manufacturer's printed recommendations and acceptable to the ENGINEER.
- E. **Laying Lengths:** Maximum pipe laying lengths shall be 20 feet with shorter lengths provided as required.
- F. **Finish:** The pipe shall have smooth dense interior surfaces and shall be free from fractures, excessive interior surface crazing and roughness.
- G. **Closures and Correction Pieces:** Closures and correction pieces shall be provided as required so that closures may be made due to different headings in the pipe laying operation and so that correction may be made to adjust the pipe laying to conform to pipe stationing.

2.2 PIPE DESIGN

- A. **General:** Ductile iron pipe shall be designed in accordance with the pressure class requirements of ANSI/AWWA C150 as applicable. The minimum pressure class shall be Class 350 for 4 inch through 12 inch sizes; Class 250 for 14 inch through 20 inch sizes; Class 200 for sizes larger than 20 inches, unless otherwise determined by the ENGINEER or as shown on the Drawings.
- B. **Minimum Pipe Wall Thickness:** In addition to the requirements of this Section, the minimum wall thickness shall be in accordance with Table 5 of ANSI/AWWA C150.

2.3 MATERIALS

- A. **Ductile Iron Pipe:** Pipe materials shall conform to the requirements of ANSI/AWWA C151.

- B. **Cement Mortar Lining:** Cement for mortar lining for water and reclaimed water systems shall conform to the requirements of ANSI/AWWA C104; provided that cement for mortar lining shall be Type II for potable water systems, and Type V for reclaimed water and sanitary sewer systems. A fly ash or pozzolan shall not be used as a cement replacement.
- C. **External Coating:** External coatings for buried Ductile Iron pipe using potable water shall be Polyethylene encasement or coal tar paint, in conformance to Section 099000, "Protective Coating." Fire Hydrant Laterals and Fire Service Laterals may also be coal-tar coated for potable water use. For reclaimed water use, the Polyethylene encasement shall be purple and conform to the marking requirements of Section 330526, "Piping Identification Systems". Unless otherwise specified or shown on the Drawings coating for all uses shall be polyethylene encasement.

2.4 PIPE FITTINGS AND SPECIALS

- A. Fittings for ductile iron pipe shall conform to the requirements of ANSI/AWWA C153 or ANSI/AWWA C110 flanged fittings only, for diameters 4 inch through 48 inch and shall have a minimum pressure rating of 250 psi. Ductile iron fittings larger than 48 inches shall conform to the applicable portions of the above referenced standard.
- B. Connections to sanitary sewer mains shall be:
 - 1. Existing lines - Tap-Tite method or cast iron saddle fittings which utilize neoprene gasket seals and stainless steel bands.
 - 2. New lines - Wye fittings only.
- C. Acceptable products for fittings are **US Pipe, Union Foundary, Trinity or equal.**

2.5 DESIGN OF PIPE

- A. **General:** The pipe furnished shall be ductile iron pipe, lined and coated, as required in Section 2.3, with rubber gasketed joints.
- B. The pipe shall be designed, manufactured, tested, inspected, and marked according to applicable requirements previously stated and except as hereinafter modified, shall conform to ANSI/AWWA C151.
- C. **Pipe Dimensions:** The pipe shall be of the diameter and class as shown on the Drawings.
- D. **Fitting Dimensions:** The fittings shall be of the diameter and class as shown on the Drawings.
- E. **Joint Design:** Ductile iron pipe shall be furnished with mechanical joints, flanged joints and push-on joints as required. Ductile iron fittings shall be mechanical joints, flanged joints and push-on-joints. Push-on joints will not be allowed for fittings and valves.
 - 1. Mechanical and push-on joints shall conform to ANSI/AWWA C111.
 - 2. Flanged joints shall conform to ANSI/AWWA C115, or ANSI/AWWA C110.
 - 3. When allowed by the ENGINEER, restrained joints shall be **American Cast Iron Pipe Co. "Lok-Fast" Restrained Joint, U.S. Pipe and Foundry "TR FLEX" Restrained Joint, MEG-A-LUG or equal.**
- F. Shop-applied interior linings and exterior coatings shall be held back from the ends of the pipe.

2.6 LINING

A. Cement-Mortar Lining:

1. Cement-Mortar Lining for Shop Application: Interior surfaces of all ductile iron pipe, fittings and specials shall be cleaned and lined in the shop with cement-mortar lining applied centrifugally in conformity with ANSI/AWWA C104. During the lining operation and thereafter, the pipe shall be maintained in a round condition by suitable bracing or strutting. The lining machines shall be of a type that has been used successfully for similar work. Every precaution shall be taken to prevent damage to the lining.
2. If lining is damaged or found faulty at delivery site, the damaged or unsatisfactory portions shall be replaced with lining conforming to these Specifications and having a minimum thickness matching the factory lining.
3. Protection of Pipe Mortar Lining: All shop-applied cement mortar lining shall be given a seal coat of asphaltic material in conformance with ANSI/AWWA C104.

2.7 EXTERIOR COATING

- A. **Exterior Coating of Exposed Piping:** The exterior surfaces of pipe which will be exposed to the atmosphere inside structures or above ground shall be thoroughly cleaned and then given a factory coat of rust-inhibitive primer and a field coat of rust prohibitive finish conforming to the requirements of Section 099000, "Protective Coating."
- B. **Exterior Coating of Buried Piping:** Coating of buried pipe shall be as specified in PART 2 -- PRODUCTS of this Section.

2.8 CLEANOUTS

- A. Sanitary Sewer cleanouts shall be as specified in Section 331200, "Miscellaneous Piping, Valves, Fittings, and Appurtenances."

PART 3 -- EXECUTION

3.1 INSTALLATION OF PIPE

- A. **Handling and Storage:** All pipe, fittings, and appurtenances, shall be carefully handled and protected against damage, impact shocks and free fall. All pipe handling equipment shall be in conformance with the manufacturer's printed recommendations and acceptable to the ENGINEER. Pipe shall not be placed directly on rough ground but shall be supported in a manner which will protect the pipe against injury whenever stored at the trench site or elsewhere. No pipe shall be installed where the lining or coating show defects that may be harmful as determined by the ENGINEER. Such damaged lining or coating shall be repaired, or a new undamaged pipe shall be furnished and installed.
 1. All damaged pipe shall be repaired or replaced by the CONTRACTOR.
 2. The CONTRACTOR shall inspect each pipe and fitting prior to installation to insure that there are no damaged portions of the pipe or fitting.
 3. Before placement of pipe in the trench, each pipe or fitting shall be thoroughly cleaned of any foreign substance, which may have collected thereon and shall be kept clean at all times thereafter. For this purpose, the openings of all pipes and fittings in the trench shall be closed during any interruption to the WORK.
 4. Coatings shall be provided in accordance with Section 099000, "Protective Coating."

B. **Pipe Laying:** The pipe shall be installed in accordance with AWWA C600.

1. Pipe shall be laid directly on the imported bedding material. No blocking will be permitted, and the bedding shall be such that it forms a continuous, solid bearing for the full length of the pipe. Excavations shall be made as needed to facilitate removal of handling devices after the pipe is laid. Bell holes shall be formed at the ends of the pipe to prevent point loading at the bells or couplings. Excavation shall be made as needed outside the normal trench section at field joints to permit adequate access to the joints for field connection operations and for application of coating on field joints.
2. Each section of pipe 18 inches in diameter and larger shall be laid in the order and position shown on the laying schedule. In laying pipe, it shall be laid to the set line and grade.
3. On pressurized main pipelines, where necessary to raise or lower the pipe due to unforeseen obstructions or other causes, the ENGINEER may change the alignment and/or the grades. Such change shall be made by the deflection of joints, by the use of bevel adapters, or by the use of additional fittings. Changes in alignment using additional fittings shall be in conformance with the Drawings. However, in no case shall the deflection in the joint exceed the maximum deflection recommended by the pipe manufacturer. No joint shall be misfit any amount which will be detrimental to the strength and water tightness of the finished joint.
4. All gravity lines shall be laid uphill starting at the lowest point with the spigot end pointing in the direction of flow. Pressurized lines laid on a downhill grade shall be blocked and held in place until sufficient support is furnished by the following pipe to prevent movement. All bends shall be properly installed as shown on the Drawings. Water lines shall be laid uphill on grades exceeding 10 percent.
5. Trenches shall be in a reasonably dry condition when the pipe is laid. The CONTRACTOR shall take all necessary precautions to prevent the pipe from floating, due to water entering the trench from any source, shall assume full responsibility for any damage due to this cause, and shall at its own expense restore and replace the pipe to its specified condition and grade if it is displaced due to floating.

C. **Cold Weather Protection:** No pipe shall be installed upon a foundation into which frost has penetrated or at any time that there is a danger of the formation of ice or penetration of frost at the bottom of the excavation. No pipe shall be laid unless it can be established that the trench will be backfilled before the formation of ice and frost occurs.

D. **Pipe and Specials Protection:** The openings of all pipe and specials shall be protected with suitable bulkheads to prevent unauthorized access by persons, animals, water or any undesirable substance.

E. **Pipe Cleanup:** As pipe laying progresses, the CONTRACTOR shall keep the pipe interior free of all debris. The CONTRACTOR shall completely clean the interior of the pipe of all sand, dirt, mortar splatter and any other debris following completion of pipe laying, and any necessary interior repairs prior to testing the completed pipeline.

3.2 RUBBER GASKETED JOINTS

A. **Rubber Gasketed Joints:** The rubber gasket joint shall be made by properly lubricating the rubber gasket with a suitable vegetable compound soap before it is placed in the groove at the spigot end. The gasket shall be stretched over the spigot end of the pipe and carefully seated in the groove, with care taken to equalize the stress in the gasket around the circumference of the joint. The gasket shall not be twisted, rolled, cut, crimped, or otherwise injured or forced out of position during the closure of the joint. A feeler gage shall be used to check the position of the rubber gasket after the

joint has been assembled. Where joint placement is found to be improper, the tested pipe section shall be removed, the gasket checked for damage, a new gasket installed if necessary, the pipe relaid, and the gasket placement rechecked.

3.3 JOINT PROTECTION

- A. **Joint and Fitting Protection:** Fittings and joints between pipe sections shall be field coated with the same products as adjacent pipe sections.
- B. Polyethylene encasement and coal tar paint shall be applied in conformance with the coating manufacturer's printed recommendations, and in accordance with the requirements of Section 099000, "Protective Coating."

3.4 SANITARY SEWER CLEANOUTS

- A. Sanitary Sewer clean-outs shall be installed in conformance with Section 331200, "Miscellaneous Piping, Valves, Fittings, and Appurtenances."

3.5 TESTING

- A. Testing shall be in accordance with Sections 331300, "Pressure Pipeline Testing and Disinfection," and 330130, "Sanitary Sewer and Storm Drain System Leakage Testing."

3.6 WARNING TAPE

- A. Installation of warning tape and identification shall conform to Section 330526, "Piping Identification Systems."

- END OF SECTION -

CITY OF LIVERMORE
TECHNICAL SPECIFICATIONS

DIVISION 9 – FINISHES

SECTION 099000 - PROTECTIVE COATING

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide all materials, equipment and labor necessary to furnish and install the protective coating of all specified surfaces including, but not necessary limited to, all surface preparation, pretreatment, coating application, touch-up of factory-coated surfaces, protection of surfaces not to be coated, cleanup, and all appurtenant work, complete in place, as specified herein.
- B. The following surfaces shall not be protective coated unless specifically shown or specified.
 - 1. Concrete.
 - 2. Stainless steel.
 - 3. Machined surfaces.
 - 4. Grease fittings.
 - 5. Glass.
 - 6. Equipment nameplates.
- C. The Coating System Schedules summarize the surfaces to be coated, the required surface preparation, and the coating systems to be applied. Coating notes on the drawings are used to show exceptions to the schedules, to show or extend the limits of coating systems, or to clarify or show details for application of the coating systems.
- D. The CONTRACTOR shall be responsible for compliance with EPA and DHS regulations for all products and materials, and use of all products and materials.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. **Commercial Standards:**

ANSI/AWWA C105	Standard for Polyethylene Encasement for Ductile-Iron Piping for Water and Other Liquids.
ASTM C 309	Specification for Liquid Membrane - Forming Compounds for Curing Concrete.
AWWA C550	Standard for Protective Epoxy Interior Coatings for Valves and Hydrants.
AWWA C 205	Standard for Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 inch and larger - Shop applied.
NACE	National Association of Corrosion Engineers.
NSF	National Sanitation Foundation.
SSPC	Steel Structures Painting Council.

1.3 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. **Paint Manufacturer's Information:** For each paint system to be used the CONTRACTOR shall submit the following listed data.
 - 1. Paint manufacturer's data sheet for each product used, including statements on the suitability of the material for the intended use.
 - 2. Paint manufacturer's printed instructions and recommendations on surface preparation and application.
 - 3. Colors available for each product (where applicable).
 - 4. Compatibility of shop and field applied coatings (where applicable).
 - 5. Current material safety data sheet for each product used.
 - 6. Two sets of color samples to match each color selected by the ENGINEER from the manufacturer's standard color sheets. If custom mixed colors are required by this Section, the color samples shall be made using color formulations prepared to match the color samples furnished by the ENGINEER. The color formula shall be shown on the back of each color sample.

1.4 QUALITY ASSURANCE

- A. **Surface Preparation:** Evaluation of blast cleaned surface preparation work will be based upon comparison of the blasted surfaces with the definitions and standard visual samples available from the SSPC, using SSPC-VIS1 Standards. The ENGINEER shall be sole judge as to whether the quality of blast cleaning conforms to visual comparison standards, and its decision as to allowability shall be final.
- B. **Film Thickness Testing:** On ferrous metals, the dry film coating thickness will be measured in accordance with SSPC "Paint Application Specification No. 2." Each coat will be tested for the correct thickness. No measurements will be made until at least 8 hours after application of the coating. On non-ferrous metals and other substrates, the coating thicknesses will be measured at the time of application using a wet film gage.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. **Definitions:** The term "paint," "coatings," "linings," or "finishes" as used herein, shall include surface treatments, emulsions, enamels, paints, epoxy resins, and all other protective coatings, excepting galvanizing or anodizing, whether used as a pretreatment, primer, intermediate coat, or finish coat. The term "DFT" means minimum dry film thickness.
- B. **General:** Coating materials shall be sealed in containers that plainly show the designated name, formula or specification number, batch number, color, date of manufacture, manufacturer's directions, and name of manufacturer, all of which shall be plainly legible at the time of use.

- C. The CONTRACTOR shall use coating materials suitable for the intended use and recommended by their manufacturer for the intended service.
- D. **Compatibility:** In any coating system only compatible materials from a single manufacturer shall be used in the WORK. Particular attention shall be directed to compatibility of primers and finish coats. If necessary, subject to the requirements of the ENGINEER, a barrier coat shall be applied between existing prime coat and subsequent field coats to ensure compatibility.
- E. **Colors:** All colors of paint shall be as selected or specified by the ENGINEER. Finish colors shall be as specified from the manufacturer's standard color samples.
- F. **Protective Coating Materials:** Products shall be standard products produced by recognized manufacturers who are regularly engaged in production of such materials for essentially identical service conditions.
- G. **Substitute or "Or-Equal" Submittals:** Unless otherwise specified, materials are from the catalogs of the companies listed herein. Materials by other manufacturers are acceptable provided that they are established as being compatible with and of equal quality to the coatings and colors of the companies listed. The CONTRACTOR shall provide satisfactory documentation from the firm manufacturing the proposed substitute or "or-equal" material that said material meets the specified requirements and is equivalent or better than the specified materials.

2.2 COATING SYSTEMS

- A. **Materials:** Each of the following manufacturers listed in this section is capable of supplying many of the coating materials specified herein. Where manufacturers and paint numbers are listed, it is to show the type and quality of coatings that are required. Proposed substitute materials must be shown to satisfy the material descriptions and to equal or exceed the properties of the listed materials as required in the paragraph entitled "Substitute or 'Or-Equal' Submittals" herein. The decisions of the ENGINEER as to acceptable color substitutions will be final.
- B. **System 1 - Alkyd Enamel:** High quality, gloss or semi-gloss, medium long oil alkyd finish shall have a minimum solids content of 49 percent by volume. Primer shall be as recommended by manufacturer. Hydrant colors shall be as follows:

1. Potable Water System:

a. City Water Systems

(1) New Hydrants:

- i. Manufacturers standard color compatible with Rustoleum Enamel No. 7448, Caterpillar Yellow.

(2) Repair and Maintenance:

- i. Fuller O'Brien, Heavy Duty Gloss Enamel No. 312-74 or 612-35, Hi-Way Yellow.
- ii. Kelly Moore, Kel-Guard Rust Inhibiting Enamel No. 1700-63, Safety Yellow.

b. California Water Service System:

(1) New hydrants:

- i. Manufacturers standard color compatible with Rustoleum Enamel No. 1210, Red.
 - (2) Repair and Maintenance:
 - i. Fuller O'Brien, Heavy Duty Gloss Enamel No. 312-74 or 612-74, Bright Red.
 - ii. Kelly Moore, Kel-Guard Rust Inhibiting Enamel No. 1700-63, Siren Red.
2. Recycled Water Systems:
 - a. All fire hydrants, valve covers, water meters, backflow preventors, angle meter stops and other Appurtenances on Recycled Systems shall be:
 - i. Kelly Moore No. 3-03*942LM, Livermore Grape.
3. Fire Hydrant Valve Lids and Potable Water Main Valves:
 - a. Potable System: Valve cover lids on fire hydrant laterals in potable systems shall be painted white with **Bauer Zone-lac Traffic Paint or Pervo Traffic Paint.**
 - b. Potable water main valve cover lids shall be painted blue with **Handicap Blue Traffic Paint manufactured by Pervo Paint or equal.**
4. **Guard Posts:** Guard posts shall be installed as shown on the Drawings. All Guard posts for potable and recycled water systems shall be painted white with gloss enamel paint as approved by the ENGINEER.
5. Paint manufacturers for all other uses shall be as follows:
 - a. Prime Coat: **Sherwin Williams, Kem-Kremik Universal Primer, DuPont 681 FD, or equal.**
 - b. Finish Coat: **Sherwin Williams, Industrial Gloss Enamel, DuPont 31 PSG, or equal.**
6. Coating requirements shall be as follows:
 - a. Prime Coat DFT=3 mils each
 - b. Finish Coats (2 or more) DFT=3 mils each
 - c. Total System DFT=6 mils, minimum
- C. **System 2 - Fusion Bonded Epoxy:** The coating material shall be a 100-percent powder epoxy applied in conformance with AWWA C550, except that the surface preparation shall be as specified in the Coating System Schedule of this Section.
 1. Liquid Epoxy: For field repairs the use of a liquid epoxy will be permitted, applied in not less than 3 coats to provide a total DFT of 12 mils. The liquid epoxy shall be a 100-percent solids epoxy recommended by the powder epoxy manufacturer.
 2. Field repair coating (DFT = 12 mils), **Scotchkote 306 or 312, DURA-POX 646, or equal.**
- D. **System 3 - Polyethylene Encasement:** Application of polyethylene encasement shall be in conformance with ANSI/AWWA C105 using Method A.

- E. **System 4 - Cement Mortar Coating:** Unless otherwise specified on the Drawings, mortar coating and reinforcement shall be in conformance with AWWA C205.
- F. **System 5 - Factory Applied Epoxy:** The coating material shall be a liquid epoxy applied in conformance with AWWA C550.
- G. **System 6 - Coal Tar Paint:** High solids content coal tar paint for use on buried pipeline and fittings.
 - 1. Prime coat and finish coats (2 or more, total DFT=24 mils), **Protecto Wrap CA-1200, Polyguard No. CA-14, Kop-Coat Bitumastic Super Service Black, or equal.**

PART 3 -- EXECUTION

3.1 STORAGE, MIXING AND THINNING OF MATERIALS

- A. **Manufacturer's Recommendations:** Unless otherwise specified herein, the coating manufacturer's printed recommendations and instructions for thinning, mixing, handling, applying, and protecting its coating materials, for preparation of surfaces for coating, and for all other procedures relative to coating shall be strictly adhered to. The CONTRACTOR shall supply the ENGINEER with copies of each manufacturer's printed recommendations and instructions for review prior to use of any coating product.
- B. All protective coating materials shall be used within the manufacturer's recommended shelf life.
- C. **Storage and Mixing:** Coating materials shall be protected from exposure to cold weather, and shall be thoroughly stirred, strained, and kept at a uniform consistency during application. Coatings of different manufacturers shall not be mixed together.

3.2 PREPARATION FOR COATING

- A. **General:** All surfaces to receive protective coatings shall be cleaned as specified herein prior to application of said coatings. The CONTRACTOR shall examine all surfaces to be coated, and shall correct all surface defects before application of any coating material. All marred or abraded spots on shop-primed and on factory-finished surfaces shall receive touch-up restoration prior to any coating application.
- B. **Protection of Surfaces Not to be Coated:** Surfaces which are not to receive protective coatings shall be protected during surface preparation, cleaning, and coating operations.
- C. All hardware, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not to be coated shall be removed, masked or otherwise protected. The working parts of all mechanical and electrical equipment shall be protected from damage during surface preparation and coating operations. Openings in motors shall be masked to prevent entry of coating or other materials.
- D. Care shall be exercised not to damage adjacent work during blast cleaning operations. Spray painting shall be conducted under carefully controlled conditions. The CONTRACTOR shall be fully responsible for and shall promptly repair any and all damage to adjacent work or adjoining property occurring from blast cleaning or coating operations.
- E. **Protection of Painted Surfaces:** Cleaning and coating shall be so programmed that dust and other contaminants from the cleaning process will not fall on wet, newly-coated surfaces.

3.3 SURFACE PREPARATION STANDARDS

- A. The following referenced surface preparation specifications of the Steel Structures Painting Council's "Steel Structure Painting Manual, Volume 2, Systems and Specification" shall form a part of this specification:
1. Solvent Cleaning (SSPC-SP1): Removal of oil, grease, dirt, soil, salts, and contaminants by cleaning with solvent, vapor, alkali, emulsion, or steam.
 2. Hand Tool Cleaning (SSPC-SP2): Removal of loose rust, loose mill scale, and loose paint to degree specified, by hand chipping, scraping, sanding, and wire brushing.
 3. Power Tool Cleaning (SSPC-SP3): Removal of loose rust, loose mill scale, and loose paint to degree specified by power tool chipping, descaling, sanding, wire brushing, and grinding.
 4. White Metal Blast Cleaning (SSPC-SP5): Removal of all visible rust, mill scale, paint, and foreign matter by blast cleaning by wheel or nozzle (dry or wet) using sand, grit, or shot.
 5. Commercial Blast Cleaning (SSPC-SP6): Blast cleaning until at least two-thirds of each element of surface area is free of all visible residues.
 6. Brush-Off Blast Cleaning (SSPC-SP7): Blast cleaning of all except tightly adhering residues of mill scale, rust, and coatings, exposing numerous evenly distributed flecks of underlying metal.

3.4 METAL SURFACE PREPARATION (UNGALVANIZED)

- A. The minimum abrasive blasting surface preparation shall be as specified in the "Coating System Schedules" specified in Section 3.11 herein . Where there is a conflict between these specifications and the coating manufacturer's printed recommendations for the intended service, the higher degree of cleaning shall apply.
- B. Workmanship for metal surface preparation shall be in conformance with the current SSPC Standards and this Section. Blast cleaned surfaces shall match the standard samples available from the National Association of Corrosion Engineers, NACE Standard TM-01-70.
- C. All oil, grease, welding fluxes and other surface contaminants shall be removed by solvent cleaning per SSPC-SP1 prior to blast cleaning.
- D. All sharp edges shall be rounded or chamfered and all burrs, and surface defects and weld splatter shall be ground smooth prior to blast cleaning.
- E. The CONTRACTOR shall comply with the applicable federal, state, and local air pollution control regulations for blast cleaning.
- F. Compressed air for air blast cleaning shall be supplied at adequate pressure from well maintained and properly operating compressors equipped with oil/moisture separators which remove at least 95 percent of the contaminants.
- G. Surfaces shall be cleaned of all dust and residual particles of the cleaning operation by dry air blast cleaning, vacuuming or another approved method prior to coating.
- H. Enclosed areas and other areas where dust settling is a problem shall be vacuum cleaned and wiped with a tack cloth.

- I. Damaged or defective coating shall be removed by the specified blast cleaning to meet the clean surface requirements before recoating.
- J. If the specified abrasive blast cleaning performed in the field will damage adjacent work, the area to be cleaned is less than 100 square feet, and the coated surface will not be submerged in service, then SSPC-SP2, hand tool cleaning or SSPC-SP3, power tool cleaning, may be used.
- K. For unburied surfaces, shop applied coatings of unknown composition shall be completely removed before the specified coatings are applied. Valves, castings, ductile or cast iron pipe, and fabricated pipe or equipment shall be examined for the presence of shop-applied temporary coatings. Temporary coatings shall be completely removed by solvent cleaning per SSPC-SP1 before the abrasive blast cleaning work has been started.
- L. Shop primed surfaces shall be solvent cleaned per SP1 in the field before finish coats are applied.

3.5 SURFACE PREPARATION FOR GALVANIZED FERROUS METAL

- A. Galvanized ferrous metal shall be alkaline cleaned per SSPC-SP1 to remove oil, grease, and other contaminants detrimental to adhesion of the protective coating system to be used.
- B. Pretreatment coatings of surfaces shall be in accordance with the printed recommendations of the coating manufacturer.

3.6 SURFACE PREPARATION OF FERROUS SURFACES WITH EXISTING COATINGS

- A. **General:** All grease, oil, heavy chalk, dirt, or other contaminants shall be removed by solvent or detergent cleaning per SP1 prior to abrasive blast cleaning. The generic type of the existing coatings shall be determined as necessary to assure compatibility with field applied coatings.
- B. **Abrasive Blast Cleaning:** The CONTRACTOR shall provide the degree of cleaning specified in the Coating System Schedule for the entire surface to be coated. If the degree of cleaning is not specified in the schedule, deteriorated coatings shall be removed by abrasive blast cleaning to SSPC-SP6. Areas of tightly adhering coatings shall be cleaned to SSPC-SP7, with the remaining thickness of existing coating not to exceed 3 mils.
- C. **Incompatible Coatings:** If coatings to be applied are not compatible with existing coatings the CONTRACTOR shall apply intermediate coatings per the coating manufacturer's printed recommendation for the specified coating system or shall completely remove the existing coating prior to abrasive blast cleaning. A small trial application shall be conducted for compatibility prior to coating large areas.
- D. **Unknown Coatings:** Coatings of unknown composition shall be completely removed prior to application of new coatings.
- E. **Regulatory Compliance:** Surface preparation shall be performed in strict compliance with applicable regulations governing worker safety, disposal and removal of used solvents and abrasives, and disposal of materials removed.

3.7 WORKMANSHIP

- A. Skilled craftsmen and experienced supervision shall be used on all work.
- B. All damage to surfaces resulting from the work hereunder shall be cleaned, repaired, and refinished to their original condition.

- C. All coatings shall be applied under dry and dust-free conditions. Coating shall be done in a workmanlike manner so as to produce an even film of uniform thickness. Edges, corners, crevices, and joints shall receive special attention to insure that they have been thoroughly cleaned and that they receive an adequate thickness of coating material. The finished surfaces shall be free from runs, drops, ridges, waves, laps, brush marks, and variations in color, texture, and finish. Special attention shall be given to insure that edges, corners, crevices, welds, and similar areas receive a film thickness equivalent to adjacent areas, and installations shall be protected by the use of drop cloths or other approved precautionary measures.

3.8 SHOP COATING REQUIREMENTS

- A. Unless otherwise indicated, all items of equipment, or parts of equipment which are not submerged in service, shall be shop primed and then finish coated in the field after installation with the indicated or selected color. The methods, materials, application equipment and all other details of shop painting shall comply with this section. If the shop primer requires topcoating within a specified period of time, the equipment shall be finish coated in the shop and then touch-up painted after installation.
- B. All items of equipment, or parts and surfaces of equipment which are submerged or inside an enclosed hydraulic structure when in service, with the exception of pumps and valves, shall have all surface preparation and coating work performed in the field.
- C. For certain pieces of equipment it may be undesirable or impractical to apply finish coatings in the field. Such equipment may include engine generator sets, equipment such as electrical control panels, switchgear or main control boards, submerged parts of pumps, ferrous metal passages in valves, or other items where it is not possible to obtain the indicated quality in the field. Such equipment shall be primed and finish coated in the shop and touched up in the field with the identical material after installation. The CONTRACTOR shall require the manufacturer of each such piece of equipment to certify as part of its shop drawings that the surface preparation is in accordance with these specifications. The coating material data sheet shall be submitted with the shop drawings for the equipment.
- D. For certain small pieces of equipment the manufacturer may have a standard coating system which is suitable for the intended service conditions. In such cases, the final determination of suitability will be made during review of the shop drawing submittals. Equipment of this type generally includes only indoor equipment such as instruments, small compressors, and chemical metering pumps.
- E. Shop painted surfaces shall be protected during shipment and handling by suitable provisions including padding, blocking, and the use of canvas or nylon slings. Primed surfaces shall not be exposed to the weather for more than 2 months before being topcoated, or less time if recommended by the coating manufacturer.
- F. Damage to shop-applied coatings shall be repaired in accordance with this Section and the coating manufacturer's printed instructions.
- G. The CONTRACTOR shall make certain that the shop primers and field topcoats are compatible and meet the requirements of this Section. Copies of applicable coating manufacturer's data sheets shall be submitted to the ENGINEER.

3.9 APPLICATION OF COATINGS

- A. The application of protective coatings to steel substrates shall be in accordance with "Paint Application Specification No. 1, (SSPC-PA1)," Steel Structures Painting Council.

- B. Cleaned surfaces and all coats shall be inspected by the CONTRACTOR prior to each succeeding coat.
- C. Blast-cleaned ferrous metal surfaces shall be coated before any rusting or other deterioration of the surface occurs. Blast cleaning shall be limited to only those surfaces that can be coated in the same working day.
- D. Coatings shall be applied in accordance with the manufacturer's printed instructions and recommendations and this Section, whichever has the most stringent requirements.
- E. Special attention shall be given to materials which will be joined so closely that proper surface preparations and application are not possible. Such contact surfaces shall be coated prior to assembly or installation.
- F. Coatings shall not be applied under the following conditions:
 - 1. Temperature above or below the manufacturer's recommended maximum and minimum allowable.
 - 2. Dust or smoke laden atmosphere.
 - 3. Damp or humid weather.
- G. All field coating shall be in conformance with the Manufacturer's printed recommendations.

3.10 CURING OF COATINGS

- A. The CONTRACTOR shall provide curing conditions in accordance with the conditions recommended by the coating material manufacturer or by this Section, whichever is the most stringent requirement, prior to placing the completed coating system into service.

3.11 COATING SYSTEM SCHEDULES - FERROUS METALS

A. **Coating System Schedule, Ferrous Metal - Not Galvanized:**

	Item	Surface Preparation	System No.
FM-1	All surfaces, indoors and outdoors, exposed or covered, except those surfaces included below.	Commercial Blast Cleaning SSPC-SP6	(1) Alkyd Enamel
FM-2	Exposed FHs, valve lids, marker posts, Backflow Preventors lettering, exposed pipe and fittings, and vent pipe.	Solvent Cleaning SSPC-SP1	(1) Alkyd Enamel
FM-3	Buried pipe with a nominal diameter of less than 6 inches and greater than 2 inches, excluding ductile iron pipe.	Solvent Cleaning SSPC-SP1	(6) Coal Tar Paint

FM-4	Fittings and flanged joints, where the piping is plastic. Buried fittings on ductile iron pipe used for FH laterals, fire service laterals, and Backflow Prevention Assemblies. Joints, and fittings on ductile iron pipe with coal tar coating.	Commercial Blast Cleaning SSPC-SP6	(6) Coal Tar Paint
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	Item	Surface Preparation	System No.
FM-5	Buried pipe couplings; fittings; and flanged joints, including epoxy coated surfaces, except valves; where the piping is polyethylene encased ductile iron.	As specified by reference specification for appropriate fittings.	(3) Polyethylene Encasement
FM-6	Buried pipe couplings, fittings, and flanged joints, where piping is cement mortar coated and lined steel pipe, excluding epoxy coated surfaces.	Solvent Cleaning SSPC-SP1	(4) Cement Mortar Coating
FM-7	Buried cast couplings, buried sleeve-type tapping sleeves, welded tapping outlets. Ferrous surfaces of gate valves.	White Metal Blast Cleaning SSPC-SP5	(2) Fusion Bonded Epoxy
FM-8	External ferrous surfaces of check valves.	White Metal Blast cleaning SSPC-SP5	(2) Fusion Bonded Epoxy
FM-9	Ferrous internal surfaces of fire hydrants.	White Metal Blast cleaning SSPC-SP5	(2) Fusion Bonded Epoxy
FM-10	Internal/External Ferrous Surfaces of butterfly valves	White Metal Blast Cleaning SSPC-SP5	(5) Factory Applied Epoxy

B. Coating System Schedule, Ferrous Metal - Galvanized: Pretreatment coatings, barrier coatings, or washes shall be applied as recommended by the coating manufacturer. All galvanized surfaces except for floor gratings and frames, shall be coated unless coating is required by other Sections:

	Item	Surface Preparation	System No.
FMG-1	All exposed surfaces, indoors or outdoors, including exposed galvanized pipe, except those surfaces included	Alkaline Cleaning per SSPC-SP1	(1) Alkyd Enamel

below.

FMG-2

Buried pipe with a nominal diameter of 2 inches and less, including valves, fittings

Alkaline Cleaning per SSPC-SP1

(6)
Coal Tar Paint

- END OF SECTION -

SECTION 099100

PROTECTIVE COATINGS FOR CONCRETE SANITARY SEWER MANHOLES

PART 1- GENERAL

1.1 SECTION INCLUDES

- A. This section includes specifications for installing protective coatings for the concrete in existing sanitary sewer manholes at the locations shown on the plans.
- B. The Contractor shall furnish all materials, equipment, and labor necessary to acceptably rehabilitate the interior concrete surfaces of existing sanitary sewer manholes at locations depicted on the project plans. All concrete surfaces shall be coated, including the manhole flow channel above the normal flow line.

1.2 RELATED SECTIONS

- A. Section 330200 – Cured-In-Place Pipe
- B. Division 1 - General Requirements.

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- | | |
|-------------|---|
| ASTM D 4259 | Standard Practice for Abrading Concrete |
| ASTM D 4787 | Standard Practice for Continuity Verification of Liquid or Sheet Linings Applied to Concrete Substrates |

1.4 GUARANTEE

- A. All coating work shall be fully guaranteed by the Contractor for a period of (5) years from the date of the Notice of Completion. During this period all serious defects discovered by the City shall be removed and replaced in a satisfactory manner at no cost to the City. The City may conduct an independent inspection, at their own expense, of the lining work prior to the completion of the (5) year guarantee period.
- B. Said guarantee shall be in written form acceptable to the City, and shall be furnished to the Engineer prior to the City filing a notice of completion for the project.

1.5 QUALIFICATIONS

- A. Installer: The application of coating system shall be performed by a licensed professional applicator, which shall be manufacturer certified on a non-exclusive basis. Provide written documentation of applicator certification by manufacturer.

1.6 SUBMITTALS

- A. Submittals shall be in accordance with Section 013300.
- B. Submit certificates showing:
 - 1. Evidence of acceptance of applicator by manufacturer.
 - 2. Materials and components furnished conform to requirements of these specifications.
- C. Submit samples and manufacturer's literature:
 - 1. Product data and samples.
 - 2. Manufacturer's requirements for product use.
 - 3. List of materials proposed for use.

PART 2- PRODUCTS

2.1 MANHOLE REHABILITATION COATINGS

Protective coatings for the concrete in existing sanitary sewer manholes shall be as follows:

- A. Plugging active leaks (waterstop): **“Seal Tite” by Parson Environmental, “EC Flex Grout” by Environmental Coatings, LLC**, or approved equal.
- B. Underlayment/leveling course/primer: **“CA Liner 100” by Parson Environmental, “Hydro-Pox 251”, thickened with “Hydro-Thix” by Con-Tech of California, Inc.**, or approved equal.
- C. Corrosion Barrier: **“Parsonpoxy SEL-80”, by Parson Environmental, “Hydro-Pox 212 GL” by Con-Tech of California, Inc.**, or approved equal.

The underlayment and the corrosion barrier shall be from the same manufacturer to ensure compatibility.

PART 3- EXECUTION

3.1 GENERAL

Prior to entering access areas such as manholes, and performing lining or cleaning operations, an evaluation of the atmosphere to determine the presence of toxic, explosive, or flammable vapors or lack of oxygen must be undertaken by the CONTRACTOR in accordance with local, state, or federal safety regulations.

3.2 SURFACE PREPARATION

- A. All active infiltration must be stopped prior to application of coating system.
- B. Surfaces shall be cleaned to achieve an ASTM 4259 standard for concrete. Cleaning shall occur by mechanical means such as abrasive air blasting or jet water blasting at a minimum of 3500 psi, maximum of 4500 psi. If necessary, manual scrubbing with a wire brush may be required. All of the surfaces shall be cleaned to remove all dirt, dust, corrosion products, loose concrete, debris, grease, oils, growth, and foreign matter. Existing coatings shall be removed to the extent of any loose, scaling material, which would prevent the coating system from proper adhesion to the substrate. The coating system will adhere to coal tar epoxies previously applied, but the substrate must be totally free of any loose, scaling or oxidizing material, and must be applied to a sound clean porous surface. Cracks shall be routed out and cleaned to provide an adequate bonding surface for the application of underlayment material or waterstop.
- C. Cleaning operations shall not occur on the **first Wednesday of each month** to avoid interference with the operations of the wastewater treatment plant. The Contractor shall schedule construction activities accordingly.

3.3 APPLICATION

All products under this section shall be mixed, applied, and cured per the manufacturer's recommendations. All interior concrete surfaces shall be coated except approximately the bottom third of the flow channel (the portion below the normal flowline).

Construction shall occur in the following order:

- A. Cleaning/surface preparation of manhole per Section 3.2.
- B. Stopping active leaks using waterstop material.
- C. Application of underlayment material. All voids, cracks, joints and surface irregularities shall be prepared, filled and smoothed with this step. Material shall be applied to a minimum finish thickness of 150 mil (not including void depth) using one coat. If the “**Hydro-Pox**” system is used, “**Hydro-Pox 251**” shall be thickened by adding 0.75-1.0lb “**Hydro-Thix**” per gallon of “**Hydro-Pox 251**”.

D. Application of corrosion barrier. Material shall be applied at a minimum total thickness of 150 mil using two coats.

Application of all manhole coatings shall be performed by confined space entry. The use of drop-in, rotary sprayers shall not be permitted.

3.4 TESTING

A. The coating shall not have blisters, cracks, under film voids, mechanical damage, holidays, pinholes or discontinuities. The contractor shall conduct a high voltage spark test for holiday or pinhole detection in accordance with ASTM D4787 in the presence of the Engineer.

3.5 REPAIR OF HOLIDAYS OR PINHOLES

Surface preparation for repair of holidays and pinholes shall be in strict conformance with the manufacturer's written directions. The finished coat shall be free of all voids and imperfections.

END OF SECTION

CITY OF LIVERMORE
TECHNICAL SPECIFICATIONS

DIVISION 31 – EARTHWORK

SECTION 310000 - EARTHWORK

PART 1 -- GENERAL

1.1 THE REQUIREMENT

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

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

1. Site Clearing, Grubbing and Stripping.
2. Preparation for Fill Material.
3. Roadway Excavation.
4. Roadway Grading and Compaction.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- | | |
|-------------------|--|
| A. Section 024100 | Demolition. |
| B. Section 015700 | Site Preparation. |
| C. Section 312300 | Utility Earthwork. |
| D. Section 321000 | Asphalt Pavement, Base and Surface Treatments. |
| E. Division 1 | General Requirements. |

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

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

1. Standard Specifications:

- | | |
|------------|------------------------|
| Section 16 | Clearing and Grubbing. |
| Section 19 | Earthwork. |
| Section 68 | Subsurface Drains. |
| Section 88 | Engineering Fabrics. |

B. **Uniform Building Code.**

C. **Commercial Standards:**

- | | |
|-------------|---|
| ASTM C 117 | Test Method for Materials Finer than 75- μ m (No. 200) Sieve in Mineral Aggregates by Washing. |
| ASTM C 136 | Method for Sieve Analysis of Fine and Course Aggregates. |
| ASTM D 1556 | Test Method for Density of Soil in Place by the Sand-Cone Method. |
| 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 2844	Test Method for Resistance <i>R</i> -Value and Expansion Pressure of Compacted Soils.
ASTM D 2922	Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
ASTM D 3017	Test Method for Water Content of Soil and Rock in Place By Nuclear Methods (Shallow Depth).
ASTM D 4318	Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

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.

1.5 QUALITY ASSURANCE

- A. All soils testing will be done by a testing laboratory of the CITY'S choice and at the CITY'S expense, except as otherwise specified 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 will be performed in conformance with ASTM D 2922 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 insure 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.
- E. The CONTRACTOR shall notify the ENGINEER at least 48 hours prior to performing any site clearing, grubbing, or stripping.
- F. Finish subgrade at any point shall not vary more than 0.1-foot above or below the subgrade shown on the Drawings.

1.6 PROJECT CONDITIONS

- A. Material for embankments, where required, shall consist of suitable excavated material if available, or such imported fill material as may be required conforming to the requirements of this Section and the appurtenant soils report.
- B. The CONTRACTOR shall be solely responsible for the maintenance of the graded surface at all times including implementing all erosion control measures as shown on the drawings during the winter months.
- C. The CONTRACTOR shall be solely responsible for provision of adequate site drainage at all times as shown on the grading and erosion control plans during the course of the WORK.

PART 2 -- PRODUCTS

2.1 SUITABLE FILL MATERIAL

- A. Import fill material shall consist of inert granular soil and rock fragments and shall conform to the requirements of the appurtenant soils report.

- B. All fill material, import or native, shall be free of organic materials, trash and debris, moderately to highly expansive clays, or any other deleterious materials, and shall be subject to the approval of the ENGINEER.
- C. In addition to the soils report requirements, the top 2 feet of import fill material below the subgrade for the roadway shall conform to the following requirements:
 - 1. Fill material shall conform to the following as determined by ASTM C 117 and ASTM C 136:

a. Maximum particle size	3 inches
b. Percent passing 1-inch sieve	90-100 percent
c. Percent passing No. 200 sieve	less than 20 percent
 - 2. Plasticity Index for acceptable import fill materials shall be a maximum of 15 when determined by the procedure set forth in ASTM D 4318.
 - 3. The liquid limit shall not exceed 40 percent as determined by the procedures set forth in ASTM D 4318.
 - 4. Import fill material shall have an R-value of 25 or greater as determined by ASTM D 2844.
- D. The CONTRACTOR shall submit to the ENGINEER at least 10 working days prior to use on the site its proposed source of import fill material along with a soils report and Certification from the designated source that the proposed source materials conform to this Section.
- E. All suitable native fill material containing clods or hard lumps of earth over 6 inches in the greatest dimension shall be broken up before compaction. All suitable native fill material consisting of large rocky material or hard lumps, such as hardpan or cemented gravel which cannot be broken readily, shall be well distributed in the lower portions throughout the earthwork.

PART 3 -- EXECUTION

3.1 SITE CLEARING, GRUBBING AND STRIPPING

- A. Clearing and grubbing shall conform to Section 16, "Clearing and Grubbing," of the Caltrans Standard Specifications and this Section.
- B. Unless otherwise shown on the Drawings, clearing and grubbing shall be performed within the entire street right-of-way area. No burning of material will be allowed.
- C. The site shall be stripped and cleared of all vegetation, debris and organic-laden top soil as required by the appurtenant soils report. The stripped material shall be removed from the site or stockpiled for landscaping purposes if allowed by the appurtenant soils report. This material shall not be used as import fill.
- D. No clearing or grubbing of the site can take place until any environmental review associated with the project, if any, has been completed and approved by the appropriate agencies.

3.2 PREPARATION FOR FILL MATERIAL

- A. Prior to placing import fill material, all areas to receive fill shall be scarified and compacted. Unless otherwise stated in the appurtenant soils report, the area shall be scarified to a minimum of 8 inches, material shall be moisture conditioned by wetting or drying to a range of 2 percent to 5 percent over optimum moisture content, and compacted to a density of not less than 90 percent relative compaction in conformance with ASTM D 1557.

3.3 ROADWAY GRADING AND COMPACTION

- A. Roadway grading shall consist of grading the site to the lines and grades called for on the Drawings. Roadway grading, placing and compacting shall conform to Section 19-5, "Compaction" and Section 19-6, "Embankment Construction," of the Caltrans Standard Specifications and as modified by this Section.
- B. Damage to underlying native soils caused by the CONTRACTOR'S operations shall be repaired and re-compacted under the supervision of and to the satisfaction of the ENGINEER at no additional cost to the CITY.
- C. Material for roadway fill shall be placed in lifts or horizontal layers not exceeding 8 inches in uncompacted thickness. Unless otherwise specified in the appurtenant soils report, material shall be moisture conditioned by wetting or drying as specified in Section 3.2 above, and compacted to a density of not less than 90 percent relative compaction in conformance with ASTM D 1557. In addition, in fill areas the upper 2 feet below street subgrade for the width of the traveled way shall be compacted to a density of not less than 95 percent relative compaction in conformance with ASTM D 1557.
- D. Final preparation of subgrade shall be in conformance with PART 3 - EXECUTION of Section 321000, "Asphalt Pavement, Base and Surface Treatments."

3.4 ROADWAY EXCAVATION

- A. Roadway excavation shall conform to Section 19-1, "General" and Section 19-2, "Roadway Excavation" of the Caltrans Standard Specifications, except the reference to Section 19-5, "Compaction," is deleted, and except that Section 19-2.02, "Unsuitable Material," is modified as follows:
 - 1. When directed by the ENGINEER, the CONTRACTOR shall excavate the unstable or unsuitable underlying material to the depth determined by the appurtenant soils report.
 - 2. Subgrade shall be prepared in conformance with PART 3 - EXECUTION, of Section 321000, "Asphalt Pavement, Base and Surface Treatments."

3.5 UNDERGROUND STRUCTURES

- A. Where abandoned underground structures and pipelines are encountered in the street areas, remove to sufficient depth to allow underground lines to cross, backfill and compact during rough grading. The ENGINEER may require further work to be done if visual inspection indicates during construction.

3.6 DISPOSAL OF EXCESS EXCAVATED MATERIAL

- A. The CONTRACTOR shall remove and dispose of all excess excavated material to a suitable site. All testing required for legal disposal of excess materials shall be conducted by the Contractor at the Contractor's expense. The proper and legal disposal shall be the responsibility of the CONTRACTOR. If the material is tested and found to be hazardous and requires disposal in a Class 1 or Class 2 landfill then the Contractor's price and contract time shall be adjusted as per the General Conditions.

- END OF SECTION -

SECTION 311300

SELECTIVE TREE AND VEGETATION TRIMMING AND REMOVAL

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide all materials, equipment and labor necessary to perform the selective tree and vegetation trimming and all appurtenant work, complete in place, as shown on the Drawings and as specified herein.
- B. Work Specified in this Section:
 - 1. Verification of trees and vegetation to be trimmed with ENGINEER.
 - 2. Trimming of trees and other vegetation in the street right of way.
 - 3. Removal of trees and other vegetation as approved by the ENGINEER.
 - 4. Removal of cuttings and clean-up of the jobsite.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 321000 Asphalt Pavement, Base, and Surface Treatments.
- B. Section 321200 Flexible Pavement Coatings.
- C. Division 1 General Requirements.

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. State of California (Caltrans) Standards:

1. Standard Specifications:

Section 12 Construction Area Traffic Control Devices.

B. Commercial Standards:

- 1. CAL-OSHA Standards.
- 2. ANSI Regulations.

1.4 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall submit copies of the supervising arborist's certification from the Western Chapter of the International Society of Arboriculture to the ENGINEER prior to performing the WORK.
- B. The CONTRACTOR shall submit copies of required resident notifications to the ENGINEER for review prior to distribution. The CONTRACTOR shall follow up each notification and parking restriction posting with submittal to the ENGINEER of a signed affidavit confirming time and date of each notification or posting.

1.5 QUALITY ASSURANCE

- A. All trimming work shall be performed under the direct supervision of and in conformance with the recommendations of an arborist certified by the Western Chapter of the International Society of Arboriculture and the City of Livermore Municipal Code Section 12.20.

1.6 QUALITY CONTROL

- A. The CONTRACTOR shall be held responsible for any damage to trees, vegetation, or private property caused by its construction operations or trees that die after improper pruning or trimming. At the CITY'S option, the CONTRACTOR shall be assessed for the value of the damage to the trees, vegetation or private property based upon the International Society of Arboriculture's Standard method of valuation.
- B. The CONTRACTOR shall furnish all tools and equipment and employ trained tree trimmer personnel under the direction of the arborist to operate all equipment and perform all handwork efficiently and skillfully.
- C. The trimming work shall be performed in a safe and proper manner adhering to CAL-OSHA standards and ANSI regulations.

PART 2 -- PRODUCTS

2.1 TREE SEALER

- A. Tree sealer shall be as manufactured by **Ready to Use "Tre-hold,"** or equal, tree sealer conforming to the following specifications:
 - 1. A commercial grade, quick drying, tree sealer which shall have suitable qualities to coat and seal damaged bark and cuts, and inhibit secondary growth. Application shall be made in accordance with the manufacturer's printed recommendations.

