GRANADA COMMUNITY SERVICES DISTRICT

SAN MATEO COUNTY, CALIFORNIA

STANDARD SPECIFICATIONS

FOR

DESIGN AND CONSTRUCTION OF

SANITARY SEWER COLLECTION AND

CONVEYANCE FACILITIES

NOVEMBER 2023

Granada Community Services District
P.O. Box 335
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SECTION A1 - INTRODUCTION AND SCOPE

A1.01 INTRODUCTION

The District's Standard Specifications have been prepared by the Granada Community Services District to aid all persons engaged in the design or construction of sewerage facilities for the District. These specifications are periodically updated to reflect changes in the technology affecting the District's wastewater facilities.

The information contained herein is not intended to be used as a contract document either for contracts between the District and a contractor or for contracts between a subdivider or private person and a contractor. Rather, separate contract documents must be prepared for each project, with each such contract containing a "Special Provisions" section applicable to that particular project. In such contracts, construction details included herein may be included by reference.

The District Standard Specifications are divided into four parts, each of which is briefly described below:

1. Part A - General Information

   Part A includes a general description of the intent and purpose of the District's Standard Specifications, a brief description of the District's Master Plan, and definitions of terms used herein.

2. Part B - Design Standards

   Part B describes standards to be used in the design of all sewerage facilities for the District.

3. Part C - Construction Standards

   Part C, written in the form of typical specifications, covers the District's construction standards. These standards must be followed in any work constructed for the District's acceptance, and may be included by reference in construction contracts.

4. Part D - Standard Drawings

   Part D consists of eighteen (18) standard drawings and details which must be followed where applicable, in any work done for the District's acceptance. Applicable standard details must be shown on construction drawings.

A1.02 DISTRICT BOUNDARY

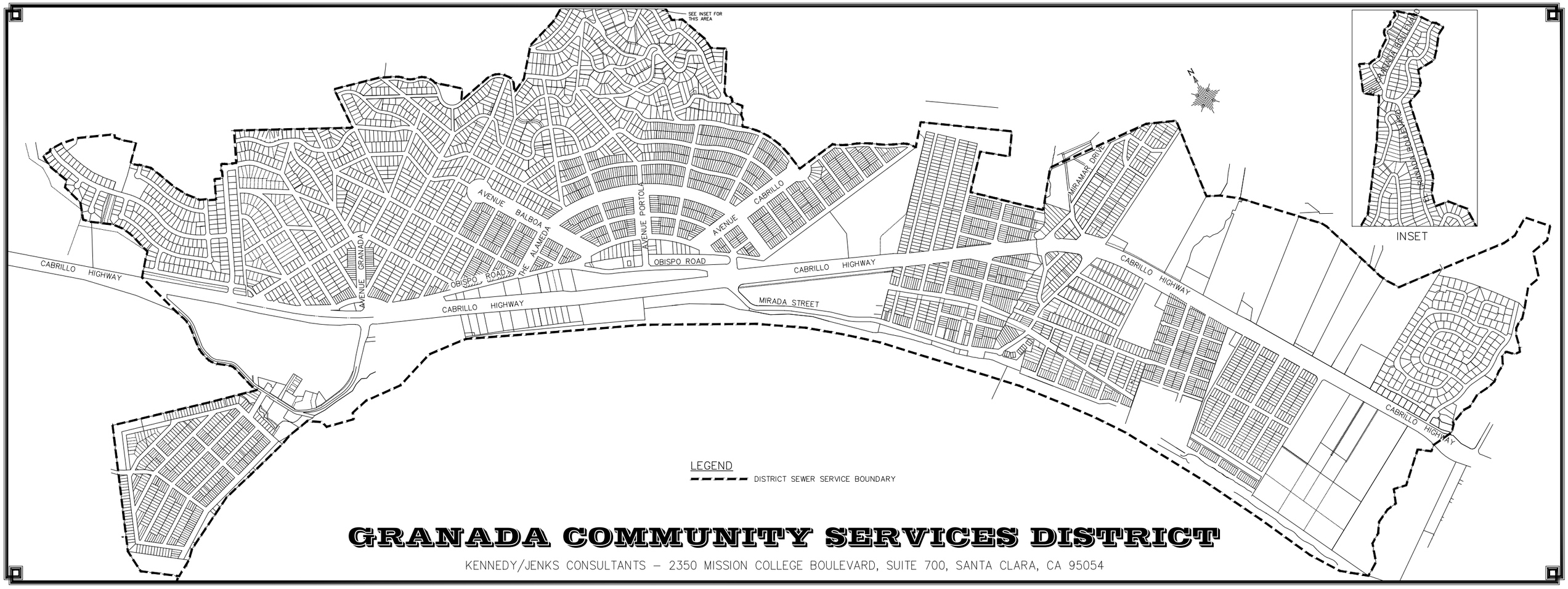
The boundary of the Granada Community Services District is shown on the map on page A-04. All sanitary sewers constructed within that boundary come under the jurisdiction of the District and must comply with the standards set forth herein.