PART 3 -- EXECUTION

3.1 ORDER OF WORK

- A. Trimming and/or removal shall be performed only on trees or vegetation requiring work in order to conform to the parameters set forth in this Section, unless otherwise directed by the ENGINEER.
- B. The CONTRACTOR shall identify all trees and vegetation determined to require trimming or removal with temporary chalk paint markings on the adjacent street travel way for review by the ENGINEER prior to beginning any cutting operations.
- C. A list verifying the address and/or location of all trees or vegetation to be trimmed or removed shall be prepared by the CONTRACTOR and submitted to the ENGINEER for review by the City's designated landscape specialist.
- D. The CONTRACTOR shall notify all property occupants when trees or vegetation is to be trimmed or removed in accordance with this Section. All written notifications to be distributed to affected property occupants shall be submitted to the ENGINEER for review prior to distribution. The CONTRACTOR shall distribute notifications and post temporary no parking restrictions per this Section a minimum of 72 hours in advance of any cutting operations.

3.2 PUBLIC NOTIFICATION

- A. All residents, businesses, and public facilities affected by the WORK shall be provided with prior notification in accordance with Division 1, General Requirements. All notifications shall be in a form of written posting, setting the time and date that the cutting operations will take place. The CONTRACTOR shall follow up each notification with submittal to the Engineer of a signed affidavit confirming time and date of each notification or posting.
- B. "No Parking" zones shall also be established where necessary to accomplish trimming operations in conformance with the Division 1, General Technical Requirements.

3.3 TREE AND VEGETATION TRIMMING

- A. Tree limbs or other vegetation obstructions shall be trimmed to a minimum height of 11 feet above the roadway, as measured from the lip of gutter, and to 8 feet-9 inches above the sidewalk, as measured from the back of sidewalk. The crown of the tree shall be balanced as necessary. Balancing of the crown of the tree shall be accomplished by thinning, reducing end weights, shortening long heavy limbs, removing deadwood, weak limbs, and sucker growth. Limbs shall be pruned back to an appropriate lateral branch.
- B. Tree limbs shall not be torn or ripped. All final pruning cuts shall be clean cuts.
- C. Trees and vegetation shall be trimmed in such a manner as not to injure adjacent trees, plants, and/or improvements which are to be preserved.
- D. Cuts or damage to areas of tree bark caused by the CONTRACTOR'S trimming operations shall be treated with a sealer such as "Tre-hold," or equivalent, as approved by the ENGINEER. Application of the tree sealer shall be made according to the manufacturer's printed recommendations.
- E. All trimmings and debris generated from these operations shall be removed completely from both the public right of way and adjacent private property and properly disposed of in a legal manner in conformance with the Division 1, General Requirements.

- END OF SECTION -

SECTION 311316

ROOT PRUNING

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide all materials, equipment, and labor necessary to perform all root pruning necessary to construct improvements, and all 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. Section 321300 Concrete Surface Improvements.
- C. Division 1 General Requirements.

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

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

1. Standard Specifications:

- Section 12 Construction Area Traffic Control Devices.

B. **Commercial Standards:**

- 1. CAL-OSHA Standards.
- 2. ANSI Regulations.

1.4 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall submit copies of the supervising arborist's certification from the Western Chapter of the International Society of Arboriculture to the ENGINEER prior to performing the WORK.

1.5 QUALITY ASSURANCE

- A. All root pruning work shall be performed under the direct supervision of and in conformance with the recommendations of an arborist certified by the Western Chapter of the International Society of Arboriculture.

1.6 QUALITY CONTROL

- A. The CONTRACTOR shall be held responsible for any damage to trees, vegetation, or private property caused by its construction operations.
- B. The CONTRACTOR shall furnish all tools and equipment and employ sufficient trained personnel to operate all equipment and perform all handwork efficiently and skillfully.
- C. The root pruning work shall be performed in a safe and proper manner adhering to CAL-OSHA standards and ANSI regulations.

PART 2 -- PRODUCTS

2.1 ROOT SEALER

- A. Root sealer shall be manufactured by **Ready to Use "Tre-hold,"** or equal conforming to the following specifications:
 - 1. A commercial grade, quick drying, root sealer which shall have suitable qualities to coat and seal damaged bark and cuts, and inhibit secondary growth. Application shall be made in accordance with the manufacturer's printed recommendations.

PART 3 -- EXECUTION

3.1 TRAFFIC CONTROL

- A. The CONTRACTOR shall use suitable measures, including signs, portable barricades, tape and flaggers, as required in conformance with the Division 1, General Requirements.

3.2 ROOT PRUNING

- A. Where concrete repair work occurs adjacent to or over tree roots where damage has been caused by root intrusion, the roots shall be removed to a minimum depth of at least 8 inches below the bottom of the new concrete improvements. Roots shall be cut as far from the tree as possible alongside the edge of the new curb or sidewalk. Roots must be completely severed prior to their removal.
- B. If removal of a root is determined by the Arborist to potentially endanger the stability or health of the tree, the CONTRACTOR shall provide the ENGINEER with the findings and avoid cutting the roots until approval from the ENGINEER has been received.
- C. Root pruning shall not be performed until after removal of the existing concrete improvements but shall be completed prior to base and subgrade excavations. Root pruning shall be achieved by use of a **Vermeer** root cutter or equivalent method approved by the ENGINEER. Tree roots may occasionally be cut by sawing or chopping with a sharp saw or axe on an individual case basis, but only with the express approval of the Arborist and the ENGINEER.
- D. Tree roots shall not be torn or ripped. All final root pruning cuts shall be clean cuts.
- E. Cuts on tree roots 1-inch diameter or larger and areas of bark or skin damage caused by root pruning operations shall be treated with a root sealer and growth inhibitor.
- F. At sites where excavation has exposed living roots to the air the CONTRACTOR shall cover the exposed roots within 2 hours of exposure with base rock, soil, moist burlap or other means acceptable to the Arborist and the ENGINEER. Inspection by the ENGINEER is required prior to permanent backfill.
- G. Roots shall be pruned in such a manner as not to injure adjacent trees, plants and/or improvements which are to be preserved.
- H. In addition to root pruning, trimming of the tree crown may be required as determined by the Arborist. Trimming of the tree crown shall be in conformance with PART 3 - Execution of Section 311300 "Selective Tree and Vegetation Trimming and Removal."

- END OF SECTION -

SECTION 312300 - UTILITY EARTHWORK

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide all materials, equipment, and labor necessary to perform and complete all utility earthwork as shown on the Drawings and as specified herein.
- B. The work of this Section includes all earthwork required for construction of the project. Such earthwork shall include, but may not necessarily be limited to, the loosening, removing, loading, transporting, depositing, and compacting in its final location of all materials wet and dry, as required for the purposes of completing the work, which shall include, but not necessarily be limited to, the furnishing, placing, and removing of sheeting, shoring and bracing necessary to safely support the sides of all excavations; all pumping, ditching, draining and other required measures for the removal or exclusion of water from the excavation; the supporting of structures above and below the ground; all backfilling around structures and all backfilling of trenches and pits; the disposal of excess excavated materials; borrow of materials to make up deficiencies for fills; and all other incidental earthwork.
- C. Hazardous materials shall be handled in accordance with all regulatory agency requirements.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 024100 Demolition.
- B. Section 015700 Site Preparation.
- C. Section 310000 Earthwork.
- D. Section 312323 Controlled Low Strength Materials (CLSM).
- E. Division 2 and 5 Pipe Sections as applicable.
- F. Section 328000 Irrigation Systems.
- G. Section 329113 Landscape Soil Preparation.
- H. Section 329300 Landscape Planting.
- I. Section 331100 Piping, General.
- J. Division 1 General Requirements.

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. State Codes:

California Labor Code.

Construction Safety Orders of the State of California.

B. State of California (Caltrans) Standards:

1. Standard Specifications:

Section 25	Aggregate Subbases.
Section 26	Aggregate Bases.
Section 68	Subsurface Drains.
Section 88	Engineering Fabrics

C. **Commercial Standards:**

ASTM D 422	Test Method for Particle-Size Analysis of Soils.
ASTM D 1556	Test Method for Density of Soil in Place by the Sand-Cone Method.
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 1633	Test Method for Compressive Strength of Molded Soil-Cement Cylinders.
ASTM D 2419	Method for Sand Equivalent Value of Soils and Fine Aggregate.
ASTM D 2487	Test Method for Classification of Soils for Engineering Purposes.
ASTM D 2922	Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
ASTM D 3017	Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
ASTM D 3776	Test Methods for Mass Per Unit Area (Weight) of Woven Fabric.
ASTM D 3786	Method of Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabrics: Diaphragm Bursting Strength Tester Method.
ASTM D 4253	Test Methods for Maximum Index Density of Soils Using a Vibratory Table.
ASTM D 4254	Test Methods for Minimum Index Density of Soils and Calculation of Relative Density.
ASTM D 4318	Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
ASTM D 4491	Test Methods for Water Permeability of Geotextiles by Permittivity.

ASTM D 4632	Test Method for Grab Breaking Load and Elongation of Geotextiles.
ASTM D 4751	Test Method for Determining the Apparent Opening Size of a Geotextile.
OSHA	Occupational Safety and Health Administration.

1.4 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR'S attention is directed to the provisions for "Shoring and Bracing Drawings" in Section 6705 of the California Labor Code. The CONTRACTOR, prior to beginning any trench or structure excavation 5 feet deep or over, shall submit to the ENGINEER for review for compliance with Section 6705 the CONTRACTOR'S detailed plan showing design of all shoring, bracing, sloping of the sides of excavation, or other provisions for worker protection against the hazard of caving ground during the excavation of such trenches or structure excavation. If such plan varies from the shoring system standards established in the Construction Safety Orders of the State of California, such alternative system plans shall be prepared, stamped and signed by a civil or structural engineer licensed in the State of California at the CONTRACTOR'S expense.
- B. **Certificates of Compliance:** Certificates of Compliance shall be provided for all products and materials proposed to be used under this Section.
- C. For all materials that are not pre-approved by the CITY the CONTRACTOR shall designate the source and/or submit samples of all materials in advance of their use for required testing and ENGINEER'S approval. All testing costs shall be at the CONTRACTOR'S expense.

1.5 QUALITY ASSURANCE

- A. **General:** All soils testing will be done by a testing laboratory of the CITY'S choice at the CITY'S expense except as otherwise specified in Paragraph 1.5 C. below.
- B. Where soil material is required to be compacted to a percentage of maximum density the maximum density at optimum moisture content will be determined in accordance with ASTM D 1557. Where cohesionless, free draining soil material is required to be densified to a percentage of relative density the calculation of relative density will be determined in accordance with ASTM D 4253 and D 4254. Field density in-place tests will be performed in accordance with ASTM D 2922, or by such other means acceptable to the ENGINEER.
- C. In case the first test and one re-test of the fill or backfill show non-compliance with the requirements the CONTRACTOR shall accomplish such remedy as may be required to insure compliance. Subsequent re-testing after the first re-test to show compliance shall be at the CONTRACTOR'S expense.
- D. The CONTRACTOR shall notify the ENGINEER at least 48 hours prior to performing any utility excavation.

PART 2 -- PRODUCTS

2.1 SUITABLE BACKFILL MATERIALS

- A. Suitable Backfill shall be a selected or processed clean, fine earth, rock, or sand, free from objectionable material, vegetation, or other deleterious substances.
- B. The following TYPES of backfill materials are designated and defined as follows:

- TYPE 1. **Sand** shall be material with 100 percent passing a 3/8-inch sieve, at least 90 percent passing a No. 4 sieve, and a sand equivalent value not less than 30.
- TYPE 2. **Class 2 Aggregate Base** shall be crushed rock aggregate base material meeting the requirements of Section 26, "Aggregate Bases," for 19 millimeter maximum grading, of the Caltrans Standard Specifications.
- TYPE 3. **Class 1, Type A or B, Permeable Material** shall be crushed stone, or gravel, durable and free from slaking or decomposition under action or alternate wetting or drying, uniformly graded, and shall meet the requirements of Section 68-1.025 for Class 1, "Permeable Material," of the Caltrans Standard Specifications.
- TYPE 4. **Class 2 Permeable Material** shall be crushed rock or gravel, durable and free from slaking or decomposition under the action of alternate wetting or drying, uniformly graded, and shall meet the requirements of Section 68-1.025 for Class 2 "Permeable Material," of the Caltrans Standard Specifications.
- TYPE 5. **Manufactured Backfill** shall be manufactured, angular, granular, crushed stone, rock, or slag with 100 percent passing a one-inch sieve and less than one percent passing a No. 4 sieve.
- TYPE 6. **Controlled Low Strength Materials (CLSM)** shall conform to the requirements of Section 02320 "Controlled Low Strength Materials (CLSM)."
- TYPE 7. **Native** material shall be material obtained from on-site excavations, provided the materials are not classified as unsuitable. Native material shall be free of stones, lumps, broken concrete or bituminous surfacing over 4 inches in diameter, objectionable material, vegetation, and deleterious substances.
- TYPE 8. **Topsoil** material may be material which has been obtained at the site or may be imported, and shall meet the requirements of Section 02911, "Landscape Soil Preparation." Removal of the topsoil shall be done after the area has been stripped of vegetation and debris as specified.
- TYPE 9. **Aggregate Subbase** shall conform to the grading and quality requirements of Section 25, "Class 2 Aggregate Subbase" of the Caltrans Standard Specifications.

2.2 UNSUITABLE BACKFILL MATERIAL

- A. Unsuitable soils for backfill material shall include soils which, when classified under ASTM D 2487, fall in the classifications of Pt, OH, or OL. Types CH and MH soils will be permitted in unimproved areas only where required compaction and stability can be demonstrated. In addition, any soil which cannot be compacted sufficiently to achieve the percentage of maximum density specified for the intended use, shall be classified as unsuitable material.
- B. Any material determined to be hazardous is defined as unsuitable material.
- C. Washed, smooth rock (pea gravel) is classified as unsuitable material.
- D. Where moisture content of the material is not in conformance with Section 310000, "Earthwork," the material will be classified as unsuitable material.

2.3 USE OF SUITABLE BACKFILL MATERIAL TYPES

- A. The CONTRACTOR shall use the types of materials as designated herein for all required backfill construction.

B. Backfill material types shall be used in conformance with the following provisions:

1. **Bedding** backfill, as defined under PART 3 - EXECUTION of this Section herein, shall be Sand; Class 2 Aggregate Base; Class 1, Type A Permeable Material; or Class 2 Permeable Material, meeting the requirements of Product Types 1, 2, 3A, or 4.
2. **Pipe Zone** backfill, exclusive of bedding, as defined under PART 3 - EXECUTION of this Section herein, shall be as follows:
 - a. Plastic pipe shall be backfilled with Sand meeting the requirements of Product Type 1.
 - b. Mortar coated pipe, concrete pipe, and ductile iron pipe shall be backfilled with Sand; Class 2 Aggregate Base backfill material; Crushed Rock or Gravel, meeting the requirements of Product Types 1, 2, 3A, or 4.
 - c. Coal tar enamel coated pipe, polyethylene encased pipe, tape wrapped pipe, and other non-mortar coated pipe shall be backfilled with Sand; or natural, rounded, non-crushed material, meeting the gradation requirements of Product Types 1, 3 A, or 4.
 - d. Vitrified clay pipe shall be backfilled with Sand, or Manufactured Backfill material, meeting the requirements of Product Type 1 or 5; or Class 2 Aggregate Base; Class 1, Type A Permeable Material; or Class 2 Permeable Material, meeting the requirements of Product Types 2, 3A, or 4, only if properly compacted with hand tampers or vibratory compactors as appropriate.
 - e. Backfill for sub-drainage systems shall be designed on a case-by-case basis.

The pipe zone backfill for all other pipelines excluding those listed above shall be Sand; Class 2 Aggregate Base; Class 1 Type A Permeable Material; Class 2 Permeable Material; Manufactured Backfill; meeting the requirements of Product Types 1, 2, 3A, 4, or 5. **Note:** Where pipelines are installed on grades exceeding 4 percent, and where backfill materials are graded such that there is less than 10 percent passing a No. 4 sieve, trench plugs of impermeable clay type material or concrete shall be provided at minimum intervals of 200 feet.

3. Trench **Zone** backfill as defined under PART 3 - EXECUTION of this Section herein, shall be Sand; Class 2 Aggregate Base; Class 1, Type A, Permeable Material; Class 2 Permeable Material; Manufactured Backfill; Native; or Aggregate Subbase meeting the requirements of Product Types 1, 2, 3A, 4, 5, 6, 7, or 9.
4. **Final Zone** backfill as defined under PART 3 - EXECUTION of this Section herein, shall consist of the following materials for each condition listed below.
 - a. Final Zone backfill under paved areas shall be Class 2 Aggregate Base, CLSM, or Class 2 Aggregate Subbase, meeting the requirements of Product Types 2, 6, or 9.
 - b. Final Zone Backfill in unimproved areas shall be Native or Class 2 Aggregate Subbase meeting the requirements of Product Types 7 or 9.
 - c. Final Zone backfill in landscape areas shall be Native meeting the requirements of Product Type 7. Topsoil and amendments shall be Product Type 8 as specified in Section 02911, "Landscape Soil Preparation," and as shown on the Drawings.
 - d. Final Zone backfill under graveled roads shall be Class 2 Aggregate Base, CLSM, Native, or Class 2 Aggregate Subbase meeting the requirements of Product Types 2, 6, 7, or 9.
5. **Minor structures.** Backfill materials around minor structures shall be any Trench Zone Product Type except Sand, Native, or Topsoil, Product Types 1, 7, or 8.

- 6. **Over-excavation** backfill shall be Class 1, Type B Permeable Material meeting the requirements of Product Type 3B. For wet trench conditions place a filter fabric on top and below of the permeable material to prevent migration of fines.

2.4 FILTER FABRIC

- A. Filter fabric shall be non-woven synthetic fabric meeting the requirements of Section 88-1.03, "Filter Fabric," of the Caltrans Standard Specifications. Filter fabric shall be non-woven synthetic fabric with a minimum Grab Strength of 90 pounds; a minimum Burst Strength of 180 pounds, a minimum Puncture Strength of 50 pounds, a Water Flow Rate of at least 40 gal/min/sf, and an Apparent Opening Size of between 60 and 110.

2.5 STEEL PLATE

- A. When steel plate bridging is provided in-lieu of backfill and temporary asphalt, it shall conform to Section 602.1 of the Caltrans Encroachment Permit Manual, with the following minimum thicknesses:

Trench Width	Minimum Plate Thickness
(10") 0.25 m	(1/2") 13 mm
(1' - 11") 0.58 m	(3/4") 19 mm
(2' - 7") 0.80 m	(7/8") 22 mm
(3' - 5") 1.04 m	(1") 25 mm
(5' - 3") 1.60 m	(1 1/4") 32 mm

For spans greater than 5 feet-3 inches, a structural design shall be prepared by a California registered civil engineer.

PART 3 -- EXECUTION

3.1 GENERAL

- A. Where abandoned underground structures are encountered in the street areas, remove to sufficient depth to allow underground lines to cross, backfill and compact during rough grading. The ENGINEER may require further work to be done if visual inspection indicates during construction.

3.2 MINOR STRUCTURE EXCAVATION

- A. **General:** Except when specifically provided to the contrary, excavation shall include the removal of all materials of whatever nature encountered, including all obstructions of any nature that would interfere with the proper execution and completion of the work. The removal of said materials shall conform to the lines and grades shown on the Drawings or ordered by the ENGINEER. Unless otherwise provided, the entire construction site shall be stripped of all vegetation and debris, and such material shall be removed from the site prior to performing any excavation or placing any fill. The CONTRACTOR shall furnish, place, and maintain all supports and shoring that may be required for the sides of the excavations, and all pumping, ditching, or other measures required for the removal or exclusion of water, including storm water, groundwater, and wastewater reaching the site of the work from any source so as to prevent damage to the work or adjoining property. Excavations shall be sloped or otherwise supported in a safe manner in accordance with applicable State safety requirements and the requirements of OSHA Safety and Health Standards for Construction (29CFR1926). The limits of structure excavation shall be a minimum of 12 inches beyond the outside edge of the structure, and at a minimum no larger than necessary to facilitate backfill, compaction and testing operations. For structures poured against undisturbed soil the width of the structure wall shall be no more than 2 inches greater than specified or shown on the Drawings.

- B. **Excavation Beneath Minor Structures:** Except where otherwise specified for a particular structure or as directed by the ENGINEER, excavation shall be carried to the grade of the bottom of the structure. When directed by the ENGINEER, areas beneath minor structures shall be over-excavated. When such over-excavation is directed, both over-excavation and subsequent backfill to the required grade shall be performed. After over-excavation is performed and before backfill is placed, the exposed surface shall be scarified to a depth of 6 inches, brought to optimum moisture content, and rolled with heavy compaction equipment to obtain 90 percent of maximum density.

3.3 PIPELINE AND UTILITY TRENCH EXCAVATION

- A. **Trench Width:** Unless otherwise shown or directed, excavation for pipelines and utilities shall be open-cut trenches. Trench widths shall be kept as narrow as is practical for the method of densification selected by the CONTRACTOR, but shall have a minimum width at the bottom of the trench equal to the outside diameter of the pipe plus 24 inches. The maximum width at the top of the pipe shall be equal to the outside diameter of the pipe plus 36 inches for pipe diameters 18 inches and larger, and to the outside diameter of the pipe plus 24 inches for pipe diameters less than 18 inches. For deep trenches, the maximum width requirement may be waived for constructability reasons with the written approval of the ENGINEER upon submittal of pipe loading calculations prepared by a registered civil engineer in accordance with the City's pipe design criteria shown in the Development Plan Check and Procedures Manual at the CONTRACTOR's expense. For telecommunications conduits (electrical, telephone, cable TV/communication conduits), street light and traffic signal conduits, the width of the trench shall be as shown on the City standard details.
- B. **Subgrade:** The surface of the subgrade after compaction shall be hard, uniform, smooth, self draining, and true to grade and cross section.
- C. **Trench Bottom:** The pipe bedding shall be given a final trim establishing grade such that each pipe section when first laid will be continually in contact with the bedding along the extreme bottom of the pipe. Rounding out the trench bottom or bedding to form a cradle for the pipe will not be allowed. The CONTRACTOR shall excavate for bell holes and fittings.
- D. **Open Trench:** The maximum amount of open trench permitted in any one location shall be the length necessary to accommodate the amount of pipe installed and backfilled in a single day. All trenches shall be fully backfilled at the end of each day or, in lieu thereof, shall be covered by heavy steel plates adequately braced and capable of supporting vehicular traffic in those locations where it is impractical to backfill at the end of each day. The above requirements for backfilling or use of steel plate may be waived in cases where the trench is located further than 100 feet from any travelled roadway or occupied structure. In such cases, however, barricades and warning lights meeting safety requirements shall be provided and maintained.
- E. **Trench Over-Excavation:** Where indicated trenches shall be excavated to the depth shown, and then backfilled to the grade of the bottom of the Pipe Zone.
- F. **Over-Excavation:** When ordered by the ENGINEER, whether or not indicated on the Drawings, trenches shall be over-excavated beyond the depth shown. Such over-excavation shall be to the depth ordered. The trench shall then be backfilled to the grade of the bottom of the Pipe Zone.
- G. Where pipelines are to be installed in embankment or structure fills, the fill shall be constructed to a level a minimum of 2 feet above the top of the pipe, as directed by the ENGINEER, or as recommended by the pipe manufacturer, whichever is greater, before the trench is excavated.
- H. **Continuous Sheet piling and Shoring:** In areas of known existing underground utilities or street intersections with various utility lines traversing throughout the intersection, the CONTRACTOR shall anticipate the potential for disturbed soils caused by loose backfill from existing utilities and use continuous sheet piling and shoring or other methods necessary for controlling loose backfill from entering the trench while installing the new pipeline or utilities.

3.4 OVER-EXCAVATION NOT ORDERED, SPECIFIED, OR SHOWN

- A. Any over-excavation carried below the grade ordered, specified, or shown, shall be backfilled to the required grade and densified with the specified material and compaction. Such work shall be performed by the CONTRACTOR at its own expense.

3.5 EXCAVATION IN LAWN AREAS

- A. Where excavation occurs in lawn areas, the sod shall be carefully removed, stockpiled, watered and preserved for replacement. Excavated material may be placed on the lawn provided that a tarp or other suitable method is employed to protect the lawn from damage. The lawn shall not remain stockpiled for more than 48 hours. Immediately after completion of backfilling and testing of the pipeline, the sod shall be replaced in a manner so as to restore the lawn as near as possible to its original condition. CONTRACTOR shall provide new sod, in kind, if removed sod has remained stockpiled for more than 48 hours.
- B. All other landscaping shall be replaced in kind in conformance with Section 329113, "Landscape Soil Preparation," and Section 329300, "Landscape Planting," as shown on the Drawings or as directed by the ENGINEER. All damaged irrigation systems, including piping and electrical wiring, shall be repaired and operating properly the same day they are damaged, in conformance with Section 328000, "Irrigation Systems."

3.6 EXCAVATION IN VICINITY OF TREES

- A. Except where trees are shown to be removed, trees shall be protected from injury during construction operations. No tree roots over 2 inches in diameter shall be cut without express permission of the ENGINEER. Trees shall be supported during excavation by any means previously reviewed by the ENGINEER.
- B. If existing roots over one inch in diameter are cut during the course of the work, the cut faces shall be thoroughly coated with emulsified asphalt made especially for use on cut or damaged plant tissues. Exposed roots shall be covered with wet burlap to prevent them from drying out.

3.7 ROCK EXCAVATION

- A. Rock excavation shall include removal and disposal of the following: (1) all boulders measuring 1/3 of a cubic yard or more in volume; (2) all rock material in ledges, bedding deposits, and unstratified masses; (3) concrete or masonry structures which have been abandoned; and (4) conglomerate deposits which are so firmly cemented that they possess the characteristics of solid rock.
- B. **Explosives and Blasting:** Use of Explosives and Blasting will not be permitted.

3.8 DISPOSAL OF EXCESS EXCAVATED MATERIAL

- A. The CONTRACTOR shall remove and dispose of all excess excavated material to a suitable site. All testing required for legal disposal of excess materials shall be conducted by the Contractor at the Contractor's expense. The proper and legal disposal shall be the responsibility of the CONTRACTOR. If the material is tested and found to be hazardous and requires disposal in a Class 1 or Class 2 landfill then the Contractor's price and contract time shall be adjusted as per the General Conditions.

3.9 BACKFILL - GENERAL

- A. Backfill shall not be dropped directly upon any structure or pipe. Backfill shall not be placed around or upon any structure for a minimum of 72 hours or until the concrete has attained sufficient design strength to withstand the loads imposed, whichever is greater.
- B. Except for Product Type 3B material being placed in over-excavated areas or trenches and unless specifically excepted by the ENGINEER, backfill shall not be placed until after all water is removed from the excavation.

3.10 PIPE AND UTILITY TRENCH ZONES AND BACKFILL

A. **Pipe Zone and Backfill:**

- 1. The Pipe Zone is defined as that portion of the vertical trench cross-section lying between a plane 6 inches below the bottom surface of the pipe, i.e., the trench subgrade, and a plane at a point 12 inches above the top surface of the pipe.
- 2. The Pipe Zone shall be backfilled with the specified backfill material. The CONTRACTOR shall exercise care to prevent damage to the pipeline coating, cathodic bonds, or the pipe itself during the installation and backfill operations.

B. **Bedding:** The bedding is defined as that portion of the Pipe Zone lying between a plane 6 inches below the bottom surface of the pipe, the trench subgrade, and a level line from the bottom of the pipe.

- 1. Bedding shall be provided for all pipelines.
- 2. After compacting the bedding the CONTRACTOR shall perform a final trim for establishing grade, such that each pipe section when first laid will be continually in contact with the bedding along the extreme bottom of the pipe.

C. **Trench Zone and Backfill:** After the Pipe Zone backfill has been placed as specified above, and after all excess water has completely drained from the trench, backfilling of the Trench Zone may proceed.

The Trench Zone is defined as that portion of the vertical trench cross-section lying between a plane 12 inches above the top surface of the pipe and a plane at a point 24 inches below the roadway subgrade in paved areas, or 24 inches below the finished surface grade in landscaped or unimproved areas.

D. **Final Zone and Backfill:** The Final Zone is defined as the last 24 inches between the top of the Trench Zone and the roadway subgrade in paved areas, and the last 24 inches of the vertical trench cross-section lying between the top of the Trench Zone and the finish final grade in landscaped or unimproved areas.

E. **Utility Crossing:** For any new pipeline installation that crosses under an existing electric, gas, telephone, or cable tv utility pipe(s) or conduit(s) the CONTRACTOR shall replace the existing backfill material around the existing utility pipe(s) or conduit(s) with PG&E SAND. PG&E SAND shall be placed from a plane 6 inches below the bottom of the lowest utility pipe or conduit to a plane 12 inches above the top of the highest utility pipe or conduit, and for the full width of the new trench. PG&E SAND backfill shall be compacted to 95 percent maximum density in conformance with COMPACTION AND BACKFILL MATERIALS as specified below.

3.11 PLACING AND SPREADING OF BACKFILL MATERIALS

- A. Backfill materials shall be placed and spread evenly in horizontal layers. The backfill layers shall be evenly spread so that when compacted each layer shall not exceed 6 inches in thickness.
- B. During spreading each layer shall be thoroughly mixed as necessary to promote uniformity of material in each layer and uniformity of moisture throughout backfill materials. Pipe Zone backfill materials shall be manually spread around the pipe so that when compacted the Pipe Zone backfill will provide uniform bearing and side support.
- C. Where the backfill material moisture content is below the optimum moisture content water shall be added before or during spreading until the proper moisture content is achieved.
- D. Where the backfill material moisture content is too high to permit the specified degree of compaction, the material shall be dried or replaced until the moisture content is satisfactory.
- E. Backfill shall be mechanically compacted by means of tamping rollers, sheepsfoot rollers, pneumatic tire roller, vibrating rollers, or other mechanical tampers. All such equipment shall be of a size and type subject to review by the ENGINEER. Impact-type pavement breakers (stompers) will not be permitted. Permission to use specific compaction equipment shall not be construed as guaranteeing or implying that the use of such equipment will not result in damage to adjacent ground, existing improvements, or new improvements. The CONTRACTOR shall make its own determination in this regard.
- F. Material for mechanically compacted backfill may be placed in loose lifts which, prior to compaction, shall not exceed the thickness specified below for various types of equipment:
 - 1. Vibratory equipment, including vibratory plates, vibratory smooth-wheel rollers, and vibratory pneumatic-tired rollers - maximum lift thickness of 2 feet.
 - 2. Rolling equipment, including sheepsfoot (both vibratory and non-vibratory), grid, smooth-wheel (non-vibratory), pneumatic-tired (non-vibratory), and segmented wheels - maximum lift thickness of 1 foot.
 - 3. Hand-directed mechanical tampers-maximum lift thickness of 4 inches.
- G. Mechanically compacted landfill shall be placed in horizontal layers of thickness not exceeding those specified above, compatible to the material being placed and the type of equipment being used. Each layer shall be evenly spread, moistened or dried, if necessary, and then tamped or rolled until the specified relative compaction has been attained.

3.12 COMPACTION OF BACKFILL MATERIALS

- A. Each layer of backfill material as defined herein, shall be mechanically compacted to the specified percentage of maximum density. Equipment that is consistently capable of achieving the required degree of compaction shall be used and each layer shall be compacted over its entire area while the material is at the required moisture content range.
- B. Flooding, ponding, or jetting shall not be used.
- C. Equipment weighing more than 10,000 pounds shall not be used closer to structure walls than a horizontal distance equal to the depth of the fill against the structure wall at that time. Hand operated power compaction equipment shall be used where use of heavier equipment is impractical or restricted due to weight limitations.
- D. **Compaction Requirements:** The following compaction test requirements shall be in accordance with ASTM D 1557 for cohesive type materials and in accordance with ASTM D 4253 and D 4254 for "non-

plastic" cohesionless free draining granular type materials. Where other agency or utility company requirements govern, the highest compaction standards shall apply.

<u>Location or Use of Fill</u>	<u>Percentage of Maximum Density</u>	<u>Percentage of Relative Density</u>
Pipe Zone backfill including bedding and overexcavated zone.	90	65
Final Zone backfill beneath paved areas or structures.	95	70
Final Zone backfill beneath unpaved access areas, landscape, or unimproved areas.	90	55
Trench Zone backfill.	90	65
Backfill beneath minor structures.	95	70
Backfill around minor structures.	90	65

Maximum Density refers to maximum dry density according to ASTM D 1557 laboratory test procedures. Percentage of Relative Density refers to ASTM D 4253 and ASTM D 4254 laboratory test procedures. Relative density should only be used for "non-plastic" cohesionless free draining, granular-type materials.

- E. **Trench Backfill Requirements:** The pipe class has been structurally designed based upon the trench configuration previously specified herein.
1. The CONTRACTOR shall maintain the previously specified trench width up to a horizontal plane lying 12 inches above the top of the pipe.
 2. If, at any location under said horizontal plane, the CONTRACTOR slopes the trench walls or exceeds the maximum trench widths indicated the Pipe Zone backfill shall be "improved" or the pipe class improved at no additional cost to the CITY. "Improved" backfill shall mean Control Low Strength Materials or other equivalent materials acceptable to the ENGINEER.
 3. If the allowable deflection specified for the pipe is exceeded, the CONTRACTOR shall expose and reround or replace the pipe, repair all damaged lining and coating, and reinstall the Pipe Zone material and Trench Zone backfill as specified.
 4. All trenches shall have a minimum of 2 inches of temporary asphalt placed daily and maintained unless final paving can be completed in the same day. Temporary asphalt shall be placed flush with adjacent pavement grade.

Steel plates may be used to cover open trenches in-lieu of backfill and temporary asphalt pavement.

3.13 STEEL PLATE

- A. **General:** When backfilling operations of an excavation in the traveled way, whether transverse or longitudinal, cannot be properly completed within a work day, steel plate bridging with a non-skid surface and shoring may be required to preserve unobstructed traffic flow.
- B. When steel plate bridging is required, the following conditions shall apply:

1. Steel plates used for bridging must extend a minimum of 12 inches beyond the edges of the trench.
 2. Steel plate bridging shall be installed to operate with minimum noise.
 3. The trench shall be adequately shored to support the bridging and traffic loads.
 4. Temporary paving with cold asphalt concrete shall be used to feather the edges of the plates, if plate installation by Method (2) is used.
 5. Bridging shall be secured against displacement by using adjustable cleats, shims or other devices.
- C. Steel plate bridging and shoring shall be installed using either Method (1) or (2):
1. Method 1 For speeds more than 45 mph:

The pavement shall be cold planed to a depth equal of the thickness of the plate and to a width and length equal to the dimensions of the plate.
 2. Method 2 For speeds 45 mph or less:

Approaching plate(s) and ending plate (if longitudinal placement) shall be attached to the roadway by a minimum of 2 dowels pre-drilled into the corners of the plate and drilled 2 inches into the pavement. Subsequent plates are butted to each other. Fine graded asphalt concrete shall be compacted to form ramps, maximum slope 8.5 percent with a minimum 12 inch taper to cover all edges of the steel plates. When steel plates are removed, the dowel holes in the pavement shall be backfilled with either graded fines of asphalt concrete mix, concrete slurry or an equivalent slurry.
- D. Steel plate bridging should not exceed 4 consecutive working days in any given week.

- END OF SECTION -

SECTION 312323 - CONTROLLED LOW STRENGTH MATERIALS (CLSM)

PART 1 -- GENERAL

1.1 REQUIREMENTS

- A. Controlled Low Strength Materials (CLSM) will be allowed only on a case-by-case basis with the written approval of the ENGINEER.
- b. The CONTRACTOR shall provide all materials, equipment, and labor necessary to furnish and place CLSM, complete in place, and shall mix, place, finish, and do all other work to produce a cementitious hand excavatable mixture of aggregate, cement, pozzolan, water, and admixtures to be used as backfill or pipe abandonment fill, as shown on the Drawings and as specified herein.
- C. The CONTRACTOR is hereby advised that flotation or displacement of the pipe may occur during installation of the CLSM. The CONTRACTOR shall make necessary provisions to ensure that the pipe is installed according to the alignment and grade specified on the Drawings. Any pipe that is floated shall be removed and replaced at the CONTRACTOR'S expense.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 312300 Utility Earthwork.
- B. Division 1 General Requirements.

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. **Commercial Standards:**

ACI 229	Controlled Low Strength Materials.
ACI 232	Fly Ash/Other Pozzolans in Concrete.
ASTM C 31	Practice for Making and Curing Concrete Test Specimens in the Field.
ASTM C 39	Test Method for Compressive Strength of Cylindrical Concrete Specimens.
ASTM C 42	Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
ASTM C 94	Specification for Ready-mixed Concrete.
ASTM C 150	Specification for Portland Cement.
ASTM C 260	Specification for Air-Entraining Admixtures for Concrete.
ASTM C 494	Specification for Chemical Admixtures for Concrete.
ASTM C 618	Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Additive in Portland Cement Concrete.
ASTM D 1586	Method for Penetration Test and Split Barrel Sampling of Soils.

ASTM D 1633	Test Method for Compressive Strength of Molded Soil-Cement Cylinders.
ASTM D 2922	Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow-Depth).
ASTM D 3017	Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow-Depth).

1.4 CONTRACTOR SUBMITTALS

- A. **Mix Design:** Prior to beginning any work the CONTRACTOR shall submit to the ENGINEER for review, the pre-approved CLSM mix designs which shall show the proportions and gradations of all materials proposed for each class and type of CLSM to be used.
- B. **Certificate 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 CONTROLLED LOW STRENGTH MATERIALS (CLSM)

A. **General:**

1. CLSM shall be a flowable, hand-excavatable mixture of cement, pozzolan, coarse and fine aggregate and water which has been mixed in accordance with ASTM C 94.
2. **Composition:** The following parameters shall be within the indicated limits and as necessary to produce the indicated compressive strengths.
 - a. Mix proportions shall be as approved.
 - b. Entrained air content shall be between 8 percent minimum and 20 percent maximum.
 - c. Water reducing agent content shall be as approved.
3. **Properties:**
 - a. Density shall be between 120 PCF minimum and 135 PCF maximum.
 - b. Slump shall be as approved.
 - c. Compressive strength at 28 days for flowable CLSM shall be between 50 psi minimum and 150 psi maximum.

- B. **Cement:** Cement shall be Type II in accordance with the requirements of ASTM C 150.
- C. **Pozzolan:** Pozzolan shall be added to improve the flowability and shall be Type F in accordance with the requirements of ASTM C 618.
- D. **Aggregate:** Coarse aggregate shall consist of a well graded mixture of crushed rock, soil, or sand with a maximum size aggregate of ½ inch. 100 percent shall pass the ¾ inch sieve. Not more than 30 percent shall be retained by the 3/8 inch sieve and not more than 12 percent shall pass the No. 200 sieve. All material shall be free from organic matter and not contain more alkali, sulfates, or salts than the native materials at the site of the WORK.

E. **Admixtures:**

1. Air entraining shall be added to improve the workability and shall be in accordance with the requirements of ASTM C 260.

F. **Water:** Water shall be clean and free from objectionable quantities of silty organic matter, alkali, salts, and other impurities.

G. **Controlled Low Strength Materials (CLSM):**

1. CLSM shall be a mixture of cement, pozzolan, coarse and fine aggregate, admixtures, and water batched by a ready mix concrete plant and delivered to the WORK by means of standard transit mixing trucks. The mixture shall produce a cementitious, flowable, hand excavatable material.
2. The actual mix proportion and slump shall be as determined by the approved mix design.
3. The entrained air content shall be a minimum of 8 percent and a maximum of 20 percent as required by the CONTRACTOR to meet the uses specified herein.

PART 3 -- EXECUTION

3.1 TESTING

- A. All testing during the work will be done by a testing laboratory of the CITY'S choice at the CITY'S expense except as otherwise noted.
- B. In case the tests of the CLSM show non-compliance with the specifications the CONTRACTOR shall accomplish such remedy as may be required to insure compliance. Subsequent testing to show compliance shall be by a testing laboratory selected by the CITY and shall be at the CONTRACTOR'S expense.
- C. **Density:** The installed density of the material will be determined in accordance with ASTM D 2922.
- D. **Compressive Strength:** The compressive strength will be determined in accordance with ASTM C 39.

3.2 PREPARING PLACEMENT FOR CLSM

- A. The trench subgrade or compacted fill to receive CLSM shall be complete and acceptable in accordance with Section 312300, "Utility Earthwork."

3.3 DELIVERING CLSM

- A. CLSM shall be delivered to the WORK in standard transit mix trucks.

3.4 PLACING CLSM

- A. CLSM shall be delivered in place by means of tailgate discharge, conveyor belts, pumped in place, or other means acceptable to the ENGINEER.
- B. CLSM shall be directed in place by means of a vibrator, shovel or rod to ensure that all voids, crevices, and pockets are filled with CLSM. Care shall be taken to avoid over-consolidation of the material separating the large and fine aggregate.

- C. CLSM shall be continuously placed against undisturbed in-situ earth material unless otherwise approved by the ENGINEER. Where new CLSM must be placed against existing CLSM, the placement shall be clean of all loose and foreign material. The surface of existing CLSM shall be soaked a minimum of one hour before placement of fresh CLSM. No standing water will be allowed before starting placement of fresh CLSM.
- D. When placing CLSM for trench plugs (trench dams), the CONTRACTOR shall ensure that no voids exist around the pipe barrel and that the CLSM completely fills the trench width, including keyways, for the full depth required, as shown on the Drawings.

3.5 PROTECTING CLSM

- A. CLSM shall be protected from running water, rain, freezing or other conditions that could damage the material until the material has been accepted and final fill complete.
- B. No equipment, traffic, or backfill shall be allowed on the CLSM until the surface of the CLSM is able to withstand a 20 psi load without displacement or damage. If necessary, the CONTRACTOR shall provide steel trench plates that span the trench, as specified in Section 312300, "Utility Earthwork," until the CLSM has reached the required strength.

3.6 CURING

- A. CLSM shall be kept damp for a minimum of 7 days or until final fill is completed.

- END OF SECTION -

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:

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

at 77-degrees F.

Resilience ASTM D 3407 30 percent minimum
at 77-degrees F.

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.

<u>Test</u>	<u>Test Method</u>	<u>Requirements</u>
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/m ²)

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 31000, "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 than 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 overlaid 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 International Slurry Surfacing Association.
(revised 2005) Recommended Performance Guidelines For Emulsified Asphalt Slurry Seal.

- ISSA A143 International Slurry Surfacing Association.

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* @ 20°C, 10 rad/sec, MPa	AASHTO TP 5	Report Only
Penetration @ 25°C	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	57°C
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:

$$1 - (\text{calculated lbs. of aggregate per SY} / 20 \text{ lbs. per SY}) = \text{reduction factor}$$

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	ASTM D 2042 ^a	50	35
% Nonvolatile soluble in tri-clorethylene		10	
Wet track abrasion, g/m ²	ASTM D 3910		380
Dried film color		Black	
Viscosity	ASTM D 562	75 KU ^b	

^aWeigh 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:

<i>Primary Aggregate Nominal Size</i>	<i>Sieve Sizes</i>	<i>Limits of Proposed Gradation</i>
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)
TiO₂ 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 all 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 without 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, if 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 then 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
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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
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ASTM A-48	Standard Specification for Gray Iron Castings
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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-eighths 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-foot 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-inch to 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 ratio 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 ratios. 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 or 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, 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 -

CITY OF LIVERMORE
TECHNICAL SPECIFICATIONS

DIVISION 33 – UTILITIES

**SECTION 330130 - SANITARY SEWER AND
STORM DRAIN SYSTEM LEAKAGE TESTING**

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide all materials, equipment and labor to perform and complete pipeline flushing and testing, complete, for sanitary sewer and storm drain system piping, as specified herein.
- B. The CONTRACTOR shall be responsible for conveying test water from the source to the point of usage and also for proper disposal, as required, of water used in the testing operations. All costs associated with supply and disposal of test water shall be at the CONTRACTOR'S expense.
- C. Structural (Deflection) testing requirements for sanitary sewers and storm drains are as specified in the various appropriate piping sections.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. **Commercial Standards:**

ASTM C 828	Standard Test Method for Low-Pressure Air Test of Vitrified Clay Pipe Lines.
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1.3 CONTRACTOR SUBMITTALS

- A. A testing schedule, including proposed plans for conveyance, control and disposal of test water shall be submitted in writing to the ENGINEER for review a minimum of 72 hours before testing is to start.
- B. The CONTRACTOR shall submit laboratory calibration certificates for all gages to the ENGINEER for review along with the testing schedule.

PART 2 -- PRODUCTS

2.1 MATERIAL REQUIREMENTS

- A. All testing equipment and materials shall be provided by the CONTRACTOR. No materials shall be used which would be injurious to pipeline system or structure and future function. All test gages shall be laboratory-calibrated test gages and shall be recalibrated by a certified laboratory at the CONTRACTOR'S expense prior to the leakage test.

PART 3 -- EXECUTION

3.1 GENERAL

- A. All lines shall be cleaned and flushed prior to testing using a "Wayne Ball," high pressure sewer "jets," or other methods acceptable to the ENGINEER.
- B. CONTRACTOR will be solely responsible for the proper disposal of all water used in the flushing and testing process. Disposal of all water shall be in accordance with appropriate regulatory agency requirements.
- C. All flushing and testing operations shall be performed in the presence of the ENGINEER.

3.2 TESTING OF MAINTENANCE HOLES

- A. All sanitary sewer maintenance holes shall be vacuum tested for leakage after installation in the presence of the ENGINEER. Prior to vacuum testing all maintenance holes shall be visually inspected for leaks. All leaks, cracks and lift holes shall be repaired by the CONTRACTOR, prior to vacuum testing, to the satisfaction of the ENGINEER. All repairs shall be made with non-shrink grout. The CONTRACTOR shall test the maintenance hole up to and including the cone, and shall make all repairs as necessary to achieve a final passing test. Any alternative repair methods shall be approved by the ENGINEER. All pipe inlets and outlets in the maintenance hole shall be securely plugged to sufficiently hold against vacuum pressure during testing, and removed following successful completion of the testing. A rubberized test plate shall be placed on the maintenance hole dome after potential leaks on the top of the dome have been sealed.
- B. A suitable vacuum pump shall be used to reduce the pressure inside the maintenance hole to a vacuum of ten (10) inches of mercury, stabilizing the vacuum at ten (10) inches of mercury for one (1) minute. The vacuum pump shall be shut off, and with the valves closed, the increase (loss of vacuum) shall be measured inside the maintenance hole during the test hold period. The maximum allowable pressure increase (loss of vacuum) shall be one (1) inch of mercury over a sixty (60) second test hold period. If vacuum drops below nine (9) inches of mercury within the test period, the leakage shall be considered excessive. The CONTRACTOR shall make all repairs necessary to achieve a passing test and the maintenance hole shall be retested. Maintenance holes repairs and retesting shall proceed until a passing test is completed.

3.3 TESTING OF PIPING SYSTEMS

- A. **General:** All sanitary sewer and storm drain systems and service laterals shall be tested as specified. All sanitary sewer gravity lines shall be tested for leakage using a low pressure air test. All sanitary sewer maintenance holes shall be tested for leakage, as specified. Maintenance holes shall be tested prior to backfill placement, whereas all pipe shall be backfilled prior to testing. All leakage tests shall be completed and approved prior to placing of permanent surfacing. When leakage exceeds the amount allowed, the CONTRACTOR at its expense, shall locate the leaks and make the necessary repairs or replacements in accordance with the Specifications to reduce the leakage to the specified limits. Any individually detectable leaks shall be repaired, regardless of the results of the tests.
- B. During flushing of the sewer lines, the maintenance hole at the low end of the new line shall be plugged and incoming water pumped to a drain point approved by the CITY. Before the plug can be removed, all sand, silt, gravel and other foreign material shall be completely removed from the maintenance hole.
- C. **Deflection:** All PVC non-pressure pipe shall be tested for deflection obstructions and protruding laterals by passing a "mandrel" from the nearest downstream structure to the nearest upstream structure. The "deflection test" procedure shall be acceptable to the ENGINEER. The 'mandrel' diameter shall be 95 percent of the pipe inside diameter.
- D. **Air Pressure Test:** The CONTRACTOR shall furnish all materials, equipment and labor for making an air test. Air test equipment shall be approved by the ENGINEER.

The CONTRACTOR may conduct an initial air test of the sewer main line after densification of the backfill but prior to installation of the laterals. Such tests will be considered to be for the CONTRACTOR'S convenience and need not to be performed in the presence of the ENGINEER.

Each section of the sewer shall be tested between successive maintenance holes by plugging and bracing all openings in the main sewer line and the end of all laterals. Prior to any air pressure testing, all pipe plugs shall be checked with a soap solution to detect any air leakage. If any leaks

are found, the air pressure shall be released, the leaks eliminated and the test procedure started over again.

The final leakage test of the sewer main line and laterals shall be conducted in the presence of the ENGINEER. The time and procedure for air testing vitrified clay pipe (VCP) shall be calculated in accordance with ASTM C 828.

For other pipe types, the test procedure shall be conducted by first increasing the pressure within the line to approximately 4 psi using a compressed air supply. After the air supply is turned off or disconnected, there shall be a two minute waiting period to allow stabilization of air within the sewer line before the actual test begins. In no case shall the test pressure within the line be less than 3.5 psi when the test begins. The allowable air pressure loss shall not exceed 1 psi. After completion of the test, the air pressure shall be released slowly and the test plugs shall not be removed until the air pressure is no longer measurable. The test periods for all sewer pipes other than VCP shall be determined using the Ramseier's equation, as follows:

$$T = 0.085 * \frac{DK}{Q}$$

- Where: T = Shortest time, in seconds, allowed for the air pressure to drop to 1.0 psig.
K = 0.000419 DL, but not less than 1.0.
Q = 0.0015 cubic feet/minute/square feet of internal surface.
D = Nominal pipe diameter in inches.
L = Length of pipe being tested in feet.

At the CONTRACTOR'S option, joints may be air tested individually, joint by joint, with the use of specialized equipment. The CONTRACTOR shall submit its joint testing procedure for the ENGINEER'S review prior to testing. Prior to each test, the pipe at the joint shall be wetted with water. The maximum test pressure shall be 3.0 psi. The minimum allowable pressure drop shall be 1.0 psi over a 30-second test period.

- E. **T.V. Inspection:** All sanitary sewer systems shall be TV inspected. In addition, all storm drain systems are subject to TV inspection. In all paved areas the TV inspection must be coordinated by the CONTRACTOR to allow sufficient time for the TV inspection to be performed prior to the final lift of asphalt paving being placed. The CITY or approved TV testing company will perform the TV inspections. The CONTRACTOR shall repair all problems revealed by the TV inspection. The CONTRACTOR shall coordinate with the ENGINEER to arrange for a compatible time to conduct the inspection.
- F. **The Contractor shall contact the Water Resources Division for a list of approved TV testing companies.**
- G. **The Contractor shall submit the sanitary sewer video tape (VHS) to the City for review. Tape shall become the property of the City.**

3.4 FLOW TESTING OF EXISTING COMMERCIAL/INDUSTRIAL SEWER LATERALS

- A. Prior to connecting to all existing sewer laterals other than single family residential units, the CONTRACTOR shall flush test the existing sewer lateral with water in the presence of the ENGINEER to determine if the lateral is damaged

- END OF SECTION -

SECTION 330523 - STEEL CASING BORING AND JACKING

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide all materials, equipment and labor necessary to furnish and install bored or jacked steel casing, and all appurtenant work, complete and in place as shown on the Drawings and as specified herein. Carrier pipe installation within the steel casing shall be as specified herein.
- B. In the performance of the work, the CONTRACTOR shall comply with the lawful requirements of the affected public agencies, owners of public utilities or other facilities, and railway companies, relative to the safeguarding of traffic and improvements which might be endangered by the boring and jacking operations.
- C. If the CONTRACTOR is not ready to place the pipe in the casing at the time of completion of boring and jacking operations, the ends shall be bulkheaded, and the approach trenches shall be backfilled, plated, and barricaded: and in public streets the trenches shall be backfilled, temporary surfacing placed thereon, and the affected portion of the street reopened to traffic.
- D. The CONTRACTOR shall be responsible for maintaining the specified line and grade, and for preventing settlement of overlying structures, or other damage due to the boring and jacking operations.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 312300 Utility Earthwork.
- B. Section 331300 Pressure Pipeline Testing and Disinfection.
- C. Section 331102 Steel Pipe - Mortar-Lined and Mortar Coated.
- D. Section 330130 Sanitary Sewer and Storm Drain System Leakage Testing.
- E. Section 033050 Utility Cast-in-Place Concrete.
- F. Division 1 General Requirements.

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Codes:

California Labor Code.

Construction Safety Order of the State of California.

B. Commercial Standards:

ASTM A 283 Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.

ANSI/AWWS D1.1 Structural Welding Code Steel.

AWWA C200 Standard for Steel Water Pipe-6 In. (150mm) and Larger.

1.4 CONTRACTOR SUBMITTALS

- A. **Shop Drawings:** The CONTRACTOR shall submit shop drawings of pipe casing in accordance with the following requirements:
1. The CONTRACTOR, prior to beginning any trench or structure excavation 5 feet deep or over, shall submit to the ENGINEER for review for compliance with Section 6705 of the California Labor Code the CONTRACTOR'S detailed plan showing design of all shoring, bracing, sloping of the sides of excavation, or other provisions for worker protection against the hazard of caving ground during the excavation of such trenches or structure excavation. The CONTRACTOR'S attention is directed to the provisions for "Shoring and Bracing Drawings" in Section 6705 of the California Labor Code. If such plan varies from the shoring system standards established in the Construction Safety Orders of the State of California, such alternative systems plans shall be prepared by a civil or structural engineer licensed in the State of California at the CONTRACTOR'S expense.
 2. Casing installation schedules which include schedules of excavation, pipeline installation, and backfill operations.
 3. Material list including diameter, thickness, and class of steel casing.
 4. Detailed locations and sizes of all boring or jacking and receiving pits.
 5. Permits associated with the boring or jacking operations.
 6. Welders Certificates
- B. **Certificates of Compliance:** Certificates of Compliance shall be provided for all products and materials proposed to be used under this Section, including certificates for physical and chemical properties of all steel.
- C. All expenses incurred in making samples for certification and tests shall be borne by the CONTRACTOR.

1.5 QUALITY ASSURANCE

- A. All boring or jacking operations shall be done by a qualified CONTRACTOR with at least 5 years experience involving work of a similar nature.
- B. The CONTRACTOR shall give the ENGINEER a minimum of 3 days advance notice of the start of an excavation or boring operations.
- C. All work shall be performed in the presence of the ENGINEER, unless the ENGINEER has granted prior written approval to perform such work in its absence.
- D. **Welding Requirements:** CONTRACTOR shall furnish Certificates of Compliance for all welding procedures as required by the ENGINEER.
- E. All welding procedures used to fabricate and install steel casings shall be prequalified under the provisions of ANSI/AWS D1.1. Welding procedures shall be required for, but not necessarily limited to, longitudinal and girth or special welds for pipe cylinders, casing joint welds, reinforcing plates, and pressure grout coupling connections.
- F. All welding shall be done by skilled welders, welding operators, and tackers who have had adequate experience in the type of materials to be used. Welders shall be qualified under the provisions of

ANSI/AWS D1.1 by an independent local, approved testing agency not more than 6 months prior to commencing work on the casing or pipeline. Machines and electrodes similar to those used in the WORK shall be used in qualification tests. The CONTRACTOR shall furnish all material and bear the expense of qualifying welders.

- G. No exterior or interior joints of the carrier pipe shall have mortar grout applied over a seam until the seam has cooled. Exterior and interior joints of the carrier pipe shall be mortar coated and lined in the field, in accordance with the requirements of the specification Sections for the type of pipe material installed.

1.6 SAFETY

- A. The CONTRACTOR shall obtain from the California Division of Occupational Safety and Health Administration a preliminary gas classification for each bore, 30 inches in diameter and larger. It shall be the CONTRACTOR'S responsibility to see that the WORK is done in conformance with all applicable federal, state, and local safety requirements.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Steel casings shall be welded steel pipe of the diameters and plate thicknesses shown. The steel pipe casings shall conform to AWWA C200, subject to the following supplemental requirements. The casing shall be of the diameter and thickness as required by the owner of the utility of structure to be crossed, and shall be furnished complete with welded joint ends and, for pipes 24 inches and larger, pressure grout couplings. The CONTRACTOR, at its expense, may select a greater diameter or thickness for the method of work and loadings involved, site conditions, and possible interferences.

2.2 MATERIALS

- A. **Steel Casing:** The steel casing pipe shall be in accordance with ASTM A 283, Grade C, unless shown otherwise. Casing section joints shall be butt welded, lap welded, or welded using butt straps in the field. Each end of each casing section for butt welding shall be prepared by providing 1/4-inch by 45-degree chamfer on the outside edges.
- B. **Grout:** Grout shall consist of one part portland cement, 3 parts sand, and the minimum amount of water necessary to obtain the desired consistency; and, all grout mixtures shall contain 2 percent of bentonite by weight of the cement. Portland cement, water, and sand shall conform to the applicable requirements of the Section 03300, "Utility Cast-in-Place Concrete," except that sand to be used shall be of such fineness that 100 percent will pass a No. 8 sieve and at least 45 percent, by weight, will pass a No. 40 sieve. Bentonite shall be a commercial-processed powdered bentonite, Wyoming type, such as **Imacco-gel, Black Hills, or equal**.
- C. **Grout Connections:** The CONTRACTOR shall provide 2 inch grout connections regularly spaced at 5 feet on center alternating at 30 degrees from plumb each side of the vertical centerline for pipes 24 inches and larger. Longitudinal spacing between the grout connections may be decreased to provide more frequent grouting, but in no case shall the spacings shown or specified, be exceeded.
- D. **Casing Insulators and End Seals:** The CONTRACTOR shall provide casing insulators and resilient end seals with stainless steel bands designed sufficient to withstand earthload and hydraulic conditions. Casing Insulators shall be **Williamson M-2, Calpico Model M, or equal**, and seals shall be **Williamson Z-Seal, Calpico Model W, or equal**.
- E. **Steel Plate:** Steel plate for bridging shall be in conformance with Section 02315, "Utility Earthwork."

PART 3 -- EXECUTION

3.1 INSTALLATION OF STEEL CASING

- A. **Jacking Head:** A steel jacking head shall be fitted to the lead section of the casing in such a manner that it extends around the entire outer surface of the steel casing and projects at least 18 inches beyond the driving end of the casing. The jacking head shall not protrude more than 1/2-inch outside of the outer casing surface. The head shall be securely anchored to prevent any wobble or alignment variation during the boring or jacking operations. To minimize voids outside the casing, excavation shall be carried out entirely within the jacking head and not in advance of the head. Excavated materials shall be removed from the casing as the boring or jacking operation progresses and no accumulation of excavated materials within the casing shall be permitted.
- B. **Jacking Pit:** The excavations for the boring or jacking operations shall be adequately shored to safeguard existing substructures and surface improvements and to ensure against ground movement in the vicinity of the jack supports. Heavy guide timber, structural steel, or concrete cradles of sufficient length shall be provided to assure accurate control of boring or jacking alignment. The CONTRACTOR shall provide adequate space within the excavation to permit the insertion of the lengths of casing to be bored or jacked. Timbers and structural steel sections shall be anchored to ensure action of the jacks in line with the axis of the casing. A bearing block, consisting of a timber or structural steel framework, shall be constructed between the jacks and the end of the casing to provide uniform end bearing over the perimeter of the casing and distribute the jacking pressure evenly.
- C. **Control of Alignment and Grade:** The CONTRACTOR shall control the application of the jacking pressure and excavation of materials ahead of the casing as it advances to prevent the casing from becoming earthbound or deviating from the required line and grade. The CONTRACTOR shall restrict the excavation of the materials to the least clearance necessary to prevent binding in order to avoid loss of ground and consequent settlement or possible damage to overlying structures. Allowable grade deviations in horizontal and vertical alignments shall be no greater than 0.2 foot per 100 feet in any direction over the length of the jacking or boring to a maximum deviation of 0.5 foot.
- D. **Grouting:** Immediately after completion of the boring or jacking operations, the CONTRACTOR shall inject grout through the grout connections, for pipes 24 inch and larger, in such a manner as to completely fill all voids outside the casing pipe, whether natural voids or voids resulting from the boring or jacking operations. Grout pressure shall be controlled so as to avoid deformation of the steel casing and avoid movement of the surrounding ground. After completion of the grouting operations where grout connections are required, the CONTRACTOR shall close the grout connections with cast-iron threaded plugs.
- E. **Installation:** The installation of the casing shall be subject to the approval of the permitting agency, owner of the carrier pipe having jurisdiction over the facility and the area containing the boring or jacking operation, and the CITY.

3.2 INSTALLATION OF CARRIER PIPE

- A. All carrier pipes to have "Casing Insulators" installed at a maximum spacing of 10 feet.
- B. **Testing of the Carrier Pipe:** Testing of the carrier pipe shall be performed in accordance with the Section 331300, "Pressure Pipeline Testing and Disinfection," or Section 330130 "Sanitary Sewer and Storm Drain System Leakage Testing" as applicable. Testing shall be completed before the casing ends are sealed.
- C. CONTRACTOR shall install casing seals at each end of the casing, in accordance with the manufacturer's printed recommendations.

3.3 CLOSING OF PITS

A. After jacking equipment and excavated materials from the boring or jacking operations have been removed from the jacking pit, the CONTRACTOR shall:

1. Scarify and recompact the bottom of the jacking pit, remove all loose and disturbed materials below pipe grade to undisturbed earth and recompact the subgrade material.

2. Backfill the excavation in accordance with Section 312300 "Utility Earthwork."

3.4 STEEL PLATE

A. Steel plate used for bridging for the jacking and receiving pits shall be in conformance with Section 312300, "Utility Earthwork."

- END OF SECTION -

SECTION 330526 - PIPING IDENTIFICATION SYSTEMS

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide all materials, equipment, and labor necessary to furnish, mark, and install identification devices for piping, valves, and appurtenances using warning tape, buried wire, color codes, lettering, and related permanent identification devices as required and as specified herein.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 331219 Fire Hydrants.
- B. Section 055900 Ductile Iron Pipe
- C. Section 099000 Protective Coating
- D. Division 1 General Requirements.

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. **Commercial Standards:**

- ANSI A13.1 Scheme for the Identification of Piping Systems.

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 IDENTIFICATION OF BURIED PIPING

- A. Identification of all buried pressure pipe shall be accomplished by color-coded warning tape consisting of a minimum 2 inch wide plastic tape with lettering giving a warning and a description of the pipe function (for example: "WARNING, WATER LINE BURIED BELOW"). For pipe diameters larger than 12 inches the warning tape shall be a minimum 6 inch wide. Identification color codes shall be as listed in the IDENTIFICATION SCHEDULE in PART 3 – "Execution" of this Section.
- B. Warning Tape manufacturer shall be **THOR ENTERPRISES, CALPICO, or equal.**
- C. In addition, for all non-metallic buried pressure pipe systems a No. 10 A.W.G. UF Insulated solid copper wire shall be attached to the pipeline.
- D. Tape to hold the wire in place shall be pipe wrap tape, 2 inches wide, 10 mil.

2.2 RECYCLED WATER SIGNING

- A. All identification signs and stickers for irrigation controllers for recycled water systems are to be purchased by the CONTRACTOR from the Water Resources Division located at 101 West Jack London Boulevard, Livermore, CA.

2.3 PAINT MANUFACTURERS AND COLORS

- A. Paint manufacturers and colors shall be as specified in Section 099000 "Protective Coating."

PART 3 -- EXECUTION

3.1 WARNING TAPE

- A. Warning tape shall be installed with all buried pressure piping. The tape shall be placed directly at the top of the Pipe Zone.

3.2 COPPER WIRE

- A. Buried non-metallic pressure pipelines for potable/recycled water systems, sewer force main systems and irrigation mains shall be provided with a No. 10 A.W.G. Insulated copper wire laid along the top of the pipe. On main line installations the wire shall be held in place with ties or tape spaced not more than 10 feet apart. On service laterals the wire shall be wrapped around the pipe. At all buried valves install copper tracer wire on the outside of the polyvinyl chlorite valve sleeve to a notch cut out at the top of the valve sleeve.

3.3 IDENTIFICATION SCHEDULE

A. Application of identifying water systems and devices shall conform to the following color codes.

- B Blue (Potable)
- G Green
- P Purple (Recycled)
- R Red
- W White
- Y Yellow

	FH	Valve Lid	Dist. /Type in Face of Curb	"W" on top of Curb over Service	Vent Pipe	Guard Post	Marker Post
Sanitary Sewer/Storm Drain System	-	-	-	-	-	-	G
Water Sampling Station	-	-	-	-	-	W	-
Potable Fire Hydrants	Y or R	W	R	-	-	W	-
Dedicated FS, street valves	-	-	R	W	-	-	-
All other main line potable valves	-	B	W	-	-	-	W with B top
Recycled	P	P	P	P	-	W	W with P top
Comm/Ind Dom/Fire	-	W	W	W	-	-	W with B top
Manifold	-	W	W	W	-	-	-
Air Release Valve	-	-	W	-	*W with B or P	-	-

* Vent pipe on Air Release valves: white post with top 6 inches of pipe B or P, with 3" "AR" in B or P 12" below top of pipe facing curb, color to match top 6" of pipe.

3.4 RECYCLED WATER SIGNING

A. All recycled hydrant signs will be installed on a square formed steel tube, telescoping metal breakaway type post in accordance with PART 2 "Products" and PART 3 "Execution" of Section 02891 "Signage." Signs shall be located behind the hydrant between 36" and 48" from the center of hydrant. The top of the sign shall be level with the top of the hydrant.

B. The locations of all signage for landscape irrigation systems shall be as approved by the Water Resources Division.

Irrigation controllers will also contain the purple recycled water sticker. The following message on the irrigation controller sticker will be printed in English and Spanish:

CONTROLLER OPERATES IRRIGATION SYSTEM USING RECYCLED WATER

1. Controller Operation hours: 10:00 p.m. p.m. to 6:00 a.m.
2. Operate controller to minimize overspray and runoff.
3. Maintain controller schedule and system map located inside.
4. Failure to comply may result in loss of service.

UNAUTHORIZED OPERATION PROHIBITED

- C. All recycled water piping and purple warning tape will be clearly marked stating “**Caution: Recycled Water - Do Not Drink.**” All purple polyethylene encasement for recycled water piping shall be clearly marked stating “**Caution: Recycled Water – Do Not Drink.**”
- D. All recycled water meters, valves, covers, backflow preventers and other appurtenances shall be painted purple.
- E. All recycled water stickers shall be purple, with white lettering.
- F. All internal signs (building interiors) shall be purple, with white lettering stating “**Caution: Recycled Water - Do Not Drink.**”
- G. Dual plumbed buildings shall have all internal and external water spigots clearly marked with the appropriate small blue metal sign for potable water or the small purple metal warning sign for recycled water.

- END OF SECTION -

SECTION 331100 - PIPING, GENERAL

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide all materials, equipment, and labor necessary to furnish and install all piping systems as shown on the Drawings and as specified herein. Each system shall be complete with all necessary fittings, hangers, supports, anchors, expansion joints, flexible connectors, valves, accessories, insulation, lining and coating, testing, disinfection, excavation, backfill and encasement, to provide a functional installation.
- B. The piping shown is intended to define the general layout, configuration, routing, method of support, pipe size, and pipe type. It is the CONTRACTOR'S responsibility to develop the details necessary to construct all mechanical piping systems, to accommodate the specific equipment provided, and to provide and install all spools, spacers, adapters, connectors, and appurtenances, for a complete and functional system.
- C. All pipe grades and elevations shown the Drawings are the pipe flow-line.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 312300 Utility Earthwork.
- B. Section 330523 Steel Casing, Boring and Jacking.
- C. Section 331300 Pressure Pipeline Testing and Disinfection.
- D. Section 033050 Utility Cast-in-Place Concrete.
- E. Section 033055 Cast-in-Place Concrete Pipe
- F. Section 055000 Miscellaneous Metalwork.
- G. Section 099000 Protective Coating.
- H. Section 330526 Piping Identification Systems.
- I. Section 331200 Miscellaneous Piping, Valves, Fittings, and Appurtenances.
- J. Division 1 General Requirements.
- K. Division 2 and 5 Pipe Sections as applicable.
- L. Division 15 As applicable.

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards:

- ANSI/ASME B1.20.1 Pipe Threads, General Purpose (inch).
- ANSI B16.5 Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and Other Special Alloys.

ANSI B31.1	ASME Code for Pressure Piping.
ANSI/AWS D1.1	Structural Welding Code.
ASTM A 307	Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile for Strength.
ASTM A 325	Specification for Structural Bolts, Heat Treated 120/105 ksi Minimum Tensile Strength.
ASTM C 564	Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
ASTM D 792	Test Methods for Specific Gravity (Relative Density) and Density of Plastics by Displacement.
ASTM D 2000	Classification System for Rubber Products in Automotive Applications.
AWWA C207	Standard for Steel Pipe Flanges for Waterworks Service - Sizes 4 In. Through 144 In.
AWWA C606	Standard for Grooved and Shouldered Joints.
AWWA Manual M-11	Restrained Joint Harness.

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. The CONTRACTOR shall submit complete shop drawings and certificates, and test reports, for all products and materials proposed to be used for all piping systems. The shop drawings shall include all necessary dimensions and details on pipe joints, fittings, fitting specials, valves, appurtenances, design calculations, and material lists. The submittals shall include detailed layout, spool, or fabrication drawings which show all pipe spools, spacers, adapters, connectors, fittings, and pipe supports necessary to accommodate the equipment and valves provided in a complete and functional system.
- C. All expenses incurred in making samples for certification of tests shall be borne by the CONTRACTOR.
- D. The CONTRACTOR shall submit copies of welder's certificates to the ENGINEER.

1.4 QUALITY ASSURANCE

- A. **General:** All pipe shall be subject to inspection at the place of manufacture. During the manufacture of the pipe, the ENGINEER shall be given access to all areas where manufacturing is in progress and shall be permitted to make all inspections necessary to confirm compliance with the Specifications.
- B. **Tests:** Except where otherwise specified, all materials used in the manufacture of the pipe shall be tested in accordance with the applicable Specifications and Standards. The CONTRACTOR shall assure tests are performed at no additional cost to the CITY.

- C. **Welding Requirements:** Certificates of Compliance shall be supplied by the pipe fabricator for all welding procedures used to fabricate pipe and welding procedures shall be prequalified under the provisions of ANSI/AWS D1.1.
- D. **Welder Qualifications:** All welding shall be done by skilled welders, welding operators, and tackers who have had adequate experience in the methods and materials to be used. Welders shall be qualified under the provisions of ANSI/AWS D1.1 by an independent, local, approved testing agency not more than 6 months prior to commencing work on the pipeline. The CONTRACTOR shall furnish all material and bear the expense of qualifying welders.

1.5 MANUFACTURER'S SERVICE REPRESENTATIVE

- A. Where the assistance of a manufacturer's service representative is required, in order to obtain compliance for pipe fabrication and installation, the CONTRACTOR shall furnish such assistance at no additional cost to the CITY.

1.6 MATERIAL DELIVERY, STORAGE, AND PROTECTION

- A. All piping materials, fittings, valves, and accessories shall be delivered in a clean and undamaged condition and stored off the ground, to provide protection against oxidation caused by ground contact. All defective or damaged materials shall be replaced with new materials.

1.7 CLEANUP

- A. After completion of the work, all remaining pipe cuttings, joining and wrapping materials, and all other debris, shall be removed from the site. The entire piping system shall be left in a clean and functional condition.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. All pipes, fittings, and appurtenances shall be furnished in accordance with the requirements of the applicable Sections of Divisions 2 through 15 and as specified herein.
- B. **Miscellaneous Pipes:** Miscellaneous pipes and fittings shall be in accordance with the requirements of Section 331200, "Miscellaneous Piping, Valves, Fittings, and Appurtenances" and as specified herein.
- C. **Lining:** All requirements pertaining to thickness, application, and curing of pipe lining, shall be in conformance with the requirements of the applicable piping specifications and Section 099000, "Protective Coating," unless otherwise specified.
- D. **Coating:** All requirements pertaining to thickness, application, and curing of pipe coating, shall be in conformance with the requirements of the applicable piping specifications, and Section 099000, "Protective Coating."
- E. **Pressure Rating:** All piping systems shall be designed for the maximum expected pressure and test pressure as defined in Section 331300, "Pressure Pipeline Testing and Disinfection," or as shown on the piping schedule.

2.2 THREADED INSULATING CONNECTIONS

- A. **General:** Threaded insulating bushings, unions, or couplings, as appropriate, shall be used for joining threaded pipes of dissimilar metals and for piping systems where corrosion control and cathodic protection are involved.
- B. **Materials:** Threaded insulating connections shall be of nylon, Teflon, polycarbonate, polyethylene, or other non-conductive materials, and shall have ratings and properties to suit the service and loading conditions.

2.3 COUPLINGS

- A. **Cast Couplings/Transition Couplings:** Flexible couplings for 4 inch through 12 inch pipe shall be ductile iron or steel, with ductile iron followers and Buna N gaskets, **APAC Style 341, Ford FC1 or FC3, or equal.** Cast transition couplings shall be **APAC Style 335, Ford FL2A, or equal.** The couplings shall have the manufacturer's factory fusion bonded epoxy coating and lining, and Type 304 stainless steel bolts and nuts.
- B. **Rigid PVC Coupling:** Rigid couplings for 4 inch through 12 inch pipe shall be PVC High Deflection Stop Couplings and Closure couplings, **Certain Teed C900 HD Stop and Closure Coupling, or equal.**
- C. **Sleeve-Type Couplings**
 - 1. **Construction:** Sleeve-type couplings shall be provided for pipe 14 inch and larger, steel with steel bolts, without pipe stop, and shall be of sizes to fit the pipe and fittings shown. The middle ring shall be not less than 1/4 inch in thickness and shall be either 5 or 7 inches long for standard steel couplings, and 16 inches long for long-sleeve couplings. The followers shall be single-piece contoured mill section welded and cold-expanded as required for the middle rings. They shall be of sufficient strength to accommodate the number of bolts necessary to obtain adequate gasket pressures without excessive rolling. The shape of the follower shall be of such design as to provide positive confinement of the gasket. Bolts and nuts shall conform to the requirements of Section 055000, "Miscellaneous Metalwork." Buried sleeve-type couplings shall be epoxy-coated at the factory in accordance with Section 099000, "Protective Coating."
 - 2. **Pipe Preparation:** The ends of the pipe, where specified or shown, shall be prepared for flexible couplings. Plain ends for use with couplings shall be smooth and round for a distance of 12 inches from the ends of the pipe, except for AC pipe, with outside diameter not more than 1/64 inch smaller than the nominal outside diameter of the pipe. For connections to existing AC pipe the tolerances will be established by the ENGINEER. The middle ring shall be tested by cold-expanding a minimum of one percent beyond the yield point, to proof-test the weld to the strength of the parent metal. The weld of the middle ring shall be subjected to air test for porosity.
 - 3. **Gaskets:** Gaskets for sleeve-type couplings shall be rubber-compound material that will not deteriorate from age or exposure to air under normal storage or use conditions. Gaskets for wastewater and sewerage applications shall be Buna "N," grade 60, or equivalent suitable elastomer. The rubber in the gasket shall meet the following specifications:
 - a. Color - Jet Black.
 - b. Surface - Non-blooming.
 - c. Durometer Hardness - 74 +/- 5.
 - d. Tensile Strength - 1000 psi Minimum.

- e. Elongation - 175 percent Minimum.

The gaskets shall be immune to attack by impurities normally found in water or wastewater. All gaskets shall meet the requirements of ASTM D 2000 - Classification System for Rubber Product in Automotive Applications, AA709Z, meeting Suffix B13 Grade 3, except as noted above. All gaskets shall be compatible with the piping service and use.

- 4. **Insulating Sleeve Couplings:** Where insulating couplings are required, both ends of the coupling shall have a wedge-shaped gasket which assembles over a rubber sleeve of an insulating compound in order to obtain insulation of all coupling metal parts from the pipe.
- D. **Flexible Joints:** Where harnesses are required for flexible sleeve-type couplings, they shall be in conformance with the Drawings. Hardware shall be stainless steel in conformance with Section 055000, "Miscellaneous Metals."
- E. **Repair Clamps:** Repair clamps shall be full circle repair clamps, **APAC Series 431, 432, and 433; Ford F1, F2, or F3; or equal**, with ductile iron lugs and Type 304 stainless steel bands, rubber gasket, and T-Head stainless steel bolts and nuts. The repair clamp shall have the manufacturer's standard coatings and linings for the appropriate service use.
- F. **Mechanical Compression Joints:** Mechanical compression joints shall have a synthetic SBR rubber body conforming to ASTM C 564 and shall have Type 302 stainless steel bands and clamps. They shall be manufactured by **Calder Couplings, Fernco, or equal**.

2.4 PIPE THREADS

- A. All pipe threads shall be in accordance with ANSI/ASME B1.20.

2.5 PRESSURE GAUGES

- A. Pressure gauges shall be provided on each side of pressure reducing valves, and where shown on the Drawings.
- B. Gauges shall be industrial quality type with stainless steel movement and stainless steel or alloy case, unless otherwise shown or specified, gauges shall have a 4-inch dial, 1/4 threaded connection, a Type 316 stainless steel snubber adapter, and a shut-off valve.
- C. **Manufacturers or Equal:**
 - 1. **Ashcroft Industrial Instruments (Dresser)**
 - 2. **Foxboro/Jordan, Inc.**
 - 3. **Duro Instrument, Corp., Series 100**

2.6 PIPE INSULATION

- A. Domestic backflow preventers and appurtenances without an approved protective enclosure shall be insulated.
- B. By-pass piping and appurtenances on Class 3, 4, 5, and 6 Fire Service Installations shall be insulated.
- C. Insulation shall be a prefabricated foam insulation material with an all-purpose jacket. The minimum insulation thickness shall be 2-inches. The insulation shall be **Polycell Insulating Foam, or equal**.

D. The insulation shall be wrapped with a 2-inch wide minimum, 10 mil black pipe tape.

2.7 RUBBER LINK SEALS

A. Rubber link seals shall be modular rubber sealing elements, with non-metallic pressure plates and galvanized folds, **Thunderline "Link Seals," O-Z Electrical "Thruwall" and "Floor Seals," or equal.**

2.8 FLANGED COUPLING ADAPTORS

A. Flanged coupling adapters for pressure reducing stations shall be factory fusion bonded epoxy **Ford FFCA or FFCA-1, APAC 201 or 221, or equal.** Nuts and bolts shall be for ductile iron pipe.

PART 3 -- EXECUTION

3.1 GENERAL

A. All pipes, fittings, and appurtenances shall be installed in conformance with the requirements of the applicable Sections of Divisions 2 and 15 and with the manufacturer's printed recommendations. All coatings shall be in conformance with Section 099000, "Protective Coatings."

B. Where the grade or alignment of the pipe is obstructed by existing utilities and structures such as conduits, ducts, pipes, maintenance holes, or other utility facilities, the obstruction shall be permanently supported, relocated, removed, or reconstructed by the CONTRACTOR in conformance with the requirements and approval of the owners of such utilities and structures.

C. All pipe shall be stockpiled and stored in conformance with the manufacturer's printed recommendations.

D. **Fill Material or Trench Support:** Overexcavation fill material, bedding, and trench subgrade shall be compacted as specified in Section 312300, "Utility Earthwork," and graded to provide a uniform and continuous support beneath the pipe at all points.

- END OF SECTION -

SECTION 331102 - PVC PRESSURE PIPE

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide all materials, equipment, and labor necessary to furnish and install 4 inch to 36 inch polyvinyl chloride (PVC) pressure pipe, and all appurtenant work, complete and operable, including all connections as shown on the Drawings and as specified herein.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 312300 Utility Earthwork.
- B. Section 331300 Pressure Pipeline Testing and Disinfection.
- C. Section 330130 Sanitary Sewer and Storm Drain System.
- D. Section 055900 Ductile Iron Pipe.
- E. Section 331100 Piping, General.
- F. Section 330526 Piping Identification Systems.
- G. Section 331200 Miscellaneous Piping, Valves, Fittings, and Appurtenances.
- H. Division 1 General Requirements.

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards:

- AASHTO Standard for Highway Bridges.
- ANSI/AWWA C104 Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
- ANSI/AWWA C110 Standard for Ductile-Iron and Gray-Iron Fittings, 3-In. through 48-In., for Water and Other Liquids.
- ANSI/AWWA C111 Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- ANSI/AWWA C153 Standard for Ductile-Iron Compact Fittings, 3-In. through 6-In., for Water and other Liquids.
- AWWA C600 Installation of Ductile-Iron Water Mains and their Appurtenances.
- AWWA C900 Polyvinyl Chloride (PVC) Pressure Pipe, 4-In. through 12-In., for Water Distribution.
- AWWA C905 Polyvinyl Chloride (PVC) Water Transmission Pipe, Nominal Diameters 14-In. through 36-In.

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, as specified in the referenced standards, and the following supplemental requirements:
1. Hydrostatic proof test reports.
 2. Sustained pressure test reports.
 3. Burst strength test reports.
- B. All expenses incurred in making samples for certification of tests shall be borne by the CONTRACTOR.

1.5 QUALITY ASSURANCE

- A. **Tests:** Except as modified herein, all materials used in the manufacture of the pipe shall be tested in accordance with the requirements of this Section, and as specified in the referenced standards, as applicable.
- B. The CONTRACTOR shall have said material tests performed at no additional costs to the CITY. The ENGINEER shall have the right to witness all testing provided, that the CONTRACTOR'S schedule is not delayed for the convenience of the ENGINEER.
- C. In addition to those tests specifically required, the ENGINEER may request additional samples of any material for testing by the CITY. The additional samples shall be furnished at no additional cost to the CITY.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. PVC pressure pipe, 4 inch through 12 inch and 14 inch through 36 inch shall conform to the applicable requirements of AWWA C900 and AWWA C905, respectively, and shall be subject to additional requirements specified herein.
- B. All pipe material used for reclaimed water shall be purple such as **PW Purple Plus pipe as manufactured by PW Pipe, Purple Save Pipe as manufactured by J-M Manufacturing Company, Inc., Purple Centurion Pipe as manufactured by IPEX , or equal.**
- C. All PVC pipe shall be continuously marked in conformance with the appropriate ASTM. All purple PVC pipe shall be continuously marked in accordance with the requirements of Section 330526, "Piping Identification Systems."

2.2 PIPE DESIGN

- A. **General:** PVC pressure pipe shall be designed in accordance with the requirements of AWWA C900, or AWWA C905, as applicable, except that safety factors and surge pressure requirements of C900 shall be applied to all pipe, 4 inch through 36 inch. Pressure class shall be as shown on the Drawings, but in no case shall the dimension ratio be greater than 18 for C900 or 26 for C905 pipe. The pressure class for reclaimed water pressure pipe shall have a dimension ratio of 14 for C900 pipe or a dimension ratio of 18 for C905 pipe.

2.3 PIPE

- A. The pipe shall be of the diameter and pressure class as specified or shown, furnished complete with rubber gaskets, and all specials and fittings shall be provided as required. The dimensions and pressure classes for Dimension Ratios for PVC pressure pipe with Cast-Iron Pipe Equivalent O.D.'s shall conform to the requirements of AWWA C 900, or AWWA C 905, as applicable.
- B. **Joints:** All joints for the buried PVC pipe shall be an integral bell manufactured on the pipe employing a rubber ring joint. The bell shall be the same or greater thickness as of the pipe barrel.
- C. **Joint Deflection:** Deflection at the joint shall not exceed 1.0 degrees for AWWA C905 or 1.5 degrees for C900 or the maximum deflection recommended by the manufacturer. No deflection of the joint shall be allowed for joints which are over-belled or not belled to the stop mark.
- D. Bending of pipe shall not exceed recommendations of AWWA or manufacturers printed recommendations.

2.4 FITTINGS

- A. Fittings shall be ductile iron and shall conform to the requirements of AWWA C 110 or AWWA C153 minimum Class 250. Fittings shall be mechanical joint.
- B. Restrained joints shall be as approved in writing by the ENGINEER.
- C. All fittings shall be lined and coated in accordance with the requirements of Section 05060 "Ductile Iron Pipe."
- D. Each fitting shall be clearly labeled to identify its size and pressure class.
- E. **Service Saddles and Tapping Sleeves:** All service saddles, and tapping sleeves shall be in accordance with the requirements of Section 331200, "Miscellaneous Piping, Valves, Fittings, and Appurtenances."

PART 3 -- EXECUTION

3.1 GENERAL

- A. All laying, jointing, testing for defects and for leakage shall be performed in the presence of the ENGINEER, and shall be subject to its approval before acceptance. All material found during the progress to have defects will be rejected and the CONTRACTOR shall promptly remove such defective materials from the site of the work.
- B. Installation shall conform to the requirements of AWWA Manual M23, instructions furnished by the pipe manufacturer, and to the supplementary requirements or modifications specified herein. Wherever the provisions of this Section and the aforementioned requirements are in conflict, the more stringent provision shall apply.

3.2 PIPE HANDLING

- A. **Handling:** Pipe, fittings and accessories shall be carefully inspected before and after installation and those found defective shall be rejected. Pipe and fittings shall be free from fins and burrs. Before being placed in position, pipe, fittings, and accessories shall be cleaned, and shall be maintained in a clean and sanitary condition. Proper facilities shall be provided for lowering sections of pipe into trenches. Under no circumstances shall pipe, fittings or any other material be dropped or dumped into trenches.

3.3 STORAGE

- A. Pipe shall be stored, if possible, at the job site in unit packages provided by the manufacturer. Caution is to be exercised to avoid compression damage or deformation to bell ends of the pipe. Pipe shall be stored in such a way as to prevent sagging or bending and protected from exposure to direct sunlight by covering with an opaque material while permitting adequate air circulation above and around the pipe. Gaskets shall be stored in a cool, dark place out of the direct rays of the sun, preferably in original cartons. Pipe, fittings, or accessories improperly stored are subject to rejection by the ENGINEER.

3.4 TRENCHING AND BACKFILL

- A. Trench excavation and backfill shall conform to the requirements of Section 312300, "Utility Earthwork," and as specified herein.

3.5 INSTALLATION

- A. Bell and spigot pipe shall be laid with the bell end pointing in the direction of laying. Pipe shall be set to grade in straight lines, taking care to avoid the formation of any dips or low points. Pipe shall not be laid when the conditions of trench or weather are unsuitable as determined by ENGINEER. At the end of each day's work, open ends of pipe shall be closed temporarily with water-tight, expandable type plugs.
- B. Pressurized lines laid on a downhill grade shall be blocked and held in place until sufficient support is furnished by the following pipe to prevent movement. Water lines shall be laid uphill on grades exceeding 10 percent.
- C. Pipe shall be supported at its proper elevation and grade, care being taken to secure firm and uniform support. Wood support blocking will not be permitted. The full length of each section of pipe and fittings shall rest solidly on the pipe bed, with recessed excavation to accommodate bells and joints. Anchors and supports shall be provided where necessary and where indicated on the Drawings for fastening work into place. Fittings shall be independently supported.
- D. Joints shall be installed according to manufacturer's recommendations. Trenches shall be kept free of water until joints have been properly made. The maximum combined deflection at any coupling shall be in accordance with the manufacturer's printed recommendations.
- E. Pipe shall be cut by means of saws, power driven abrasive wheels or pipe cutters, which will produce a square cut. No wedge-type roller cutters will be permitted. After cutting, the end of the pipe shall be beveled using a beveling tool, portable type sander or abrasive disc.
- F. All necessary precautions shall be taken to prevent uplift or floating of the pipe prior to the completion of the backfilling operation. The CONTRACTOR shall assume full responsibility for any damage due to this cause and shall, at its own expense, restore and replace the pipe to its specified condition and grade if it is displaced due to floating.
- G. Each pipe elastomeric gasket joint shall be installed in conformance with the manufacturer's printed recommendations.

3.6 COPPER WIRE AND WARNING TAPE

- A. Installation of copper wire, warning tape, and pipe identification shall conform to Section 330526, "Piping Identification Systems."

3.7 SERVICE CONNECTIONS

- A. **Service Connections:** Service saddles or fittings for PVC pipe shall be used for all service connections on new pipeline installations. On existing PVC pipelines all service connections shall be tapping sleeves. Service saddles shall have a bearing area of sufficient width along the axis of the pipe, so that the pipe will not be distorted when the saddle is made tight. An internal shell cutter shall be used to drill through the corporation stop to minimize PVC shavings, retain the coupon, and reduce stress. **Single fluted shell cutters or twist drills will not be allowed.** Lubricate the cutting and tapping edges of the tool with cutting lubricant. Make the cuts slowly and use the follower very lightly. Do not force cutter through pipe wall. Shell cutter shall have sufficient throat depth to handle the heavy wall PVC pipe. Maximum outlet size permitted with service saddle is 2 inches.
- B. Tapping sleeves and valves shall be used for all outlets greater than 2 inches in diameter. Tapping sleeves shall be assembled and installed in accordance with the manufacturer's printed recommendations and Section 331200, "Miscellaneous Piping, Valves, Fittings, and Appurtenances."

3.8 TESTING AND DISINFECTION

- A. Field testing and disinfection of all pressure pipe shall conform to the requirements of Section 331300, "Pressure Pipeline Testing and Disinfection."

- END OF SECTION -

SECTION 331104 - STEEL PIPE - MORTAR-LINED AND MORTAR-COATED

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide all materials, equipment, and labor necessary to furnish and install mortar-lined and mortar-coated steel pipeline, and all appurtenant work, complete and operable, including all connections as shown on the Drawings and as specified herein.
- B. All steel pipe shall be cathodically protected and the cathodic protection system shall be designed on a case by case basis and signed and stamped by a Civil Engineer Registered in California.
- C. Connections to existing steel spiral wrapped pipe shall be designed by a registered Civil Engineer and submitted to the ENGINEER for review.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 02510 Pressure Pipeline Testing and Disinfection.
- B. Section 02513 Steel Pipe-Fabricated Specials.
- C. Section 03600 Grout.
- D. Section 09900 Protective Coating.
- E. Section 15050 Piping, General.
- F. Section 15075 Piping Identification Systems.
- G. Section 15105 Miscellaneous Piping, Valves, Fittings, and Appurtenances.
- H. Division 1 General Requirements.

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. **Commercial Standards:**

- AASHTO Standard Specifications for Highway Bridges.
- ANSI/AWS D1.1 Structural Welding Code Steel Thirteenth Edition (AWS).
- ASTM A 36 Specification for Structural Steel.
- ASTM A 139 Specification for Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4-in. and Over).
- ASTM A 283 Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.
- ASTM A 570 Specification for Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality.
- ASTM A 572 Specification for High-Strength Low-Alloy Columbian-Vanadium Structural Steel.

ASTM C 150	Specification for Portland Cement.
ASTM E 165	Practice for Liquid Penetrant Inspection Method.
AWWA C200	Standard for Steel Water Pipe - 6-In. (150 mm) and Larger.
AWWA C205	Standard for Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4-In. and Larger - Shop Applied.
AWWA C206	Standard for Field Welding of Steel Water Pipe.
AWWA C208	Standard for Dimensions for Fabricated Steel Water Pipe Fittings.
AWWA C602	Standard for Cement-Mortar Lining of Water Pipelines-4-In. (100 mm) and Larger - in Place.
AWWA MANUAL M 11	Steel Pipe - A Guide for Design and Installation.

1.4 CONTRACTOR SUBMITTALS

- A. **Shop Drawings:** The CONTRACTOR shall submit shop drawings of pipe and fittings in accordance with the following supplemental requirements:
1. Joint and pipe fitting wall construction details which indicate the type and thickness of cylinder, the position, type, size and area of reinforcement, manufacturing tolerances, and all other pertinent information required for the manufacture of the product. Joint details shall be submitted where deep bell or butt strap joints are required for control of temperature stresses.
 2. Fittings and specials details such as elbows, wyes, tees, outlets, connections, test bulkheads, and nozzles or other specials where shown which indicate amount and position of all reinforcement. All fittings and specials shall be properly reinforced to withstand the internal pressure, both circumferential and longitudinal, and the external loading conditions as indicated in the approved design calculations.
 3. Design calculations including a complete stress analysis of each critical section of pipe wall, girth joints, and specials - all sufficient to ascertain conformance of pipe and fittings with these Specifications.
 4. Material lists and steel reinforcement schedules which include and describe all materials to be utilized.
 5. Line layout and marking diagrams which indicate the specific number of each pipe and fitting and the location of each pipe and the direction of each fitting in the completed line. In addition, the line layouts shall include: the pipe station and invert elevation at all changes in grade or horizontal alignment; the station and invert elevation to which the bell end of each pipe will be laid; all elements of curves and bends, both in horizontal and vertical alignment; and the limits of each reach of restrained and/or welded joints, or of concrete encasement.
 6. Full and complete information regarding location, type, size and extent of all welds shall be shown on the shop drawings. The shop drawings shall distinguish between shop and field welds. Shop drawings shall indicate by welding symbols or sketches the details of the welded joints and the preparation of parent metal required to make them. Joints or groups of joints in which welding

sequence or technique are especially important shall be carefully controlled to minimize shrinkage stresses and distortion.

7. Full and complete information regarding the cathodic protection system, designed and sealed by a corrosion engineer registered in the State of California.

B. **Certificate of Compliance:** Certificates of Compliance shall be provided for all products and materials proposed to be used under this Section, as specified in AWWA C200 and AWWA C205, respectively, and the following supplemental requirements:

1. Physical and chemical properties of all steel.
2. Hydrostatic test reports.
3. Results of production weld tests.

C. All expenses incurred in making samples for certification of tests shall be borne by the CONTRACTOR.

1.5 QUALITY ASSURANCE

A. **Inspection:** All pipe shall be subject to inspection at the place of manufacture in accordance with the provisions of AWWA C200 and AWWA C205, respectively, as supplemented by the requirements herein. The CONTRACTOR shall notify the ENGINEER, in writing, of the manufacturing starting date not less than 14 calendar days prior to the start of any phase of the pipe manufacture.

B. **Tests:** Except as modified herein, all materials used in the manufacture of the pipe shall be tested in accordance with the requirements of AWWA C200 and AWWA C205, as applicable.

1. After the joint configuration is completed and prior to lining with cement-mortar, each length of pipe of each diameter and pressure class shall be shop-tested and certified to a pressure of at least 80 percent of the yield strength of the pipe steel.
2. In addition to the tests required in AWWA C200, weld tests shall be conducted on each 5,000 feet of production welds and at any other times there is a change in the grade of steel, welding procedure, or welding equipment.

C. The CONTRACTOR shall perform said material tests at no additional cost to the CITY. The ENGINEER shall have the right to witness all testing conducted by the CONTRACTOR; provided, that the CONTRACTOR'S schedule is not delayed for the convenience of the ENGINEER.

D. In addition to those tests specifically required, the ENGINEER may request additional samples of any material including mixed concrete and lining and coating samples for testing by the CITY. The additional samples shall be furnished at no additional cost to the CITY.

E. **Welding Requirements:** All welding procedures used to fabricate pipe shall be prequalified under the provisions of ANSI/AWS D1.1. Welding procedures shall be required for, but not necessarily limited to, longitudinal and girth or spiral welds for pipe cylinders, spigot and bell ring attachments, reinforcing plates and ring flange welds and plates for lug connections.

F. **Welder Qualifications:** All welding shall be done by skilled welders, welding operators and tackers who have had adequate experience in the methods and materials to be used. Welders shall be qualified under the provisions of ANSI/AWS D1.1 by an independent local, approved testing agency not more than 6 months prior to commencing work on the pipeline. Machines and electrodes similar to those used on the project shall be used in qualification tests. The CONTRACTOR shall furnish all material and bear the expense of qualifying welders.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Mortar-lined and mortar-coated steel pipe shall conform to AWWA C200 and AWWA C205, subject to the following supplemental requirements:
1. The pipe shall be of the diameter and class shown on the Drawings, shall be furnished complete with rubber gaskets or welded joints, as specified, and all specials and bends shall be provided as specified or required.
 2. For pipe 14 inches in diameter and larger, the inside diameter after lining shall not be less than the nominal diameter specified or shown. Pipe smaller than 14 inches in diameter may be furnished in standard outside diameters.
- B. **Marking:** The CONTRACTOR shall insure all pipes and specials are legibly marked in accordance with the laying schedule and marking diagram. Each pipe shall be numbered in sequence and said number shall appear on the laying schedule and marking diagram in its proper location for installation. All special pipe sections and fittings shall be marked at each end with top field centerline.
- C. **Handling and Storage:** The pipe shall be handled by use of wide slings, padded cradles, or other devices, acceptable to the ENGINEER, designed and constructed to prevent damage to the pipe coating. The use of chains, hooks, or other equipment which might injure the pipe coating will not be allowed. Stockpiled pipe shall be suitably supported and shall be secured to prevent accidental rolling. All other pipe handling equipment and methods shall be acceptable to the ENGINEER.
- D. The CONTRACTOR shall be fully liable for the cost of replacement or repair of pipe which is damaged.
- E. Stockpiled pipe shall be supported on sand or earth berms free of rock exceeding 3 inches in diameter. The pipe shall not be rolled and shall be secured to prevent accidental rolling.
- F. **Strutting:** Adequate strutting shall be provided on all specials, fittings and straight pipe so as to avoid damage to the pipe and fittings during handling, storage, hauling and installation. For mortar-lined or mortar-coated steel pipe, the following requirements shall apply:
1. The strutting shall be placed as soon as practicable after the mortar lining has been applied and shall remain in place while the pipe is loaded, transported, unloaded, installed and backfilled at the jobsite.
 2. The strutting materials, size and spacing shall be adequate to support the earth backfill plus any greater loads which may be imposed by the backfilling and compaction equipment.
 3. Any pipe damaged during handling, hauling, storage, or installation due to improper strutting shall be repaired or replaced.
 4. The details of the strutting assembly shall be submitted for review by the ENGINEER prior to the start of pipe manufacture.
- G. **Laying Lengths:** Maximum pipe laying lengths shall be 40 feet with shorter lengths provided as required by the Shop Drawings.
- H. **Offset Tolerances:** For pipe wall thicknesses of 3/8-inch or less, the maximum radial offset (misalignment) for submerged arc and gas metal arc welded pipe shall be 0.1875 times the pipe wall

thickness or 1/16-inch, whichever is larger. For pipe wall thickness of greater than 3/8-inch, the maximum radial offset shall be 0.1875 times the wall thickness or 5/32-inch, whichever is smaller.