A1.03 LOCAL COASTAL PLAN (LCP)

In late 1980, the County Board of Supervisors and the California Coastal Commission approved San Mateo County's Local Coastal Plan (LCP). In April 1981, the County assumed responsibility for implementing the State Coastal Act in the unincorporated area of San Mateo County, including issuance of Coastal Development Permits.

All development in the Coastal Zone requires either a Coastal Development Permit or an exemption from Coastal Permit requirements. For a permit to be issued, the development must comply with the policies of the LCP and those ordinances adopted to implement the Plan. The project must also comply with other provisions of the County Ordinance Code, such as zoning, building and health regulations.

The LCP outlines the ability of the District to serve vacant lots in the Coastal Zone and the District has to comply with these planning requirements. Copies of the "Local Coastal Plan" are on file at the Planning Department of San Mateo County and the District's office for reference.



GRANADA COMMUNITY SERVICES DISTRICT

KENNEDY/JENKS CONSULTANTS – 2350 MISSION COLLEGE BOULEVARD, SUITE 700, SANTA CLARA, CA 95054

SECTION A2 - DEFINITIONS

A2.01 DEFINITIONS

Terms which appear throughout these Standard Specifications shall have the following meanings:

1. APPLICANT shall mean the person making application for a permit for a sewer or plumbing installation and shall be the owner, or his authorized agent, of the premises to be served by the sewer for which a permit is requested.

2. BOARD shall mean the Board of Directors of said District.

3. BUILDING shall mean any structure used for human habitation or a place of business, recreation or other purposes.

4. BUILDING SEWER shall mean that portion of a side sewer beginning at the plumbing or drainage outlet of any building or industrial facility and running to the property line or to a private sewage disposal system.

5. COLLECTION SYSTEM shall mean all facilities owned or constructed by the District for collecting, pumping, treating, and disposing of sewerage (except private property).

6. CITY shall mean the City of Half Moon Bay, California.

7. COMBINED SEWER shall mean a sewer which was designed to receive both surface runoff and sewage.

8. COMMERCIAL USER AND/OR INDUSTRIAL USER (both private and public) shall mean any user of the sewage works of the District located on property or in structures not classified as a single family unit or multiple dwellings.

9. CONTRACTOR shall mean an individual, firm, corporation, partnership, or association duly licensed by the State of California who shall do work for the District's acceptance.

10. COUNTY shall mean the County of San Mateo, California.

11. DAY shall mean a calendar day of 24 hours.

12. DISTRICT shall mean the Granada Community Services District (GCSD). See the map showing the District boundaries in this section.

13. DISTRICT ENGINEER as used in these specifications shall be taken to designate the party or parties authorized or employed by the District to observe completed work, and to observe their general compliance with plans, specifications, design and planning concept. Kennedy/Jenks Consultants located at 2350 Mission College Boulevard, Santa Clara, CA 95054 serves as the District Engineer.

14. DISTRICT MANAGER shall mean the person or persons appointed by the Board to administer and enforce the rules and regulations of the District.

15. DWELLING shall mean any house, duplex, apartment, commercial establishment, or any other building to be connected to a public or main sewer.

16. FORCE LATERAL shall mean that portion of pressurized side sewer located in a public street

connecting a building sewer to the main sewer.

17. GARBAGE shall mean solid wastes from the preparation, cooking, and dispensing of food and from the handling, storage, and sale of produce.

18. LATERAL SEWER (SERVICE LATERAL) shall mean the portion of a side sewer lying within a public street connecting a building sewer to the main sewer.