- I. **Lining:** The pipe lining shall have smooth dense interior surfaces and shall be free from fractures, excessive interior surface crazing and roughness.
- J. **Bonding and Electrical Conductivity:** All unwelded pipe joints shall be bonded for electrical conductivity in accordance with the approved cathodic protection system design. Insulated joints shall be provided as required by the approved cathodic protection system design.
- K. **Closures and Correction Pieces:** Closures and correction pieces shall be provided as required so that closures may be made due to different headings in the pipe laying operation and so that correction may be made to adjust the pipe laying to conform to pipe stationing shown on the Drawings. The locations of closure assemblies are shown on the Drawings. Any change in location or number of said items must be approved by the ENGINEER.

2.2 PIPE DESIGN

- A. **General:** The pipe furnished shall be steel pipe, mortar-lined and mortar-coated, with rubber gasketed or field welded joints. The pipe shall consist of a steel cylinder, shop-lined with cement-mortar and shop-coated with an exterior coating of cement-mortar. Pipes 60-in and larger pipe may be lined in-place with cement mortar.
- B. The pipe shall be designed, manufactured, tested, inspected, and marked according to applicable requirements specified herein and except as hereinafter modified, shall conform to AWWA C200.
- C. **Pipe Dimensions:** The pipe shall be of the diameter and class shown on the Drawings. The minimum steel cylinder thickness for each pipe size shall be as specified or shown on the Drawings but in no case shall the minimum steel cylinder thickness be less than 0.135 inches or the nominal pipe diameter in inches divided by 240, whichever is greater.
- D. **Fitting Dimensions:** The fittings shall be of the diameter and class shown on the Drawings.
- E. **Joint Design:** Unless welded joints are specifically required on the Drawings, the standard field joint for steel pipe shall be either a single-welded lap joint or a rubber-gasketed joint for all pipe sizes up to and including 60-inch diameter and shall be a single-welded lap joint for pipe sizes above 60-inch diameter. Flanged joints shall be required where shown on the Drawings. Butt-strap joints shall be used only where required for closures or where shown on the Drawings. The joints furnished shall have the same or higher pressure rating as the abutting pipe.
- F. Lap joints prepared for field welding shall be in accordance with AWWA C200. The method used to form, shape and size bell ends shall be such that the physical properties of the steel are not substantially altered. Bell ends shall be formed by an expanding press or by being moved axially over a die in such a manner as to stretch the steel plate beyond its elastic limit to form a truly round bell of suitable diameter and shape. Faying surfaces of the bell and spigot shall be essentially parallel, but in no case shall the bell slope vary more than 2 degrees from the longitudinal axis of the pipe.
- G. For bell-and-spigot ends with rubber gaskets, the clearance between the bells and spigots shall be such that when combined with the gasket groove configuration and the gasket itself, will provide watertight joints under all operating conditions when properly installed. The CONTRACTOR shall require the pipe manufacturer to submit details complete with significant dimensions and tolerances and also to submit performance data indicating that the proposed joint has performed satisfactorily under similar conditions. In the absence of a history of field performance, the results of a test program shall be submitted. Bell ends shall be formed by an expanding press or by being moved axially over a die in such a manner as to stretch the steel plate beyond its elastic limit to form a truly round bell of suitable diameter and shape. No process will be permitted in which the bell is formed by rolling.

Spigot ends with rolled gasket grooves shall be formed using dies conforming to the minimum radii specified in Appendix X1 of ASTM A570 and the actual yield strength of the steel used in the spigot rolling operation (i.e., yield strength values in mill certifications and subsequent destructive test results) shall be limited to 42,000 psi.

- H. Shop-applied interior linings and exterior coatings shall be held back from the ends of the pipe as shown on the Drawings.
- I. **Restrained Joints:** Where shown, restrained joints shall be field-welded joints. Designs shall include considerations of stresses induced in the steel cylinder, the joint rings and any field welds caused by thrust at bulkheads, bends, reducers and line valves resulting from the design working pressure. For field welded joints, design stresses shall not exceed 50 percent of the specified minimum yield strength of the grade of steel utilized, or 16,500 psi, whichever is less, for the part being examined when longitudinal thrust is assumed to be uniformly distributed around the circumference of the joint. At the CONTRACTOR'S option, the steel cylinder area may be progressively reduced from the point of maximum thrust to the end of the restrained length. All joints to be field welded for thrust restraint shall have the joint rings attached to the cylinder with double fillet welds.

2.3 MATERIALS

- A. **Cement:** Cement for mortar shall conform to the requirements of AWWA C205; provided, that cement for mortar coating shall be Type V and mortar lining shall be Type II or V. A fly ash or pozzolan shall not be used as a cement replacement.
- B. **Steel for Cylinders and Fittings:** Pipe manufactured under AWWA C200 shall be fabricated from sheet conforming to the requirements of ASTM A 570, Grades 30, 33, 36 or 40, or from plate conforming to the requirements of ASTM A 36; A 283, Grades C or D; or ASTM A 572, Grade 42 or coil conforming to the requirements of ASTM A 139, Grades B or C. All longitudinal and girth seams, whether straight or spiral, shall be butt welded using an approved electric-fusion-weld process.
- C. All steel used for the fabrication of pipe shall have a maximum carbon content of 0.25 percent and shall have a minimum elongation of 22 percent in a 2-inch gage length.
- D. **Welding of Joint Rings to Resist Thrust:** Where steel pipe with field-welded separate formed joint rings are used for thrust restraint, the joint rings shall be welded to the cylinder with double fillet welds.

2.4 PIPE FITTINGS AND SPECIALS

- A. Unless otherwise specified, all specials and fittings shall be in accordance with Section 02513, "Steel Pipe-Fabricated Specials" and shall conform to the dimensions of AWWA C208.
- B. Sufficient handholes shall be provided in fittings and specials to allow repair of linings after field welding. Handholes shall be 5 inch minimum, threaded outlets.

2.5 CEMENT-MORTAR LINING

- A. **Cement-Mortar Lining for Shop Application:** Except as otherwise provided herein, interior surfaces of all steel pipe, fittings, and specials shall be cleaned and lined in the shop with cement-mortar lining applied centrifugally in conformity with AWWA C205. During the lining operation and thereafter, the pipe shall be maintained in a round condition by suitable bracing or strutting.
- B. The nominal lining thickness shall be in accordance with AWWA C 205. The pipe shall be designed for deflection using the nominal lining thickness.
- C. The pipe shall be left bare where field joints occur. Ends of the linings shall be left square and uniform. Feathered or uneven edges will not be permitted.

- D. Defective linings, shall be removed from the pipe wall and shall be replaced to the full thickness required. Defective linings shall be cut back to a square shoulder in order to avoid feather edged joints.
- E. The progress of the application of mortar lining shall be regulated in order that all hand work, including the repair of defective areas is cured in accordance with the provisions of AWWA C205. Cement-mortar for patching shall be the same materials as the mortar for machine lining, except that a finer grading of sand and mortar richer in cement shall be used when field inspection indicates that such mix will improve the finished lining of the pipe.
- F. **Cement-Mortar Lining for Field Application:** The materials and design of in-place cement-mortar lining shall be in accordance with AWWA C602 and the following supplementary requirements:
 - 1. Admixtures shall contain no calcium chloride.
 - 2. The minimum lining thickness shall be as specified for shop-applied cement-mortar lining and finished inside diameter after lining shall be as shown on the Drawings.
- G. **Protection of Pipe Lining:** For all pipe and fittings with shop-applied cement-mortar linings, a polyethylene or other suitable bulkhead shall be provided on the ends of the pipe and on all special openings to prevent drying out of the lining. All bulkheads shall be substantial enough to remain intact during shipping and storage until the pipe is installed.

2.6 EXTERIOR COATING

- A. **Exterior Coating of Exposed Piping:** Unless otherwise specified by the ENGINEER the exterior surfaces of pipe which will be exposed to the atmosphere inside structures or above ground shall be thoroughly cleaned and then given a shop coat of rust-inhibitive primer conforming to the requirements of Section 09900, "Protective Coating."
- B. **Exterior Coating of Buried Piping:** All pipe for buried service, including bulkheads, shall be coated with cement-mortar coating, with thickness and tolerances in conformance with AWWA C205. Unless otherwise shown on the Drawings, exterior surfaces of pipe or fittings passing through structure walls shall be cement-mortar coated from the first flange inside the structure to the end of the underground portion of pipe or fitting. The coating shall be reinforced in accordance with AWWA C205.

2.7 PIPE APPURTENANCES

- A. Pipe appurtenances shall be in accordance with the requirements of Section 15050, "Piping, General."

PART 3 -- EXECUTION

3.1 INSTALLATION OF PIPE

- A. **Handling and Storage:** All pipe, fittings and specials, shall be carefully handled and protected against damage to lining and coating, impact shocks and free fall. Pipe shall not be placed directly on rough ground but shall be supported in a manner which will protect the pipe against injury whenever stored at the site of the work or elsewhere. No pipe shall be installed when the lining or coating show cracks as defined in AWWA C205. Such damaged lining and coating shall be repaired, or a new undamaged pipe shall be furnished and installed.
- B. The CONTRACTOR shall inspect each pipe and fitting to insure that there are no damaged portions of the pipe. The CONTRACTOR shall remove or smooth out any burrs, gouges, weld splatter or other small defects prior to laying the pipe.

- C. Installation of pipes in prepared trenches shall start at the lowest point, with the spigot ends pointing in the direction of flow.
- D. Before placement of pipe in the trench, each pipe or fitting shall be thoroughly cleaned of any foreign substance which may have collected thereon and shall be kept clean at all times thereafter. For this purpose, the openings of all pipes and fittings in the trench shall be closed during any interruption in the installation of the pipe.
- E. **Pipe Laying:** When the pipe is being laid, it shall be turned and placed where possible, so that any slightly damaged coating portion will be on top. The damaged area shall be repaired. All interior or exterior damaged areas shall be repaired using materials and methods in accordance with AWWA C205 and Section 03600, "Grout."
- F. Pipe shall be laid directly on the bedding material. No blocking will be permitted, and the bedding shall be such that it forms a continuous, solid bearing for the full length of the pipe. Excavations shall be made as needed to facilitate removal of handling devices after the pipe is laid. Bell holes shall be formed at the ends of the pipe to prevent point loading at the bells or couplings. Excavation shall be made as needed outside the normal trench width at field joints to permit adequate access to the joints for field connection operations and for application of coating on field joints.
- G. Each section of pipe shall be laid in the order and position shown on the laying schedule. In laying pipe, it shall be laid to the set line and grade, within approximately one inch plus or minus. Renumbering of pipe or using pipe out of sequence will not be allowed. The CONTRACTOR has the option of having spare pipe lengths on site for use as replacement lengths at its own expense.
- H. Vertical or horizontal grade changes, where approved by the ENGINEER, may be made by the deflection of joints or by the use of bevel adapters. In no case shall the deflection in the joint exceed the maximum deflection recommended by the pipe manufacturer. No joint shall be misfit any amount which will be detrimental to the strength and water tightness of the finished joint.
- I. Except for short runs which may be permitted by the ENGINEER, pipes shall be laid uphill. Pipe which is laid on a downhill grade shall be blocked and held in place until sufficient support is furnished by the following pipe to prevent movement. Pipes shall be laid uphill on grades exceeding 10 percent.
- J. Pipe struts shall be left in place until backfilling operations have been completed for pipe 42 inches in diameter and larger. The struts shall remain the property of the CONTRACTOR. Struts in pipe smaller than 42 inches may be removed immediately after laying, provided, that the deflection of the pipe during and after backfilling does not exceed that specified.
- K. **Cold Weather Protection:** No pipe shall be installed upon a foundation into which frost has penetrated or at any time that there is a danger of the formation of ice or penetration of frost at the bottom of the excavation. No pipe shall be laid unless it can be established that the trench will be backfilled before the formation of ice and frost occurs.
- L. **Pipe and Specials Protection:** The openings of all pipe and specials where the pipe and specials have been cement-mortar lined in the shop shall be protected with appropriate bladders or bulkheads to maintain a moist atmosphere and to prevent unauthorized access by persons, animals, water or any undesirable substance. The bulkheads shall be so designed to prevent drying out of the interior of the pipe. Plywood will not be allowed. The CONTRACTOR shall introduce water into the pipe to keep the mortar moist where moisture has been lost due to damaged bulkheads.
- M. All necessary precautions shall be taken to prevent uplift or floating of the pipe prior to the completion of the backfilling operation. The CONTRACTOR shall assume full responsibility for any damage due to this cause and shall, at its own expense, restore and replace the pipe to its specified condition and grade if it is displaced due to floating.

- N. **Pipe Cleanup:** As pipe laying progresses, the CONTRACTOR shall keep the pipe interior free of all debris. The CONTRACTOR shall completely clean the interior of the pipe of all sand, dirt, mortar splatter and any other debris following completion of pipe laying, pointing of joints and any necessary interior repairs prior to testing and disinfecting the completed pipeline.

3.2 RUBBER GASKETED JOINTS

- A. **Rubber Gasketed Joints:** Immediately before jointing pipe, the spigot end of the pipe shall be thoroughly cleaned, and a clean rubber gasket lubricated with an approved vegetable-based lubricant shall be placed in the spigot groove. The volume of the gasket shall be "equalized" by moving a metal rod between the gasket and the spigot ring around the full circumference of the spigot ring. The bell of the pipe already in place shall be carefully cleaned and lubricated with a vegetable-based lubricant. The spigot of the pipe section shall then be inserted into the bell of the previously laid joint and telescoped into its proper position. Tilting of the pipe to insert the spigot into the bell will not be permitted. After the pipe units have been joined, a feeler gage shall be inserted into the recess and moved around the periphery of the joint to detect any irregularity in the position of the rubber gasket. If the gasket cannot be "felt" all around, the joint shall be disassembled. If the gasket is undamaged, as determined by the ENGINEER, it may be reused, but only after the bell ring and gasket have been relubricated.

3.3 WELDED JOINTS

- A. **General:** Field welded joints shall be in accordance with AWWA C206.
- B. Where exterior welds are performed, adequate space shall be provided for welding and inspection of the joints.
- C. During installation of welded steel pipe in either straight alignment or on curves, the pipe shall be laid so that at any point around the circumference of the joint there is a minimum lap of 1/2-inch and a minimum space of 3/4-inch plus the thickness of the steel pipe wall between the spigot end of the pipe and the nearest tangent to a bell radius.
- D. Butt straps, where used or required, shall be a minimum of 6-inches wide, the same thickness as the pipe wall and shall provide for a minimum of 3/4-inch lap at each pipe joint.
- E. After the pipe and pipe joint are properly positioned in the trench, the length of pipe between joints shall be backfilled to at least one foot above the top of the pipe. Care shall be exercised during the initial backfilling to prevent movement of the pipe and to prevent any backfill material from being deposited on the joint.
- F. To control temperature stresses, the unbackfilled joint areas of the pipe shall be shaded from the direct rays of the sun by the use of properly supported awnings, umbrellas, tarpaulins, or other suitable materials for a minimum period of 2 hours prior to the beginning of the welding operation and until the weld has been completed. Shading materials at the joint area shall not rest directly on the pipe but shall be supported to allow air circulation around the pipe. Shading of the pipe joints need not be performed when the ambient air temperature is below 45 degrees F.
- G. Prior to the beginning of the welding procedure, any tack welds used to position the pipe during laying shall be removed. Any annular space between the faying surfaces of the bell and spigot shall be equally distributed around the circumference of the joint by shimming, jacking, or other suitable means. The weld shall then be made in accordance with AWWA C206. Where more than one pass is required, each pass except the first and final one shall be peened to relieve shrinkage stresses; and all dirt, slag, and flux shall be removed before the succeeding bead is applied.
- H. As soon as practicable after welding of each joint, all field-welded joints shall be tested by the liquid penetrant inspection procedure conforming to the requirements of ASTM E 165 under Method "B" and

"Leak Testing." All defects shall be chipped out, rewelded and retested. Upon retest, the repaired area shall show no leaks or other defects. All CITY costs for re-tests after the first re-test shall be paid for by the CONTRACTOR.

- I. Following tests of the joint, the exterior joint spaces shall be coated, and interior linings shall be repaired in accordance with these specifications.
- J. **Qualifications of Procedures and Welders:** All welding procedures used to install pipe shall be prequalified under provisions of ANSI/AWS D1.1. Welding procedures shall be required for field attachments and field welded joints. Copies of welders certificates shall be provided to the ENGINEER.
- K. **Joints:** The pipe ends shall be cut straight on joints where butt straps are used for realignment, adjustment, or deflection, and fillet welds shall be made as shown on the Drawings.
- L. Unless double fillet welds are shown on the Drawings, field welded lap joints may, at the CONTRACTOR'S option, be made on either the inside or the outside of the pipe.

3.4 JOINT COATING AND LINING

- A. **General:** The interior and exterior joint recesses shall be thoroughly wiped clean and all water, loose scale, dirt and other foreign material shall be removed from the inside surface of the pipe. Joint grout shall be non-shrink grout as specified in Section 03315, "Grout."
- B. **Joint Coating:** After the pipe has been laid and after sufficient backfill has been placed between the joints to hold the pipe securely in place, the outside annular space between pipe sections shall be completely filled with non-shrink grout formed by the use of grout bands. The grout shall be thoroughly mixed with water to a consistency of thick cream. The grout space prior to filling shall be flushed with water so that the surface of the joint to be in contact with the grout will be thoroughly moistened when the grout is poured. The joint shall be filled with grout by pouring from one side only, and shall be rodded with a wire or other flexible rod or vibrated so that the grout completely fills the joint recess by moving down one side of the pipe, around the bottom of the pipe and up the opposite side. Pouring and rodding the grout shall be continued to allow completion of the filling of the entire joint recess in one operation. Care shall be taken to leave no unfilled space. Grouting of the outside joint spaces shall be kept as close behind the laying of the pipe as possible except that in no case shall grouting be closer than 3 joints of the pipe being laid.
- C. **Grout Bands (Diapers):** The grout bands or heavy-duty "diapers" shall either be polyethylene foam-lined fabric with steel strapping or polypropylene fabric with fabric backing. The materials shall be of sufficient strength to hold the fresh mortar, resist rodding of the mortar and allow excess water to escape. The foam plastic shall be 100 percent closed cell, chemically inert, insoluble in water and resistant to acids, alkalis, and solvents, and shall be **Dow Chemical Company "Ethafom 222," or equal.** The polypropylene fabric shall be a minimum of 3 ounces per square yard and shall be manufactured by **Dupont, Typar, or equal.**
- D. The fabric backing shall be cut and sewn into 9-inch wide strips with slots for the steel strapping on the outer edges. The polyethylene foam shall be cut into strips 6-inches wide and slit to a thickness of 1/4-inch which will expose a hollow or open cell surface on one side. The foam liner shall be attached to the fabric backing with the open or hollow cells facing towards the pipe. The foam strip shall cover the full interior circumference of the grout band with sufficient length to permit an 8-inch overlap of the foam at or near the top of the pipe joint. Splices to provide continuity of the material will be permitted. The polyethylene foam material shall be protected from direct sunlight.
- E. The polyethylene foam-lined grout band shall be centered over the joint space with approximately equal widths extending over each pipe end and securely attached to the pipe with the steel straps. After filling the exterior joint space with non-shrink grout, the flaps shall be closed and overlapped in a

manner that fully encloses the grout with polyethylene foam. The grout band shall remain in position on the pipe joint.

- F. **Joint Lining:** After the backfill has been completed to final grade, the interior joint recess shall be filled with non-shrink grout of stiff consistency. The mortar shall be tightly packed into the joint recess and troweled flush with the interior surface, and all excess shall be removed. At no point shall there be an indentation or projection of the mortar exceeding 1/16-inch. With pipe smaller than 24 inches in diameter, before the spigot is inserted into the bell, the bell shall be daubed with non-shrink grout. The spigot end then shall be forced to the bottom of the bell and excess mortar on the inside of the joint shall be swabbed out.
- G. **Handholes:** Handholes shall be provided for applying cement mortar lining in the field at butt-strap connections. Handholes shall be 5-inch standard steel couplings and shall be furnished with malleable iron plugs.
- H. **Cement-Mortar Lining, Field-Applied:** For pipe diameters of 60 inches or larger, the CONTRACTOR may construct the cement-mortar lining in-place. The application of in-place cement-mortar lining shall be in accordance with AWWA C602.
- I. Equipment and machines shall conform to AWWA C205. The CONTRACTOR shall perform all work in a thorough and workmanlike manner by trained personnel, under the supervision of experienced personnel skilled in machine application of cement-mortar lining.
- J. Curing of the in-place cement-mortar lining shall be in accordance with AWWA C602. The CONTRACTOR shall provide additional protective devices as required to ensure that the airtight covers, which maintain a moist condition in the pipeline, are not damaged.
- K. Defective areas encompassing the full diameter of the pipe shall be replaced by machine wherever the length measured along the pipe centerline is greater than 5 feet; otherwise defective areas may be replaced by hand.

3.5 INSTALLATION OF PIPE APPURTENANCES

- A. **Protection of Appurtenances:** Where the joining pipe is concrete or coated with cement mortar, buried appurtenances shall be coated with a minimum thickness of one inch of cement mortar having one part cement to not more than 2 parts plaster sand.
- B. **Installation of Flanged Joints:** Before the joint is assembled, the flange faces shall be thoroughly cleaned of all foreign material with a power wire brush. The gasket shall be centered and the connecting flanges drawn up watertight without unnecessarily stressing the flanges. All bolts shall be tightened in a progressive diametrically opposite sequence and torqued with a suitable, approved and calibrated torque wrench. All clamping torque shall be in conformance with the manufacturers printed recommendations and shall be applied to the nuts only.
- C. All buried flanges shall be coated and protected in accordance with Section 09900, "Protective Coating."
- D. **Insulated Joints:** Insulated joints and appurtenant features shall be made by the CONTRACTOR as shown on the Drawings or as required by the approved cathodic protection system design. The CONTRACTOR shall exercise special care when installing these joints to prevent electrical conductivity across the joint. After the insulated joint is completed, an electrical resistance test will be performed by the ENGINEER. Should the resistance test indicate a short circuit, the CONTRACTOR shall remove the insulating units to inspect for damages, replace all damaged portions and reassemble the insulating joint. The insulated joint shall then be retested to assure proper insulation.

- E. **Flexible Coupled Joints:** When installing flexible couplings, care shall be taken that the connecting pipe ends, couplings and gaskets are clean and free of all dirt and foreign matter with special attention being given to the contact surfaces of the pipe, gaskets and couplings. The couplings shall be assembled and installed in conformity with the recommendation and instruction of the coupling manufacturer. Sleeve type coupling shall conform to the requirements of Section 15050, "Piping, General."
- F. Wrenches used in bolting couplings shall be of a type and size recommended by the coupling manufacturer. Coupling bolts shall be tightened so as to secure a uniform annular space between the follower rings and the body of the pipe with all bolts tightened approximately the same amount. Diametrically opposite bolts shall be tightened progressively and evenly. Final tightening shall be done with a suitable, approved and calibrated torque wrench set for the torque recommended by the coupling manufacturer. All clamping torque shall be applied to the nut only.
- G. Upon completion of the coupled joint, the coupling and bare metal of the pipe shall be cleaned, primed and protected in accordance with the requirements of Section 09900, "Protective Coating."
- H. Installation of warning tape shall be in conformance with Section 15075, "Piping Identification Systems."

3.6 CORROSION CONTROL

- A. **Joint Bonding:** Except where otherwise specified, all joints shall be cleaned to bare bright metal at the point where the bond is installed.
- B. **Cathodic Protection:** Corrosion mitigation and testing materials, such as cathodic protection system with or without impressed current, magnesium anodes, deep well anode bed sand bed rectifiers, reference electrodes and test lead wires shall be furnished and installed when required in conformance with the approved cathodic protection system design.
- C. Electrolysis test station design and installation shall be submitted for review by the ENGINEER and shall be installed where shown on the drawings.

3.7 TESTING AND DISINFECTION

- A. Field testing and disinfection of all steel pipe shall conform to the requirements of Section 02510, "Pressure Pipeline Testing and Disinfection."

- END OF SECTION -

SECTION 331106 - STEEL PIPE - FABRICATED SPECIALS

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide all materials, equipment and labor necessary to furnish and install, all closure and correction pieces, bends, reducers, nozzles, wyes, tees, crosses, outlets, manifolds and other steel plate specials and all appurtenant work, complete and operable, including connections as shown on the Drawings and as specified herein.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 02510 Pressure Pipeline Testing and Disinfection.
- B. Section 02512 Steel Pipe - Mortar-Lined and Mortar-Coated.
- C. Section 03600 Grout.
- D. Section 09900 Protective Coating.
- E. Section 15050 Piping General.
- F. Section 15105 Miscellaneous Piping, Valves, Fittings, and Appurtenances.
- G. Division 1 General Requirements.

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards:

- AWWA C200 Standard for Steel Water Pipe 6 in. (150mm) and Larger.
- AWWA C 205 Standard for Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 in. and Larger - Shop applied.
- AWWA C208 Standard for Dimensions for Fabricated Steel Water Pipe Fittings.
- ASTM A 105 Specification for Carbon Steel Forgings for Piping Applications.
- ASTM A 216 Specification for Steel Castings, Carbon, suitable for Fusion Welding, for High Temperature Service.
- ASTM A 234 Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
- ASTM E 165 Practice for Liquid Penetrant Inspection Method.
- AWWA Manual M 11 Steel Pipe - A Guide for Design and Installation.

1.4 CONTRACTOR SUBMITTALS

- A. **Shop Drawings:** The CONTRACTOR shall submit shop drawings and laying diagrams of all pipe, joints, closure and correction pieces, bends, reducers, nozzles, wyes, tees, crosses, outlets, manifolds and other steel plate specials.
- B. Design calculations shall be submitted to the ENGINEER for review prior to manufacture of pipe specials.
- C. **Certificates of Compliance:** Certificates of Compliance shall be provided for all products or materials proposed to be used under this Section.

1.5 QUALITY ASSURANCE

- A. **Shop Testing of Steel Plate Specials:** Upon completion of the welding, but prior to lining and coating, each steel plate special shall be bulkheaded and tested under a hydrostatic pressure of 1-1/2 times the design pressure. Hydrostatic testing will not be required if the straight pipe used in fabricating the specials has been previously tested and meets the requirements of the applicable piping Section, provided that all other welded seams are tested by the liquid penetrant inspection procedure conforming to ASTM E 165, under Method "B" and "Leak Testing" or where applicable by the soap and compressed air method at an air pressure of 25 psi. Any pin holes or porous welds which may be revealed by the test shall be chipped out and rewelded and the pipe or fitting retested.
- B. No outside mortar shall be applied over a seam prior to testing; however, mortar lining may be applied over a seam prior to hydrostatic testing, but under such conditions said pressure test shall be held on the pipe or fitting for a period of not less than 30 minutes.
- C. **Field Testing:** Field testing shall conform to the requirements of Section 02510, "Pressure Pipeline Testing and Disinfection."

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Specials are defined as fittings, closure pieces, correction pieces, bends, reducers, nozzles, wyes, tees, crosses, outlets, manifolds and other steel plate specials wherever located.

2.2 PIPE DESIGN

- A. **Design:** Except as otherwise provided herein, materials, fabrication and shop testing of straight pipe shall conform to the requirements of AWWA C200, and shall conform to the dimensions of AWWA C208.

2.3 FABRICATION AND MATERIALS

- A. **General:** Reinforcement for closure and correction pieces, bends, reducers, nozzles, wyes, tees, crosses, outlets, manifolds and other steel plate specials shall be designed in accordance with AWWA Manual M-11. Reinforcement shall be designed for the design pressure specified or shown and shall be in accordance with the design details shown. Specials and fittings shall be equal in pressure design strength and shall have the same lining and coating as the adjoining pipe. Unless otherwise shown, the minimum radius of elbows shall be 2.5 times the pipe diameter and the maximum miter angle on each section of the elbow shall not exceed 11-1/4 degrees.
- B. Specials and fittings that cannot be mechanically lined and coated shall be lined and coated by hand-application, using the same materials as are used for the pipe and in accordance with the applicable AWWA or ASTM Standards. Coating and lining applied in this manner shall provide protection equal to that specified for the pipe. Fittings may be fabricated from pipe that has been mechanically lined

and/or coated. Areas of lining and coating that have been damaged by such fabrication shall be repaired by hand-applications in accordance with applicable AWWA or ASTM Standards.

- C. Access maintenance holes with covers shall be as detailed on the Drawings.
- D. All threaded outlets shall be forged steel suitable for 3000 psi service per ASTM A 105 or ASTM A 216, and shall be as manufactured by **Bonnie Forge Co., "Threadolet," Allied Piping Products Co., "Branchlet" or equal.**
- E. Moderate deflections and long radius curves may be made by means of beveled joint rings, by pulling standard joints, by using short lengths or pipe, or a combination of these methods; provided that pulled joints shall not be used in combination with bevels. The maximum total allowable angle for beveled joints shall be 5 degrees per pipe joint. Bevels shall be provided on the bell ends. Mitering of the spigot ends will not be permitted. The maximum allowable angle for pulled joints shall be in accordance with the manufacturer's recommendations or the angle which results from a 3/4 inch pull out from normal joint closure, whichever is less. All horizontal deflections or fabricated angles shall fall on the alignment. In congested areas or at locations where underground structures are encountered, the chord produced by deflecting the pipe shall be no further than 6 inches from the alignment shown.
- F. All vertical deflections shall fall on the alignment and at locations adjacent to underground obstructions, points of minimum earth cover, and pipeline outlets and structures, the pipe angle points shall match the angle points shown.
- G. **Outlets, Nozzles, Tees, Wyes, and Crosses:** All outlets 12 inch and smaller may be fabricated from Schedule 30 or heavier steel pipe in the standard outside diameters, i.e., 12-3/4 inch, 10-3/4 inch, 8-5/8 inch, 6-5/8 inch, and 4-1/2 inch.
- H. The design of outlet reinforcement shall be in accordance with the procedures given in Chapter 13 of AWWA Manual M-11, except that the design pressure, P, used in the AWWA Manual M-11 procedure shall equal the greater of $1.25 P_w$ or $0.9375 P_t$. Unless otherwise shown outlets 2 inches in diameter and smaller, Weld-O-Let as specified in Section 15105, "Miscellaneous Piping, Valves, Fittings and Appurtenance," need not be reinforced.
- I. In lieu of saddle or wrapper reinforcement as provided by the design procedure in AWWA Manual M-11, pipe or specials with outlets may be fabricated in their entirety of steel plate having a thickness equal to the sum of the pipe wall plus the required reinforcement.
- J. Where required by the AWWA Manual M-11 design procedure crotch plate reinforcement shall be furnished.
- K. **Steel Welded Fittings:** Steel welded fittings shall conform to ASTM A 234.
- L. **Ends for Mechanical-Type Couplings:** Except as otherwise provided herein, where mechanical-type couplings are indicated, the ends of pipe shall be banded with Type C collared ends using double fillet welds.
- M. **Lining:** All requirements pertaining to thickness, application and curing of lining specified for straight pipe shall apply to specials, with the following additional requirements. If the special cannot be lined centrifugally, it shall be lined by hand. In such case, the lining shall be reinforced with 2-inch by 4-inch by No. 12 welded wire fabric positioned approximately in the center of the lining. The wires, spaced 2 inches on centers, shall extend circumferentially around the pipe with the fabric securely fastened to the pipe. Splices shall be lapped 4 inches and the free ends tied or looped to assure continuity.
- N. **Coating:** All requirements pertaining to thickness, application and curing of coating specified for straight pipe shall apply to specials. Unless otherwise shown, the mortar coating on the buried portion of a pipe section passing through a structure wall shall extend to the first flange located inside the

structure. Pipe above ground or in structures shall be field-painted as specified in Section 09900, "Protective Coating."

- O. **Marking:** A mark indicating the true vertical axis of the special shall be placed on the top and bottom of the special.

PART 3 -- EXECUTION

3.1 GENERAL

- A. Unless otherwise provided, the CONTRACTOR shall furnish and install all fittings, correction and closure pieces, bends, reducers, wyes, tees, crosses, nozzles, outlets, manifolds, and other steel plate specials, bolts, nuts, gaskets, jointing materials, and all other appurtenances as shown and as required to provide a complete and workable installation. Where pipe support details are shown, the supports shall conform to the details, and shall be placed as indicated; provided, that the support for all exposed piping shall be complete and adequate to support the pipe specials regardless of whether or not supporting devices are specifically shown. Where required by the drawings, concrete thrusts blocks and welded joints shall be provided. At all times when the WORK of installing pipe is not in progress, all openings into the pipe and specials and the ends of the pipe in trenches or structures shall be kept tightly closed to prevent entrance of animals and foreign materials. The CONTRACTOR shall take all necessary precautions to prevent the pipe and specials from floating due to water entering the trench from any source. The CONTRACTOR shall assume full responsibility for any damage due to this cause and shall at its own expense restore and replace the pipe and specials to its specified condition and grade if it is displaced due to floating. The CONTRACTOR shall maintain the inside of the pipe and specials free from foreign materials and in a clean and sanitary condition until its acceptance by the CITY.

3.2 INSTALLATION

- A. Trenches shall be in a reasonable dry condition when the pipe and special are laid. Necessary facilities including slings shall be provided for lowering and properly placing the pipe and specials in the trench without damage. No pipe shall be installed when the lining or coating show cracks as detailed in the AWWA C 205. Such damaged lining and coating shall be repaired or a new undamaged pipe shall furnished and installed. The pipe and specials shall be laid to the line and grade shown and they shall be closely jointed to form a smooth flow line.

Immediately before placing each section of pipe special in final position for jointing, the bedding for the pipe shall be checked for firmness and uniformity of surface.

- B. Installation of pipes and specials in prepared trenches shall start at the lowest point, with the spigot ends pointing in the direction of flow.
- C. Cathodic protection shall be installed in conformance with the approved cathodic protection system design as specified in Section 02512, "Steel Pipe - Mortar-Lined and Mortar-Coated."

3.3 TESTING

- A. Pipeline testing shall be in accordance with Section 02510, "Pressure Pipeline Testing and Disinfection."

- END OF SECTION -

**SECTION 331200 - MISCELLANEOUS PIPING, VALVES, FITTINGS,
AND APPURTENANCES**

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide all materials, equipment, and labor necessary to furnish and install all exposed and buried piping, complete, including but not necessarily limited to small steel pipe, small valves, red brass pipe, copper tubing, solvent-welded PVC pipe, fittings, gaskets, bolts, insulating connections, and all such other specialties as required for a complete and operable piping system, as shown on the Drawings and as specified herein.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- | | |
|---------------------|--------------------------------|
| A. Division 2 and 5 | Piping Sections. |
| B. Section 331219 | Fire Hydrants. |
| C. Section 055000 | Miscellaneous Metalwork. |
| D. Section 099000 | Protective Coating. |
| E. Section 331100 | Piping, General. |
| F. Section 330526 | Piping Identification Systems. |
| G. Division 1 | General Requirements. |

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. **Commercial Standards:**

- | | |
|------------------|--|
| ANSI B16.22 | Wrought Copper and Copper Alloy Solder Joint Pressure Fittings. |
| ANSI/ASME B16.3 | Malleable Iron Threaded Fittings, Classes 150 and 300. |
| ANSI/ASME B16.15 | Cast Bronze Threaded Fittings, Classes 125 and 250. |
| ANSI/ASME B31.1 | Power Piping, DoD Adopted. |
| ASTM A 53 | Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless. |
| ASTM A 106 | Specification for Seamless Carbon Steel Pipe for High- Temperature Service. |
| ASTM A 325 | Specification for Structural Bolts, Steel, Heat-Treated, 120/105 ksi minimum tensile strength. |
| ASTM B 43 | Specification for Seamless Red Brass Pipe, Standard Sizes. |
| ASTM B 62 | Specification for Composition Bronze or Ounce Metal Castings. |

ASTM B 88	Specification for Seamless Copper Water Tube.
ASTM D 1785	Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
ASTM D 2239	Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR). Based on Controlled Inside Diameter.
ASTM D 2737	Specification for Polyethylene (PE) Plastic Tubing.
AWWA C207	Standard for Steel Pipe Flanges for Waterworks Service - Sizes 4 inch through 144 inch.
AWWA C507	Standard for Ball Valves 6 In. Through 48 In. (150mm through 1200mm).
AWWA C 800	Standard for Underground Service Line Valves and Fittings.
AWWA Manual M 11	Steel Pipe - A Guide for Design and Installation.

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.

1.Manufacturers product specifications and performance details shall be provided for all products and materials proposed to be used under this Section.

PART 2 -- PRODUCTS

2.1 SMALL STEEL PIPE

- A. Galvanized steel pipe shall conform to the requirements of ASTM A 53, and shall be Schedule 40 or 80. NPT fittings for galvanized steel pipe shall be of galvanized malleable iron.

2.2 POLYETHYLENE PLASTIC PIPE AND TUBING (FOR WATER SERVICES)

- A. Polyethylene plastic pipe, for 1 inch Residential Joint Domestic/Fire Services only, shall be PE 3408 with SIDR 7, iron pipe size conforming to the requirements of ASTM D 2239, and a rating of 200 psi. Polyethylene plastic tubing, for 1 inch, 1-1/2 inch, and 2 inch services, shall be PE 3408 with SIDR 9, copper tubing size conforming to the requirements of ASTM D 2239, and a rating of 160 psi.

- B. All joints connecting Polyethylene Plastic Pipe or Tubing shall utilize "Pack Joint Type" compression fittings.

2.3 BRASS PIPE

- A. Brass pipe shall conform to the requirements of ASTM B 43. Fittings shall be of bronze conforming to the requirements of ASTM B 62 with threaded ends, conforming to ANSI/ASME B16.15.

- B. Two inch brass street elbows, for Dead End and In-Line Blowoffs shall be **Jones 2619, Ford F84.77-G, or equal.**

2.4 COPPER TUBING

- A. Copper tubing shall conform to the requirements of ASTM B 88 and shall be Type K, soft temper, joint free, for buried tubing; and hard-drawn joint free, for above-ground applications. All fittings connecting copper tubing shall be compression fittings.

2.5 PVC (POLYVINYL CHLORIDE) PRESSURE PIPE, SOLVENT-WELDED

- A. PVC pipe shall be made from all new rigid unplasticized polyvinyl chloride and shall be Schedule 40 or 80, as specified, conforming to ASTM D 1785. Joints and fittings shall be of the same material as the pipe and shall be solvent-welded construction.

2.6 CORPORATION STOP VALVES

A. **Tapered Plug Type**

1. Tapered plug style valves shall be brass conforming to AWWA C800.
2. The connection joint to the service saddle shall be in conformance with AWWA C800 iron pipe thread.
3. The connection joint to the service lateral shall be a "Pack Joint Type" compression joint.
4. Tapered plug style valves on steel or ductile iron pipe shall utilize a threaded insulating bushing between the tapping outlet or service saddle on the water main and the stop valve.

B. **Manufacturers, or Equal**

1. Iron Pipe Sizes, 1" Residential Joint Domestic/Fire Service only:

Size	Mueller	Jones	Ford
1"	n/a	J-3404	F-1101-4

2. Copper Tubing sizes, 1", 1-1/2", and 2" service:

Size	Mueller	Jones	Ford
1"	n/a	J-3403	F-1100-4
1-1/2"	n/a	n/a	n/a
2"	n/a	n/a	n/a

C. **Ball Valve Type**

1. Ball valve style valves shall be brass conforming to AWWA C800.
2. The connection joint to the service saddle shall be in conformance with AWWA C800 iron pipe thread.
3. The connection joint to the service lateral shall be a "Pack Joint Type" compression joint.
4. Ball valve style valves on steel or ductile iron pipe shall utilize a threaded insulating bushing between the tapping outlet or service saddle on the water main and the stop valve.

D. **Manufacturers, or equal.**

1. Iron pipe sizes, 1" Residential Joint Domestic/Fire Service only:

	Mueller	Jones	Ford
Size			
1"	E-25029	J-1936	FB-1101-4

2. Copper tubing sizes, 1", 1-1/2", 2" services:

	Mueller	Jones	Ford
Size			
1"	P25028	J-1935	FB-1100-4
1 1/2"	P-25028	J-1935	FB-1100-6
2"	P-25028	J-1935	FB- 1100-7

2.7 ANGLE METER STOP VALVES

- A. Angle meter stop valves shall be a brass ball valve or brass angle meter valve with a 90-degree lock wing. The connection joint to the water service line shall be a "Pack Joint Type" compression joint.

B. **Manufacturers, or Equal**

1. Iron pipe sizes, 1" Residential Joint Domestic/Fire Service only:

	Mueller Jones Ford		
Size			
1"	n/a	J-1962W	BA63-444W

2. Copper tubing sizes, 1", 1-1/2", and 2" services:

	Mueller	Jones	Ford
Size			
1"	P-24258	J-1963W	BA43-444W
1-1/2"	P-24276	J-1975W	BA43-666W
2"	P-24276	J-1975W	FV43-777W

2.8 METER ADAPTERS

- A. Slotted meter adapters shall be used for piston meter sizes 1" and smaller when service lateral size is 1-1/2" or 2".
- B. Manufacturers shall be **Ford A47 slotted adapter, Jones or equal.**

2.9 LOCKABLE BALL VALVES

- A. Lockable ball valves for commercial services shall be a brass ball valve with iron pipe threads on both ends with padlock wings.

B. Manufacturers, or equal.

1. Female iron pipe threads both ends for turbine meter installation:

	Mueller	Jones	Ford
Size			
1"	B-20200	J-1900W	B11-444
1-1/2"	B-20200	J-1900W	B11-666
2"	B-20200	J-1900W	B11-777

2. Female iron pipe threads by meter swivel for piston meter:

	Mueller	Jones	Ford
Size			
1"	B-24351	n/a	BF13-444W
1-1/2"	B-24337	J-1912W	BF13-666W
2"	B-24337	J-1912W	B13-777W

2.10 POLYETHYLENE PIPE TUBING LINERS

- A. Stainless steel liners shall be used with all compression fittings on polyethylene pipe and tubing.

B. Manufacturers, or equal.

1. Iron pipe sizes, 1" Residential Joint Domestic/Fire Service only:

	Mueller	Jones	Ford
Size			
1"	505142	J-2806	72

2. Copper tubing sizes, 1", 1-1/2", 2" services:

	Mueller	Jones	Ford
Size			
1"	504385	J-2805	52
1-1/2"	506139	J-2105	54
2"	506141	J-2805	55

2.11 TAPPING SLEEVES

- A. Tapping sleeves shall be cast iron, mechanical-joint sleeves with a rated working pressure of at least 150 psi, stainless steel with stainless steel nuts and bolts, or steel, mortar lined and coated, with stainless steel nuts and bolts. Bolts and nuts on epoxy lined sleeves shall be Type 304 or 316 stainless steel.

B. Manufacturers, or equal

Pipe Type	APAC	Clow	Ford	Mueller	Tyler
Plastic	512 (14-30")	F-5205 (4-16")	FTSC* (14-30")	H-615 (4-12")	5-149
	512 (6-12")*	F 5207** (4-12")	FTSC (4-12")*	H-304 (14-24")	
Ductile Iron	512 (4-30")	F-5205 (4-16')	FTSC (4-30")	H-615 (4-24")	5-149
				H-304 (4-24")	
Asbestos Cement	512 (6-30) *	F-5207 (4-12") **	FTSC (14-30")* FTSS (SS)(4-12")	H-619 (4-12") H-304 (14-16")	5-349
Steel	504 (4-36")	--	FWS (4-16")		

* allowed only if the pipe is out of round and it is approved by Water Resources.

** for Class 100 pipe, 10" and 12", use the F-5205.

2.12 TAPPING OUTLETS

- A. Tapping outlets for steel mortar-lined and coated pipe shall be designed and fabricated to comply with design procedures in AWWA Manual M-11. The tapping outlets shall be designed for the pressure rating of the pipeline to which they are attached, with a minimum rated working pressure of 150 psi.
- B. Tapping outlets for mortar-lined and coated steel pipe shall be factory fusion bonded epoxy lined and coated steel in conformance with Section 099000, "Protective Coatings," with stainless steel nuts and bolts.
- C. **Manufacturers for steel pipe, or equal:**

APAC	Ford
534	FWS

2.13 SERVICE SADDLES

- A. Service saddles shall be bronze or stainless steel for use on plastic; bronze for use on asbestos cement ; and steel or iron for use on ductile iron pipe.
- B. Service saddles will not be allowed on mortar lined and coated steel pipe. Tapping outlets shall be used on mortar-lined and coated steel pipe.
- C. Service saddles shall be double strap type except for service saddles on plastic pipe.
- D. The service tap on the service saddle shall have an AWWA C800 iron pipe thread.

E. **Manufacturers, or equal**

Pipe Type	APAC	Mueller	Jones	Ford
Asbestos Cement	113	BR 2B 0684 IP to BR 2B 1732 IP	J-979	202 B
Ductile Iron	102 to 103	DR 2A 0659 IP to DR 2A 1740 IP	n/a	202
Plastic PVC C900	n/a	H-13491 to H-13494	J-996	S-91
Plastic PVC C905	n/a	n/a	n/a	202 BS

2.14 WELD-O-LETS

- A. For 1", 1-1/2", and 2" service connections to steel mortar lined and coated pipe use 3000#, forged steel, **Bonney Forge Co., "Weldolet," Allied Piping Products Co., "Branchlet; or equal.**

2.15 SANITARY SEWER LATERAL CONNECTIONS TO EXISTING MAINS

- A. Lateral connections to existing vitrified clay pipe, PVC, and ductile iron pipe sanitary sewer mains shall be made using the "Tap-Tite" Method or the Saddle-Type Method with a sewer pipe saddle manufactured by **Sealtite, Romac, or equal.**
- B. Lateral connections to existing ABS and PVC composite pipe shall be made with solvent welded saddle fittings in accordance with the manufacturer's printed recommendations.

2.16 SANITARY SEWER LATERAL CLEAN OUTS

- A. Two-way Sanitary Sewer Clean outs on 4 inch sanitary sewer laterals shall be cast iron **ANACO, Two-Way Combination Clean-out; American Brass and Iron, Two-Way Clean-out fitting (Kelly); or equal.** Sanitary sewer cleanouts on 6 inch and larger pipe shall be a combination Wye and 1/8th bend, **ANACO; American Brass and Iron; or equal.**

2.17 AIR RELEASE VALVES

- A. Air release valves shall be **Crispin P-Series, APCO 200 Series, or equal.**

2.18 THREADED INSULATING BUSHING

- A. Male threaded by compression or slip insulating bushings of PVC shall be provided at CITY water meters.

2.19 WATER SAMPLING STATION

- A. Water Sampling Station housing, base flange, internal valve and support and bolts will be supplied and installed by the CITY and paid for by the developer. The CONTRACTOR shall furnish all other products and materials required to install Water Sampling Stations and as shown on the Drawings.

2.20 PIPE SUPPORTS

- A. All piping systems and pipe connections to equipment shall be properly supported to prevent undue deflection, vibration and stresses on piping, equipment and structures. All supports and parts thereof shall conform to the requirements of ANSI/ASME B31.1, except as supplemented or modified by this Section.

2.21 STOCK PARTS

- A. Where not specifically shown or detailed use stock or production parts wherever possible. Such parts shall be new, of best commercial quality, designed and rated for the intended purpose.

2.22 PIPE FLANGES

- A. **Flanges:** Where the design pressure is up to a maximum of 275 psi, flanges shall conform to either AWWA C207 Class E or ANSI B16.5 for 150-pound flanges. Flanges shall have flat faces and shall be attached with bolt holes straddling the vertical axis of the pipe unless otherwise shown. Attachment of the flanges to the pipe shall conform to the applicable requirements of AWWA C207. Flanges for miscellaneous pipes shall be in accordance with the appropriate Specification Sections for these pipes.
- B. **Blind Flanges:** Blind flanges shall be in accordance with AWWA C207, or with the appropriate Specification Sections for the various pipe types.
- C. **Flange Coating:** All machined faces of metal blind flanges and pipe flanges shall be coated with a temporary rust-inhibitive coating to protect the metal until the installation is completed.
- D. **Flange Bolts:** All bolts and nuts shall conform to Section 055000, "Miscellaneous Metalwork." Studs and bolts shall extend through the nuts a minimum of 1/4 inch. All-thread studs shall be used on all valve flange connections where space restrictions preclude the use of regular bolts. Flange bolts for fire hydrant installations shall be in accordance with Section 331219, "Fire Hydrants."
- E. **Insulating Flange Sets:** Insulating flange sets shall be provided where shown. Each insulating flange set shall consist of an insulating gasket, insulating sleeves and washers and a steel washer. Insulated flanges shall have bolt hole diameter 1/4 inch greater than the bolt diameter. Insulating sleeves shall be 1/32 inch thick NEMA LI-1 (1989) Grade G-10 fiberglass epoxy. Washers shall be 5/32 inch thick NEMA LI-1 (1989) Grade G-10 fiberglass epoxy. Steel washers, bolts and nuts shall be in accordance with ASTM A 325. Insulating gaskets shall be 1/8 inch thick full-face Neoprene-faced phenolic.
- F. **Insulating Flange Manufacturers, or Equal:**
 - 1. **JM Red Devil, Type E**
 - 2. **Maloney Pipeline Products Co.**
 - 3. **PSI Products, Inc.**
- G. **Flange Gaskets:** Gaskets for flanged joints shall be full-faced, 1/16 inch thick compressed sheets of aramid fiber base, with nitrile binder and non-stick coating, suitable for temperatures to 700 degrees F, a pH

of one to 11, and pressures to 1000 psig. Blind flanges shall have drop-in gaskets. Drop-in gaskets shall be 1/4 inch smaller than the inside edge of the bolt holes. Ring gaskets will not be allowed.