19. MAIN SEWER shall mean a public sewer designed to accommodate more than one lateral sewer.

20. MULTIPLE DWELLING shall mean a building containing two or more units for rental, lease, or similar legal instrument, for residential occupancy purposes, including, but not limited to the following: Hotels, Motels, Auto Courts, Trailer Courts, Mobil Home Parks, Apartment Houses, Duplexes, Rooming Houses, Boarding Houses, and Dormitories.

21. ORDINANCE shall mean Ordinance Number 57 adopted by the District in 1984, and amendment thereto. The Ordinance outlines procedures to be followed in the design, construction, and use of sewerage facilities for the Granada Community Services District.

22. OUTSIDE SEWER shall mean a sanitary sewer beyond the limits of the District not subject to the control or jurisdiction of the District.

23. PERMIT shall mean any written authorization required pursuant to this or any regulation of the District for the installation of any sewerage works.

24. PERSON shall mean any human being, individual, firm, company, partnership, association and private or public and municipal corporation, the United States of America, the State of California, Districts, and all political subdivisions, governmental agencies and mandatories thereof.

25. PRIVATE SEWER shall mean that portion of a sewer serving an independent sewage disposal system not connected with a public sewer and which accommodates one or more buildings or industries.

26. PUBLIC NUISANCE shall mean continued habitation of any building or continued operation of any industrial facility in violation of the provisions the District's Ordinances, rules or regulations of the District.

27. PUBLIC SEWER shall mean a sewer lying within a street or easement, and which is controlled by or under the jurisdiction of the District.

28. SANITARY SEWER shall mean a sewer which carries sewage and to which storm, surface, and ground waters are not intentionally admitted.

29. SEWAGE shall mean a combination of water-carried wastes from residences, business buildings, institutions, and industrial establishments.

30. SEWAGE TREATMENT PLANT shall mean any arrangement of devices and structures used for treating sewage.

31. SEWAGE WORKS shall mean all facilities owned or controlled by the District for collecting, pumping, treating, and disposing of sewage (Except private sewers).

32. SEWER shall mean a pipe or conduit for carrying sewage.

33. SIDE SEWER shall mean the sewer line connecting any dwelling to a public sewer beginning at the foundation wall of any building and terminating at the main sewer and includes the building sewer and lateral sewer together.

34. SINGLE DWELLING UNIT. A single dwelling unit is defined to mean and refer to the place of residence, detached or attached unit, that can be legally owned by the occupant or occupants, including, but not limited to, condominiums, townhouses, houses or similar design.

35. STANDARD SPECIFICATIONS shall mean a set of documents containing design and construction standards for all sewerage works within the District (i.e., this set of documents).

36. STORM SEWER OR STORM DRAIN shall mean a sewer which carries storm and surface ground waters and drainage, but excludes sewage and polluted industrial wastes.

37. STREET shall mean any public highway, road, street, avenue, alley, way, public place, public easement, or right of way.

38. TRENCHLESS REPLACEMENT shall mean a method of sewer replacement in which existing sewers are replaced by means other than the conventional open-cut trench method.

39. USER shall mean any owner, possessor, tenant, occupier, inhabitant, holder or person owning or occupying premises which are connected directly or indirectly with the sewage works of the District.

40. WASTEWATER FACILITIES shall mean any part of the sewage collection, treatment, and disposal system of the District.

END PART A

PART B

DESIGN STANDARDS

SECTION B1 - GENERAL REQUIREMENTS

B1.01 SCOPE

This section covers the general design requirements and design criteria applicable to the sewerage system as a whole.

B1.02 DESIGN CALCULATIONS

Design calculations submitted for District review shall be in a neat, acceptable form, and shall indicate the date, signature of the supervising engineer, and the engineer's State of California Engineering Registration Number and expiration date.

1. When Required

   Design calculations will be required for all mainline extensions including residential subdivisions, commercial and industrial sewers, or where, in the judgement of the District Engineer, they are necessary.