2.23 SEWER LATERAL BACKFLOW PREVENTOR

- A. Sanitary sewer lateral backflow preventors shall be as manufactured by National Diversified Sales, Lindsay, CA, Flow Control Inc., Burbank, CA, or equal.

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. **Small Steel Pipe:** Galvanized steel pipe shall be coated as specified in Section 099000, "Protective Coating."
- B. **Plastic Pipe:** PVC pipe joints shall be solvent-welded in accordance with the manufacturer's printed instructions.
- C. **Couplings:** Pipe couplings shall be installed in strict accordance with the manufacturer's printed recommendations, using the correct style coupling and gasket as appropriate.
- D. **Gaskets for Flanged Joints:** Gaskets shall be in accordance with the requirements of Section 331100, "Piping, General."
- E. **Insulating Connections:** All insulating connections shall be installed in accordance with manufacturer's printed instructions and Section 331100 "Piping, General." Care shall be exercised to prevent damage to insulating fittings while making up the joints.
- F. Unless otherwise shown on the Drawings, service saddles, tapping sleeves, tapping outlets and Weld-O-Lets shall be field coated equal to the existing pipe coating.
- G. Tapping of any existing main shall be coordinated with the ENGINEER. A minimum of 48 hours notice shall be given to the ENGINEER before installation. The ENGINEER will be present during the tapping process. After completion of the tap the Coupon ("Cookie") shall be given to the ENGINEER.
- H. Plastic water service pipe or tubing shall be installed joint free between the corporation stop valve and angle meter stop valve.
- I. Water Sampling Stations shall be installed at the locations shown and in conformance with the Drawings.
- J. Installation of warning tape and copper wire shall be in conformance with Section 330526, "Piping Identification Systems."

- END OF SECTION -

SECTION 331213

BACKFLOW PREVENTION ASSEMBLIES AND PRESSURE REDUCING VALVES

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide all materials, equipment, and labor necessary to furnish and install Backflow Prevention Assemblies and small and large Pressure Reducing Valves, complete and operable including accessories and, where designated operators, as shown on the Drawings and as specified herein.

1.2 RELATED WORK SPECIFIED ELSEWHERE:

- A. Section 331100 Piping, General.
- B. Section 331200 Miscellaneous Piping, Valve Fittings, and Appurtenances.
- C. Section 331215 Valves, General.
- D. Division 1 General Requirements.

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. CITY OF LIVERMORE Backflow Preventer Ordinance.
- B. **Commercial Standards:**
 - ANSI B16.1 Cast Iron Pipe Flanges and Flanged Fittings.
 - ASTM B 62 Specification for Composition Bronze or Ounce Metal Castings.
 - AWWA C 510 Double Check Backflow-Prevention Assembly.
 - AWWA C 511 Reduced-Pressure Principle Backflow-Prevention Assembly.
 - USC University of Southern California, Manual of Cross-Connection Control.

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.

1.5 QUALITY ASSURANCE

- A. **Valve Testing:** Unless otherwise specified, each valve body shall be tested under a test pressure equal to twice its design water-working pressure.
- B. **Bronze Parts:** Unless otherwise specified, all interior bronze parts of valves shall conform to the requirements of ASTM B 62.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. The CONTRACTOR shall contact the Water Resources Division for a list of the approved Backflow Prevention Assemblies, and testing services.
- B. All exposed, manually operated butterfly valves shall have operators with position indicators.

2.2 BACKFLOW PREVENTION ASSEMBLIES

- A. Backflow Prevention Assemblies shall be as follows:
 - 1. For low hazard Industrial/Commercial Fire Services: Double-Check Detector-Check Backflow Prevention Assembly.
 - 2. For high hazard Industrial/Commercial Fire Services: Reduced-Pressure Detector-Check Backflow Prevention Assembly.
 - 3. For low hazard domestic or non-CITY owned irrigation: Double Check Backflow Prevention Assembly.
 - 4. For high hazard domestic or non-CITY owned irrigation: Reduced-Pressure Backflow Prevention Assembly.
 - 5. For CITY owned irrigation: Reduced-Pressure Backflow Prevention Assembly.

2.3 INSULATED ENCLOSURES

- A. Insulated enclosures are required for Backflow Prevention Devices 2 inches and smaller. Insulated enclosures shall be an above ground fiberglass rock enclosure by **Hot Box- Hot Rok, , Dekorra Products LLC, or equal**, and as shown on the Drawings.

2.4 PRESSURE REDUCING VALVES

- A. Small pressure reducing valves (2 inch and smaller)
 - 1. **General:** Small Pressure Reducing Valves, 2 inches and smaller, shall be of the spring-loaded diaphragm type with a pressure rating not less than 250 psi, with bronze body, nickel alloy or stainless steel seat, and threaded ends. Each valve shall be furnished with built-in or separate strainer and union ends.
 - 2. **Manufacturers, or Equal:**
 - a. **Mueller Company**
 - b. **Watts Regulator Company**
 - c. **Wilkins Regulator**

- B. Large pressure reducing valves (4 inch and larger)
- 1. The CONTRACTOR shall purchase all large pressure reducing valves 4 inches and larger from the Water Resources Division. The CONTRACTOR shall provide all required connections and fittings.

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. All Backflow Prevention Assemblies and Pressure Reducing Valves shall be installed in accordance with the manufacturer's printed recommendations, as required by the CITY'S Backflow Prevention Ordinance, and applicable codes and regulations.
- B. **Valve Accessories:** Where combinations of valves, sensors, switches, and controls are specified, it shall be the responsibility of the CONTRACTOR to properly assemble and install these various items so that all systems are compatible and operating properly.
- C. Backflow Prevention Assemblies shall be installed in potable and recycled water lines where required by City of Livermore Backflow Prevention Ordinance, Title 17 California Code of Regulations, applicable codes or regulations, or wherever there is any danger of contamination, and where shown on the Drawings.
- D. Backflow Prevention Assemblies shall be installed in the location shown on the Drawings and in conformance with the CITY'S Backflow Prevention Ordinance, Title 17 California Code of Regulations, and City Standard Detail.
- E. Backflow Prevention Assemblies shall be tested by an approved testing service prior to putting the assemblies into service. The CONTRACTOR shall contact the City's Water Resource Division for a list of approved testing services. All costs of testing shall be at the CONTRACTOR'S expense.
- F. Insulated enclosures for backflow prevention assemblies 2 inches and smaller shall be installed as required and in conformance with the manufacturer's printed recommendations and as shown on the Drawings.
- G. The CONTRACTOR shall install all CITY supplied large Pressure Reducing Valves in accordance with manufacturer's printed recommendations.

- END OF SECTION -

PART 2 -- PRODUCTS

2.1 VALVES

- A. **General:** The CONTRACTOR shall furnish all valves, valve-operating units, stem extensions and other accessories as shown or specified. All valves shall be new and of current manufacture. Where buried, all valves shall be provided with valve boxes and covers and valve extensions as required.
- B. **Valve Flanges:** The flanges of valves shall be in accordance with Section 331100, "Piping, General."
- C. **Elastomers:** All elastomers used in valves shall be made of EPDM synthetic polymers that are specifically developed for their chemical resistance. EPDM elastomers are to be used in both the gate valves and butterfly valves.
- D. **Protective Coating:** Except where otherwise specified, ferrous surfaces, exclusive of stainless steel surfaces, in the water passages of all valves, as well as the exterior surfaces of all valves, shall be coated as specified in Section 099000, "Protective Coating."
- E. All unburied manual operators shall have handwheels.
- F. All buried valves shall have operating nuts, valve boxes and other features as shown on the Drawings. Stem extensions shall be provided when valve is more than 8 feet deep.
- G. **Bolts and Nuts:** All nuts and bolts on valve flanges and supports shall be in accordance with Section 055000, "Miscellaneous Metalwork."
- H. **Valve Traffic Boxes and Covers:** Traffic boxes and covers shall be as specified in Section 034800, "Precast Concrete Vaults, Utility Boxes, and Storm Water Field Drop Inlets."

PART 3 -- EXECUTION

3.1 VALVE INSTALLATION

- A. **General:** All valves, operating units, stem extensions, valve boxes and accessories shall be installed in accordance with the manufacturer's printed instructions and as shown and specified. Valves shall be firmly supported to avoid undue stresses on the pipe.
- B. **Access:** All exposed valves shall be installed to provide easy access for operation, removal and maintenance and to avoid conflicts between valve operators, structural members, or piping.
- C. All valves shall be handled in a manner to prevent any injury or damage to any part of the valve. All joints shall be thoroughly cleaned and prepared prior to installation. All valves shall be installed so that the valve stem is plumb and valve is in the location shown on the Drawings.
- D. Prior to installation of any valve the CONTRACTOR shall operate each valve and, as necessary, adjust stem packing to ensure proper operation.

- END OF SECTION -

SECTION 331216 - GATE VALVES

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide all materials, equipment, and labor necessary to furnish and install gate valves, 4 inch to 12 inch, complete and operable, including but not necessarily limited to operators, epoxy lining and coating, and appurtenant work, as shown on the Drawings and as specified herein. Unless otherwise shown or specified, all shut-off valves 12 inches and smaller shall be Gate Valves.
- B. All manual shutoff valves over 12 inches shall be Butterfly Valves in accordance with Section 331217, "Butterfly Valves."

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 099000 Protective Coating.
- B. Section 331215 Valves, General.
- C. Section 331217 Butterfly Valves.
- D. Division 1 General Requirements.

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards:

- AWWA C509 Standard for Resilient-Seated Gate Valves for Water and Sewerage Systems.
- AWWA C550 Standard for Protective Epoxy Interior Coating for Valves and Hydrants.

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 GATE VALVES

- A. **General:** All gate valves shall be resilient-seated, of the inside screw type. Valves shall be capable of being repacked under line pressure. All ferrous surfaces of the valves shall be factory fusion bonded epoxy lined and coated, as specified, in conformance with AWWA C550 and Section 099000, "Protective Coating" for exterior coating.
- B. **Elastomers:** All elastomers used in valves shall be made of EPDM synthetic polymers that are specifically developed for their chemical resistance. EPDM elastomers are to be used in both the gate valves and butterfly valves.
- C. Resilient-seated gate valves conforming to AWWA C509 shall be provided. Resilient-seated gate valves shall have cast iron bodies with flanged or mechanical joint ends,

elastomer-coated cast iron wedge/disc, flanged bonnet, bronze stem, O-ring seals, and operators with handwheel or square nut, unless otherwise shown.

D. Manufacturers, or Equal:

1. **American Flow**
2. **M and H No. 4067, Kennedy 1500, Clow**
3. **Mueller A-2370**

PART 3 -- EXECUTION

2.3 INSTALLATION

- A. All gate valves shall be installed in accordance with AWWA Standards and the manufacturer's printed recommendations, and in accordance with the applicable provisions of Section 331215, "Valves, General."

- END OF SECTION -

SECTION 331217 - BUTTERFLY VALVES

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide all materials, equipment, and labor necessary to furnish and install manually-operated full body butterfly valves, complete and operable, including epoxy lining and coating, appurtenances, operators, and accessories as shown on the Drawings and as specified herein. Unless otherwise shown or specified, all shutoff valves 14 inches and larger shall be Butterfly Valves. Wafer style Butterfly Valves will not be allowed.
- B. All manual shut-off valves 12 inches and smaller shall be Gate Valves in conformance with Section 331216, "Gate Valves."

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 099000 Protective Coating.
- B. Section 331215 Valves, General.
- C. Section 331216 Gate Valves.
- D. Division 1 General Requirements.

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards:

- ANSI/AWWA C504 Standard for Rubber-Seated Butterfly Valves.
- AWWA C550 Standard for Protective Epoxy Interior Coatings for Valves and Hydrants.

1.4 CONTRACTOR SUBMITTALS

- A. **Certificate 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 BUTTERFLY VALVES

- A. **General:** Butterfly valves shall conform to ANSI/AWWA C504 subject to the following requirements. Valves shall be of the size shown. Flanged valves shall be a 150-pound class B type valve drilled with a 125-pound bolt pattern and unless otherwise shown, may be either short-bodied or long-bodied. When flanged valves are installed on the Recycled Water System or on the Potable Water System where the working pressure exceeds 150 psi, the valves shall be a 250-pound class type valve drilled with a 125-pound bolt pattern and unless otherwise shown, may be either short-bodied or long-bodied. Mechanical Joint Ends are allowed except when using PVC C900 DR14 and C905 DR18 pipe. Shaft seals shall be designed for use with standard split-V type packing, or other acceptable seal. The interior passage of butterfly valves shall not have any obstructions or stops. The rubber seat shall be positively clamped or bonded into the disc or body of the valve. Cartridge-type seats will not be allowed. All interior ferrous surfaces of valves shall be factory applied epoxy lined in

conformance with AWWA C550. Exterior ferrous surfaces of valves exclusive of the flange faces, shall be factory applied epoxy in conformance with Section 099000, "Protective Coating" for exterior coating.

- B. **Elastomers:** All elastomers used in valves shall be made of EPDM synthetic polymers that are specifically developed for their chemical resistance. EPDM elastomers are to be used in both the gate valves and butterfly valves.
- C. **Manual Operators:** Operators shall conform to ANSI/AWWA C504, subject to the following requirements. Unless otherwise shown, all unburied manually-operated butterfly valves shall be equipped with a handwheel and position indicator. Buried valves shall be equipped with a 2 inch square operating nut. All operators shall be side mounted.
- D. **Manufacturers, or Equal:**
 - 1. **Kennedy Valve/M&H/Clow**
 - 2. **Mueller/Pratt**

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. The installation of all butterfly valves shall be in accordance with Section 331215 "Valves, General."
- B. All buried butterfly valves shall be oriented so that the operating nuts are on the side of the water main closest to the curb.
- C. Where butterfly valves are connected to a "Tee" or "Cross" fitting, a 12-inch spool shall be installed between the fitting and the valve. An adaptor (FLGxMJ) is required between the valve and the pipe when PVC C-900 DR14 and PVC C905 DR18 pipe are used.
- D. Where butterfly valves are installed with PVC C-900 DR14 and PVC C905 DR18 pipe, an adaptor (FLGxMJ) is required on both sides of the valve.
- E. All exposed butterfly valves shall be installed with a coupling that can be used in removing the complete valve assembly without dismantling the valve or operator.

- END OF SECTION -

SECTION 331218 - CHECK VALVES

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide all materials, equipment and labor necessary to furnish and install all check valves in the types and sizes shown and specified, complete and operable, including epoxy lining and coating as appropriate, appurtenances and accessories, as shown on the Drawings and as specified herein.
- B. All valves on Fire Service Installations shall be Factory Mutual approved or Underwriters Laboratories listed.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 099000 Protective Coating.
- B. Section 331215 Valves, General.
- C. Division 1 General Requirements.

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. **Commercial Standards:**

ANSI/ASME B1.20.1	Standard for Pipe Threads, General Purpose.
ANSI B16.1	Standard for Cast Iron Pipe Flanges and Flanged Fittings
ASTM A126	Specifications for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
ASTM B 61	Specifications for Stream or Valve Bronze Castings.
ASTM B 62	Specification for Composition Bronze or Ounce Metal Castings.
ASTM B 148	Specifications for Aluminum-Bronze Sand Castings.
AWWA C508	Standard for Swing-Check Valves for Waterworks Service, 2-In Through 24-In, NPS.
AWWA C550	Protective Epoxy Interior Coatings for Valves and Hydrants.
FM	Factory Mutual Engineering of Research Corp.
UL	Underwriters Laboratories Inc. Standards.

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 SWING CHECK VALVES (3 INCH AND LARGER)

- A. **General:** Swing check valves 3 inch or larger for general service shall be of the outside lever and spring or weight type, in accordance with AWWA C508, unless otherwise specified below, full-opening; designed for a water-working pressure of 250 psi unless otherwise shown, and shall have a flanged cover piece to provide access to the disc. All ferrous surfaces of valves shall be factory fusion bonded epoxy lined and coated in conformance with AWWA C550 and Section 099000, "Protective Coating."
- B. **Body:** The valve body and cover shall be of cast iron conforming to ASTM A 126, with flanged ends conforming to ANSI B 16.1, or mechanical joint ends, as shown.
- C. **Disc:** The valve disc shall be of cast iron, ductile iron, or bronze conforming to ASTM B 62.
- D. **Seat and Rings:** The valve seat and rings shall be of bronze to conforming ASTM B 62 or B 148, or Buna-N.
- E. **Hinge Pin:** The hinge pin shall be of bronze or stainless steel.
- F. **Manufacturers, or Equal:**
 - 1. **Mueller Company**
 - 2. **Kennedy Valve**
 - 3. **Hersey**

2.2 SWING CHECK VALVES (2-1/2 INCH AND SMALLER)

- A. **General:** Swing check valves in sizes 2-1/2 inch and smaller shall be suitable for a water pressure of 300 psi. They shall have screwed ends, unless otherwise shown, and screwed caps.
- B. **Body:** The valve body and cap shall be of bronze conforming to ASTM B 61 and with threaded ends conforming to ANSI/ASME B1.20.1.
- C. **Disc:** Valves shall have bronze discs.
- D. **Hinge Pin:** The hinge pins shall be of bronze or stainless steel.
- E. **Manufacturers, or Equal:**
 - 1. **Ford**
 - 2. **Mueller**
 - 3. **Stockham**

2.3 DOUBLE-LEAF CHECK VALVES

- A. **General:** Double-leaf check valves shall be of the wafer-type designed to fit between ANSI B16.1 flanges for 125-pound rating. The check valve leaves shall be spring-loaded. Flow from one direction shall cause the valve to open, and upon valve shutoff, the spring shall shut the valve leaves before reverse flow starts and at a point of zero velocity, for non-slam

closure. The spring-tension of each valve shall be designed for the individual operating condition.

- B. **Body:** The valve body shall be of cast iron with integrally-cast seat, rated for minimum 150-psi working pressure. All ferrous surfaces of valves shall be factory fusion bonded epoxy lined and coated in conformance with AWWA C550 and Section 099000, "Protective Coating."
- C. **Leaves:** The leaves shall be of bronze, aluminum bronze, or ductile iron, revolving on stainless steel or monel hinge pins with retainers.
- D. **Seat:** The valves shall have resilient seats for bubble-tight shut-off. The seat rings shall be firmly attached to the body or disc by compression-molding or similar acceptable method.
- E. **Springs:** The springs shall be of Type 316 stainless steel, or Inconel.
- F. **Manufacturers, or Equal:**
 - 1. **APCO 900 Series**
 - 2. **TRW Mission**
 - 3. **VAL-MATIC**

2.4 DETECTOR CHECK VALVES

- A. Detector check valves shall conform to the requirements of PART 2 – "Products" of this Section herein, except that valves shall be provided with a full-faced rubber clapper seal and an elevated bypass meter. The elevated bypass shall be comprised of a shutoff valve, check valve, and either a magnetic turbine or positive displacement meter. The bypass pipe shall be either copper or brass pipe. When the pressure loss through the bypass exceeds a preset amount, the valve automatically opens, allowing unrestricted flow.
- B. **Manufacturers, or Equal:**
 - 1. **Mueller A-2132-6 (4"-10")**
 - 2. **Hersey**

PART 3 -- EXECUTION

3.1 GENERAL

- A. All valves shall be installed in accordance with provisions of Section 331215, "Valves, General."

- END OF SECTION -

SECTION 331219 - FIRE HYDRANTS

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide all materials, equipment, and labor necessary to furnish and install fire hydrants, complete and operable including all appurtenances and accessories, as shown on the Drawings and as specified herein.
- B. All valves on fire hydrant Installations shall be in conformance with 331216, "Gate Valves."
- C. All valves on Fire Service laterals shall be Gate Valves for laterals 8 inch and less and Butterfly Valves for laterals larger than 8 inches.
- D. In the California Water Service Area the CONTRACTOR shall contact California Water Service Company for their requirements.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 331300 Pressure Pipeline Testing and Disinfection.
- B. Section 099000 Protective Coating.
- C. Section 330526 Piping Identification System.
- D. Section 331215 Valves, General.
- E. Section 331216 Gate Valves.
- F. Section 331217 Butterfly Valves.
- G. Division 1 General Requirements.

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. **Commercial Standards:**

AWWA C503 Standard for Wet-Barrel Fire Hydrants.

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 WET-BARREL FIRE HYDRANTS

- A. **Construction:** Fire hydrants shall be of the wet-barrel type, in accordance with AWWA C 503. Fire hydrants shall have a factory supplied buried section of mortar lined ductile iron and a solid spool that has a minimum diameter of 10" and a minimum length of 12" connected to the hydrant head. When located in residential areas, the hydrant shall have one 4-1/2 inch steamer connection and one 2-1/2 inch hose connection. For commercial and industrial areas, hydrants shall have one 4-1/2 inch steamer connection and two 2-1/2 inch hose connections. The hydrant inlet shall be 6 inches in diameter. The hose and steamer connections shall be provided with cast iron caps and metal chains. Hose connection threads shall be American National Fire Hose Threads. The hydrants shall be tested to 300 psig and they shall be

suitable for a working pressure of 150 psig. All interior and exterior surfaces of fire hydrant, spool, and bury shall be coated in accordance with Section 099000, "Protective Coating."

B. Fire hydrants shall have a minimum weight of 190 pounds.

C. **Manufacturers or Approved Equal:**

a. Hydrants for residential areas shall be:

1. **Clow Corporation East Bay Series, Model 5; or Ranger 900 Series, Model 950.**

b. Hydrants for commercial/industrial areas shall be:

1. **Clow Corporation Ranger 900 Series, Model 960.**

2.2 BOLTS AND NUTS

A. See notes on City Standard Detail W-1C.

2.3 IDENTIFICATION

A. All valve lids on potable and reclaimed water systems shall be identified in conformance with Section 330526, "Piping Identification Systems." Valve lids in reclaimed water systems shall be factory purple.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. All fire hydrants shall be installed in strict accordance with the manufacturer's printed recommendations, AWWA Standards, and all applicable codes, and the applicable provisions of Section 331215, "Valves, General." Any deviation from installation requirements or specified location is subject to prior approval of the Fire Department.

B. All fire hydrant lateral gate valves shall be flanged by mechanical joint valves. All fire hydrant buries shall be installed with a concrete thrust block. Fire hydrant flange bolts shall be installed with the bolt end facing up. Slotted on offset spools shall be used only when approved by the ENGINEER.

C. The 4-1/2 inch steamer connection shall be installed perpendicular to the street. The fire hydrant lateral must be installed perpendicular to the water main.

D. Hydrants, fire hydrant valve lids and guard posts shall be painted in accordance with Section 099000 "Protective Coatings."

3.2 TESTING

A. Testing for fire flows shall be in accordance with Section 331300, "Pressure Pipeline Testing and Disinfection."

- END OF SECTION -

SECTION 331233 - WATER METERS

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide all materials, equipment, and labor necessary to furnish and install water meters, radio read meter transceiver units and other appurtenances in the CITY'S water service area, complete and operable as shown on the Drawings and specified herein.
- B. In the CITY'S Water Service Area the CONTRACTOR shall purchase all meters, radio read meter transceiver units and other appurtenances from the CITY. The CONTRACTOR shall provide all water meter parts and accessories not purchased with the CITY'S water meter packages.
- C. All meters, radio read meter transceiver units and appurtenances purchased from the CITY shall be inventoried and controlled by the CONTRACTOR. Any meters found to be defective must be returned to the CITY for exchange. Damaged meters will not be eligible for exchange.
- D. In the California Water Service Area the CONTRACTOR shall contact California Water Service Company for their requirements.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 034800 Precast Concrete Vaults, Utility Boxes, and Storm Water Inlets.
- B. Division 1 General Requirements.
- C. Divisions 2 and 15 As applicable.

1.3 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 WATER METER STRAINERS

- A. Separate strainers shall be purchased from the CITY for all turbine meter installations 3 inches and larger.

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. The CONTRACTOR shall assemble and install all equipment specified herein, in strict accordance with the manufacturer's printed instructions, and as shown on the Drawings.
- B. Care shall be taken to protect the meters from damage, dirt or foreign material.
- C. For all turbine meters 3 inches and larger the CONTRACTOR shall install a separate strainer purchased from the CITY.

- END OF SECTION -

SECTION 331300 - PRESSURE PIPELINE TESTING AND DISINFECTION

PART 1 -- GENERAL

1.1 REQUIREMENT

- A. The CONTRACTOR shall furnish all materials, equipment, and labor to perform and complete flushing and testing of all pipelines and appurtenant piping, and disinfection of all pipelines and appurtenant piping for potable and recycled water, complete, including conveyance of test water from CITY-designated source to point of use and all disposal thereof, and as specified herein.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. **Commercial Standards:**

AWWA B300 Standard for Hypochlorites.

AWWA C651 Standard for Disinfecting Water Mains.

1.3 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. A testing schedule, including proposed plans for water conveyance, control, disposal, and disinfection shall be submitted in writing to the ENGINEER for review a minimum of 72 hours before testing is to start.

1.4 TESTING AND DISINFECTION

- A. The CONTRACTOR will test the pipe for pressure and disinfection. All testing will be conducted in the presence of the ENGINEER.

PART 2 -- PRODUCTS

2.1 MATERIAL REQUIREMENTS

- A. All test equipment, chemicals for chlorination, temporary valves or assemblies, bulkheads, or other water control equipment and materials shall be determined and furnished by the CONTRACTOR subject to the ENGINEER'S review. No materials shall be used which would be injurious to the piping system or its proposed function.
- B. Chlorine for disinfection shall be in the form of sodium hypochlorite solution, or calcium hypochlorite granules or tablets.
- C. Sodium hypochlorite and calcium hypochlorite shall be in accordance with the requirements of AWWA B300.

PART 3 -- EXECUTION

3.1 GENERAL

- A. The CITY will furnish the water for the first hydrostatic test, and for the first disinfection test up through the first flushing sequence. All water for any re-testing shall be paid for by the CONTRACTOR. The CONTRACTOR shall make all necessary provisions for conveying the water from the CITY-designated source to the points of use.
- B. All pressure pipelines shall be tested. Disinfection shall be accomplished by chlorination. All chlorinating and testing operations shall be performed in the presence of the ENGINEER.
- C. Bacteriological testing will be performed by the ENGINEER. Results of the bacteriological testing must meet the requirements of the State Department of Health Services.

3.2 HYDROSTATIC TESTING OF PIPELINES

- A. Connections for testing of pipe shall be in conformance with the Drawings. Backflow assemblies used to comply with City Standard Detail W-7 shall be tested and approved by a certified backflow assembly tester. A passing test report on the backflow assembly shall be provided by the CONTRACTOR to the CITY before the assembly is used.
- B. The CONTRACTOR shall test all pipelines as a single unit, or in sections if approved by the ENGINEER. No section of the pipeline shall be tested until all field-placed concrete or mortar has attained an age of 72 hours. The test may be made by closing new valves when available, or by placing temporary bulkheads in the pipe and filling the line slowly with water. Unless approved by the ENGINEER testing shall not be performed against existing system closed valves. The CONTRACTOR shall be responsible for ascertaining that all test bulkheads are suitably restrained to resist the thrust of the test pressure without damage to, or movement of, the adjacent pipe. Any unharnessed sleeve-type couplings, expansion joints, or other sliding joints shall be restrained or suitably anchored prior to the test, to avoid movement and damage to piping and equipment. The CONTRACTOR shall provide sufficient temporary air release assemblies to allow for evacuation of all entrapped air in each pipe unit or section to be tested. After completion of the tests, such taps shall be permanently plugged. Care shall be taken to see that all air release assemblies are open during filling.
- C. The pipeline shall be filled at a rate which will not cause any surges or exceed the rate at which the air can be released through the air release assemblies at a reasonable velocity and all the air within the pipeline shall be properly purged. After the pipeline unit or section thereof has been filled, it shall be allowed to stand under pressure for at least 24 hours to allow the pipe concrete or mortar lining, as applicable, to absorb what water it will and to allow the escape of air from any air pockets. During this period, bulkheads, valves, and connections shall be examined for leaks. If leaks are found, corrective measures satisfactory to the ENGINEER shall be taken.
- D. The hydrostatic test shall consist of holding the test pressure on the pipeline for a period of 4 hours. The test pressure for pipelines shall be 100 percent of the pipe pressure class. The test pressure for piping shall be as shown or specified, measured at the lowest point of the pipeline unit or section being tested. All visible leaks shall be repaired in a manner acceptable to the ENGINEER.

E. Maximum Leakage

1. The maximum allowable leakage for pressure pipelines shall be in accordance with the following formula:

Design Basis

$$L = \frac{ND\sqrt{P}}{7400}$$

Where: L = allowable leakage (gal/hr)
N = number of joints in the tested line
D = nominal diameter of pipe (in.)
P = average test pressure (psi)

Pipe with welded joints, flanged joints, and service lateral pipe shall have no leakage.

2. In the case pipelines fail to pass the prescribed leakage test, the CONTRACTOR shall determine the cause of the leakage, shall take corrective measures necessary to repair the leaks, and shall again test the pipelines.

3.3 DISINFECTING PIPELINES

- A. **General:** All potable and recycled water pipelines shall be disinfected. Pipeline disinfection operations shall be performed at the Primary Jumper location in conformance with the Drawings.
- B. **Chlorination:** Hypochlorite shall be used to chlorinate the piping system in accordance with the requirements of AWWA C651 and as modified by this Section. Care shall be taken to prevent chlorine solution in the pipeline being disinfected from flowing back into the pipeline supplying the water. Any one of the following 2 methods as listed in the AWWA standard (brief summary of two methods as modified below) can be used for the initial disinfection; however, if the pipeline fails a bacteriological test, it must be disinfected again by the slug method:
 1. The continuous feed method consists of placing calcium hypochlorite granules in the main during construction, completely filling the main to remove all air pockets, flushing the completed main to remove particulates, and filling the main with potable water. The potable water shall be chlorinated so that after a minimum 24 hour holding period in the main there will be a free chlorine residual of not less than 25 mg/l.
 2. The slug method consists of placing calcium hypochlorite granules in the main during construction, completely filling the main to eliminate all air pockets, flushing the main to remove particulates and slowly flowing through the main a slug of water dosed with chlorine to a concentration of 100 mg/l.
- C. **Retention Period:** Chlorinated water shall be retained in the pipeline long enough to destroy all non-spore-forming bacteria. This period shall be at least 24 hours but disinfecting solution higher than 50 mg/l shall not remain in the pipeline for more than 96 hours. After the chlorine-treated water has been retained for the required time, the free chlorine residual at the pipeline extremities and at other representative points shall be at least 25 mg/l.

- D. **Valve Disinfection:** During the process of chlorinating the pipelines, all valves and other appurtenances shall be operated while the pipeline is filled with the heavily-chlorinated water.
- E. **Final Flushing:** After the retention period, the heavily chlorinated water shall be flushed from the pipeline until chlorine measurements show that the concentration in the water leaving the pipeline is no higher than that generally prevailing in the existing system. The CONTRACTOR shall apply a reducing agent to the water to thoroughly neutralize the chlorine residual remaining in the water prior to disposal of the water. The CONTRACTOR will be solely responsible for the proper disposal of all water used for the disinfection process in accordance with regulatory agency requirements. With prior approval by the ENGINEER, the CONTRACTOR may discharge the heavily chlorinated water into the sanitary sewer system in lieu of the above neutralization requirements.
- F. **Bacteriological Testing:** Pipe shall be left for a period of 24 hours after final flushing before any sample is collected. A sample, or samples will be collected by the ENGINEER and will be tested for bacteriological quality in accordance with the requirements of the State Department of Health Services and AWWA C651. Should the initial disinfection treatment fail to produce satisfactory bacteriological test results, the disinfection procedure shall be repeated until acceptable results are obtained. All lab costs for subsequent bacteriological testing after the initial test shall be borne by the CONTRACTOR. All lab costs for initial bacteriological testing will be paid by the CITY. All costs for water used for flushing, and re-filling of the pipeline after failure of a bacteriological test shall be borne by the CONTRACTOR.

3.4 CONNECTIONS TO EXISTING SYSTEM

- A. Where connections are to be made to an existing potable water system, the interior surfaces of all pipe and fittings used in making the connections shall be swabbed or sprayed with a sodium hypochlorite solution in conformance with the requirement of AWWA C651, except that the solution shall be 5 percent, before they are installed.

3.5 TESTING

- A. Fire flow testing of fire service lines and fire hydrant laterals will be tested by the CITY and approved by the ENGINEER prior to acceptance of the pressure pipeline installation.

- END OF SECTION -

SECTION 333100 - REINFORCED CONCRETE PIPE (PVC-LINED)

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide all materials, equipment and labor necessary to furnish and install PVC-lined reinforced concrete pipe and all appurtenant work, complete and operable, including all connections as shown on the Drawings and as specified herein.
- B. All sanitary sewer lines in industrial areas shall be vitrified clay pipe in conformance with Section 333106, "Vitrified Clay Pipe."

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 312300 Utility Earthwork.
- B. Section 333106 Vitrified Clay Pipe.
- C. Section 333900 Precast Concrete Maintenance Holes.
- D. Section 330130 Sanitary Sewer and Storm Drain System Leakage Testing.
- E. Section 033050 Utility Cast-in-Place Concrete.
- F. Section 036000 Grout.
- G. Section 331100 Piping, General.
- H. Division 1 General Requirements.

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. **Commercial Standards:**

- ASTM C 76 Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
- ASTM C 150 Specification for Portland Cement.
- ASTM C 361 Specification for Reinforced Concrete Low-Head Pressure Pipe.
- ASTM D 412 Test Methods for Rubber Properties in Tension.
- ASTM D 2240 Test Method for Rubber Property - Durometer Hardness.
- AWWA C302 Standard for Reinforced Concrete Pressure Pipe, Noncylinder Type, for Water and Other Liquids.

1.4 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall submit certificates, test reports, shop drawings and laying diagrams of all pipe, joints and piping appurtenances.

- B. Design calculations of each critical section of pipe wall and specials shall be submitted and shall be sufficient to ascertain conformance of pipe and fittings to these Specifications. Submittals will be reviewed by an independent engineer hired by the CITY. All expenses incurred in making samples for certification of tests shall be borne by the CONTRACTOR.
- C. **Certificates of Compliance:** Certificates of Compliance shall be provided for all products or materials proposed to be used under this Section and the following:
- D. Hydrostatic test reports of rubber gasket joints.
 - 1. Three-edge-bearing strength (D-load) test reports as a proof of design for one pipe section of each size and strength class.
 - a. PVC liner test reports.

1.5 QUALITY ASSURANCE

- A. **Inspection:** All pipe will be subject to inspection at the place of manufacture in accordance with the provisions of the applicable referenced standards as supplemented by the requirements of this Section. The CONTRACTOR shall notify the ENGINEER, in writing, of the manufacturing schedule not less than 14 calendar days prior to the start of any phase of pipe manufacture.
- B. **Tests:** Unless otherwise specified, all materials used in the manufacture of the pipe shall be tested in accordance with the requirements of the applicable referenced standards. The CONTRACTOR shall have said material tests performed at no additional cost to the CITY. The ENGINEER shall have the right to witness all testing conducted by the CONTRACTOR'S provided, that the CONTRACTOR'S schedule is not delayed for the convenience of the ENGINEER. In addition to those tests specifically required, the ENGINEER may request additional samples of any material for testing by the CITY. The additional samples shall be furnished at no additional cost to the CITY.
- C. All pipe shall be subject to testing for compliance with the applicable specifications and standards, including (1) a 3-edge-bearing strength (D-load) test in accordance with ASTM C 76; (2) a hydrostatic test of the rubber gasket joints in accordance with ASTM C 361 or AWWA C 302 except test pressure shall be 5 psi; and (3) PVC liner tests as specified herein.
- D. **Basis of Acceptance for PVC-Lined Reinforced Concrete Pipe:**
 - 1. The basis of acceptance of reinforced concrete pipe manufactured in compliance with this Section shall be in accordance with Section 5.1.1 of ASTM C 76 and as follows:
 - a. ENGINEER review of required submittals.
 - b. Three-edge-bearing test loads shall be applied to produce a 0.01 inch maximum crack except that applied test loading may be terminated without producing a 0.01 inch maximum crack if or when such loading has reached 110 percent of that required for and relative to the specified D-load for the subject pipe.
 - c. Test results shall be submitted to the ENGINEER prior to shipment of the pipe/product to the jobsite. Results shall indicate Project Name, testing agency and operator performing the test, test date, pipe size, and specified D-load applied.
 - 2. For PVC-lined pipe, all PVC liner sheets; joints, corner, or weld strips shall have the following physical properties when tested at 77 degrees F. +/- 5 degrees F.

<u>Property</u>	<u>Initial</u>	<u>Exposure</u> ⁽¹⁾
Tensile strength	2200 psi min.	2100 psi min.
Elongation at break	200 percent min.	200 percent min.
Shore Durometer, Type D	within 1 sec. 50-60 within 10 sec. 35-50	+/- 5 ⁽²⁾ +/- 5 ⁽²⁾
Weight change	---	1.5 percent ⁽²⁾

Note: (1) For 112 days in chemical solutions listed in paragraph 1.5.D.3 below
(2) With respect to initial test result.

- a. Tensile and elongation specimens shall be prepared and tested in accordance with ASTM D 412 using Die B.
- b. Indentation hardness test shall be in accordance with ASTM D 2240 using a Type D durometer except that a single thickness of material will be used.
- c. Weight change and indentation hardness specimens shall be 1 inch by 3 inch samples of the sheet thickness.
- d. Specimens may be taken from sheet and strip at any time prior to final acceptance.

3. All PVC liner sheets, joints, corner, and weld strips shall resist the following chemicals:

<u>Chemical Solution</u>	<u>Concentration</u>
Sulfuric acid	20 percent ⁽¹⁾
Sodium hydroxide	5 percent
Ammonium hydroxide	5 percent ⁽¹⁾
Nitric acid	1 percent ⁽¹⁾
Ferric chloride	1 percent
Soap	0.1 percent
Detergent (linear alkyl benzyl sulfonate or LAS)	0.1 percent

Note: (1) Volumetric percentages of concentrated C.P. grade reagents.

- a. After conditioning to constant weight at 110 degrees F, test specimens shall be exposed to each of the above solutions for a period of 112 days at 77 degrees F. +/- 5 degrees F.
 - b. At 28-day intervals, test specimens shall be removed from each of the chemical solutions and tested. If any specimen fails to meet the 112-day requirements before completion of the 112-day exposure, the material will be subject to rejection.
4. PVC-liner locking extensions embedded in concrete shall withstand a test pull of at least 100 pounds per linear inch, applied perpendicularly to the concrete surface for a period of one minute, without rupture of the locking extensions or withdrawal from embedment. This test shall be made at a temperature of 75 degrees F. +/- 5 degrees F., inclusive.

5. Shop-welded joints, used to fuse individual sections of PVC-liner together, shall be at least equal to the minimum requirements of the PVC-liner for thickness, corrosion resistance and impermeability. Welds shall show no cracks or separations and shall be tested for tensile strength. Tensile strength measured across the welded joint in accordance with ASTM D 412 using Die B shall be at least 2000 psi. Test temperature shall be 77 degrees F +/- 5 degrees F and the measured minimum width and thickness of the reduced section shall be used.
6. All PVC-liner shall be shop-tested for holes with a spark tester set to provide from 15,000 to 20,000 volts. Sheets having holes shall be satisfactorily repaired in the shop prior to shipment from the Manufacturer's plant. Repairs shall be made by welders qualified in accordance with the following requirements.

E. PVC-Liner Welder Qualifications:

1. Each PVC-liner welder shall pass a qualification welding test acceptable to the CITY before doing any welding field joints in PVC liners. Requalification may be required at any time deemed necessary by the CITY.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. PVC-lined reinforced concrete pipe shall be a minimum of Class III and shall conform to the requirements of ASTM C 76. Class I and II pipe will not be allowed.

2.2 PIPE DESIGN

- A. Reinforced concrete pipe (PVC-Lined) shall be manufactured and provided to meet the pipe strength classifications as shown on the Drawings and in accordance with ASTM C 76, but in no case shall be less than Class III for Wall B or Wall C.
- B. Wall A pipe shall not be allowed.

2.3 MATERIALS

- A. **General:** Materials shall comply with Section 6 of ASTM C 76 as modified below. All reinforcement shall be circular. Elliptical reinforcing will not be allowed.
- B. **Cement:** Cement used in the manufacture of reinforced concrete pipe shall be Type V in conformance with ASTM C 150.
- C. **Admixtures:** No admixture shall be used unless otherwise specified or accepted in writing by the ENGINEER.
- D. **Rubber Gaskets:** Rubber gaskets shall be neoprene and shall comply with the requirements of ASTM C 361 or AWWA C 302.
- E. **PVC-Liner:** PVC-liner shall be **Ameron Amer-Plate T-Lock, Poly-Tee Inc., or equal**. The liner shall be installed with 360 degrees coverage of the pipe interior surface.
 1. The material used in the liner and in all joints, corners, and welding strips shall be a combination of polyvinyl chloride resin, pigments, and plasticizers, especially compounded to remain flexible. Polyvinyl chloride resin shall constitute not less than 99

percent, by weight, of the resin used in the formulation. Copolymer resins will not be permitted.

2. All PVC liner sheets, including locking extensions, all joints, corners and welding strips, shall be free of cracks, cleavages or other defects adversely affecting the protective characteristics of the material.
3. Minimum thicknesses of sheet with integral locking extensions, plain sheet, joint strip and weld strip are 0.065, 0.094, 0.075 and 0.094 inches, respectively. Locking extensions shall be approximately 2-1/2 inches apart and shall be at least 0.375- inches high.
4. Pipe lining shall be supplied as pipe-size sheets, fabricated by shop-welding the basic size sheets. Shop welds shall be made by lapping sheets a minimum of 1/2-inch and applying heat and pressure to the lap to produce a continuous welded joint.
5. Sheets shall have transverse strap channels cut in the locking extensions so that the strap can be placed into and perpendicular to the locking extensions.
6. These channels shall be not less than 3/4 inch and not more than 1-1/4 inch wide and shall be cut so that a maximum of 3/16 inch of the base of the locking extension remains in the base of the strap channel. Strap channels shall be provided at intervals of not less than 15 inches nor more than 20 inches center to center. The strap channels shall not be cut through the final 2 locking extensions on each edge of the sheet.
7. Transverse flaps shall be provided at the ends of sheets for pipe. Locking extensions shall be removed from flaps so that a maximum of 1/64-inch of the base of the locking extension is left on the sheet.
8. Weld strips shall be approximately one inch wide. The edges of weld strips shall be beveled in the manufacturing process. Thickness of weld strip shall be equivalent to that of the liner.
9. Joint strips for pipe shall be 4 inches wide. Thickness of joint strips shall be equivalent to that of the liner.
10. Prior to preparing the sheets for shipment, they shall be tested for holes using an electrical spark tester set at 20,000 volts minimum. Any holes shall be repaired and retested.

2.4 JOINTS

- A. Joint assembly design shall be reinforced concrete bell and spigot type incorporating a fully retained single rubber gasket in accordance with ASTM C 361 or AWWA C 302.

PART 3 -- EXECUTION

3.1 GENERAL

- A. PVC-lined reinforced concrete pipe shall be installed in accordance with the Manufacturer's printed recommendations, the requirements of Section 312300, "Utility Earthwork" and the following additional requirements.

3.2 PIPE HANDLING

- A. **General:** All laying, jointing and testing for defects and for leakage shall be performed in the presence of the ENGINEER. All material found to have defects will be rejected and the CONTRACTOR shall promptly remove such defective material from the site of the work.
- B. **Handling of Pipe and Accessories:** Pipe shall be lifted in such a manner as to minimize bending of the pipe section and prevent damage to the pipe. When being transported, pipe shall be supported in a manner that will prevent distortion or damage to the pipe. When not being handled, pipe shall be stockpiled on timber cradles or properly prepared ground with all rock points eliminated. Any pipe section that becomes damaged as a result of improper handling or stockpiling shall be repaired to the satisfaction of the ENGINEER or shall be replaced with a new unit at no additional cost to the CITY. Necessary facilities shall be provided for lowering and properly placing the pipe sections and specials in the trench without damage. Slings shall bear uniformly against the pipe. When not being handled, all pipe shall be supported on timber cradles, sand bags, or mounds of earth.

3.3 PIPE LAYING

- A. **Excavation:** Bell holes shall be excavated at each joint to provide full length barrel support of the pipe and to prevent point loading at the bells.
- B. **Pipe Laying:** Unless otherwise required, all pipe shall be laid straight between the changes in alignment and at uniform grade between changes in grade. Pipe shall have a minimum laying length of approximately 8 feet, except for closure and other special pieces as approved by the Engineer. The length of the incoming and outgoing concrete pipe at each structure shall not exceed 4 feet.
- C. Installation of pipes in prepared trenches shall start at the lowest point, with the spigot ends pointing in the direction of flow.
- D. **Rubber Gasket Joints:** The rubber gasket joint shall be made by properly lubricating the rubber gasket with a suitable vegetable compound soap before it is placed in the groove at the spigot end. The gasket shall be stretched over the spigot end of the pipe and carefully seated in the groove, with care taken to equalize the stress in the gasket around the circumference of the joint. The gasket shall not be twisted, rolled, cut, crimped, or otherwise injured or forced out of position during the closure of the joint. A feeler gauge shall be used to check the position of the rubber gasket after the joint has been assembled. Where a joint placement is found to be improper, the tested pipe section shall be removed, the gasket checked for damage, a new gasket installed, if necessary, the pipe relaid and the gasket placement rechecked.

3.4 PVC-LINER INSTALLATION

- A. **General:** PVC sheets for pipe, and structures shall be prepared and applied in conformance with the following:
 - 1. Installation of the lining, including pre-heating of sheets in cold weather and the welding of all joints, shall be done in accordance with the printed recommendations of the Manufacturer.
 - 2. Coverage of the lining shall not be less than the minimum shown.
 - 3. The lining shall be installed with the locking extensions running parallel with the longitudinal axis of the pipe.

4. The lining shall be held snugly in place against inner forms by means of steel banding straps or other means recommended by the Manufacturer. Banding straps must be located in the pre-cut strap channels to prevent crushing or tilting of the locking extensions.
5. If banding strips are used, a steel channel, angle, or bar may be inserted along the edge locking extension of each liner sheet for concrete pipe or cast-in-place structures. Steel channel, angle, or bar shall be of sufficient stiffness to hold the longitudinal edges of the lining snugly against the form. These may be removed after the concrete is vibrated into place.
6. Locking extensions shall terminate not more than 1/2 inch from the end of the inside surface of the pipe section. Joint flaps, when used, shall extend approximately 4 inches beyond the end of the inside surfaces.
7. Concrete poured against lining shall be vibrated, spaded, or compacted in a careful manner to protect the lining and produce a dense, homogenous concrete, securely anchoring the locking extensions into the concrete.
8. In removing forms, care should be taken to protect the lining from damage. Sharp instruments shall not be used to pry forms from lined surfaces. When forms are removed, any nails that remain in the lining shall be pulled, without tearing the lining, and the resulting holes clearly marked. Form tie holes shall be marked before ties are broken off and all areas of serious abrasion or damage shall be marked.
9. All nail and tie holes and all cut, torn, and seriously abraded areas in the lining shall be patched. Patches made entirely with welding strip shall be fused to the liner over the entire patch area. Larger patches may consist of smooth liner sheet applied over the damaged area with adhesive. All edges must be covered with welding strip fused to the patch and the sound lining adjoining the damaged area.
10. Hot joint compounds, such as coal tar, shall not be poured or applied to the lining.
11. The CONTRACTOR shall take all necessary measures to prevent damage to installed lining from equipment and materials used in or taken through the WORK.

B. Structure Connections to Concrete Pipe - Special Requirements:

1. The lining shall be set flush with the inner edge of the bell or spigot end of a pipe section and shall extend to the opposite end or to approximately 4 inches beyond the opposite end depending upon the type of lining joint to be made with the adjoining concrete pipe.
2. Wherever concrete pipe or cast-in-place structures protected with lining join structures not so lined (such as precast concrete, pipe, cast-in-place structures or clay pipe), the lining shall be extended over and around the end of the pipe and back into the structure for not less than 4 inches. This protecting cap may be molded or fabricated from the lining material but need not be locked into the pipe.
3. Where a pipe lateral (not of plastic-lined concrete) is installed through lined concrete pipe, the seal between the lined portion and the lateral shall be made by the method prescribed for cast-in-place structures under this Section.
4. On pipe having a 360-degree liner coverage, the longitudinal edges of the sheet shall be butt welded.

5. No pipe with damaged lining will be accepted until and unless the damage has been repaired to the satisfaction of the ENGINEER.

C. Field Joints in Lining for Concrete Pipe:

1. The joint between sections of lined pipe shall be prepared in the following manner. The inside joint shall be filled and carefully pointed with non-shrink grout in accordance with Section 036000, "Grout," in such a manner that the grout shall not, at any point, extend into the pipe beyond a straight line connecting the surfaces of the adjacent pipe sections. No lining joint shall be made until after the trench has been backfilled and consolidated. Pipe joints must be dry before lining joints are made.
2. All grout and other foreign material shall be removed from lining surfaces adjacent to the pipe joint, leaving them clean and dry.
3. Field joints in the lining at pipe joints may be either of the following described types:

Type P-1 The joint shall be made with a separate 4-inch joint strip and 2 welding strips. The 4-inch joint strip shall be centered over the joint, tack-welded to the lining, then welded along each edge to adjacent liner sheets with a one inch weld strip. The width of the space between adjacent sheets shall not exceed 2 inches. The 4-inch joint strip shall lap over each sheet a minimum of one inch.

Type P-2 The joint shall be made with a joint flap with locking extensions removed and extending approximately 4 inches beyond the pipe end. The joint flap shall overlap the lining in the adjacent pipe section a minimum of one inch and be tack welded in place prior to welding. The field joint shall be completed by welding the flap to the lining of the adjacent pipe using a one inch welding strip.

Care shall be taken to protect the flap from damage. Excessive tension and distortion in bending back the flap to expose the pipe joint during laying and joint grouting shall be avoided.

The joint flap or strip on beveled pipe shall be trimmed to a width (measured from the end of the spigot) of approximately 4 inches for the entire circumferential length of the lining.

All welding of joints is to be in strict conformance with the printed specifications and instructions of the lining Manufacturer.

Welding shall fuse both sheets together to provide a continuous joint equal in corrosion resistance and permeability to the liner plate.

Hot-air welding guns shall provide effluent air to the sheets to be joined at a temperature between 500 and 600 degrees. Welding guns shall be held approximately 1/2 inch from and moved back and forth over the junction of the 2 materials to be joined. The gun shall be moved slowly enough as the weld progresses to cause a small bead of molten material to be visible along both edges of the weld strip.

The following special requirement shall apply when the liner coverage is 360 degrees. When groundwater is encountered, the lining joint shall not be made until pumping of groundwater has been discontinued for at least three days and no visible leakage is evident at the joint.

D. Application to Cast-in-Place Concrete Structures - Special Requirements (where required):

1. Liner sheets shall be closely fitted and properly secured to the inner forms. Sheets shall be cut to fit curved and warped surfaces using a minimum number of separate pieces. If liner joints are to be type C-3 joints as described below, the adjacent sheets shall be butted with not more than 0.125 inch opening between the sheets. A welding strip fusion-welded on the back of butt joints or other means acceptable to the ENGINEER shall be used to prevent wet concrete from flowing around the edges.
2. Unless otherwise shown, the lining shall be returned 4 inches at the surface of contact between the concrete structure and items not of concrete (including maintenance hole frames, gate guides, clay pipe, or brick manholes, and clay or cast-iron pipes). The same procedure shall be followed at joints where the type of protective lining is changed or the new work is built to joint existing unlined concrete. At each return, the return liner shall be sealed to the item in contact with the plastic-lined concrete using the adhesive system recommended by the liner manufacturer. If the liner cannot be sealed with this adhesive because of the joint at the return being too wide or rough or because of safety regulations, the joint space shall be densely caulked with lead wool or other approved caulking material to a depth of 2 inches.

E. Joints in Lining for Cast-in-Place Concrete Structures (where required):

1. Lining at joints shall be free of all grout and other foreign material and shall be clean and dry before joints are made.
2. Field joints in the lining shall be of the following described types, used as prescribed:

Type C-1 The joint shall be made with a separate 4-inch joint strip and 2 welding strips. The 4-inch joint strip shall be centered over the joint, tack-welded to the liner, then welded along each edge to adjacent sheets with one-inch weld strips. The width of the space between adjacent sheets shall not exceed 2 inches. The 4-inch joint strip shall lap over each sheet a minimum of one inch. It may be used at any transverse or longitudinal joint.

Type C-2 The joint shall be made by lapping sheets not less than one inch. One welding strip is required. The upstream sheet shall overlap the one downstream. The lap shall be tack-welded into place prior to welding.

Type C-3 The joint shall be made by applying one welding strip on the back of the butt joint or by some other method approved by the ENGINEER to prevent wet concrete from getting under the sheet. After the forms have been stripped, a second welding strip shall be applied over the butt joint on the face of the sheet.

All welding is to be in strict conformance with the specifications of the lining Manufacturer and this Section.

F. Testing and Repairing Damaged Surfaces:

1. After the pipe is installed in the trench, CONTRACTOR shall test all surfaces covered with lining, including welds, with an approved electrical hole detector with the instrument set at 20,000 volts, minimum. Testing shall be performed in the presence of the

ENGINEER. All imperfections and holidays detected shall be repaired to the satisfaction of the ENGINEER.

3.5 TESTING

- A. Air Pressure Testing and other requirements shall conform to Section 330130, "Sanitary Sewer and Storm Drain System Leakage Testing."

- END OF SECTION -

SECTION 333102 - ABS AND PVC COMPOSITE PIPE

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide all materials, equipment, and labor necessary to furnish and install all acrylonitrile-butadiene-styrene (ABS) and polyvinyl chloride (PVC) composite pipe gravity sanitary sewers, and all appurtenant work, complete and operable, including all connections as shown on the Drawings and as specified herein.
- B. The pipe shall consist of two concentric extruded thermoplastic tubes integrally braced across the annulus. The resultant annular space shall be filled with inert material such as light-weight portland cement concrete to provide continuous support between the inner and outer tubes.
- C. All sanitary sewer lines in industrial areas shall be vitrified clay pipe in conformance with Section 333106 "Vitrified Clay Pipe."

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 312300 Utility Earthwork.
- B. Section 330130 Sanitary Sewer and Storm Drain System Leakage Testing.
- C. Section 333104 Small ABS and PVC Nonpressure Pipe.
- D. Section 333106 Vitrified Clay Pipe.
- E. Section 331100 Piping, General.
- F. Section 330526 Piping Identification Systems.
- G. Section 331200 Miscellaneous Piping, Valves, Fittings, and Appurtenances.
- H. Division 1 General Requirements.

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards:

- ASTM D 2564 Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings.
- ASTM D 2680 Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite Sewer Piping.

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 GENERAL

- A. Composite Pipe shall be continuously and permanently marked with the manufacturer's name, pipe size, ASTM Specification Number, type of plastic, and extrusion code, including date and location of manufacture.

2.2 PIPE DESIGN

- A. Composite Pipe shall be manufactured and provided to meet the pipe strength classifications as shown on the Drawings and in accordance with ASTM D 2680, but in no case shall have a pipe stiffness less than 200 lb/in/in.

2.3 PIPE AND FITTINGS

- A. Composite Pipe and fittings shall conform to the requirements of ASTM Designation D 2680, and shall have either solvent cement joints or elastomeric gasket joints.
- B. "WYE" fittings are required on all new mains. Connections to existing mains shall be made by Tap-tite method or solvent welded, banded, saddle "wye" fittings.
- C. Sanitary sewer clean outs shall be in conformance with in Section 331200, "Miscellaneous Piping, Valves, Fittings, and Appurtenances."
- D. Sewer lateral connections shall accommodate solid wall pipe, PVC or ABS as specified in Section 333104, "Small ABS and PVC Nonpressure Pipe."

2.4 SOLVENT CEMENT JOINTS

- A. Cement for ABS joints shall be MEK containing a minimum of 20 percent by weight of dissolved ABS and shall comply with ASTM D 2564.
- B. Cement for PVC joints shall comply with ASTM D 2564 except that the minimum resin content shall be 16 percent and minimum viscosity shall be 3500 cP.

2.5 ELASTOMERIC GASKET JOINTS

- A. Composite Pipe with gasketed joints shall comply with ASTM D 2680 and shall be manufactured with a socket configuration which will prevent improper installation of the gasket and will ensure that the gasket remains in place during the joining operation. The gasket shall be manufactured from a synthetic elastomer containing not less than 50 percent by volume of first-grade synthetic rubber.

PART 3 -- EXECUTION

3.1 GENERAL

- A. All laying, jointing, testing for defects and for leakage shall be performed in the presence of the ENGINEER, and shall be subject to its approval before acceptance. All material found during the progress to have defects will be rejected and the CONTRACTOR shall promptly remove such defective material from the site.

3.2 BEDDING

- A. Pipe bedding shall conform to the requirements of Section 312300, "Utility Earthwork."

3.3 PIPE LAYING

- A. Composite Pipe shall be installed in conformance with the requirements of the pipe manufacturer's recommendations and the provisions of this Section.

- B. Bell and spigot pipe shall be laid with the bell end at the lowest point with the spigot end pointing in the direction of the flow.
- C. Handling of the pipe shall be done with care to insure that the pipe is not damaged in any manner during storage, loading, transit, unloading, and installation.
- D. The pipe shall be laid to the lines and grades shown on the Drawings and the sections shall be closely jointed to form a smooth flow line. Immediately before placing each section of pipe in final position for jointing, the bedding for the pipe shall be checked for firmness and uniformity of surface.
- E. Proper implements, tools, and facilities as recommended by the pipe manufacturer's standard printed installation instructions shall be provided and used by the CONTRACTOR for safe and efficient installation. All pipe and accessories shall be carefully lowered into the trench by means of derrick, ropes, or other suitable equipment in such a manner as to prevent damage to pipe and fittings. Under no circumstances shall pipe or accessories be dropped or dumped into the trench.
- F. Cutting and machining of the pipe shall be accomplished in accordance with the pipe manufacturer's standard procedures for this operation. Pipe shall not be cut with a cold chisel, standard iron pipe cutter, nor any other method that may fracture the pipe or will produce ragged, uneven edges.
- G. The pipe and accessories shall be inspected for defects prior to lowering into the trench. Any defective, damaged or unsound pipe shall be repaired or replaced. All foreign matter or dirt shall be removed from the interior of the pipe before lowering into position in the trench. Pipe shall be kept clean during and after laying. All openings in the pipe line shall be closed with water tight expandable type sewer plugs or test plugs at the end of each day's operation or whenever the pipe openings are left unattended. The use of burlap, wood, or other similar plugs will not be permitted.
- H. Adequate protection and maintenance of all underground and surface utility structures, drains, sewers, and other obstructions encountered shall be furnished by the CONTRACTOR at its own expense.
- I. Installation of warning tape shall conform to Section 330526, "Piping Identification Systems."

3.4 FIELD JOINTING

- A. **General:** The pipe shall not be deflected either vertically or horizontally in excess of the manufacturer printed recommendations.
- B. When pipe laying is not in progress, the open ends of the pipe shall be closed by approved means to prevent trench water from entering pipe. Adequate backfill shall be deposited on pipe to prevent floating of pipe. Any pipe which has floated shall be removed from the trench, cleaned, and relaid in an acceptable manner. No pipe shall be laid when, in the opinion of the ENGINEER, the trench conditions or weather are unsuitable for such work.
- C. **Solvent-Weld Joints:** Each solvent-weld pipe joint shall be sealed with solvent cement in conformance with the requirements of ASTM D 2680 and the manufacturer's printed recommendations. The spigot and socket shall be wiped clean before the solvent cement is applied. After insertion of the spigot end into the solvent weld bell end the inside surfaces shall be wiped clean of excess cement.
- D. **Gasketed Joints:** Each gasketed pipe joint shall be joined with a lock-in elastomeric gasket. The gasket and the gasket seal inside the bell shall be wiped clean before the gasket is inserted. At this time a liberal amount of lubricant shall be applied to the gasket and to the outside of the clean pipe end. Lubricant other than that furnished with the pipe shall not be used. The end of the pipe shall then be forced into the bell to complete the joint. On field cut spigot ends, the outer pipe wall shall be chamfered with a file to remove all burrs and rough spots.

- E. All Composite Pipe ends which are not factory sealed shall be sealed with an approved epoxy sealing material prior to installation.

3.5 SANITARY SEWER CLEAN OUTS

- A. Sanitary Sewer cleanouts shall be installed in conformance with Section 331200, "Miscellaneous Piping, Valves, Fittings, and Appurtenances."

3.6 TESTING

- A. Testing shall conform to the requirements of Section 330130, "Sanitary Sewer and Storm Drain System Leakage Testing."

- END OF SECTION -

SECTION 333104 - SMALL ABS AND PVC NONPRESSURE PIPE

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide all materials, equipment, and labor necessary to furnish and install all 4 inch to 15 inch polyvinyl chloride (PVC) solid wall nonpressure pipe; 4 inch and 6 inch acrylonitrile-butadiene-styrene (ABS) solid wall nonpressure pipe; and all appurtenant work, complete and operable, including all connections as shown on the Drawings and as specified herein. All 4 inch and 6 inch ABS nonpressure pipe will only be allowed for sanitary sewer laterals.
- B. All sanitary sewer lines in industrial areas shall be vitrified clay pipe in conformance with Section 333106, "Vitrified Clay Pipe."

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 312300 Utility Earthwork.
- B. Section 330130 Sanitary Sewer and Storm Drain System Leakage Testing.
- C. Section 333102 ABS and PVC Composite Pipe.
- D. Section 333106 Vitrified Clay Pipe.
- E. Section 033050 Utility Cast-in-Place Concrete.
- F. Section 331100 Piping, General.
- G. Section 330526 Piping Identification Systems.
- H. Section 331200 Miscellaneous Piping, Valves, Fittings, and Appurtenances.
- I. Division 1 General Requirements.

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards:

- ASTM C 425 Specification for Compression Joints for Vitrified Clay Pipe and Fittings.
- ASTM D 1784 Specification for Rigid Poly Vinyl Chloride (PVC) Compounds and Chlorinated Poly Vinyl Chloride (CPVC) Compounds.
- ASTM D 1869 Specification for Rubber Rings for Asbestos-Cement Pipe.
- ASTM D 2241 Specification for Poly Vinyl Chloride (PVC) Pressure-Rated Pipe (SDR-Series).
- ASTM D 2321 Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.

ASTM D 2751	Specification for Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe.
ASTM D 3034	Specification for Type PSM Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings.

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.

1.5 QUALITY ASSURANCE

- A. **Tests:** All materials used in the manufacture of the pipe shall be tested in accordance with the requirements of the referenced standards as applicable.
- B. All costs of such inspection and tests shall be borne by the CONTRACTOR.
- C. The pipe shall be subjected to the specified hydrostatic strength tests, flexure tests, and crushing tests. The crushing tests shall be made on samples taken from the center of full-length sections of pipe.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. All solid wall pipe shall be continuously and permanently marked in conformance with the appropriate ASTM.
- B. The CONTRACTOR shall also require the manufacturer to mark the date of extrusion on the pipe.
- C. Pipe shall be of the pipe pressure class as shown on the Drawings.

2.2 PIPE

- A. All PVC pipe shall be joined by compression joints unless otherwise specified or as shown on the Drawings, and shall conform to the following requirements:
 1. Polyvinyl chloride pipe (PVC) shall conform to the requirements of ASTM D 3034, and shall have a maximum SDR of 35 and a minimum pipe stiffness of 46 psi. Material for PVC pipe shall conform to the requirements of ASTM D 1784 for Class 12454-B or 12454-C as defined therein.
 2. Flexible rubber rings for elastomeric gasket joints for PVC pipe and fittings shall conform to the requirements of ASTM D 1869.
- B. ABS solid wall pipe shall conform to the requirements of ASTM D 2751, and shall have a maximum SDR of 35, or a minimum SDR of 23.5 with solvent welded joints.

2.3 FITTINGS

- A. All fittings including wyes and sanitary sewer lateral cleanouts for PVC pipe shall conform to the requirements of ASTM D 2241. The ring groove and gasket ring shall be compatible with PVC pipe ends.

- B. ABS solid wall fittings shall be of the same SDR rating as the pipe and provided with solvent welded joints.
- C. The strength class of the fittings shall be not less than the strength class of any adjoining pipe.

2.4 BEDDING MATERIAL

- A. Unless otherwise specified or shown, all material used for pipe bedding shall conform to the requirements for bedding in Section 312300, "Utility Earthwork."

2.5 FLEXIBLE COUPLINGS

- A. Flexible couplings used for repairs shall be rubber, full-circle, clamp-on type conforming with ASTM C 425 and provided with 2 stainless steel band screw-clamps to secure the coupling tightly to entering and exiting pipes. All screw-clamp hardware shall be Type 304 or Type 316 stainless steel. Rubber material shall be suitable for use on sewage systems.

2.6 LATERAL CONNECTIONS TO SANITARY SEWER

- A. Service lateral connections to new sewers shall be made with wye fittings, installed as the sewer pipe is laid.
- B. Service lateral connections to existing sewers shall be made by "Tap-Tite" method, or with approved "Sealtite" type saddle fittings which utilize neoprene gasket seals and stainless steel bands.
- C. Sanitary sewer cleanouts, shall be in conformance with Section 331200, "Miscellaneous Piping, Valves, Fittings, and Appurtenances."

PART 3 -- EXECUTION

3.1 GENERAL

- A. All laying, jointing, testing for defects and for leakage shall be performed in the presence of the ENGINEER, and shall be subject to its approval before acceptance. All material found during the progress to have defects will be rejected and the CONTRACTOR shall promptly remove such defective materials from the site of the WORK.
- B. Installation shall conform to the requirements of ASTM D 2321 and to the supplementary requirements or modifications specified herein. Wherever the provisions of this Section and the requirements of ASTM D 2321 are in conflict, the more stringent provision shall apply.
- C. The CONTRACTOR shall perform the deflection 'mandrel' test as specified in Section 330130 "Sanitary Storm Drain Sewer System Leakage Testing." If the amount of allowable pipe deflection is exceeded, the CONTRACTOR shall uncover the pipe and shall improve the quality of the Pipe Zone backfill material and/or compaction to the extent that the allowable pipe deflection is not exceeded.

3.2 TRENCHING AND BACKFILL

- A. Trench excavation and backfill shall conform to the requirements of Section 312300, "Utility Earthwork," and as specified herein.

3.3 PIPE LAYING

- A. The pipe shall be installed in conformance with the requirements of ASTM D 2321, as specified herein and as shown on the Drawings. The pipe sections shall be closely jointed to form a smooth flow line. Immediately before placing each section of pipe in final position for connecting joints, the bedding for the pipe shall be checked for firmness and uniformity of surface.
- B. Proper implements, tools, and facilities as recommended by the pipe manufacturer's printed instructions shall be provided and used by the CONTRACTOR for safe and efficient execution of the work. All pipe, fittings, and accessories shall be carefully lowered into the trench by means of derrick, ropes, or other suitable equipment in such a manner as to prevent damage to pipe and fittings. Under no circumstances shall pipe or accessories be dropped or dumped into the trench.
- C. Cutting and machining of the pipe shall be accomplished in accordance with the pipe manufacturer's standard procedures for this operation. Pipe shall not be cut with a cold chisel, standard iron pipe cutter, nor any other method that may fracture the pipe or will produce ragged, uneven edges.
- D. Installation of pipes in prepared trenches shall start at the lowest point, with the spigot ends pointing in the direction of flow.
- E. The pipe and accessories shall be inspected for defects prior to lowering into the trench. Any defective, damaged or unsound pipe shall be repaired or replaced. All foreign matter or dirt shall be removed from the interior of the pipe before lowering into position in the trench. Pipe shall be kept clean during and after laying. All openings in the pipe line shall be closed with water tight expandable type sewer plugs or PVC test plugs at the end of each day's operation or whenever the pipe openings are left unattended. The use of burlap, wood, or other similar temporary plugs will not be permitted.
- F. Adequate protection and maintenance of all underground and surface utility structures, drains, sewers, and other obstructions encountered in the progress of the work shall be furnished by the CONTRACTOR at its own expense.
- G. Installation of warning tape shall conform to Section 330526, "Piping Identification Systems."

3.4 PIPE HANDLING

- A. Handling of all pipe shall be done with care to insure that the pipe is not damaged in any manner during storage, transit, loading, unloading, and installation.
- B. Pipe shall be inspected both prior to and after installation in the trench and all defective lengths shall be rejected and immediately removed from the working area.

3.5 PVC FIELD JOINTING

- A. Each pipe elastomeric-gasket joint shall be installed in conformance with the manufacturer's printed recommendations.
- B. The ring and the ring seat inside the bell shall be wiped clean before the gasket is inserted. At this time a thin film of lubricant shall be applied to the exposed surface of the ring and to the outside of the clean pipe end. Lubricant other than that furnished with the pipe shall not be used. The end of the pipe shall be then forced into the ring to complete the joint.
- C. The pipe shall not be deflected either vertically or horizontally in excess of the printed recommendations of the manufacturer.

- D. When pipe laying is not in progress, the open ends of the pipe shall be closed to prevent trench water from entering pipe. Adequate backfill shall be deposited on pipe to prevent floating of pipe. Any pipe which has floated shall be removed from the trench, cleaned, and relaid in an acceptable manner. No pipe shall be laid when, in the opinion of the ENGINEER, the trench conditions or weather are unsuitable for such work.

3.6 ABS FIELD JOINTING

- A. ABS pipe shall be solvent welded in strict accordance with the manufacturer's printed recommendations.

3.7 FITTINGS

- A. All fittings shall be installed utilizing standard installation procedures. Fittings shall be lowered into trench by acceptable means without damage to the fittings. Fittings shall be carefully connected to pipe or other facility, and joint shall be checked to insure a sound and proper joint.

3.8 SANITARY SEWER CLEANOUTS

- A. Sanitary sewer cleanouts shall be installed in conformance with Section 331200, "Miscellaneous Piping, Valves, Fittings, and Appurtenances."

3.9 TESTING

- A. Field testing of pipe shall conform to the requirements of Section 330130, "Sanitary Sewer and Storm Drain System Leakage Testing."

- END OF SECTION -

SECTION 333106 - VITRIFIED CLAY PIPE

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide all materials, equipment, and labor necessary to furnish and install all vitrified clay pipe and all appurtenant work, complete and operable, including all connections as shown on the Drawings and as specified herein.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 312300 Utility Earthwork.
- B. Section 330130 Sanitary Sewer and Storm Drain System Leakage Testing.
- C. Section 333900 Precast Concrete Maintenance Holes.
- D. Section 331100 Piping, General.
- E. Section 330526 Piping Identification Systems.
- F. Section 331200 Miscellaneous Piping, Valves, Fittings, and Appurtenances.
- G. Division 1 General Requirements.

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. **Commercial Standards:**

- - National Clay Pipe Institute - "Clay Pipe Engineering Manual."
- AASHTO Standard Specifications for Highway Bridges.
- ASTM C 12 Practice for Installing Vitrified Clay Pipe Lines.
- ASTM C 301 Test Methods for Vitrified Clay Pipe.
- ASTM C 425 Specification for Compression Joints for Vitrified Clay Pipe and Fittings.
- ASTM C 700 Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated.
- ASTM C 828 Test Method for Low-Pressure Air Test of Vitrified Clay Pipe Lines.

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.

1.5 QUALITY ASSURANCE

- A. **Testing at Manufacturer's Plant:** All pipe shall be subject to a hydrostatic pressure test and a 3-edge bearing test at the manufacturer's plant. The ENGINEER may select at random and test as specified one length of pipe for each 1000 feet or fraction thereof to be installed for the test as specified in ASTM C 301. The cost of pipe and the test shall be borne by the CONTRACTOR. Pipe will be acceptable under the test requirements specified herein when all test specimens conform to the test requirements. Should any of the test specimens fail to meet the test requirements, the manufacturer will be allowed to retest 2 additional specimens for each specimen that failed, and the pipe shall be acceptable only when all the retest specimens meet the strength requirements.
- B. **Inspection of Materials:** All pipe and fittings shall be true, circular, and concentric with the barrel of the pipe, cut off on a plane at right angles to the longitudinal axis of the pipe. At no point shall the thickness of the shell of the extreme outer end of the spigot be less in thickness than the shell of the main body of the pipe. Socket ends shall be square with the longitudinal axis and shall be true, circular, and concentric with the barrel of the pipe. All pipe shall be subject to inspection at the place of manufacture. The CONTRACTOR shall notify the ENGINEER, in writing, of the manufacturing starting date not less than 14 days prior to the start of any phase of the pipe manufacture.
- C. All pipe and fittings shall have smooth interiors and shall be free from injurious cracks, checks, blisters, broken extremities, or other imperfections.
- D. The following imperfections in the barrel or socket of a pipe or fitting will be considered injurious and cause for rejection:
1. A single crack in the barrel of the pipe or fitting extending through the entire thickness, regardless of the length of such crack; a single crack which extends through 1/5 of the barrel thickness and is over 3 inches long; any surface fire crack which is more than 1/32-inch wide at its widest point.
 2. Lumps, blisters, pits, or flakes on the interior surface of a pipe or fitting.
 3. When spigot or bell of the pipe varies from a true circle more than 3 percent of its nominal diameter.
 4. Any piece broken from the spigot end which extends through the barrel.
 5. Tramp clays, grog, or other foreign matter which is fused permanently to the exterior or interior surface of the pipe or fittings.

PART 2 -- PRODUCTS

2.1 PIPE AND FITTINGS

- A. All pipe and fittings shall conform to the following requirements:
- Clay pipe and fittings shall be extra strength, unless otherwise shown and shall conform to the requirements of ASTM C 700.
- B. Service Laterals:
1. Service laterals in new sewers shall be installed using wye-type fittings.
 2. Service laterals into existing sewers shall be in conformance with Section 331200, "Miscellaneous Piping, Valves, Fittings, and Appurtenances."

- C. Sanitary sewer cleanouts shall conform to the requirements of Section 331200, "Miscellaneous Piping, Valves, Fittings, and Appurtenances."

2.2 VITRIFIED CLAY PIPE

Vitrified clay pipe shall be extra strength pipe and shall be in accordance with ASTM C 12 and C 700.

2.3 JOINTS

Joints in vitrified clay pipe shall be made up using a factory-made bell and spigot compression joint for all pipe diameters. For connections to existing VCP up to 12 inches in diameter, a synthetic rubber collar with stainless steel shear ring and stainless steel take-up clamps, bolts and nuts, meeting the requirements of ASTM C 425, may be used.

PART 3 -- EXECUTION

3.1 GENERAL

- A. The VCP pipe shall be constructed to the alignment and grade shown. The grade line shown on the profile is the invert of the pipe. The excavation shall be made a sufficient distance below the grade line to allow for the placing of the sewer pipe and embedment. Should the trench be excavated to a depth greater than required, the CONTRACTOR shall refill such excess over-excavation according to the requirements of Section 312300, "Utility Earthwork."
- B. Installation of warning tape shall conform to Section 330526, "Piping Identification Systems."

3.2 INSTALLATION OF PIPE

- A. Installation of pipe shall be in accordance with ASTM C 12. Pipe laying shall proceed upgrade starting at lowest point with spigot ends pointing in direction of flow. After a section of pipe has been lowered into the prepared trench and immediately before joining the pipe, the ends of the pipe to be joined shall be cleaned and the gasket lubricated, all in accordance with the pipe manufacturer's written instructions. Assembly of the pipe length shall be in accordance with the recommendations of the manufacturer of the type of joint used. All special tools and appliances required for joining the pipe shall be provided by the CONTRACTOR. When cutting or machining of the pipe is necessary, only tools and methods recommended in writing by the pipe manufacturer and reviewed by the ENGINEER shall be employed.
- B. The CONTRACTOR shall take all necessary precautions to prevent excavated or other foreign material from getting into the pipe during the laying operations. At all times, when laying operations are not in progress and at the close of the day's work, the ends of the pipe in the trench shall be closed with appropriate bladders, to prevent entry to animals and foreign materials. Plywood will not be allowed.
- C. All necessary precautions shall be taken to prevent uplift or floating of the pipe prior to the completion of the backfilling operation. The CONTRACTOR shall assume full responsibility for any damage due to this cause and shall, at its own expense, restore and replace the pipe to its specified condition and grade if it is displaced due to floating.

3.3 TESTING

Testing shall conform to the requirements of Section 330130, "Sanitary Sewer and Storm Drain System Leakage Testing."

- END OF SECTION -

SECTION 333900 - PRECAST CONCRETE MAINTENANCE HOLES

1.1 THE REQUIREMENT

The CONTRACTOR shall provide all materials, equipment, and labor to furnish and install all prefabricated maintenance holes complete with frame, cover, pipe connections, and cast-in-place or prefabricated base, and all other appurtenances complete in place, as shown on the Drawings and as specified herein.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 312300 Utility Earthwork.
- B. Section 333100 Reinforced Concrete Pipe (PVC-Lined).
- C. Section 330130 Sanitary Sewer and Storm Drain System Leakage Testing.
- D. Section 033050 Utility Cast-in-Place Concrete.
- E. Section 036000 Grout.
- F. Section 034800 Precast Concrete Vaults, Utility Boxes, and Storm Field Drop Water Inlets.
- G. Division 1 General Requirements.

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Commercial Standards:

- ASTM A 48 Specification for Gray Iron Castings.
- ASTM C 150 Specification for Portland Cement.
- ASTM C 478 Specification for Precast Reinforced Concrete Manhole Sections.

1.4 CONTRACTOR SUBMITTALS

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 MATERIALS

- A. **Maintenance Holes:** Maintenance holes shall be constructed of concentric precast reinforced concrete sections in accordance with ASTM C 478. Precast concrete sections shall be manufactured by a process that will produce a dense, homogeneous concrete section of first quality. Steps or rungs will not be allowed in maintenance holes. The sections shall have a minimum wall thickness of 4 inches for 48-inch diameter sections and a minimum wall thickness of 6 inches for 60 inch diameter sections. Cement used in manufacturing the sections for sanitary sewer maintenance holes shall be Type V portland cement as specified in ASTM C 150. Maintenance hole sections shall be sealed using preformed joint material as specified in Section 034800, "Precast Concrete Vaults, Utility Boxes, and Storm Water Inlets" and grout as specified in Section 036000, "Grout." All maintenance holes shall have reinforced cast-in-place or reinforced precast concrete bases and formed channels with inverts to match the adjoining pipes. Maintenance hole sections shall be designed for a minimum of HS-20 traffic loading plus earth loads. Calculate earthload with a unit weight of 130 pcf.

- B. Maintenance holes in sewers constructed of PVC lined reinforced concrete pipe shall be provided with compatible PVC lining from the top of the base up to and including 1/2-inch minimum of the cast iron frame. PVC-lining shall conform to the requirements of Section 333100, "Reinforced Concrete Pipe (PVC-lined)." The interiors of all other manholes shall be coated per Section 099100, "Protective Coatings for Concrete Sanitary Sewer Manholes".
- C. **Castings:** Castings for maintenance holes frames and covers shall be non-rocking and shall conform to the requirements of ASTM A 48, Class 30B. Cast iron covers and frames shall be heavy duty traffic type, 24 inches in diameter, with a curved blind pickhole, and embossed lettering for "Storm Sewer" or "Sanitary Sewer," as applicable. Frame and cover shall be designed for HS-20 traffic loading. For installations in unimproved areas, cover and frames shall be bolted. All castings shall be thoroughly cleaned and subject to a hammer inspection after which they shall be twice dipped with an asphalt or coal tar coating applied at a temperature of not less than 290 degrees F. nor more than 310 degrees F.
- D. **Castings Suppliers, or Equal:**
 - 1. **Phoenix P-1002** for field installations.
Phoenix P-1090 for street and paved installations.
 - 2. **D & L Supply Company A-1024.**
- E. **Water Stops:** Plastic pipe connections to precast concrete maintenance holes and cast-in-place bases shall also be sealed using a premolded elastomeric waterstop material.
- F. All connections to precast concrete maintenance holes shall be made with non-shrink grout.

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. All precast concrete maintenance holes shall be installed in strict conformance with the manufacturer's printed instructions on a well compacted foundation as specified in Section 312300, "Utility Earthwork."
- B. Maintenance hole frames and covers shall not be set to final grade until the pavement has been completed. Frame and cover shall be set and adjusted to grade after final paving. The street cut in asphalt concrete pavement shall be circular and paving around the maintenance hole shall be in accordance with the Drawings. Openings in maintenance holes shall be protected from construction loads, debris, and unauthorized entry.
- C. Maintenance hole sections shall be set so as to be vertical with sections in true alignment. The joint of the previously set section shall be clean and covered with preformed joint sealant before the next section is placed. The joint material shall be installed in accordance with manufacturer's printed recommendations.
- D. No pipe ends shall protrude into the maintenance hole. No bell section of the pipe shall be placed into the maintenance hole wall.
- E. Structure backfill and compaction shall be as specified in Section 312300, "Utility Earthwork."

3.2 TESTING

- A. Testing of precast concrete maintenance holes shall conform to the requirements of Section 330130, "Sanitary Sewer and Storm Drain System Leakage Testing."

- END OF SECTION -

**SECTION 334100 - CORRUGATED POLYETHYLENE
NONPRESSURE PIPE (HDPE)**

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide all materials, equipment, and labor necessary to furnish and install 12 inch to 36 inch corrugated polyethylene non-pressure pipe with all necessary fittings and coupling systems and all appurtenant work, complete and operable, including all connections as shown on the Drawings and as specified herein.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 312300 Utility Earthwork.
- B. Section 330130 Sanitary Sewer and Storm Drain System Leakage Testing.
- C. Section 333900 Precast Concrete Maintenance Holes.
- D. Section 033050 Utility Cast-in-Place Concrete.
- E. Section 034800 Precast Concrete Vaults, Utility Boxes, and Storm Water Inlets.
- F. Section 331100 Piping, General.
- G. Division 1 General Requirements.

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

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

- Section 61 Culvert and Drainage Pipe Joints.
- Section 64 Plastic Pipe.

B. **Commercial Standards:**

- AASHTO M 294 Specification for Corrugated Polyethylene Pipe, 36 in. Diameter.
- ASTM D 2412 Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel - Plate Loading.
- ASTM D 2584 Test Method for Ignition Loss of Cured Reinforced Resins (R 1985).
- ASTM D 3350 Specification for Polyethylene Plastics Pipe and Fittings Materials.

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.

1.5 QUALITY ASSURANCE

- A. **Testing:** All materials testing shall be based upon applicable ASTM Test Methods referenced herein for the materials specified. All costs of such manufacturing inspections and tests shall be borne by the CONTRACTOR.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Corrugated polyethylene pipe shall be smooth interior wall Type S and shall be as specified in AASHTO M 294, except as otherwise specified herein. Corrugated polyethylene pipe shall be manufactured from high density polyethylene (HDPE) virgin compounds.

- 1. HDPE compounds used in the manufacture of corrugated polyethylene pipes shall conform to the following cell classifications as provided in ASTM D 3350:

<u>Property</u>	<u>Cell Classification</u>
Density	3
Melt index	2 ^(a) , 3 or 4
Flexural modulus	4, 5 or 6
Tensile strength	4, 5 or 6
Environmental stress crack resistance	1, 2, or 3
Hydrostatic design basis	0, 1, 2, 3, or 4
Ultraviolet stabilizer.....	C ^(b)

- (a) The melt index for cell class factory 2 material used to manufacture pipe shall not be greater than 0.6. Rotationally-molded couplings and end fittings may be produced from material compounds having a melt index cell classification of one.
- (b) HDPE resin shall contain not less than 2 +/- 1/2 percent carbon black ultraviolet stabilizer.

- B. The residue from ignition of the HDPE compounds shall not exceed 30 percent as determined by ASTM D 2584, except that the muffle furnace temperature shall be 450 +/- 25 degrees C. (840 +/- 45 degrees F.)

2.2 PIPE THICKNESS, STIFFNESS AND UNIT WEIGHT

- A. Wall thickness of Type S corrugated polyethylene pipe shall be the thickness of the inner liner measured between corrugation valleys.
- B. The pipe stiffness shall be determined in accordance with ASTM D 2412. Pipe stiffness shall be determined for 3 test specimens for each manufactured run. Minimum pipe stiffness and wall thickness shall be as follows:

Pipe Diameter (in.)	Minimum Wall Thickness (in.)	Minimum Pipe Stiffness (psi)
12"	0.035	50
15"	0.035	42
18"	0.050	40
24"	0.050	34
30"	0.050	28
36"	0.050	22

The minimum pipe unit weight shall meet the requirements of Table 2 of Section 64-1.03 "Pipe Thickness, Stiffness and Unit Weight" of the Caltrans Standard Specifications.

- C. The pipe unit weight shall be computed as the average weight per foot of length determined from 3 test specimens, taken from each manufactured run. Each test specimen for pipes 24 inches in diameter and less shall be a minimum length of 2 diameters. The length of each test specimen for pipes larger than 24 inches in diameter shall be one diameter or a maximum of 36 inches, whichever is less. The weight of pipe specimens shall be determined with any suitable weighing device accurate to 0.10 pound.

2.3 JOINTS

- A. The joint shall be bell and spigot design and shall include a rubber gasket meeting the requirements of ASTM F-47.

Fittings used in the system shall not reduce or impair the overall integrity or function of the pipe line. Fittings may be either molded or fabricated Common Corrugated fittings including in-line joint such as tees, wyes, and end caps. Unless otherwise specified, fittings shall be installed using a joint configuration meeting the requirements of cell Class 335420C as defined and described in ASTM D3350. Only fittings supplied or recommended by the manufacturer shall be used.

- B. Water tightness shall be attained by the use of approved durable, high quality, resilient joint materials designed to perform the intended function. These materials shall be neoprene expanded rubber or sheet rubber gaskets, "O" ring rubber gaskets, butyl rubber base joint sealant, or other approved resilient materials. Watertight joints shall be tested in accordance with Section 330130, "Sanitary Sewer and Storm Drain System Leakage Testing."

PART 3 -- EXECUTION

3.1 GENERAL

- A. All laying, jointing, testing for defects and for leakage, shall be performed in the presence of the ENGINEER. All material found during the progress to have defects will be rejected and the CONTRACTOR shall promptly remove such defective material from the site of the WORK.

3.2 PIPE HANDLING

- A. Pipe, fittings, and accessories shall be carefully inspected before and after installation and those found defective shall be rejected. Pipe and fittings shall be free from fins and burrs. Before being placed in position, pipe, fittings, and accessories shall be cleaned and shall be maintained in a clean condition. Proper facilities shall be provided for lowering sections of pipe into trenches. Under no circumstances shall pipe, fittings, or any other material be dropped or dumped into trenches.

3.3 INSTALLATION

- A. Pipe shall be laid and jointed in accordance with the manufacturer's printed recommendations and the following provisions in order to be suitable for the purpose intended.
- B. Necessary facilities shall be provided for lowering and properly placing the sections of pipe in the trench.
- C. The pipe shall be laid to line and grade with the sections closely jointed.
- D. Every precaution shall be taken to prevent flooding the pipe trench before backfilling operations.
- E. New pipe shall be connected to existing or new drainage facilities as shown on the Drawings.

3.4 CONNECTIONS

- A. Connections of HDPE to existing structures and pipes shall be as follows:
 - 1. Connections to cast-in-place structures shall include a water-stop at mid-wall of the structure.
 - 2. Connections to pre-cast structures shall include a water-stop at mid-wall of the structure, and opening shall be filled with cement grout in conformance with Section 036000 "Grout."
 - 3. Connections to existing HDPE pipe shall be made with a premium split-coupling saddle tee.
 - 4. Connections to existing PVC shall be made with a PVC saddle with a HDPE/SDR 35 PVC adaptor.
 - 5. Connections to existing DIP shall be made with a DIP tap and heat shrink material around the joint. Heat shrink material shall be supplied by the HDPE pipe manufacturer.
 - 6. Connections to existing RCP shall be as shown on the Drawings, except that the PCC concrete encasement around the RCP shall be extended to cover the HDPE a point 6 inches to 12 inches beyond the RCP sleeve.

3.5 TESTING

- A. Testing of corrugated polyethylene non-pressure pipe shall conform to the requirements of Section 330130 "Sanitary Sewer and Storm Drain System Leakage Testing."

- END OF SECTION -

SECTION 334102 - REINFORCED CONCRETE PIPE

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The CONTRACTOR shall provide all materials, equipment, and labor necessary to furnish and install all reinforced concrete pipe and all appurtenant work, complete and operable, including all connections as shown on the Drawings and as specified herein.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 312300 Utility Earthwork.
- B. Section 330130 Sanitary Sewer and Storm Drain System Leakage Testing.
- C. Section 333900 Precast Concrete Maintenance Holes.
- D. Section 033050 Utility Cast-in-Place Concrete.
- E. Section 034800 Precast Concrete Vaults, Utility Boxes, and Storm Water Field Drop Inlets.
- F. Section 331100 Piping, General.
- G. Division 1 General Requirements.

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards:

- ASTM C 76 Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
- ASTM C 150 Specification for Portland Cement.
- ASTM C 443 Specification for Joints for Circular Concrete Sewer and Culvert Pipe Using Rubber Gaskets.
- ASTM C 596 Test Method for Drying Shrinkage of Mortar Containing 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 in this Section.

PART 2 -- PRODUCTS

2.1 PIPE MATERIALS

- A. **Reinforced Concrete Pipe:** Reinforced concrete pipe shall conform to the requirements of ASTM Designation C 76. Cement shall conform to ASTM C150, Type II. Pipe shall be bell and spigot having O-ring rubber gaskets conforming to ASTM C 443 retained in a groove on the spigot end. All reinforcement shall be circular. **Elliptical reinforcing will not be allowed.**
- B. **Cement Mortar:** Cement mortar for structures or pipe connections shall consist of a mixture of Portland Cement, sand, and water. Mortar shall be composed of one part of cement and 2 parts of

clean, well-graded sand of such size that will pass a No. 8 sieve. Cement and sand shall first be combined in the proper proportions, and then thoroughly mixed with the required amount of water.

- C. Mortar shall be used as soon as possible after mixing and shall show no visible signs of setting prior to use. Retempering of mortar will not be allowed.
 - D. Concrete material shall conform to the requirements of Section 033050, "Utility Cast-in-Place Concrete."
 - E. **Admixtures:** No admixture shall be used in mortar unless otherwise specified or accepted in writing by the ENGINEER.
- 2.2 PIPE DESIGN
- A. Reinforced concrete pipe shall be manufactured and provided to meet the pipe strength classifications as shown on the Drawings and in accordance with ASTM C 76, but in no case shall be less than Class III for Wall "B" or Wall "C." Class I and II pipe will not be allowed.
 - B. Wall "A" pipe will not be allowed

PART 3 -- EXECUTION

3.1 PIPE LAYING

- A. Installation of pipes in prepared trenches shall start at the lowest point, with the spigot ends pointing in the direction of flow.
- B. Pipe shall have a minimum laying length of approximately 8 feet, except for closure and other special pieces as approved by the Engineer. The length of the incoming and outgoing concrete pipe at each structure shall not exceed 4 feet.
- C. Care shall be used to make sure that the bottom of the pipe is in contact with the bottom of the trench for the full length of each section.
- D. **Excavation:** Bell holes shall be excavated at each joint to provide full length barrel support of the pipe and to prevent point loading at the bells.
- E. **Pipe Laying:** Unless otherwise required, all pipe shall be laid straight between the changes in alignment and at uniform grade between changes in grade.
- F. **Rubber Gasket Joints:** The rubber gasket joint shall be made by properly lubricating the rubber gasket with a suitable vegetable compound soap before it is placed in the groove at the spigot end. The gasket shall be stretched over the spigot end of the pipe and carefully seated in the groove, with care taken to equalize the stress in the gasket around the circumference of the joint. The gasket shall not be twisted, rolled, cut, crimped, or otherwise injured or forced out of position during the closure of the joint. A feeler gauge shall be used to check the position of the rubber gasket after the joint has been assembled. Where a joint placement is found to be improper, the tested pipe section shall be removed, the gasket checked for damage, a new gasket installed, if necessary, the pipe re-laid and the gasket placement rechecked.
- G. Pointing and bonding mortar at pipe connections to structures shall be plastic and of such consistency that it will readily adhere to the pipe and structure.

3.2 TESTING

- A. Testing shall conform to the requirements of Section 330130, "Sanitary Sewer and Storm Drain System Leakage Testing."

- END OF SECTION -

CITY OF LIVERMORE
TECHNICAL SPECIFICATIONS

DIVISION 34 – TRANSPORTATION

SECTION 344100 - TRAFFIC SIGNALS AND LIGHTING SYSTEMS

PART 1 -- GENERAL

1.1 THE REQUIREMENT

- A. The DEVELOPER/CONTRACTOR shall provide all material, equipment, and labor necessary to furnish and install all traffic signals, all street lights, all associated hardware and equipment, and all appurtenant work to provide a functional installation, complete in place and operable, as shown on the Drawings and as specified herein. CONTRACTOR or SUBCONTRACTOR working with any part of the Traffic Signals and Lighting System including radar signs and flashing beacons shall possess a valid Class C10 or Class A license. Additionally, the DEVELOPER/CONTRACTOR's representative in charge on site shall possess an IMSA certification –Level 2 (Field Tech) or Journeyman Electrician certification with at least 3 years experience in the traffic signal technology.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 312300 Utility Earthwork.
- B. Section 311723 Traffic Stripes and Pavement Markings.
- C. Section 321300 Concrete Surface Improvements
- D. 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

595a Federal Standard.

NEC National Electric Code.

NEMA National Electric Manufacturers Association.

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

1. Latest version of the Standard Specifications, including (but not limited to):
Section 86 - Signals, Lighting and Electrical Systems
2. Latest version of the Standard Plans
3. Latest version of the Traffic Manual

C. **Commercial Standards:**

UL Underwriters Laboratories, Inc.

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. The DEVELOPER/CONTRACTOR shall submit the controller cabinet schematic wiring diagram and intersection sketch on one sheet, at the time the controller cabinet is delivered to the CITY for testing,

or prior to any signal modifications which require modifications to the controller cabinet. The DEVELOPER/CONTRACTOR shall notify the City Maintenance Department—and City Inspector 72 hours prior to delivery of controller cabinet for testing.

- C. The DEVELOPER/CONTRACTOR shall furnish a maintenance manual for all controller units; auxiliary equipment; and vehicle detectors sensor units, control units and amplifiers. The maintenance manual and the required operation manual may be combined into one manual. One set of traffic signal Drawings and traffic signal Specifications, and the maintenance manual, or combined maintenance and operation manual, for the controller shall be submitted at the time the controllers are delivered to the CITY for testing. The maintenance manual shall include, but is not necessarily limited to, the following items:
 - 1. Manufacturer's specifications.
 - 2. Design characteristics.
 - 3. General operation theory.
 - 4. Function of all controls.
 - 5. Trouble-shooting procedure (diagnostic routine).
 - 6. Block circuit diagram.
 - 7. Geographical layout of components.
 - 8. Schematic diagrams.
 - 9. List of replaceable component parts with stock numbers.
- D. The DEVELOPER/CONTRACTOR shall submit to the ENGINEER a list of equipment and materials proposed for to be used in accordance with Section 86-1.04, "Equipment List and Drawings," of the Caltrans Standard Specifications.
- E. The controller cabinet and its components shall be tested and certified by the controller manufacturer prior to delivery to the CITY for testing.

1.5 MANUFACTURER'S SERVICE REPRESENTATIVE

- A. The DEVELOPER/CONTRACTOR shall arrange to have a signal technician, qualified to work on the controller and employed by the controller manufacturer or his representative, present at the time the traffic signal is turned on, when signal interconnect cable is terminated, when emergency vehicle preemption system is activated, when a new signal phase is activated, or when any modifications are required to the controller cabinet, except for termination of the field wires.
- B. When video detection is used, the DEVELOPER/CONTRACTOR shall arrange to have a signal technician, qualified to work on the controller and employed by the video detection manufacturer or his representative, present at the time the traffic signal is turned on, or when any video detection is activated on an existing signal.
- C. When other specialty components are used such as batter backup systems, rectangular rapid flashing beacons, or CCTV the DEVELOPER/CONTRACTOR shall arrange to have a technician, qualified to work on those components and employed by the component's manufacturer or his representative, present at the time the traffic signal is turned on or the system is activated.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Traffic signals and street lights shall conform to Section 86, "Signals, Lighting and Electrical Systems," of the Caltrans Standard Specifications and Caltrans Standard Plans and as specified herein.

2.2 FOUNDATIONS

- A. Portland cement concrete for standards, steel pedestals and posts shall be Class A, in conformance with City Standard Detail G-6.

2.3 STANDARDS, STEEL PEDESTALS AND POSTS

- A. Standards, steel pedestals, and posts shall conform to Section 86-2.04, "Standards, Steel Pedestals and Posts," of the Caltrans Standard Specifications and as specified herein.
- B. All Traffic Signal standards and posts shall be galvanized steel, except in the Downtown Core where it shall be decorative and painted **Olive Drab (SC1TX/RAL6022)** as indicated on the project plans. Locations of Traffic Signal and street lighting standards and posts shall be marked in the field with marking chalk for review by the ENGINEER before beginning any installation.
- C. Street light standards shall be galvanized steel or spun aluminum.
- D. The decorative street light standard shall be **Lumec R80A-15-TBC1 or approved equal**. The standard shall be aluminum. All hardware shall be tamper resistant stainless steel. Anchor bolts shall be hot dipped galvanized. A 12 ½" bolt circle shall be used.

Description of Components:

Pole Shaft: Shall be made from a 4" (102mm) 8 fluted round extruded 6061-T6 aluminum tubing, having a 0.167" (4.2mm) wall thickness, welded to the pole base.

Joint Cover: One-piece round joint cover made from cast 356 aluminum, mechanically fastened with stainless steel screws.

Pole Base: Shall be made from a round fluted cast 356-T6 aluminum base having a 0.375" (9.5mm) wall thickness, complete with a cast-in anchor plate.

Maintenance Opening: The pole shall have a 4" x 9" (102mm x 229mm) maintenance opening centered 21" (533mm) from the bottom of the anchor plate, complete with a weatherproof cast 356 aluminum cover and a copper ground lug.

Base Cover: Two-piece round base cover made from cast 356 aluminum, mechanically fastened with stainless steel screws.

Hardware: All exposed screws shall be stainless steel with Ceramic primer-seal basecoat to reduce seizing of the parts. All seals and sealing devices should be made and/or lined with EPDM and/or silicone.

Finish: Color to be **Olive Drab (SC1TX/RAL6022)** within the Downtown Core per Downtown Specific Plan Area, and **Black (SC1TX/BKTK)** elsewhere, through an application of a polyester powder coat paint (4 mils/100 microns). The chemical composition provides a highly durable UV and salt spray resistant finish in accordance to the ASTM-B117-73 standard and humidity proof in accordance to the ASTM-D2247-68 standard.