2. Sewers and Pipelines

   Design calculations for sewers and pipelines shall be presented in tabular form and shall include the following information for each section of sewer:

   a. Terminal manhole designations (Basin name followed by manhole number, for example – B32)

   b. Ground elevation at each manhole (Elevations shall be based on North American Vertical Datum of 1988 (NAVD 88).)

   c. Invert elevation at each manhole

   d. Length of sewer run

   e. Sewer size

   f. Pipe size

   g. Pipe slope

   h. Pipe capacity

   i. Incremental and cumulative tributary area

   j. Incremental and cumulative tributary population

   k. Incremental average and maximum domestic sewage flow

   l. Incremental infiltration allowance

   m. Cumulative design flow

n. Velocity at design flow

3. Pumping Stations

Design calculations for pumping stations shall include soils data, structural design calculations, hydraulic calculations including the basis for average and peak flows, calculations for wet well volume, curves indicating force main characteristics, and individual and combined pump head-capacity curves.

B1.03 UNIT DESIGN FACTORS

1. Population Densities

Population densities for determining ultimate tributary population shall be as indicated in the District's "Master Plan" of 1979 on file at the District's Office. Indicated densities shall be modified where conditions are known to be different. In the case of such modification, the applicant shall submit substantiating data.

2. Sewage Flow

a. Per Capita Domestic Sewage Flow. The average dry weather per capita domestic flow shall be 90 gallons per day.

b. Domestic Flow Per Single Family Dwelling. The average dry weather flow per single family dwelling and/or equivalent shall be 221 gallons per day.

c. Ratio of Peak to Average Flow. The ratio of peak to average dry weather sewage flow is a function of the tributary population, and the tabulated values below shall be used.

TRIBUTARY POPULATION	RATIO OF PEAK TO AVERAGE SEWAGE FLOW
1,000 and less	2.50
2,000	2.25
3,000	2.15
4,000	2.05
5,000	1.98
10,000	1.82
20,000	1.68
50,000	1.55

d. Acreage Flow - Unit loadings for special design guidance, subject to District review, are as follows:

	AVERAGE FLOW GALLONS PER ACRE PER DAY	PEAK FLOW GALLONS PER ACRE PER DAY
Commercial Areas	1,500	4,500
Industrial Areas	2,000	4,000

e. Infiltration. The infiltration rate shall not exceed 500 gallons per day per inch diameter per mile of length for all new sewers.

f. Inflow Sources. No inflow sources which include rainwater, stormwater, groundwater, street drainage, subsurface drainage, roof drainage, yard drainage, and water from yard fountains, ponds, lawn sprays or swimming pools or any other uncontaminated water shall be discharged into the public sewer.

SECTION B2 - GRAVITY SEWERS, FORCE MAINS, AND PUMPING STATIONS

B2.01 SCOPE

This section covers basic design criteria and standards relating to gravity sewers, force mains, and pumping stations.

B2.02 GRAVITY SEWERS

1. Minimum Size Main Sewer

   The minimum diameter for main sewer shall be 6-inches.

2. Minimum Size Side Sewer

   The minimum diameter for side sewers shall be 4-inches. For side sewers serving commercial or industrial buildings, or multiple family living units having more than three units, the minimum diameter shall be 6-inches.

3. Minimum Slopes

   The minimum slope of side sewers shall be 1 percent for 4-inch sewers and 0.5 percent for 6-inch sewers. The minimum slope for main sewers shall be that required to obtain a velocity of 2 feet per second when the sewer is flowing full or one-half full. For the purpose of computing the velocity, the Manning's coefficient of roughness "n" shall be 0.013 for all sewers.

4. Steep Slopes

   Special design features may be required for main sewers installed on steep slopes. Depending upon conditions of the specific installation, such items as underdrains, check dams, special anchorage, or special pipe material may be required. Based upon data supplied, the District Engineer will assess each case and recommend certain special requirements.

5. Minimum Depth

   The minimum depth of cover for any public sewer shall be 3 feet. The standard depth of cover for any main sewer shall be 4 feet. If it is impossible to obtain the standard depth of cover, the depth of cover over the main shall be between the standard and minimum depths. If it is impossible to obtain the specified minimum depth, the sewer shall be constructed using pipe approved by the District Engineer or if approved by the District Engineer, covered by a concrete cap for the entire length shallower than 3.0 ft., as shown on District Standard Drawing No. 7 or constructed using pipe approved by the District Engineer, refer to Section C5 Pipelines and Sewers.