Cast components: All cast aluminum components shall **contain 0.2% copper or less**.

2.4 CONDUIT

- A. Conduit shall conform to the provisions of Section 86-2.05, "Conduit," of the Standard Specifications and this Section.

- B. Conduit and fittings to be installed underground shall be rigid non-metallic type, unless otherwise noted in the project plans. Conduits designated for traffic signal interconnect shall be installed satisfying the requirements for both twisted pair and fiber optic cables (e.g., sweeps/bends for fiber optic should be used).
- C. Conduit installed in concrete base shall be the same type size and quality used for the underground conduit runs.
- D. The size of conduit used shall be as shown on the Drawings, but in no case shall conduit be less than 2 inches in diameter. In addition, the DEVELOPER/CONTRACTOR may, at his option and expense, use conduit of larger size than that shown or specified, provided the larger size is used for the entire length of the run from pull box to pull box. Reducing couplings will not be allowed.
- E. The fourth sentence in the third paragraph in Section 86-2.05C, "Installation," of the Caltrans Standard Specifications is amended to read as follows:

When a standard coupling cannot be used for coupling metal type conduit, a UL-listed threaded union coupling, concrete-tight split coupling, or concrete-tight set screw coupling shall be used.
- F. All fiber optic and signal interconnect pull boxes shall employ a maximum of 30 degree conduit sweeps. Conduit shall be rigid. All new fiber optic or signal interconnect conduit shall be a minimum of 3 inches unless otherwise noted on the project plans. Conduit shall be installed so that a straight cable pulling path may be maintained.
- G. **DETECTABLE Muletape** or approved equal shall be installed in empty conduits with minimum 10 feet coiled in the end pull box. The detectable muletape shall be a low stretch, high strength flat woven tape, produced with abrasion-resistant polyester or aramid fibers and a corrosion-resistant metallic conductor used for installing fiber optic, copper, and coaxial cables in underground conduits. It shall be pre-lubricated for easy pulling and reduced friction, durably printed with sequential footage markings for accurate measurement, lightweight and easily blown into conduit or innerduct.

2.5 PULL BOXES

- A. Pull boxes shall conform to the provisions in Section 86-2.06, "Pull Boxes," of the Caltrans Standard Specifications and this Section.
- B. Pull box size shall be No. 5 for traffic signals, No. 3-1/2 for street lights, No. 6 for homeruns, No. 6E for fiber optic and signal interconnect cable, and 30"x48" "double lid" for fiber optic splice enclosures, unless otherwise noted on the project plans. The cover shall be reinforced concrete.
- C. Interconnect pull boxes shall have lids embossed with "INTERCONNECT," street light pull box lids with "STREET LIGHTING," and traffic signal pull boxes with "TRAFFIC SIGNAL."
- D. All 6E pull boxes shall employ a 10 inch extension. A minimum of 10 inches of space shall be maintained between the lid of the 6E pull box and material at the bottom of the box.

2.6 CONDUCTORS AND WIRING

- A. Wiring shall conform to the provisions in Section 86-2.09, "Wiring," of the Caltrans Standard Specifications and this Section. Splices shall be insulated by "Method B."

- B. Street light conductors shall be copper type TW or THW. Conductors between pull boxes shall be No. 10 or larger and conductors in street light standards shall be No. 12 or larger, unless otherwise noted on the project plans.
- C. The voltage drop in any street light circuit shall not exceed 4 volts. The following formula shall be used to calculate the current needed for selecting the conductor size:

$$\text{Current (amperes)} = \frac{\text{Total wattage of fixtures served} \times 1.5}{\text{Service Voltage}}$$

- D. Fuse holders shall be non-compression type, and shall be **BUSS HEB-AA** or equal.
- E. The fiber optic cable requirements are as follows:

Fiber Optic Cable

Fiber Cable shall be all dielectric, loose tube with 12 single strand fibers per loose tube. No ribbon fiber shall be utilized. Fiber optic cable shall be single mode. Where available, within contract, water protection tape rather than gel filling shall be utilized. Fiber and fiber cable construction shall adhere to RUS PE-90 and Bellcore GR-20. Cable shall adhere to standard industry fiber and loose tube color coding, as defined by RUS PE-90 and Bellcore GR-20. The Cable shall be constructed to provide a minimum of 30 years useful life when installed in conduit. Fiber shall be 8.3 microns (normal) diameter with mode field diameters for depressed cladding being 8.8 microns ± 0.5 microns at 1310 nm and 10.0 ± 1.0 microns at 1550 nm; for matched cladding mode field shall be 9.3 microns ± 0.5 microns and 10.5 ± 1.0 microns for respective wave lengths. (Cladding types shall not be mixed during fiber deployment). The fiber shall be protected with a cladding with diameter of 125.0 ± 1.0 microns.

The fiber within the cable shall have an attenuation of no greater than 0.35 dB/Km (0.56 dB/Mile) at 1310 nm and 0.25 dB/Km (0.40 dB/Mile) at 1550 nm. Water peak attenuation 1385 nm (±3 nm) shall not exceed 2.5 dB/Km (4.02 dB/Mile). The attenuation of the fiber shall be distributed uniformly throughout its length such that there are no localized discontinuities in excess of 0.1dB at either 1310 nm or 1550 nm as determined by TIA 455-59 Fiber Optic Test Procedures (FOTP).

The Fibers shall have a maximum dispersion of 2.8 picoseconds/nanometer – km (ps/nm-km) over an optical wavelength range of 1290 to 1330 nm and a maximum value of zero dispersion slope of 0.093 ps/(km-nm²). Dispersion tests are in accordance with TIA 455-17S FOTP. The manufacturers shall have tested for dispersion as required by Bellcore GR – 20 or RUS PE-90. New factory tests are required only if the fiber has not been pre-tested and qualified to standards.

The Construction of the cable shall follow referenced standards for construction of dielectric, loose tube fiber cable with the exception that water-blocking tape is acceptable and preferred. The dielectric strength member shall support a tensile force of 2700 Newtons during cable installation and shall protect fiber attenuation change during installation allowing no greater than 0.31 dB/Km (0.50 dB/Mile) increase over manufacturer’s specified fiber attenuation.

The cable shall include a ripcord under the sheath to support easy removal of the sheaths. The sheaths shall be marked in accordance with National Electric Safety Code 350 G. The Cable Sheath shall also be permanently marked with the manufacturer’s name, type cable and “Fiber Optic Cable.” There shall also be sequential length markers that are accurate within 1%. Marking size shall be such as to be easily read by a technician. The DEVELOPER/CONTRACTOR shall submit cut sheets for cable approval to the Construction Manager identifying the marking size, repetition and symbol per National Electrical Safety Code (i.e., Telephone Symbol).

Cable diameter for up to 72 fibers should be approximately 13mm. Cable shall be rated for an operating temperature of -40⁰C to +75⁰C. The cable shall contain no metal and shall conform to the National Electric Code’s definition of fiber.

Cable shall be shipped from the factory with protective wrapping and with sealed ends. The cable shall include a waterproof tag with the results of factory OTDR attenuation test as well as:

Contract Number/Identification

Manufacturer's Name/Address
Manufacturer's Part Number
Type of Cable
Number of Loose Tubes and Fiber
Beginning and Ending Length Marks
Reel Number
Ship Date
Weight of Cable and Reel

Cable shall be of a continuous length on the reels. The Cable runs are as shown on plans. Slack cable requirements shall be considered by the DEVELOPER/CONTRACTOR, based on normal industry installation practices, in computing required cable length.

12-Fiber drop cables with 12-fiber jumper cables shall be utilized from splice closures to Ethernet Switches located in traffic signal controller cabinet. All traffic signal controller cabinets shall employ a fiber termination panel or tray for fiber optic termination with SC (female) connectors. Each jumper cable shall be 900 microns and terminated with an SC (male) connector having integral strain relief.

The fiber optic patch cable shall comply with the fiber cable special provisions of this document. The length of the patch cable shall be 2 meters (minimum). The patch cable shall have SC (male) connectors, simplex and single mode. The jumper cable will interface with the SC (female) connectors on the optical transceivers installed in field equipment cabinets.

The DEVELOPER/CONTRACTOR is responsible for interfacing the SC (Male) connectors to test optical-to-electrical communications performance between the Ethernet Switch, other installation locations, and the Traffic Operations Center (if applicable). The DEVELOPER/CONTRACTOR is responsible for correct splicing of the drop cable onto the backbone cable in accordance with splice tables provided by the City. Only fusion splicing method shall be accepted. DEVELOPER/CONTRACTOR is responsible for point-to-point continuity in accordance with splice tables and assuring point-to-point optical path loss (attenuation) is within specifications. Fiber drop cables and patch cables shall be marked R-1, R-2, T-1, T-2 or SPARE.

Tracer Wires or Detectable Muletape shall be included with all fiber optic cable installation projects. The detectable muletape shall be a low stretch, high strength flat woven tape, produced with abrasion-resistant polyester or aramid fibers and a corrosion-resistant metallic conductor. The tracer wires or Muletape shall be installed in such a way so that underground fiber optic utilities can be identified and located in the future by maintenance staff.

Fiber Optic Splice Closures

The DEVELOPER/CONTRACTOR shall deploy splice closures compatible with the single mode fiber cable selected for deployment and which are compliant with these special provisions. The splice closure shall include a fiber organizer following the guidelines of Bellcore GR-769. The basic splice closure shall also follow the guidelines of Bellcore GR771, "Generic Requirements for Fiber Optic Splice Closures."

The construction of the splice closure shall be such that it:

- Provides a protective mechanism for organizing the fiber strands and protecting individual fiber splices

- Waterproof design supporting continued submergence in water at normal burial depths (1 meter)
- Support main fiber backbone splices to a minimum of two drop/branch cables of 12-24 fiber each.
- Any metal parts shall be protected against corrosion
- Shall be easy to disassemble and reassemble by a fiber maintenance person
- Provided with hanging provisions from the side of a pull/across box
- Permanently marked with: "Fiber Communications" or similar wording to identify its function

Splice closures to be placed in pull boxes shall be attached to the side of the pull box with nylon ties. Slack shall be provided to allow the splice closure to be removed from the pull box for maintenance.

The DEVELOPER/CONTRACTOR shall prepare and submit Record Drawings of each splice closure installed, showing each fiber enclosed, fiber color, splices, and unconnected fibers. Record drawings shall be labeled to indicate the splice closure location.

All fiber optic splices shall be completed using the fusion splice method. All splices shall be tested, and the results of those tests shall be provided to the CITY by the DEVELOPER/CONTRACTOR.

2.7 BONDING AND GROUNDING

- A. Bonding and grounding shall conform to provisions in Section 86-2.10, "Bonding and Grounding," of the Caltrans Standard Specifications and this Section.
- B. Street lights shall be grounded by the use of a 5/8-inch diameter by 8 foot copper weld ground rod installed in the pull box adjacent to the street light.

2.8 SERVICE

- A. Service shall conform to the provisions in Section 86-2.11, "Service," of the Caltrans Standard Specifications and this Section except that the CONTRACTOR shall pay all costs and fees required by the utility company for the connection of both temporary and permanent service.
- B. The service equipment cabinet shall be Type III 120/240-volt and shall be painted with graffiti-resistant paint to match the controller cabinet color. All service cabinets installed in the "Downtown Core" shall be painted to match the controller cabinet color (Olive Drab -RAL 6022). Outside of the Downtown Core, the paint shall match the controller cabinet color. Battery Backup System (BBS) shall be required on all new traffic signal service equipment installation. The service cabinet shall house both PG&E equipment and BBS equipment including batteries. The base for the Type III service equipment enclosure shall meet Caltrans Standard Plan ES-2D. The service cabinet for traffic signals shall be a **Tesco 27/22-000BBS Type III-AF** or equivalent.
- C. The service enclosure shall meet the requirements of PG&E, and shall conform to Section 86-1.02, "Regulations and Code," of the Caltrans Standard Specifications. The enclosure shall be factory pre-wired and tested to meet NEMA 3R standards. A copy of the wiring diagram for the integrated system shall be enclosed in plastic and mounted inside the enclosure. Name plates shall be provided for each control component. The name plates shall be phenolic, black background with white lettering except the main breaker, which shall be red with white lettering. All name plates shall be fastened in the enclosure by screws. I.D. numerals as shown on Standard Detail ST-14A, "Standard Street Light," shall be used to show the address for the meter below the meter window or the front of the enclosure.
- D. The traffic signal service enclosure shall have a separate disconnect for the traffic signal, safety lighting, and sign lighting circuits. Separate disconnects shall be provided for any other separate circuit, such as street lighting or irrigation systems, when shown on the plans. Lighting contactors shall be mercury displacement type conforming to the functional and operational requirements of

Section 86-6.07B(2), "Contactor," of the Caltrans Standard Specifications. The top half of the service cabinet shall be equipped with 19" rack mountable rails.

- E. Painting shall conform to the provisions in Section 86-2.16, "Painting," of the Caltrans Standard Specifications.
- F. It shall be the responsibility of the CONTRACTOR to coordinate a field meeting with representatives from PG&E and notify the City inspector to ascertain the exact service connection point prior to beginning work.

2.9 UNINTERRUPTIBLE POWER SUPPLY (UPS) – BATTERY BACKUP SYSTEM (BBS)

- A. A system for a fully functional BBS shall operate LED, incandescent or any combination of both lighting technologies for a period of at least two hours and run an additional two hours (minimum) on Red Flash only. The UPS/BBS shall have a minimum Power Rating of 1.1 KVA (1100 Watts). BBS shall be **Tesco 1400XLwith Ethernet Interface** or approved equal.
- B. Individual batteries shall be easily replaced and commercially available off the shelf. Batteries shall be extreme temperature, deep cycle, sealed prismatic lead-calcium based AGM/VRLA (Absorbed Glass Mat/ Valve Regulated Lead Acid) batteries. Recharge time for the battery, from protective low cutoff to 80% or more of full battery charge capacity, shall not exceed twenty (20) hours.
- C. Maximum transfer time due power outage shall be 150 milliseconds.
- D. Batteries shall be certified (by the manufacturer) to operate normally in harsh conditions (-25C to +74C and 20% to 95% humidity).
- E. Battery output voltage shall be 110 VAC and 125 VAC, pure sine wave output, $\leq 3\%$ THD, 60Hz ± 5 Hz.
- F. BBS shall bypass the utility line power whenever the utility line voltage is outside the following voltage range: 100VAC to 130 VAC (± 2 VAC).
- G. BBS shall be equipped to prevent a malfunction feedback to the cabinet or from feeding back to the utility service.
- H. Batteries shall be provided with appropriate interconnect wiring and corrosion resistant mounting trays and/or brackets appropriate for the cabinet into which they will be installed.
- I. Battery interconnect wiring shall be via modular harness. Batteries shall be shipped with positive and negative terminals pre-wired with red and black cabling that terminates into a typical power-pole style connector. Harness shall be equipped with mating power-pole style connectors for batteries and a single, insulate plug-in style connection to inverter/charger unit. Harness shall allow batteries to be quickly and easily connected in any order and shall be keyed and wired to insure proper polarity and circuit configuration. Battery terminals shall be covered and insulated so as to prevent accidental shorting.
- J. Batteries shall have a warranty for full replacement for two (2) years from the date of installation.
- K. The Complete UPS system including batteries shall fit inside the Type III service cabinet with the required PG&E equipment. The Type III service enclosure shall be specifically designed for the UPS/BBS with batteries, as required for the specified run time, and equipped with photoelectric unit mounted inside the cabinet. The service enclosure shall be painted with graffiti-resistant paint to match the controller cabinet color. Painting shall conform to the provisions in Section 86-2.16, "Painting," of the Caltrans Standard Specifications.

- L. All necessary hardware for mounting (shelf angles, rack, shelving, harness, etc.) shall be included in the bid price of the UPS.
- M. UPS shall be easily installed and replaced (complete turnkey system with all necessary hardware) and shall not require any special tools for installation.
- N. UPS shall include a resettable front-panel event counter display to indicate the number of times the UPS was activated and a front-panel hour meter to display, the total number of hours the unit has operated on battery power.
- O. UPS inverter module shall include a serial port allowing field programmability of input/output voltage values, self-testing, communication and diagnostics. Software to retrieve data, troubleshoot and program the UPS system shall be ASCII format and be included as a part of the system.
- P. The UPS shall include a display (status monitor) and/or meter to indicate current battery charge status and conditions.
- Q. The UPS shall have an Ethernet port interface to allow user programming of certain operational parameters in order to ensure compatibility with the specific intersection control equipment as deployed. Remote diagnostics and unit modification shall be enabled between the battery backup system and the Traffic Operations Center.
- R. UPS Manufacturer shall provide a two (2) year factory-repair warranty for parts and labor on the UPS. Manufacturer shall provide 24 hour technical support via toll-free telephone service.
- S. UPS-BBS Manufacturer shall have field service technician trained in Traffic Control Technology present during signal turn on or activation of new BBS system to make certain the system is correctly installed, and Ethernet communication established between the field and the TOC.
- T. See Part 3 - Execution, Item 3.9 of this section for more details on the required installation of the UPS-BBS.

2.10 CONTROLLER ASSEMBLIES

- A. This specification sets forth the minimum requirements for a TS-2 Type 1 controller assembly with a 16 position load bay, wired for eight phases and fully operational with all the components and plug-ins, malfunction management unit, bus interface unit, cabinet power supply, load switches, flashers and detectors including the controller unit. The controller assembly shall meet all applicable sections of the NEMA TS-2 1998 Standards and Caltrans Standard Specifications and Standard Plans.
- B. The controller cabinet shall be a new fully-wired Type "P" unless otherwise specified, aluminum cabinet shall be painted Signal Grey - RAL 7004. All new controller cabinets in the "Downtown Core" shall be painted Olive Drab - RAL 6022. The cabinet shall conform to Caltrans Standard Specifications and Standard Plans. The interior of the cabinet shall be painted powder coat white. The cabinet door shall be fitted with a No. 2 Corbin lock, and stainless steel handle with a 16mm (minimum) diameter shaft and three-point latch. The lock and latch design shall not allow the handle to open the cabinet unless the lock is engaged. A locking auxiliary police door shall be included to allow limited controller function access to switch the traffic controller between normal and flash operation. The cabinet shall be "plug and play" ready with a 2070 lite controller using latest version of the Apogee Version NTCIP based Naztec Intersection Control Software. The cabinet layout shall be configured to provide adequate shelf space for all shelf-mounted required equipment (e.g., EVP rack, power supply, detector racks, BIU, video detection equipment, video monitor, MMU, video multiplexer, Ethernet Switch, and Controller). At least one **day before the scheduled "signal turn-on"**, the controller assemblies including video detection system, shall be fully wired, programmed, tested, and organized with no unnecessary loose cables or conductors. The wiring in the cabinet

shall be tie-wrapped and labeled in a neat/orderly fashion to the satisfaction of a City Traffic Signal technician.

- C. The controller shall be a Type 2070 with the latest version of the Apogee NTCIP based Naztec Intersection Control Software, and conforming to the following specifications:

Controller

The controller shall be the "lite" version Model 2070 ATC traffic controller per California Department of Transportation's (Caltrans) specifications, and shall conform to the Transportation Electrical Equipment Specifications (TEES) dated August 2002 or newer. The controller model and manufacturer shall be registered on the Caltrans Qualified Products List (QPL). The controller shall be equipped with the following modules:

- 2070-1B
- 2070-2B
- 2070-2NZ
- 2070-3B
- 2070-4B (VME Cage Assembly)
- 2070-7A
- 2070-8

Ethernet Port

The 2070-1B shall be equipped with an Ethernet port. The controller software operating on the 2070-1B shall be capable of utilizing the Ethernet port for data transfers. The operating system shall allow the user FTP and Telnet access via the Ethernet port.

SDLC Communications

The 2070 controller software shall be capable of communicating to TS-2 BIUs via SP3S on the 2070-2B. The 2070-2B shall be optically isolated.

2070-7A

The 2070-7A shall conform to the latest TEES specification, and shall be optically isolated.

Operating System

The 2070 controller software shall operate on the 2070-1B using Microware OS9 v3.2 or higher.

Software

The controller software shall be the latest version of the Apogee NTCIP based Naztec Intersection Control Software.

- D. The cabinet shall be supplied with two 8-position detector racks. The detector racks shall meet all applicable sections of the NEMA TS-2 standards. Detector input field panel shall have SRA-6LC surge arrestors installed for each loop input for lightning protection.
- E. The loadbay shall be wired for full 8-phase operation and shall accommodate a minimum of 16 loadswitch positions. The loadbay shall also be wired for a 16-channel malfunction management unit. All field wiring terminals for vehicle phases, pedestrians, and overlap outputs shall be present on the loadbay panel. Penn-Union Corp.'s copper "Solder-less" lugs or approved equal shall be used with the terminal strips in the loadbay where more than one forked connector needs to be landed to the terminal screw on the load-bay.
- F. The cabinet shall be provided with the following auxiliary equipment:
- Roll out powder coated stainless steel document drawer under the second shelf. This drawer shall have a hinged top cover, and it shall be of sufficient size and strength to hold a complete set of cabinet wiring drawings and equipment programming manuals for all

modules applicable to each cabinet. When the cover is closed, the drawer shall double a resting place for documents or a laptop computer.

- Thermostatically controlled ventilation fan system per Caltrans Standard Specifications.
 - LED lighting fixture mounted on the inside top of the cabinet near the front edge.
 - Police panel and technician test panel - This test panel shall be equipped with switches for each vehicle and pedestrian phases. The switch for each phase when activated shall trigger a call for the corresponding phase.
 - The cabinet shall include a splice terminal block, dedicated for the interconnect cable, and/or a fiber termination panel for fiber optic drop cable termination unless otherwise shown on the plans. The number of termination channels shall match the pairs of wires for at least a 12-pair interconnect cable.
 - The cabinet shall include empty shelf space to accommodate third party video detection processing units and Ethernet communications equipment.
 - The cabinet shall be equipped with fully wired Opticom phase selectors model M752, or approved equal. There shall be a termination panel to land Opticom interface cables from the detector units. No field wiring modification allowed unless approved by the Engineer.
- G. The cabinet shall be equipped with 2 Bus Interface Unit (BIU) cards for the load bays, plus 2 BIU cards for the detector racks. The BIU shall meet, as a minimum, all applicable sections of the NEMA Standards Publication TS2-1998. The BIU shall be rack-mountable and solid-state. The BIU unit shall be constructed with discrete component circuitry in order to allow repair and maintenance of the unit by use of standard tools. The BIU shall utilize machine tooled integrated circuit (IC) sockets for all IC's of 14 pins or greater, for ease of repair. One IC-BIU spare shall be provided with the cabinet. The use of BIU units utilizing surface mount technology (SMT) shall be acceptable, provided the vendor supply one spare unit for every two SMT-BIU supplied with the cabinet (i.e., if the cabinet comes with four SMT-BIUs, there shall be two spare SMT-BIUs).
- H. The cabinet power supply shall meet, as a minimum, all applicable sections of the NEMA Standards Publication No. TS-2 1998.
- I. The loadswitches shall be solid state, meet all applicable sections of the NEMA TS-2 standards. Units shall be the dual indicating I/O type, and shall have indicator lights that show both the input and output side of the loadswitch. Units shall utilize an extruded aluminum housing with cooling fins for proper heat dissipation. Units supplied shall be listed on the Caltrans Qualified Product List (QPL) under Model 200 Switch Packs.
- J. The flasher shall meet all applicable sections of the NEMA TS-2 standards. It shall be a Type III, dual circuit rated at 15 Amperes per circuit. LED or neon output indicators shall be utilized for each circuit. Units shall utilize an extruded aluminum housing with cooling fins for proper heat dissipation. Units supplied shall be listed on the Caltrans Qualified Product List (QPL) under Model 204 flashers.
- K. The magnetic flash transfer relay shall meet all applicable sections of the NEMA TS-2 standards, and Caltrans Standard Plans & Specifications §86-4.09C(6) "Heavy Duty Relays" and shall be **Magnecraft & Struthers-Dunn W12ACPX-2/W21ACPD-5 -Coil: 120V 50/60 Hz** or approved equal.
- L. The number of inductive vehicle detector channels provided shall match the number of detector lead in cables shown on the plans, plus 2 additional 2-channel detector units as spares. All detectors shall be configured as a rack mounted printed circuit board for insertion into a NEMA TS-2 detector rack. Detector units shall be in full compliance with NEMA standards TS-2-1998. Detectors shall be two-channel programmable with front LCD display. Detectors shall be EDI Oracle/2, Reno A&E Model C, or approved equal.
- M. The MMU shall meet all applicable sections of the NEMA Standards Publication No. TS2-1998. The MMU shall be shelf-mountable, sixteen channel solid-state with an RS-232 communications port (or Ethernet Port if available) and data cable. The MMU card shall be programmed/prepared to match

the intended signal operation of the intersection as shown on the plan. The MMU shall be ready to transmit event log data to the City's Streetwise ATMS Central Software via controller communications. The MMU shall log and store three report categories:

- Indications, power fluctuations, cycles missed, and power outages
- Past twenty conflicting conditions
- Event trace of the past twenty events recorded in .01-second resolution. This report is required to display conditions, which led to the conflicting condition.

The MMU shall be a Naztec MMU-516, or approved equal.

- N. All cabinet wiring shall be incorporated into one schematic drawing. Each cabinet shall be provided with three schematic drawings **specific** for the cabinet to be used in this specific project. Traffic signal construction plan shall also be submitted. Drawings shall indicate the intersection name and phasing. Absence of the required drawings could result in the rejection of the entire controller assembly. Cabinet testing will not proceed until the required drawings are submitted. Operational/repair manuals for each component and plug-in shall be provided with each cabinet.
- O. Prior to delivery, each controller assembly shall be tested by the supplier as a complete unit with a 2070 controller under signal load for a minimum of 24 hours. Each assembly shall be delivered with a signed checklist detailing the results of the test performed on the controller assembly. The cabinet shall be "plug and play" ready with a 2070 lite controller using the latest Apogee Version NTCIP based Naztec Intersection Control Software.

After delivery, the City will conduct a separate testing of the cabinet. If the City requires technical support during its testing period, the cabinet supplier shall provide on site technical support within 48 hours after the City makes the request.

The City of Livermore reserves the right to reject a controller assembly covered by these specifications if the assembly is found to be defective within a sixty (60) day period after shipment or if the controller assembly fails any performance test.

- P. A factory certified representative from the manufacturer shall be on-site during signal pre-turn on and turn-on for support. The factory representative if requested by the City shall assist in having the cabinet fully operational as indicated on the intersection drawings and this specification.

The supplier shall provide a maximum of four hours of technical training for City Staff within four weeks after cabinet delivery. The training session should at least include a discussion on the differences between TS2 and TS1 cabinets, identify components unique to the TS2 cabinets, and cover the troubleshooting and testing of the TS2 controller cabinet.

- Q. The controller assembly including all the electronic components shall be warranted by the manufacturer against mechanical and electrical defects for a period of 1 year. The manufacturer's warranty shall be supplied in writing with each cabinet and unit within the cabinet.
- R. The supplier shall correct any defects in design, workmanship or material during the warranty period at no cost to the City of Livermore. All cost of labor, parts and transportation to and from the vendor shall be borne by the vendor for the duration of the warranty period. The vendor shall provide all revisions to any equipment furnished under these specifications, at no cost to the City of Livermore.
- S. Necessary communications cables shall be installed to allow MMU communications with the 2070 controller, other Ethernet devices, and the Traffic Operations Center.
- T. See Section 2.16 "Inductive Loop Detectors" for information regarding video and loop detection operations during fog and other inclement weather conditions.
- U. Minor holes left on an existing controller cabinet due to the removal of equipment (e.g., an attached Type II service is removed) shall be repaired by using industry standard metallic hole plugs. The

plug shall be rust resistant, and pliable sealing compound shall be used between the metallic hole plug and the cabinet to prevent water, dust, and dirt from entering the cabinet. The resulting outside surface of the repaired cabinet shall be smooth so as not to cause injury.

2.11 MODULATED SIGNAL DETECTION SYSTEM

- A. The modulated signal detection system shall be able to interface with the CITY'S "**Opticom**" detection system as manufactured by **3M**. The controllers shall be equipped with internal circuitry to provide programmable channels of emergency vehicle preemption. The detector shall have a minimum range of 2500 feet.
- B. The modulated signal detection system shall consist of "**Opticom**" phase selector model M752; "**Opticom**" detector model 721 for 1-channel or 722 for 2-channel detection; and "**Opticom**" interface cable model M138, or approved equal.
- C. The controller cabinets shall be wired with a "D" connector or special function cable to provide all necessary controller connections for emergency vehicle preemption. The phase selectors or discriminators shall be wired to provide emergency vehicle preemption for the emergency vehicle phases as shown on the Drawings.
- D. Necessary communications cables shall be installed to allow "**Opticom**" communications with the 2070 controller and the Traffic Operations Center, if applicable.

2.12 EDGE LIT LED STREET NAME SIGNS

If required on the plans Edge Lit LED street name signs shall:

- A. Edge-Lit LED street name signs (SNS) shall conform to Section 86-6.065 "Internally Illuminated Street Name Signs" of the Caltrans Standard Specifications. Bullet item 5 in Section 86-6.065 shall be amended to say "Signs shall be the LED Type".
- B. Edge-Lit LED SNS installed on signal mast arms shall be the LED type per the Project Plans and these Specifications.
- C. Edge-Lit LED SNS shall operate maintenance-free for over 50,000 hours, with no ballasts to replace.
- D. The technology consists of LEDs mounted along the top and bottom edge of the sign, concealed in the frame. The Edge-Lit sign shall use high-flux LEDs.
- E. Edge-Lit Light shall be emitted vertically from the top and bottom through a clear acrylic sheet and refracted outwards horizontally through the sign legend.
- F. Edge-Lit technology shall allow for an ultra-slim, unobtrusive frame that can be mounted in any arrangement. Edge-Lit SNS mounted shall be mounted on the Signal Mast Arm unless otherwise noted. Edge-Lit SNS signs shall be double sided signs installed using an underhang mounting per the manufacturer's specifications.
- G. Edge-Lit LED SNS shall be White on a standard MUTCD Color 1177 (Green) background. Edge-Lit LED SNS installed in the "Downtown Core" shall be standard MUTCD Color 1177 (Green) on a White background. All SNS lettering shall meet minimum MUTCD requirements.
- H. The Edge-Lit LED SNS shall be the **Carmanah Edge-Lit LED SNS Model 409** or approved equal.

2.13 VEHICLE SIGNAL FACES AND SIGNAL HEADS

- A. Vehicle signal faces and signal heads shall be in conformance with Section 86-4, "Traffic Signal Faces and Fittings" of the Caltrans Standard Specifications and as shown on the Drawings.
- B. Signal section housing shall be metal type and shall have 12-inch sections. Signal housings and mounting hardware shall be painted gloss black, except in Downtown Core where they shall be painted Olive Drab (SC1TX/RAL6022), and electrically powder coated. The backplates for mast arm mounted heads shall be ventilated. All backplates shall be such that they can be removed and reinstalled without requiring the removal of the traffic signals. Signal head visors shall be tunnel type.
- C. The second sentence in the third paragraph in Section 86-4.04, "Backplates," of the Caltrans Standard Specifications is amended to read:

Sections shall be joined using 1) aluminum rivets and washers painted or permanently colored to match the backplate, or 2) No. 10 machine screws with washer, lock washer and nut, painted to match the backplate.

- D. All vehicle signals shall be **Dialight ITE Compliant "X" and "XL"** 12-inch LED indications or approved equal and furnished by the DEVELOPER/CONTRACTOR. This specification LED modules to be used in place of the incandescent lamp, reflector, socket, gasket, and lens assembly of the vehicle signal sections. Vehicle type LED modules shall fit in all standard, incandescent vehicle traffic signal housings. Each module shall also incorporate a printed circuit board inclusive of all of the LEDs and required circuit components, 36 inch 16 AWG wire leads with strain relief and spade terminals, a rigid housing for protection in shipping, handling and installation, and a one piece neoprene gasket. *Screw-in* type products are not allowed for vehicle signals.
- E. All LED shall meet the latest ITE specifications and current Caltrans standards and measurement criteria for LED traffic signal modules, and shall conform to the following specifications:

LED (Light Emitting Diode) Traffic Signal Modules - Specifications

The following specification shall apply to all LED modules unless otherwise specified.

General Description

Ball type signals shall utilize the *LumiLeds* (1) light engine as their source of illumination.

Lenses for ball type modules shall be made of ultraviolet stabilized polycarbonate, and incorporate facets that serve to enhance the optical efficiency of the LED traffic signal module. Individual *lens-lets* are specifically not allowed. The ball type signals shall incorporate an inner lens that is sealed to the lamp housing, and serves to collimate the light emitted by the *LumiLeds* (1) light engine. An outer lens shall also be incorporated, that serves to focus the collimated light, so as to meet ITE intensity and distribution standards. Additionally, the LED shall almost perfectly, approximate to the motorist, the appearance of an incandescent traffic signal. This means that the face of the ball LED lamp shall appear to the motorist as nearly totally uniform in illumination, and have a wide viewing angle that makes it suitable for installation on wide boulevards or single-tethered span wire. This also means that it shall not be apparent that LEDs are used as the light source for the traffic signal ball. The external lens surface for all vehicle signals shall be smooth, with no raised features, so as to minimize the collection of dirt, diesel smoke, and other particulate contaminants, and to facilitate periodic cleaning. External lens facets are not allowed. The lens shall be keyed to the housing of the LED signal module to insure the proper orientation and to avoid possible rotation during any handling. External lenses shall be hard-coated in compliance with Caltrans specifications.

The LEDs shall be mounted and soldered to a printed circuit board. The LED signal module shall be watertight when properly installed in a traffic signal housing. The LED signal module shall

utilize the same mounting hardware used to secure the incandescent lens and gasket assembly, and shall only require a screwdriver or standard installation tool to complete the mounting. The LED signal module assembly shall weigh less than 5 pounds. For vehicle signals, the incandescent lamp sockets and reflectors shall be removed from the signal head housings. So as to minimize possible maintenance problems, the LED lamp module may not protrude into the signal visor area more than three-quarters of an inch in depth.

The housing of the LED signal module shall be marked 'TOP' to designate the proper orientation of the LED signal module in the traffic signal housing. The housing of red LED ball type traffic signal modules shall utilize a *partial, embedded and integral metal layer*, in its design and construction. Manufacturers part number, date code, and electrical characteristics of the LED signal module shall be visible on the rear of the assembly. A label shall be affixed to back of the all ball type modules, that certifies their complete compliance with the latest ITE VTCSH, Part II specification for LED traffic signal modules.

The LED traffic signal manufacturer shall be ISO 9001 certified.

Optical

The light intensity and distribution from red LED signal modules shall as a minimum, meet the July, 1998 ITE VTCSH Part II, and current CALTRANS standards and measurement criteria for LED traffic signal modules. Test data to verify the performance for red and green ball signals as meeting the July 1998 ITE VTCSH, Part II intensity requirements @ 74 degrees Centigrade, shall be supplied from either:

Lighting Sciences
7630 East Evans Road
Scottsdale, AZ 85260

ETL Testing Laboratories
3933 US Route 11
Cortland, NY 13045-0950

or, other certified **independent** test lab. The light output of all LED vehicle signal modules shall meet ITE specifications for chromaticity.

The LEDs shall be connected in series parallel strings. No more than 1% of the total luminosity of the entire signal module may be lost in the event of a single string failure. For red LED ball type signals, the failure of a single LED shall cause loss of light from only that LED. No loss of light output from the complete module assembly shall occur as a result of a single LED failure in a red LED ball lamp.

The control circuitry shall prevent the current flow through the LEDs in the off state to avoid any false indication as may be perceived by the human eye, during daylight and *evening* hours. The LED traffic signal module shall be operationally compatible with NEMA TS - 1 and NEMA TS - 2 *conflict monitoring* parameters. The intensity of the LED signal module shall not vary by more than 10% over the allowable voltage range as specified in the electrical section below.

Red balls shall maintain required intensity, as defined by the July, 1998 ITE VTCSH, Part II intensity standards for LED traffic signal modules, over the temperature range of -40 degrees centigrade to +74 degrees centigrade, at 120 volts A.C., when new, and also after 3 years.

Electrical

Power factor shall be 90% or greater, at nominal rated voltage, at 25°C, after 60 minutes of operation. Total harmonic distortion (THD) shall be less than 20% at rated voltage, at 25°C.

All LED traffic signal modules shall be in compliance with FCC noise regulations.

The red LEDs shall utilize exclusively AllnGaP technology, either AS (Absorbing Substrate) or TS (Transparent Substrate), and shall not exhibit degradation of more than 30% of their initial light intensity following accelerated life testing (operating at 85 degrees C and 85% humidity, for 1000 hours). AlGaAs technology is not acceptable.

The LED signal modules shall be connected directly to line voltage, **120 Volts AC nominal**, and shall be able to operate over the voltage range of 80 VAC to 135 VAC.

The 8" and 12" red ball units shall consume no more than a nominal 7 and 10.5 watts respectively, at 120 VAC, at 25 degrees centigrade. Maximum power consumption shall not exceed 9 and 12 watts respectively, at 120 VAC, at 25 degrees centigrade.

Red arrow type LED traffic signal modules shall be temperature-compensated so as to maintain intensity at elevated temperatures. Red arrow type LED traffic signal shall be tested and documented by CALTRANS as being in compliance with CALTRANS intensity standards for red arrows at elevated temperatures.

Transient voltage suppression rated at 1500 watts for 1 millisecond and fusing with a maximum rating of 2 amps shall be provided to minimize the effect and repair cost of an extreme over voltage situation or other failure mode.

WARRANTY

All LED traffic signal modules supplied shall be warranted for 5 years against manufacturing defects.

Red ball and red arrow traffic signal modules shall be performance warranted to be in compliance with July, 1998 ITE VTCSH, Part II, and CALTRANS minimum intensity standards for LED traffic signal modules, at 74 degrees centigrade, for a period of three (3) years.

2.14 PEDESTRIAN SIGNALS

- A. Pedestrian signals shall be in conformance with Section 86-4.06 "Pedestrian Signal Faces" of Caltrans Standard Specifications.
- B. Pedestrian LED shall be 16" x 18" Full Hand/Fullman. The Countdown Module shall be standard for pedestrian LED signals. Alternate pedestrian LED signals shall be approved by the Engineer. The displayed messages shall be "UPRAISED HAND" and "WALKING PERSON" symbols. The unit "counts down", or exhibits to the pedestrian a digital numerical display, as well as the Caltrans international graphic display, to communicate how much time remains to clear the intersection. The units shall have two optional operational modes; total countdown and clearance count down. The units shall be set to clearance count down unless otherwise directed by the project engineer. The units shall be capable of "learning" automatically the walk time interval and the pedestrian clearance intervals whenever pedestrian timing changes are made. The housing shall be die cast from a one-piece corrosion-resistant aluminum alloy. Additionally, the LED display shall almost perfectly, approximate to the pedestrian, the appearance of an incandescent pedestrian signal, or the UPRAISED HAND and WALKING PERSON symbols shall be LED filled. Outline of the symbols shall not be acceptable. The count-down display shall utilize Double LED rows.
- C. The housing shall be die cast from a one-piece corrosion-resistant aluminum alloy. The housing door frame shall be hinged to the housing by stainless steel pins and hinge lugs integrally cast in the housing and door frame. Pedestrian signal housings and mounting hardware shall be painted gloss

black, except in Downtown Core where it shall be painted Olive Drab (SC1TX/RAL6022), and electrically powder coated.

2.15 PEDESTRIAN AND BIKE PUSH BUTTONS

- A. Pedestrian and bike push buttons shall conform to the provisions in Section 86-5.02, "Pedestrian Push Button Assemblies," of the Caltrans Standard Specifications and this Section.
- B. Pedestrian and bike push button frames shall be Type B with appropriate signs. Pedestrian push button frames and switch housing shall be painted gloss black, except in Downtown Core where it shall be painted Olive Drab (SC1TX/RAL6022), and electrically powder coated.
- C. Push buttons signs shall be installed using theft-proof screws **PDL, Pro-Tech't machine screws, or equal**. An installation tool shall be furnished to the CITY by the DEVELOPER/CONTRACTOR.
- D. The switching unit shall be **Synchronex, part No. ADA-2; or equal**. The switching unit shall be a precision snap-acting type, single pole, single throw unit, pressure type terminals, and rated at 120-volt AC. The switching unit shall be UL listed. The switching unit shall be such a size as to permit recessed mounting in existing standard Type B frame without any modifications to either unit.
- D. The actuator shall be conical in shape with cone extending 7/16-inch to 1/2-inch beyond the bezel of the switch housing, and shall be 2 inches in diameter.
- E. Pedestrian push buttons installed on traffic signal poles located in the sidewalk shall be within 5 feet of the adjacent curb ramp. Pedestrian push buttons installed on traffic signal poles located behind the sidewalk shall be within 1 1/2 feet of the back of sidewalk. If a traffic signal pole cannot meet either of the above criteria, the associated pedestrian push button shall be installed on a separate pedestrian push button post.
- F. The pedestrian and bike push buttons shall comply with the Americans with Disabilities Act (ADA). In the event that a conflict exists between the ADA guidelines and City Specifications, the ADA guidelines shall take precedent.
- G. For **new signal installation** and where Accessible Pedestrian Signal (APS) is required, the 2" audible push buttons shall be integrated with the APS and vibrotactile features. The APS compliant pedestrian push button shall have a rated life of 100 million (minimum) activations and shall:
 1. Consist of from 2-12 push button stations (maximum of 3 per phase) controlled by a single base unit at/in the traffic control cabinet.
 2. System must be able to provide the following audible features:
 - A locating tone
 - 5 walk sound choices (field selectable)
 - 3 Ped-clearance sound choices (field selectable)
 - Direction of travel (as standard feature with extended push)
 - Information message (custom feature with extended push)
 3. All audible sounds must emanate from push button station.
 4. Each audible feature must have independently settable minimum and maximum volume limits.
 5. All sounds must automatically adjust to ambient noise levels over a 60 dB range.
 6. All sounds for all push button stations must be synchronized throughout the intersection to reduce noise clutter.
 7. System must be able to provide audible countdown during ped clearance phase.
 8. Push button stations must require only two wires coming from the traffic control cabinet for each phase / crosswalk.
 9. Each push button station must have a 2" button with a tactile raised directional arrow on the button.
 10. The arrow must be able to be changed to one of four directions.

11. The arrow/button must vibrate during the walk period, following a button push.
12. Push button station frame shall be made of cast aluminum with mounting holes to hold a 5"x7¾" or larger pedestrian sign.
13. All volumes and optional features are to be settable at the intersection from a single push button station (Global updating).
14. System must be able to mute sounds on all crosswalks except activated crosswalk (selectable feature).
15. System must be able to have multiple language capability, selectable by user.
16. System shall be able to play emergency preemption message.
17. System shall be able to self test and report any faults to traffic controller.

The APS compliant pedestrian push button shall be the **POLARA 2-wire Navigator** or approved equal.

2.16 INDUCTIVE LOOP DETECTORS

- A. Detectors shall conform to the provisions in Section 86-5, "Detectors," of the Caltrans Standard Specifications and this Section. Detector handholes shall be Type A. Type E loop detectors 6 foot in diameter may be installed in lieu of Type A loops. All front loop detectors shall be Type D. When front loop detectors are used to supplement video detection, Type D loops shall be used.
- B. Sensor units shall be **Detector Systems Digital Loop Model 910, or equal.**
- C. Loop wire shall be Type 1 or Type 2. Loop detector lead-in cable shall be Type B or Type C. No more than four 6 foot by 6 foot loops shall be connected to each sensor unit. No splices are permitted in detector lead-in cables.
- D. The CONTRACTOR shall identify loop wires by lane number, loop number, and start/finish using tie raps and permanent marker.
- E. Where detector lead-in cables are connected to the terminal strips in the controller cabinet, the pressure terminal connectors shall be soldered to the detector lead in cables.
- F. Hot-melt rubberized asphalt sealant shall be used to fill slots in pavement when installing loops.
- G. When inductive loop detectors are used in conjunction with video detection cameras, the traffic signal controller cabinet shall be wired so that when fog or other weather conditions cause the video detection equipment to enter into "fog" or "recall" mode, video detection calls will be isolated and the intersection will run solely on inductive loops.

2.17 VIDEO DETECTORS

This section describes the requirements for providing a complete Video Detection System. The video detection system shall be the **Autoscope Rack Vision Terra** or **Iteris Vantage Edge 2 with RZ4A camera** or approved equal unless otherwise specified on the plans. The system shall be capable of providing presence vehicle detection at the intersection. The video system shall be capable of monitoring all vehicles on the roadway. It shall be a color video detection system and streams MPEG-4 or H.264 and Motion JPEG video over a common Ethernet connection to a laptop at the cabinet or at the Traffic Operation Center. If a video detection system exists at an intersection requiring modifications, and that video detection system is not designated for removal, the CONTRACTOR shall provide a compatible system at that intersection unless otherwise directed by the project plans and these specifications. Any new video detection device shall be capable of seamless integration with other existing video detection system in the cabinet and with existing Traffic

Operations Center software and hardware. Under no circumstance shall the CONTRACTOR install a video detection system that is not compatible with existing hardware and software.

Overview

Acceptable systems include that of any manufacturer, provided such equipment meets the qualifying specifications identified herein. Using standard image sensor optics, the system shall be able to detect vehicle presence with 98% accuracy under normal conditions (days and nights).

All items and materials furnished shall be new, unused, current production models installed and operational in a user environment and shall be items currently in distribution. The detection algorithms shall have a proven record of field use at other installations for at least three (3) years of service i.e., not including prototype field trials prior to installation.

General

These video detection specifications describe the minimum physical and functional properties of a video detection system. The system shall be capable of monitoring all vehicles on the roadway. The entire video detection system shall consist of the following:

- Video Image Processing unit.
- Environmentally sealed Video camera(s) with IR filter, enclosure and sunshield.
- Surge suppressor.
- A switching device and cabling shall be installed to allow viewing of up to 4 cameras in the cabinet monitor without changing cables in the cabinet, and allow remote configuration from the Traffic Operations Center.
- All cabling and mounting hardware.
- Ethernet port to allow IP video and data transmission and remote configuration of all cameras from the Traffic Operations Center.
- All other necessary equipment for operation.

The system shall be fully compatible for installation in a NEMA type TS1 or TS2 traffic controller cabinet or in a Caltrans 332 traffic controller cabinet if applicable.

The controller cabinet shall be wired for a Video Detection System with appropriate number of cameras and cables as required in each specific project, mounted according to the manufacturer's specifications for each direction of vehicular travel. The supplied equipment must meet the following requirements:

1. The Video Detection System shall be an above ground vehicle detection system that utilizes machine vision when interfaced with standard monochrome or color CCD cameras to provide complete intersection and roadway detection.
2. The Video Detection System shall provide a minimum of four camera inputs for vehicle detection and an Ethernet interface card to transmit video and data to the Traffic Operations Center. All cables shall be provided and wired in the controller cabinet. All connectors and hardware must also be supplied for the required number of camera operation.
3. Each Video Detection System will include, as a minimum, color cameras for each approach requiring video detection. Camera resolution, image size, and lens angle will be determined by the manufacturer based on optimum system performance. Each camera shall include heater, sun shield and mounting brackets, and have at least twelve user programmable detection zones.
4. The Video Detection System shall provide quick and easy configuration and setup of detection zones at the intersection shall be done by using a standard computer mouse as pointing device, and a graphical interface built into the video processor and displayed on a video monitor, or using

- a "Wizard" during initial configuration but can be modified using standard mouse with the video monitor.
5. All delay and extension functions for an approach must be performed within the processing element of the video unit.
 6. The units must have the capability of detecting vehicles at a minimum distance of 300 feet from the stop bars of each approach.
 7. The video detection system shall be wired and programmed such that during fog conditions, an alternate Max Green Timing can be used.
 8. The Video Detection System shall have remote access capability ENABLED to transmit video and detector information to the Traffic Operation Center (TOC) unless the intersection is not connected to the TOC. The Video Detection System shall have the capability to remotely reconfigure detection zones, access, logging and statistics, and transmit video via twisted pair, coaxial cable, and fiber optic interconnect via an external communication port. The communications port shall be Ethernet (IP) enabled and accessible with proprietary software and/or a standard internet browser.
 9. All software and hardware, for installation, operation, and maintenance shall be supplied along with necessary technical support upon setup. A minimum of 12-month technical/field support period, and updated software revisions shall be provided to the CITY's staff at no cost. Also, training by the manufacturer shall be provide at the convenience of CITY staff.
 10. The Video Detection System shall utilize standard 24 volt logic signal outputs to interface with NEMA TS1/TS2, 170/179, 2070, or 2070N controllers.
 11. All equipment schematics and technical material used to completely service the equipment must accompany any equipment supplied to the CITY.
 12. A factory representative shall be present during (a) initial setup, to install cabinet equipment, provide initial setup of detection zones; and (b) during the initial traffic signal turn-on to provide assistance as needed, and to ensure proper operation.
 13. Luminaire arm installations shall be installed on the luminaire arm, with the camera/video manufacturers recommended brackets. Camera luminaire brackets shall provide adjustments for both vertical and horizontal positioning of the camera. Camera attachments shall be designed to securely fasten the camera to the luminaire arm. If Signal mast arm installation is required on the plans, 6-foot risers shall be used with the installation. Miscellaneous hardware shall be stainless steel or galvanized steel.
 14. The video detection system shall be warranted against manufacturing defects in materials and workmanship for a period of two years from date of installation. The video detection supplier shall provide all documentation necessary to maintain and operate the system.
 15. Cabling shall be rated for outdoor use and shall comply with manufacturer's specification accommodating video, power, zoom, and focus control from the controller cabinet.
 16. Each controller cabinet shall be equipped with a color monitor rated for traffic signal cabinet use, compatible with the video detection system for viewing the video and setting up the detection zones. A switching device and cabling shall be installed to allow viewing of up to 4 cameras on the monitor without changing cables in the field and from the Traffic Operation Center.
 17. Each controller cabinet shall be equipped with terminals to allow focus and zooming from the cabinet. A device to provide focus and zooming shall be provided to the City.

18. The system shall be fully compatible for installation in NEMA TS1 or TS2 traffic controller cabinet or in a Caltrans 332 cabinet if applicable.
19. The system shall meet testing requirements in ambient operating temperatures from –35 to +55 degrees Centigrade at 0 to 95% relative humidity non-condensing.
20. Surge ratings shall be set forth in the NEMA TS1 and TS2 specifications of the standard specifications.
21. Serial communications shall be through an RS232 serial port. This port can be used for communications to a modem or laptop to upload/download detector configurations, count data and software upgrades.
22. Ethernet communications shall be through an RJ-45 port. This port will transmit streaming video and data from the video detection units to the Traffic Operations Center.
23. The environmental housing shall be an aluminum enclosure designed for outdoor CCD camera installations.
24. See Section 2.16 "Inductive Loop Detectors" for information regarding video and loop detection operations during fog and other inclement weather conditions.

Installation and Training

1. The supplier of the video detection system shall supervise the installation and the testing of the video equipment. A factory certified representative from the manufacturer shall be on-site during installation or relocation of existing system. The factory representative shall install, make fully operational, and test the system as indicated on the intersection drawings and this specification.
2. The video detection system shall be installed and programmed such that during fog conditions, an alternate Max Green Timing can be used. The Engineer will provide the alternate timing.
3. Necessary training shall be provided by the manufacturer as required by the contracting agency for its personnel to be proficient in the operation, setup, and maintenance of the video detection system. Instruction and materials shall be produced for up to 5 persons and shall be conducted at a location selected by the City. The City is responsible for travel, room and board expenses for its own personnel.

Warranty

The video detection system shall be warranted against manufacturing defects in materials and workmanship for a period of two years from date of installation. The video detection supplier shall provide all documentation necessary to maintain and operate the system.

2.18 LIGHTING

- A. Traffic signal lighting shall conform to the provisions in Section 86-6, "Lighting," of the Caltrans Standard Specifications and this Section.
- B. Luminaires shall be LEOTEK Green Cobra, or approved equal.
- C. Decorative luminaires shall be Lumec S56C1-90W49LED4K-ACDR-LE3-240-SFX-PH8-FN10-SC1TX/RAL6022 in the Downtown Core, and Lumec S55-65W49LED4K-ES-ACDR-LE3-120-SFX-HGS-PH8-BKTX elsewhere.

Description of Components for Lumec Luminaires:

Finial: Decorative cast 356 aluminum, mechanically assembled.

Hood: (ACDR), One-piece, seamless, pressure-molded impact-resistant (DR) acrylic globe having internal prisms with smooth external self-cleaning surface, permanently assembled to the globe.

Guard: In a round shape, this guard is made of four cast aluminum 356 decorative arms and one decorative ring. The guard is welded to the fitter.

Globe: (ACDR), One-piece, seamless, injected-molded impact-resistant (DR) acrylic globe having an inner prismatic surface with semi-prismatic house side shield and glare softening prisms on the street side. The smooth external finish offers self-cleaning properties. The globe is permanently sealed onto the access-mechanism.

Lamp: (Included), Composed of 49 improved performance white LEDs, 40w or 90w lamp wattage. Color temperature of 4000 Kelvin nominal, 70 CRI. Operating lifespan, 70 000 hours after which the system emits 70% of its original lumen output, all of those parameters are tested for 100% of light engines. Use of a metal core board ensures greater heat transfer and longer lifespan of the light engine.

Optical System: (LE2, LE3), I.E.S type II or III (asymmetrical). Composed of high performance collimators, optimized with varying acrylic beam angles to achieve desired distribution. System is rated IP66. Performance shall be tested per LM63 and LM79 (IESNA) certifying its photometric performance. Street-side indicated.

Heat Sink: Made of cast aluminum optimising the LEDs efficiency and life. Product does not use any cooling device with moving parts (passive cooling device)

Driver: High power factor of 90%. Electronic driver, operating range 50-60 Hz. **Auto-adjusting to a voltage between 120 and 277 volt AC, Class II**, THD of 20% max. Maximum ambient operating temperature from -40F(-40C) to 130F(55C) degrees. Certified in compliance to CUL requirement. Weather tightness rating IP66. Assembled on a unitized removable tray with Tyco quick disconnect plug resisting to 221F(105C) degrees.

The current supplying the LEDs will be reduced by the driver if the internal temperature exceeds 203F(95C), as a protection to the LEDs and the electrical components. Output is protected from short circuits, voltage overload and current overload. Automatic recovery after correction.

Surge Protector: LED Driver 3 poles surge Protectors that protect Line-Ground, Line-Neutral, and Neutral-Ground in accordance with IEEE / ANSI C62.41.2 guidelines.

Access-Mechanism: A cast A360.1 aluminum technical ring with latch and hinge. The mechanism shall offer toolfree access to the inside of the luminaire. **The Photoelectric Cell can be independently oriented from the optical system.** An embedded memory-retentive gasket shall ensure weatherproofness.

Fitter: Cast aluminum A360.1 c/w 4 set screws 3/8-16 UNC. Fits on a 4"(102mm) outside diameter by 4"(102mm) long tenon.

Luminaire Options: (PH8), Photoelectric Cell, Twistlock Type c/w receptacle.

Wiring: Gauge (#14) TEW/AWM 1015 or 1230 wires, 6" (152mm) minimum exceeding from luminaire.

Hardware: All exposed screws shall be stainless steel with Ceramic primer-seal basecoat to reduce seizing of the parts. All seals and sealing devices are made and/or lined with EPDM and/or silicone.

Finish: Color to be **dark green (SC1TX/RAL6022)**. Application of a polyester powder coat paint. (4 mils/100 microns). The chemical composition provides a highly durable UV and salt spray resistant finish in accordance to the ASTM-B117-73 standard and humidity proof in accordance to the ASTM-D2247-68 standard.

Voltage: 240

Cast components: All cast aluminum components contains 0.2% copper or less.

Lamp Technical Information									
Lamps #	Rated life hrs. ¹	LED Manufacturer	CRI	Color Temperature ²	Initial Lumens	Wattage		Max System AC current: 120v	LED mA
						Lamp	System ³		
40W30LED4K	70,000	Philips Lumileds Rebel or Cree XP	70	4000K	3000	40W	45W	0.48A	400mA
40W49LED4K	70,000		70	4000K	3800	42W	47W	0.48A	285mA
60W30LED4K	70,000		70	4000K	4000	60W	68W	0.72A	600mA
65W49LED4K	70,000		70	4000K	5200	65W	72W	0.72A	428mA
90W49LED4K	70,000		70	4000K	6300	90W	102W	0.95A	571mA
105W79LED4K	70,000	Philips Lumileds Rebel or Cree XP	70	4000K	8200	105W	119W	1.2A	428mA
130W98LED4K	70,000		70	4000K	10400	130W	147W	1.4A	428mA
150W79LED4K	70,000		70	4000K	10300	150W	170W	1.7A	600mA
180W98LED4K	70,000		70	4000K	12600	180W	204W	1.9A	571mA

¹ Rated life represents the time it takes for the LED system to reach 70% of initial lumen output.
² On average.
³ System wattage includes the lamp and the LED driver.

- **How to calculate the lamp lumen per watt ratio:** In the above table and according to your choice of lamp, please note the initial lamp lumen value and divide this value by the lamp wattage. (Example: 40W30LED4K : 3000/40=75)
- **How to calculate the system lumen per watt ratio (LER):** First, visit our website at www.lumec.com and download the IES file (photometric file) of your selected Philips Lumec product . Then, use a photometric software to get the absolute system lumens value and divide by the system wattage. (Example: 40W30LED4K : Absolute system lumens / 45W = LER)

- D. The luminaires on standard street lights shall have photoelectric control facing north, unless otherwise noted on the project plans.
- E. Pole numbers for decorative lights shall be attached to a 2.5" x 15" x 0.020 aluminum plate and mounted on the pole by use of 1/16" rivets.
- F. Fuse holders for streetlights shall be located in the pole handhole at the bottom of the pole with 5 feet of conductor coiled in the handhole.

2.19 PHOTOELECTRIC CONTROL

- A. Photoelectric control shall be Type V for traffic signals and Type IV for standard street lights. Photoelectric units shall be installed inside the service cabinet.

2.20 INTERCONNECT

- A. The controller cabinet shall include appropriately sized terminal facilities for connection of the interconnect cable to the local controller. All required equipment and facilities for reliable communication with the master controller shall be provided. It shall be the CONTRACTOR's responsibility to establish communication between the local controllers and the central master controller unless otherwise indicated in this specification or on the plans.
- B. Each controller cabinet shall contain a sufficient number of terminals of appropriate size and type to terminate and/or splice the interconnect cable.

- C. Interconnect cable shall be 6 pair minimum for underground use, No. 20 twisted pairs each pair with shielding and solid core copper wire, unless otherwise shown on the plans.
- D. See fiber optics specifications under Section 2.6 - Conductors and Wiring.
- E. The CONTRACTOR shall be responsible for maintaining existing interconnect during construction. Any interruption of interconnectivity during the construction process due to CONTRACTOR activity shall be resolved by the CONTRACTOR within **72 hours** at the CONTRACTOR's expense. Failure to resolve may result to liquidated damages.
- F. Temporary twisted-pair (copper) interconnect splicing shall be allowed during construction for a maximum period of 60 days. Temporary splices of interconnect shall be insulated with heat-shrink tubing of the appropriate size and shall overlap the conductor insulation at least 0.6 inches. The overall cable splice shall be covered with heat-shrink tubing, with at least 1 1/2 inch of overlap of the cable jacket. Any alternate temporary splice method shall be approved by the Project Engineer.

2.21 ETHERNET SWITCHES AND COMMUNICATIONS

The Ethernet switch to be used for a specific project depends on the signal interconnect cable media (i.e., fiber optic or copper twisted pair) used in the project. See plans to determine if fiber optic or copper twisted pair is identified.

FIBER OPTIC CABLE

Where fiber optic installation is part of the project, the Ethernet Switch shall meet the following specifications:

- Provides a minimum of four 10/100 switched RJ-45 ports and three 100 Mb fiber ports
- Designed for un-heated / un-cooled "outdoor" applications. Conduction cooled, sealed case with no fans and no air vent openings
- Ambient operating temperature: -40° to 170° F (-40° to 75° C). Plenum rated
- Link-Loss-Learn feature for redundant LANs with industry standards
- Two 100 Mb fiber ports built in. Connectors shall be 20km single mode SC (female).
- Over 10 years MTBF
- AC-powered
- Meets IEC 61850 and IEEE 1613 Environmental Standard for Electric Power Substations
- DIN-Rail mounting
- A power supply unit shall be included with the Ethernet Switch

The CONTRACTOR shall provide the City with all applicable product documentation for configuration. If a switch is installed at existing drop of an intersection already utilizing a particular Ethernet Switch, the CONTRACTOR shall be responsible for providing the same make and model switch. The Ethernet Managed Switch for fiber optic use shall be the **RuggedCom RS 900-HI-P-C2-C2-C2-XX** or approved equal.

COPPER CABLE

Where copper signal interconnect installation is part of the project, the CONTRACTOR shall provide an Ethernet over Copper Bridge in the controller cabinet supporting Ethernet data and video communications between the Traffic Operation Center (TOC) communications servers and field devices located at the intersection, including (but not limited to) the traffic signal controller, Battery Backup System, Video Detection System, and Closed-Circuit Television Camera (CCTV). When multiple devices are present, the controller shall provide a field hardened switch to allow connectivity to the Bridge. The CONTRACTOR shall provide all necessary wiring and cabling to establish communications with these devices. All proposed communications cable shall be outdoor rated to operate between -40 degrees Fahrenheit and 158 degrees Fahrenheit. Communications cable shall be **CommScope Ultra II Enhanced Category 5e Outdoor Cable** or approved equal.

The Bridge shall meet the following specifications:

- Support a minimum of 9.2 Mbps on two twisted pair
- 10/100 BaseT LAN enabled
- Remote Management Capabilities, including remote unit diagnostics, VLAN tagging, bandwidth resource allocation, and alarm/email paging.
- Communicate up to 27,000 feet
- Two (2) RJ45 LAN Switch Ports
- One RS232 Serial Port (DB9 Female) or Console Port for unit diagnostics
- Tested to NEMA TS2-2003 Specifications
- 802.1d and 802.1q compliant
- IEEE 802.3 10BaseT
- 15,000 fps forwarding rate
- 10,000 MAC Address Table
- 1-year manufacturers warranty
- AC Powered
- LED Status indication lights

If the CONTRACTOR proposes a managed bridge, the CONTRACTOR shall provide the City with all applicable product documentation for configuration. If a bridge is installed at existing drop of an intersection already utilizing a particular Ethernet over Copper bridge, the CONTRACTOR shall be responsible for providing the same make and model bridge. The Ethernet over Copper bridge shall be the **Actelis MetaLight ML688** or approved equal.

2.22 CLOSED CIRCUIT TELEVISION (CCTV) CAMERA

The CONTRACTOR if required shall install a power over Ethernet (PoE) CCTV Network Dome Camera including all associated equipment such as mounting hardware and weatherproof housing per the project plans. The CONTRACTOR shall install necessary conductors, and communication wiring between the CCTV camera mounted on the signal pole or street light pole shaft and the traffic signal controller cabinet. The City will provide IP address for the CCTV camera. The CONTRACTOR shall work with the Engineer to determine exact mounting location of the CCTV camera on the pole. It shall be the CONTRACTOR's responsibility to make certain that the appropriate mounting screws/hardware are used such that the camera's viewing angle is unobstructed to the satisfaction of the Engineer.

The CONTRACTOR shall provide all necessary cables, and shall be responsible establishing communications from the CCTV to the Traffic Operations Center at City Hall. Included with the CCTV camera shall be any license required with the camera, and any software required at no charge to the City and shall directly interface with the City's traffic signal network of CCTV cameras. The CCTV camera shall deliver superior quality H.264 and Motion JPEG video in all lighting conditions and shall meet the following requirements:

Shutter	1 to 1/10,000 seconds
Min. Illum.	0.7 Lux (Color); 0.01 Lux (B/W)
Exposure	Auto
White Balance	Auto
Iris	Auto
Focus	Auto and manual
View Angle	1.7° - 57.8°
Focal Length	3.4 – 122.4 mm
F-number	1.4
Zoom ratio	36x Optical; 4x Digital; 144x Total
Pan Angle	360°
Pan Speed	360° per second
Tilt Angle	-90° to 0° (113° view range)
Tilt Speed	360° per second
Ethernet	10/100 Mbps Ethernet, (RJ-45)
I/O Terminals	4 Input/Output
Resolution	704 x 480 max
Compression	M-JPEG, H.264
Frame Rate	30 FPS
Protocols	TCP/IP, HTTP, FTP, SMTP
Weight	16 lbs. or less
Voltage Req.	Ultra High Power PoE
Power Cons.	50 W
Oper. Temp	-29° to 50° C
Dimensions	14" H x 11" W x 16" D
Rating	IP-66

The power over Ethernet CCTV shall be the **IVC PTZ-3330-NC66** outdoor dome camera or approved equal. All mounting hardware and outdoor housing for the CCTV camera shall be as per the CCTV manufacturer specification.

2.23 WIRELESS ETHERNET DEVICE

CONTRACTOR shall furnish and install power over Ethernet wireless Ethernet Mesh Networks that have dynamic, scalable, and cost effective solution equipment enabled with “network redundancy / expansion” that will ensure a robust network for future expansion, able to send/receive concurrent video, voice, and data linking various Intelligent Transportation Systems (ITS) infrastructure with the City’s traffic signal network and ultimately with the Traffic Operations Center (TOC).

The objective is to establish solid Ethernet communication link from the traffic signals back to the TOC at City Hall using wireless technology, potentially in combination with the City’s fiber optic network. It shall be the CONTRACTOR’s responsibility to establish solid communication between installed Ethernet field devices as part of the project and the TOC. A manufacturer’s representative shall be responsible in installing and programming the wireless system, and shall be present during signal turn-on to make sure the wireless system is fully operational.

The City will provide required IP addresses to establish VLAN and communicate with the City’s TOC. Included with the wireless system shall be any license required with system, and any software required at no charge to the City and shall directly interface with the City’s traffic signal network. The wireless Ethernet Mesh network shall be **Ruckus ZoneFlex™ 7731, Intuicom Nitro58** or approved equal.

At a minimum, the wireless provider or CONTRACTOR, shall complete the following tasks:

- Must perform Spectrum Analysis using a spectrum analyzer.
- Perform own site survey.
- Provide Path Calculations & link budget calculations.
- Must provide own bucket truck.
- Must identify a preferred installation location within the established area. Wireless antenna locations shown on the plans are schematic.
- Identify potential cost savings by utilizing existing infrastructure (i.e. adjacent fiber optic cable, adjacent wireless bridges, etc).
- Properly ground all radios and antennas.
- Install lightning suppression systems according to manufacturer specifications.
- Install proper weather proofing on complete system.
- All radios must be back-to-back tested according to manufacture specifications.
- Perform a minimum of four (4) hours of end user training for interested City Staff.
- Must have all proper Bonds and Insurance.
- Responsible for all necessary City Permits and Licenses.
- Provide two year support and Maintenance (phone support within 2 hours of call from City and provide on site support within 4 hours).

At a minimum, the equipment shall meet the following specifications:

- Shall operate using a single Power-over-Ethernet (POE) Cat-5e cable.
- Links must provide 99.999% reliability.
- Shall have external LED indicators to simplify antenna alignment
- Cables must be VSWR tested.
- Support 100 to 300 Mbps throughput
- Range of up to 10 miles.
- Support asymmetric user defined data transmission rates.
- Shall be able to operate in the 4.9 GHz (US Public Safety band)
- Security and Encryption
 - 128 bit, 256 bit AES keys (WPA2, end-to-end data)
 - MAC access control list
 - Radius Authentication
 - Digital certificates on nodes
- Traffic Prioritization
 - Quality of Service (QoS 802.1p)
- Wireless Interface
 - IEEE 802.11a/n
- Ability to configure 5, 10, 20 and 40 MHz
- Channel bandwidth
 - Dynamic Frequency Selection (DFS)
 - Transmit Power Control (TPC)
- Environmental Specifications
 - Operating temperature: -40°C to +60°C
 - Storage temperature: -40°C to +85°C
 - Humidity (non-condensing): 10% to 90%
 - Storage humidity (non-condensing): 5% to 95%
- Lightning Suppression: PolyPhaser and Transtector (or as recommended by wireless system manufacturer).
- CAT-5e Outdoor rated "Shielded" cable for radios.
- Network Ports
 - GigE 10/100/1000 Mbps Ethernet ports with weatherproof connectors, LED activity indicator
 - IEEE 802.3, 802.3u compliant

- CSMA/CD 10/100 autosense
- Ports 2, 3 PSE Power over Ethernet per 802.3af
- Enclosure
 - Cast aluminum NEMA-4X/IP66 enclosure
 - One weatherproof power connector
 - Weatherproof Ethernet connectors
 - System LEDs (power, status, mesh)
- Power
 - AC Input: 100–240 VAC, 50–60 Hz, 0.9 A
 - DC Input: 12 VDC +/-15%, 5 A
 - Ports 2 and 3: IEEE 802.3af compliant PoE (PSE), consumption
- Warranty
 - Hardware: one year limited warranty
 - Software: 90 days limited warranty
- The system shall be fully compatible for installation in NEMA TS1 or TS2 traffic controller cabinet, or in a Caltrans 332 cabinet if applicable.
- The System shall provide quick and easy configuration and setup using a standard computer or laptop and a graphical user interface.

2.24 INTELLIGENT TRANSPORTATION SYSTEMS (ITS) INTEGRATION

This section is meant to provide direction for future ITS device installation, which includes (but is not limited to) Closed Circuit Television Cameras, Wireless Ethernet devices, Changeable Message Signs, Interagency Communications devices, future IP enabled traffic signal control equipment, streaming video encoders/decoders, etc. When providing products that are not details in Sections 2.1- 2.23, the following general conditions shall apply:

- If a proposed ITS device already exists at other locations in the City, the contractor shall provide an identical device “or equal” unless otherwise directed by the project plans and these specifications. Any “or equal” device shall be able to seamlessly integrate with other existing ITS devices and with existing Traffic Operations Center software and hardware. Under no circumstance shall the contractor install a device that is not compatible with existing hardware and software.
- All equipment shall be installed by a technician certified by the manufacturer. The contractor shall provide necessary training on any devices installed as part of the project.
- If applicable, all ITS equipment IP Addresses shall be provided to the contractor by the City.
- When possible, all devices using IP technology shall utilize Power over Ethernet technology.
- All field devices shall be environmentally hardened to meet minimum cabinet temperatures ranging from 32-140 degrees Fahrenheit.
- All ITS devices shall be approved by the Project Engineer prior to installation.

2.25 RECTANGULAR RAPID FLASHING BEACON

DEVELOPER/CONTRACTOR shall furnish and install Rectangular Rapid Flashing Beacon (RRFB), which shall consist of two rapidly and alternately flashed rectangular yellow indications having LED-array based pulsing light sources, and shall be designed, located, and operated in accordance with the detailed requirements specified below. The RRFB shall be the **Carmanah SC315 Gen III, TAPCO RRFB-XL**, or approved equal. The system shall be solar powered unless otherwise noted on the plans.

1. Sign/Beacon Assembly Locations:
 - a. For any approach on which RRFBs are used, two W11-2 or S1-1 crossing warning signs (each with RRFB and W16-7p plaque) shall be installed at the crosswalk, one on the right-hand side of the roadway and one on the left-hand side of the roadway. On a divided highway, the left-hand side assembly should be installed on the median, if practical, rather than on the far left side of the highway. The signs shall have diamond grade reflectivity.

- b. An RRFB shall not be installed independent of the crossing signs for the approach the RRFB faces. The RRFB shall be installed on the same support as the associated W11-2 (Pedestrian) or S1-1 (School) crossing warning sign and plaque.
2. Beacon Dimensions and Placement in Sign Assembly:
 - a. Each RRFB shall consist of two rectangular-shaped yellow indications, each with an LED-array based light source. Each RRFB indication shall be a minimum of approximately 5 inches wide by approximately 2 inches high. Installation on each pole shall be bi-directional. Each direction can be adjusted to desired angle for maximum visibility to approaching traffic.
 - b. The two RRFB indications shall be aligned horizontally, with the longer dimension horizontal and with a minimum space between the two indications of approximately seven inches (7 in), measured from inside edge of one indication to inside edge of the other indication.
 - c. The outside edges of the RRFB indications, including any housings, shall not project beyond the outside edges of the W11-2 or S1-1 sign.
 - d. As a specific exception to 2003 MUTCD Section 4K.01 guidance, the RRFB shall be located between the bottom of the crossing warning sign and the top of the supplemental downward diagonal arrow plaque (or, in the case of a supplemental advance sign, the AHEAD plaque), rather than 12 inches above or below the sign assembly.
 3. Beacon Flashing Requirements:
 - a. When activated, the two yellow indications in each RRFB shall flash in a rapidly alternating "wig-wag" flashing sequence (left light on, then right light on). A small light directed at and visible day or night to pedestrians in the crosswalk shall be installed integral to the RRFB to give confirmation that the RRFB is in operation.
 - b. As a specific exception to 2003 MUTCD Section 4K.01 requirements for the flash rate of beacons, RRFBs shall use a much faster flash rate. Each of the two yellow indications of an RRFB shall have 70 to 80 periods of flashing per minute and shall have alternating but approximately equal periods of rapid pulsing light emissions and dark operation. During each of its 70 to 80 flashing periods per minute, one of the yellow indications shall emit two rapid pulses of light and the other yellow indication shall emit three rapid pulses of light.
 - c. The flash rate of each individual yellow indication, as applied over the full on-off sequence of a flashing period of the indication, shall not be between 5 and 30 flashes per second, to avoid frequencies that might cause seizures. It shall be MUTCD IA-11 compliant flash pattern.
 - d. The light intensity of the yellow indications shall meet the minimum specifications of Society of Automotive Engineers (SAE) standard J595 (Directional Flashing Optical Warning Devices for Authorized Emergency, Maintenance, and Service Vehicles) dated January 2005.
 4. Beacon Operation:
 - a. The RRFB shall be normally dark, shall initiate operation only upon pedestrian actuation, and shall cease operation at a predetermined time after the pedestrian actuation or, with passive detection, after the pedestrian clears the crosswalk.
 - b. All RRFBs associated with a given crosswalk (including those with an advance crossing sign, if used) shall, when activated, simultaneously commence operation of their alternating rapid flashing indications and shall cease operation simultaneously.
 - c. Pedestrian push buttons (PPB) used to actuate the RRFBs, shall have a pedestrian instruction sign with the legend PUSH BUTTON TO TURN ON WARNING LIGHTS should be mounted adjacent to or integral with each (PPB). The PPB shall be audible with voice message "**cross street with caution, vehicles may not stop**", and visual LED confirmation of device activation.
 - d. The duration of a predetermined period of operation of the RRFBs following each actuation should be based on the MUTCD procedures for timing of pedestrian clearance times for pedestrian signals.
 - e. A small light directed at and visible to pedestrians in the crosswalk shall be installed integral to the RRFB or push button to give confirmation that the RRFB is in operation.

Except as otherwise provided above, all other provisions of the MUTCD applicable to Warning Beacons shall apply to RRFBs.

5. User-Interface and RRFB System

The RRFB user interface and display for quick configuration and status monitoring shall allow for simple in-the-field set-up and adjustments without the need for additional device such as a laptop. Programming and adjustments shall be such that when programming any unit, the settings are broadcasted wirelessly and automatically to all units in the system. A minimum of four (4) selectable frequencies/channels shall be available such that other adjacent RRFB systems will not be interfering with each other. System operating temperature shall be -30°F to +140°F (-35°C to +60°C). It shall have ambient auto-adjust night dimming configuration.

6. Solar, Enclosure, and Battery Requirements

The enclosure shall be of minimal dimension discrete design housing the processor, all required electronics, and batteries mountable to a pole. The solar panels and power management required to power the system shall have rated usage of at least 300 cycles per day, 20 second activation with charged capacity minimum 25 days at rated usage (without charging). Batteries shall be standard sealed maintenance free and field replaceable. RRFB system requiring special proprietary batteries are not acceptable.

7. Mounting

Mounting of the RRFB system, including the required warning signs, and PPB with voice message & visual LED confirmation shall be per manufacturer's specification. Type 1B pole unless otherwise noted on the plans shall be used for new pole installation or per manufacturer's specification. If RRFB installation is on an existing streetlight pole, side mount pole solar mounting shall be used per manufacturer's specification. The bottom of the sign and RRFB assembly shall have a 7-foot minimum clearance from the sidewalk.

8. Warranty and Support

A manufacturer's representative shall be present during activation of RRFB system to make sure it is installed and programmed properly. RRFB Manufacturer shall provide 24 hour technical support via toll-free telephone service. Field technical support shall be at least 1 year. It is the Contractor's responsibility to arrange training for at least 2 City personnel. A minimum 3 year system warranty including batteries (non-prorated) is required. Manufacturer shall provide a minimum two (2) year factory-repair warranty for parts and labor.

2.26 VEHICLE SPEED FEEDBACK SIGN (Radar Speed Sign)

DEVELOPER/CONTRACTOR when required shall furnish and install solar powered Vehicle Speed Feedback sign (Radar Sign) system, which shall consist of diamond grade reflective signs, "YOUR SPEED" sign with LED display cluster display, R2-1 Speed Limit sign or SR4-1 (CA) sign, solar panel, controller module and enclosure, batteries, and mounting hardware. Signs shall conform to the latest CaMUTCD, Section 56, "Signs" of the Caltrans Standard Specifications and the Caltrans "Approved Sign Specification Sheets". A manufacturer's representative when requested shall be present in the field during initial activation and programming to make sure the system is fully operational. The Vehicle Speed Feedback sign shall be the **15" SpeedCheck by Information Display Company** or approved equal. The vehicle speed feedback sign shall meet or exceed the following requirements:



Vehicle Speed Feedback Sign (example)

General

1. Feedback sign meets FHWA, CAMUTCD requirements.
2. Feedback sign shall be 90 MPH (144 km/h) wind load rated.
3. The sign housing shall be a non-sealed, ventilated NEMA 3R type design.
4. Sign shall be FCC approved with no operating license requirements.
5. The sign shall operate normally in an environment of -40° F to 167° F, and humidity exceeding 90%.
6. The sign and its components include the battery cabinet and solar panel shall be water resistant to NEMA 3R. Internal components shall be easily accessible with removal of four or fewer external vandal-resistant fasteners.
7. Display shall be comprised of modular components that can be exchanged easily in the field without removal of the sign from the mounting post.
8. Static sign shall be retro-reflective white, dimension shall be 30" x 42"
9. The radar shall have a reporting accuracy of ± 1 MPH and shall be set to detect **approaching vehicles only**.
10. Display brightness control - Each sign shall include an Automatic Dim control setting that allows each sign to automatically adjust to light conditions. LED display shall have a minimum of 1.4 Candela.
11. Sign must not have direct sunlight issues and must be bright in all weather conditions.
12. SLOW DOWN Message: Warning message shall be embedded within the main display window as the speed display. The SLOW DOWN message shall be activated by the sign using the High Speed Flashing program or other program settings; separate SLOW DOWN display window and/or external sign shall not be accepted.
13. Speed Range and Display: Each sign shall be capable of detecting vehicle speeds ranging from 5 miles per hour to 99 miles per hour (equivalent or better).
14. Sign material and enclosure shall be .09" (2.29mm) aluminum. Outer surfaces of enclosure shall be coated with white UV resistant coating to minimize solar heat absorption.
15. Sign mounting hardware shall be of brass and/or stainless steel.
16. For field support, programmability, data downloads and diagnostics must be accessible via Bluetooth™ wireless link to a Windows-compatible notebook computer.

17. The gel cell battery shall include a 55AH or greater, 12 VDC, deep cycle; solar rated, sealed valve regulated, gelled electrolyte lead acid battery, and rated as non-spillable. Gel cells battery shall be located inside the NEMA 3R (or better) enclosure.
18. A single solar panel with appropriate wattage for the application shall be supplied, as industry-standard 12 V dc design with tempered glass cover. The power output shall be designed for at least 15 years of usable output and shall be free from defects in materials and workmanship for three years

Software and Programming

1. Software shall allow scheduling and schedule component operation to be created even while disconnected from the display sign.
2. Sign shall be programmable and data retrievable in the field using a PC Notebook with a wireless Bluetooth™ connection, up to 50 feet in front of the sign. The programming interface must be easy to use, with minimal training required. Bluetooth™ connectivity shall be included.
3. The violation alert display shall optionally flash the driver's speed once the radar detects the pre-set speed threshold and increase flashing rate proportional to higher speed. The display shall blank out or display slow down message once the radar detects the pre-set high speed threshold. Pre-sets can be set for different time periods of the day and calendar.
4. On/Off Timer Options - Each sign shall allow for a minimum of 8 unique On/Off settings per day to turn the sign display On/Off independently of data collection capabilities.
5. Calendar Programming: Programming shall have the (demonstrated) capability for creating unlimited weekly schedules and timetables with 2-years schedule exceptions defined by date and time.
6. Stealth Mode: The software shall have the ability (demonstrated) to program the sign display to be off while the radar and data collection capabilities continue to detect vehicles, collect data, and provide traffic data remotely and/or via Bluetooth communication download.
7. Each sign shall include programmable settings for a minimum speed violation alert (flashing the speed at the driver) and a maximum speed violation (Blanking the display screen).
8. All control software and/or firmware updates will be available to the end user at no charge.

Electronic Performance

1. Display control electronics shall maintain programmed settings and schedules indefinitely and shall incorporate a separate real-time clock backup power supply to maintain on-board clock settings through a power outage for up to two weeks and recharge itself when power is restored.
2. Power to the LEDs shall use DC display drive to provide continuous, non-pulsating current to LEDs when speeds are displayed, to maximize LED life.
3. Display shall operate on 12VDC nominal (10V – 18V) and display control electronics must automatically turn the display off when the voltage is below a lower threshold to prevent over-discharge damage to the solar power system.

4. Charging control system shall be a solar industry standard item with temperature compensated charging voltage and battery temperature monitoring for long battery life of 5 to 10 years.
5. The individual LEDs shall be wired such that a short failure of one LED will not result in the loss of more than 5 percent of that segment. – ensuring the digits will remain visible.
6. RADAR device shall meet specifications for an FCC part 15 Low Power Device - 24.150 GHz (K-band) and shall not require an operating license. It shall have a reporting accuracy of ± 1 MPH.

Vandalism Protection

1. Display cabinet shall be constructed to absorb impacts from thrown objects or vandalism attempts, by allowing the display boards to deflect inwards up to 2" (50mm) without damaging internal components.
2. Display window shall be made of ¼" (6.35mm) minimum thickness shatter-resistant polycarbonate. The LEDs shall be protected so that LEDs are not impacted by the polycarbonate window upon deflection.

Traffic Data Collection and Reporting

1. System data retrieval from the field shall be via a PC Notebook with a wireless Bluetooth™ connection, up to 50 feet in front of the sign. Bluetooth™ connectivity shall be included.
2. It shall capture and store separate data points for each target, which shall include final speed and the date and time for each detected target. The data shall not be averaged, consolidated or binned as the individual data points are then lost. It shall have the capacity for storing over 200,000 individual target data points. It shall be capable of capturing vehicle speed data with the display off to support "before and after" studies.
3. Reporting software shall be easy to use and charts easy to modify. Automatic reports will be provided with graphical analysis of the following data using a personal computer running Microsoft Excel™. Reporting and graphing must run locally on a desktop PC without requiring the internet. The reports shall contain reference posted speed limit, average vehicle speeds, 85th percentile vehicle speeds, total number of vehicles and percent of conforming vehicles.
4. Must have the ability to select a range of dates and times that is less than the total time period for which data is collected. A software utility shall be provided to further window the raw data to include/exclude certain hours of the day (school hours), weekdays or weekends only to remove statistical outliers, and to create a new .csv file for this data that can be used with the reporting software.

Warranty

The manufacturer's warranty for the display and accessories shall be at least three years from the time of purchase. The manufacturer's warranty on the LEDs comprising the display segments shall be at least 10 years from the time of purchase. Outbound shipping costs for warranty replacement parts shall be paid by the manufacturer. Manufacturer will supply technical telephone support at no extra charge during the warranty period. All control software and/or firmware updates will be available to the end user at no charge.

PART 3 -- EXECUTION

3.1 GENERAL

- A. Traffic signal and street light installation shall conform to Section 86, "Signals, Lighting and Electrical Systems," of the Caltrans Standard Specifications and as specified herein.

3.2 FOUNDATIONS

- A. Controller cabinet foundation shall extend 18 inches above grade.
- B. Foundations for decorative street lights shall be as shown on the approved Drawings based on the soil engineer's recommendations or in accordance with the Caltrans Standard Plans for a Type 15 lighting standard foundation.
- C. Mortar is required between the foundation and the base plate of all traffic signal and lighting standards. Mortar shall consist of one part by volume of Portland Cement and three parts of sand per Caltrans' requirements.

3.3 CONDUIT

- A. Conduit runs shown on the Drawings which are to be located behind the curbs may be installed in the street, within 2 feet of and parallel to the gutter line of the curb by the trenching method specified in Section D below.
- B. After conductors have been installed, the ends of conduits terminating in pull boxes and controller cabinets shall be sealed with an approved type of sealing compound.
- C. All conduit bends greater than 44 degrees shall be factory bends, and shall have a minimum radius of 18 inches. Where factory bends are not used conduit shall be bent without crimping or flattening using the longest radius possible. Bending of non-metallic conduit shall be by methods recommended by the conduit manufacturer and with equipment approved for that purpose. Conduits designated for signal interconnect shall be installed satisfying the requirements of both twisted pair and fiber optic cables use (e.g., sweeps/bends for fiber optic shall be used).
- D. At locations where conduit is to be installed by jacking or drilling as provided in Section 86-2.05C, "Installation," of the Caltrans Standard Specifications, and if delay to any vehicle will not exceed 2 minutes, conduit may be installed in accordance with the City Standard Details.
- E. To reduce the potential for damaging conduits when pulling conductors, only **Muletape** or approved equal shall be used when pulling conductors through. The muletape shall be a low stretch, high strength flat woven tape, produced with abrasion-resistant polyester or aramid fibers and pre-lubricated for easy pulling and reduced friction.

3.4 PULL BOXES

- A. Pull boxes in areas subject to traffic loads shall be installed on a concrete footing to withstand the traffic load. Tops of pull boxes shall be flush with the surrounding grade.
- B. The bottom of pull boxes shall be bedded in Class 2 Permeable Material in conformance with Section 312300 "Utility Earthwork" as shown on the Drawings.
- C. Grout in the bottom of pull boxes will not be required.

- D. Where the sump of an existing pull box is disturbed by the DEVELOPER/CONTRACTOR'S operations, the sump shall be reconstructed and if the sump was grouted, the old grout shall be removed and new grout shall be placed.
 - E. Recesses for suspension of ballasts will not be required.
 - F. Where pull boxes are to be placed in areas subject to traffic loads, a steel or cast iron cover shall be used in lieu of the concrete cover.
 - B. Maximum pull box spacing shall be 100' for traffic signals, 200' for street lights and hardwire signal interconnect, and 800' for fiber optic communications.
 - C. Pull boxes shall also be installed at locations where conduits branch, adjacent to the foundation for each signal standard, lighting standard, illuminated sign, controller cabinet, or service cabinet, and at the toe of slope or at the hinge point when placed on a slope.
 - D. Pull boxes are to be located behind the five (5') foot sidewalks and not within the sidewalk. Where sidewalks are wider than five feet, the pull box shall be located outside of the pedestrian's general walking area such that it will not interfere with pedestrian activity. In under no condition shall pull boxes be located within pedestrian pathways unless otherwise approved by the engineer.
- 3.5 PEDESTRIAN PUSH BUTTONS
- A. Pedestrian push buttons installed on traffic signal poles located in the sidewalk shall be within 5 feet of the adjacent handicap curb ramp. Pedestrian push buttons installed on traffic signal poles located behind the sidewalk shall be within 1 1/2 feet of the back of sidewalk. If a traffic signal pole cannot meet either of the above criteria, the associated pedestrian push button shall be installed on a separate pedestrian push button post.
- 3.6 CONDUCTORS AND WIRING
- A. Identification bands shall be placed near the ends of termination points of all conductors. All wires shall be clearly marked inside the controller cabinet designating the appropriate signal phases.
 - B. When signal heads for more than one phase are mounted on the same pole, the DEVELOPER/CONTRACTOR shall identify phases by tagging wires in the nearest pull box using nylon tie raps and permanent marker.
 - C. A 5 amp in-line fuse shall be installed on the hot leg of service in the pull box adjacent to each street light.
- 3.7 BONDING AND GROUNDING
- A. Grounding jumper shall be attached by a 3/16-inch or larger brass bolt in the signal and street light standards or controller pedestal, and shall be run to the conduit, ground rod, or bonding wire in the adjacent pull box.
 - B. Equipment grounding conductors will not be required in conduit containing loop lead-in cables only
- 3.8 DECORATIVE STREET LIGHTS
- A. Decorative street lights shall be installed in accordance with the manufacturer's recommendations.
- 3.9 UNINTERRUPTIBLE POWER SUPPLY (UPS) – BATTERY BACKUP SYSTEM (BBS)

- A. The UPS-BBS system shall be **wired and programmed** such that when AC power is interrupted, the UPS-BBS will seamlessly enter UPS mode and provide full signal operation until the battery level is at 40%. If AC power has not been restored at that time, the traffic signal shall switch to flashing red operation until failure for a minimum of two (2) hours or until AC power is restored. When AC power is restored, the system shall seamlessly revert back to AC power without interruption to the full signal operation.
- B. The UPS-BBS system shall be wired and programmed to communicate with the existing 2070 controller at the intersection through the use of special function outputs. The 2070 controller shall communicate with the TOC through the use of the special alarm functions to return BBS activation and other information to the TOC. In addition, the system shall be wired and programmed to communicate via Ethernet from the intersection to the TOC allowing remote diagnostic and unit modifications.
- C. A representative from the supplier or manufacturer shall be present during the signal turn-on or UPS-BBS activation to program/establish Ethernet communication, and make certain that the UPS-BBS system will operate properly.

3.10 CONTROLLER CABINET ASSEMBLY

- A. Interconnect cable shall be run continuously without splices between controller cabinets. Splices shall not be made in the pull boxes. Splices shall only be made in the controller cabinets on the terminal blocks provided for that purpose by the controller manufacturer. It shall be the DEVELOPER/CONTRACTOR's responsibility to establish communication between local controllers and the central master controller unless otherwise indicated.
- B. The base of the controller cabinet shall be sealed with a silicon caulking material.
- C. A representative from the supplier or manufacturer of all the components in the controller cabinet (e.g., modulated signal detection system, detectors, controller, PPB processors, video detectors) shall be present during the signal turn-on to make certain that the signal system will operate properly

3.11 FUNCTIONAL TESTING

- A. In order to properly conduct functional testing of the controller assembly, schematic drawings **specific** for the cabinet to be used in this specific project shall be submitted with the cabinet. Traffic signal construction plan shall also be submitted. Drawings shall indicate the intersection name and phasing. Absence of the required drawings could result to the rejection of the entire controller assembly. Cabinet testing will not proceed until the required drawings are submitted. The functional test for each signal system shall consist of not less than 14 days. If unsatisfactory performance of the system develops, the conditions shall be corrected and the test shall be repeated until the 14 days of continuous satisfactory operations is obtained.
- B. Controller and cabinets shall be delivered to the City of Livermore Maintenance Service Center at 3500 Robertson Park Road, Livermore, for pretesting no later than 45 days prior to installation. After completion of functional testing by the CITY, the DEVELOPER/CONTRACTOR shall pick up and install the equipment at the work site.
- C. Before scheduling the traffic signal "Turn On," the DEVELOPER/CONTRACTOR is required to coordinate a pre-testing to be conducted by the City's Signal Maintenance Department. Seventy-two (72) hours minimum advance notice is required to schedule this pre-test. During the pre-test, the City's traffic signal maintenance staff will determine if all components of the traffic signal system are operational as designed, including the Battery Backup System and video detection system. If deficiencies are found, the DEVELOPER/CONTRACTOR shall make the necessary corrections and schedule a follow up pre-testing. Only after all the deficiencies found are corrected can the

DEVELOPER/CONTRACTOR schedule the signal "Turn On." The DEVELOPER/CONTRACTOR shall provide a minimum of forty-eight (48)-hour advance notice to schedule the "Turn On".

- END OF SECTION -

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

1.5 UTILITY LOCATIONS

- A. The CONTRACTOR'S attention is called to the fact that utilities are present in the work areas. It is the CONTRACTOR'S responsibility to notify the utility companies having facilities in the project work areas at least 48 hours prior to beginning WORK to accurately locate said utilities before beginning of underground work. Utilities may be notified by contacting USA, Underground Service Alert, at (800) 642-2444.
- B. For utilities not marked by USA, such as irrigation mains and laterals or on site services, the CONTRACTOR shall contact the property owner for assistance in locating said facilities.
- C. The CONTRACTOR shall be responsible for repairing, at his own cost, any damage to utilities or irrigation facilities encountered during construction.

1.6 PRIVATE PROPERTY SIGNS

- A. All private property signs are subject to approval by the City of Livermore Planning Division and shall be in conformance with the Zoning Ordinance, the Sign Ordinance, and all other City of Livermore regulations.

PART 2 -- PRODUCTS

2.1 SIGNS

- A. **Roadside Signs:** Roadside signs shall be of the type as shown on the Drawings in accordance with the Caltrans Traffic Manual unless as otherwise noted on the drawings. Signs shall conform to Section 56, "Signs" of the Caltrans Standard Specifications and the Caltrans "Approved Sign Specification Sheets" as modified by this Section.
- B. **Sign Plates:** Sign Plates shall be 0.080 gage aluminum alloy. Sign message shall be made using engineering grade sheeting **3M or equal**. Type N markers shall be made using high intensity reflective sheeting **3M or equal**.
- C. **Street Name Signs:** Street names and size of signs shall be as shown on the Drawings. Sign background shall be reflective green with white lettering.
- D. **City/Private Property Off-Street Signs:** City/private property off-street signs shall have message and size of sign as shown on the Drawings.
- E. All signs in street right-of-way shall have "COL" and installation date etched or stamped on back of sign with 1/4" letters at lower right corner.

2.2 POSTS

A. **Roadside Signs, Street Name Signs, and City Off-Street Signs:**

1. All posts for signs installed on City property or within the public right of way shall be square formed steel tube, telescoping metal breakaway type, **Unistrut Telespar Sign Support System or equal**, of the size and dimensions as shown on the Drawings and as specified herein.
2. All posts shall be painted green and electrically powder coated except the sleeve and anchor which shall be galvanized. The color shall be green in conformance with Federal Standard 595-A, color number 14109 (Dark Limit V).
3. Tubing shall be 12 gage strip steel, structural quality, conforming to ASTM A-570 Grade 33.
4. Galvanized tubing shall be 12 gage strip steel, structural quality, conforming to ASTM A 446 Grade A; hot-dipped galvanized with a 1.25-ounce zinc coat, interior and exterior, conforming to ASTM C 653 coating designation G90; and the corner welds shall be zinc coated after scarifying operations.

2.3 HARDWARE

A. **Roadside, Street Name, and City Off-Street Signs:** Hardware for signs installed on City property or within the public right of way, shall be as shown on the Drawings and shall conform to the requirements of **Unistrut Telespar Sign Support System or equal**. Drive rivets to be **Unistrut TL 3806 or equal**.

B. **Street Name Sign Installation on Street Lights:**

1. The cantilever bracket supports for street name signs installed on round street light standards shall conform to the requirements of **SIGNFIX Cantilever Sign System or equal**.
2. For sign blanks up to 20 inches in length with a maximum area of 2 square feet use **SIGNFIX Stainless Steel Mini Cantilever Brackets** with 5/8-inch 0.030 gauge stainless steel band and buckle **BAND-IT or equal**.
3. For sign blanks up to 42 inches in length with a maximum area of 6 square feet, use **SIGNFIX V-Back Aluminum Cantilever Brackets** with 3/4-inch 0.030 gauge stainless steel band and buckle **BAND-IT or equal**.

PART 3 -- EXECUTION

3.1 GENERAL

- A. All sign locations on City property must be inspected and approved by the ENGINEER prior to installation. The CONTRACTOR shall notify the ENGINEER no later than 48 hours prior to the start of the scheduled sign installation.
- B. The locations of all Off-Street signs must be approved by the Planning Division prior to start of installation of the signs.

- C. All reference markings made by the CONTRACTOR shall be done with spray chalk and shall be removed by the CONTRACTOR after installation of the signs.
- D. Roadside signs shall be installed 6" behind 5' monolithic sidewalk, and 18" behind face of curb where there is a separated sidewalk, 10' sidewalk or no sidewalk unless otherwise noted on plans.
- E. All utilities damaged by the CONTRACTOR shall be repaired and replaced by the CONTRACTOR at its expense to the satisfaction of the ENGINEER and the owner of the utility.

3.2 INSTALLATION OF POST

- A. **Roadside, Street Name, and City Off-Street Signs:** Installation of roadside, street name, and City off-street signs installed on City property shall be at the locations shown on the Drawings or as specified herein.
 - 1. Installation shall be as shown on the Drawings and shall conform to the requirements of **Unistrut Telespar Sign Support System or equal**.
 - 2. The square end of the anchor shall not be modified or pointed, but shall be capable of being driven into the ground by the use of an approved driving cap. The driving cap shall be reusable and shall allow the square anchors to be manually driven into the ground with the aid of a sledge hammer or a jack hammer without deforming the anchor or the driving cap.

3.3 INSTALLATION IN EXISTING SIDEWALK

- A. For signs installed in existing sidewalks a 6-inch core shall be drilled, the anchor installed, the the core filled with Class B portland cement concrete in conforming to Section 033050, "Utility Cast-In-Place Concrete." Existing surfacing other than portland cement concrete shall be replaced in kind, with the replacement matching the existing product, depth, and pattern, to the satisfaction of the ENGINEER. The sleeve shall be protected such that concrete will not enter the inside of the square post.

3.4 INSTALLATION OF SIGN

- A. **Roadside, Street Name, and City Off-Street Signs:** Mounting of the sign to the pole for roadside, street name, and City off-street signs on City property shall be as shown on the Drawings and shall conform to the requirements of **Unistrut Telespar Sign Support System or equal**.
- B. Mounting of Street Name Signs on street light standards using Cantilever support brackets shall be installed in accordance with the manufacturer's recommendations. Cantilever bracket system shall be installed on both the top and bottom of each sign.
- C. An R26E, "Tow-Away Zone" shall be installed below each R26F sign in designated fire lanes.

- END OF SECTION -