   For side sewers, minimum depths of cover shall be as follows:

   a. At the property line - 3 feet.

   b. From property line to within eight feet of the building plumbing - 2.5 feet.

   c. At the building plumbing connection - 1.5 feet.

Where the minimum depths of cover listed above are impossible to obtain, the use of ductile iron or concrete caps shall be required.

6. Manholes

Manholes shall be provided at every line or grade change and at every point where the sewer changes size. In addition, manholes shall be provided at maximum intervals of 300 feet on sewers 21-inches in diameter and smaller, and 500 feet on sewers larger than 21-inches in diameter. For manholes being installed where surfaces have a slope greater than 5%, grout shall be applied under the top ring of the manhole to bring the manhole cover to grade with the surface slope of the pavement.

7. Flushing Inlets or Rod Holes

Flushing inlets or rod holes will be permitted upon approval by the District Engineer only on dead-end runs where the length of sewer downstream to the next manhole is less than 150 feet.

8. Types of Pipe Permitted

Complete specifications for all approved pipe materials are given in Article C5.02. Limitations on the use of specific pipe materials are listed below.

a. Gravity Sewers. Corrugated metal, vitrified clay pipe, and reinforced concrete pipes will not be permitted except where specifically approved by the District Engineer. Asbestos cement pipe is not permitted.

b. Force Mains. In general, any pressure pipe material listed in Article C5.02 may be used. Asbestos cement pressure mains are not permitted.

The District Engineer shall be the sole judge as to what types of pipe may or may not be used for each specific project.

9. Cleanouts

Each side sewer shall have a cleanout installed on the property within 5 feet or the property line, as shown on District Standard Drawing No. 10.

10. Backwater Overflow Device or Check Valve

Side sewers connecting houses having a finished floor elevation twelve (12) inches or less above the top elevation of the nearest upstream structure (manhole) shall have a Backwater Overflow Device installed on them at a suitable location next to the cleanout. When conditions exist where the sewage cannot overflow on the area surrounding such installation without damage to property, a Backwater Check Valve shall be installed at the property Owner's option and risk as shown on District Standard Drawing No. 16. This requirement applies to residential connections.

B2.03 FORCE MAINS

Force mains shall be designed using a Hazen and Williams coefficient for roughness "C" of 100.

B2.04 PUMPING STATIONS

Certain basic requirements for pumping station design are listed below.

1. Stand-by Power

   Each pumping station must be equipped with a source of stand-by or emergency power which will automatically start upon the failure of external power. In special cases, this requirement may be waived by the District Engineer.

2. High Water/Power Failure Alarms

   Each pumping station must be equipped with the necessary electrical equipment to transmit high water and/or power failure alarms over a leased telephone circuit to a remote location.

3. Architectural Considerations

   Pump station design shall comply with California building code. Each pumping station must blend harmoniously with neighboring structures. Architectural considerations include superstructure, ornamental fence, and landscaping.

4. Standby Pumps

   Each pumping station must have standby pumping capacity equivalent to the peak wet weather flow of the facility.

B2.05 GREASE AND SAND INTERCEPTOR

When the property requires grease and/or grit removal, the interceptor shall meet the requirements of the latest edition of the Uniform Plumbing Code, Chapter 10. See Standard Detail No. 18.

END PART B

PART C

CONSTRUCTION STANDARDS

SECTION C1 - SPECIAL CONDITIONS AND CONSTRUCTION REQUIREMENTS

C1.01 ARRANGEMENT OF SPECIFICATIONS

The Construction Standards are arranged in sections covering various phases of the work as follows:

SECTION NUMBER	TITLE
C1	Special Conditions and Construction Requirements
C2	Earthwork
C3	Concrete Work
C4	Metalwork
C5	Pipelines and Sewers
C6	Painting
C7	Resurfacing
C8	Sewer Line Cleaning
C9	Sewer Flow Control
C10	Television Inspection
C11	Smoke Testing

C1.02 STANDARD SPECIFICATIONS

Whenever Standard Specifications, codes, or regulations are referred to, they shall be the latest edition of those specifications, codes, or regulations, and they shall be considered to be a part of these standards insofar as they apply. Such documents from the following sources may be referred to herein:

American Association of State Highway and Transportation Officials (AASHTO)
American Concrete Institute (ACI)
American Gas Association (AGA)
American Institute of Electrical Engineers (AIEE)
American Institute of Steel Construction (AISC)
American Iron and Steel Institute (AISI)
American National Standards Institute (ANSI)
American Public Works Association (APWA)
American Society for Testing and Materials (ASTM)
American Society of Civil Engineers (ASCE)
American Society of Heating, Refrigeration & Air Conditioning Engineers (ASHRAE)
American Society of Mechanical Engineers (ASME)
American Water Works Association (AWWA)
American Welding Society (AWS)
State of California, Department of Transportation (CALTRANS)
State of California, Division of Occupational Safety and Health (CAL OSHA)
Federal Environmental Protection Agency (EPA)
Federal Specifications (Fed. Spec)
National Electrical Code (NEC)
National Electrical Manufactures Association (NEMA)
National Electric Safety Code (NESC)
National Lumber Manufactures Association (NLMA)
Underwriter's Laboratories, Inc. (UL)
Uniform Building Code (UBC)
Uniform Plumbing Code (UPC)

C1.03 EXISTING UTILITIES

The Contractor shall maintain all water or sewer lines, lighting, power or telephone conduits, structures, house connection lines, and other surface or subsurface structures of any nature that may be affected by the work. Should it be necessary in the performance of the work to disconnect or reroute any underground utility, or should any such utility be damaged during construction, all expenses of whatever nature arising from such disconnection, rerouting, damage or replacement shall be borne by the Contractor.

The District reserves the right, if requested by the utility owner, to permit the Contractor to move or maintain any such conflicting utility at the Contractor's expense.

The right is reserved by the State, the County, the City or the District, and by owners of public utilities, to enter upon any street or road right-of-way, or easement for the purpose of maintaining their property and for making necessary repairs or changes caused by the work.

C1.04 DUST CONTROL

Reasonable means shall be provided to prevent a nuisance occurring due to dust from areas under construction. Such means shall include watering and sweeping, and in cases of extreme nuisance, light oiling of the affected surface.

C1.05 ENCROACHMENT PERMITS

Before any construction commences, the Contractor shall obtain and provide the District with a copy of any Encroachment Permit from the jurisdiction in which the work is located. All work done in City and County street shall be subject to the requirements of the City and/or County as included in the Encroachment Permit.

C1.06 WORK WITHIN RAILROAD AND HIGHWAY RIGHT-OF-WAYS

Construction within the Railroad and State Highway right-of-ways shall be subject to utility Encroachment Permits provided by the Railroad Company or CalTrans.

C1.07 WORK IN EASEMENTS

Before construction commences on an easement, the District must have in its possession a signed copy of the Deed of Easement. Should an area greater than that included in the easement be required for construction purposes, the Contractor shall negotiate for use of the additional area from the property owners. Fences, structures, and landscaping within the easement which are removed and damaged by the Contractor shall be restored as nearly as possible to their original condition at the Contractor's expense. Any damage caused by the Contractor's operations shall be the Contractor's responsibility.

C1.08 OPERATION OF EXISTING FACILITIES

Existing sewerage facilities shall be maintained in service at all times. The Contractor shall devise acceptable methods for maintaining continuity of service equal to that which existed prior to construction.

Existing sewer manholes to be abandoned shall be filled with sand, and their frames and covers shall be salvaged by the Contractor. These District owned frames and covers shall be delivered by the Contractor to a location within the District designated by the District Engineer.

The Contractor shall notify the District in writing at least two days in advance before a new sewer line is to be connected to an existing sewer.

To prevent dirt, rocks, and other debris from entering the sewerage system, the Contractor shall install and maintain an acceptable grit interceptor in a manhole designated by the District Engineer.

C1.09 SAFETY AND HEALTH PROVISIONS

The Contractor shall conform to all applicable occupational safety and health standards, rules, regulations and orders established by Federal and State Agencies.

All working areas utilized by the Contractor to perform work during the hours of darkness, shall be lighted to conform to the minimum illumination intensities established by California Division of Occupational Safety and Health Construction Safety Orders. (CAL OSHA).

All lighting fixtures shall be mounted and directed in a manner precluding glare to approaching traffic.

Specific attention is directed also to OSHA safety rules, regulations and precautions to be taken by the Contractor before entering sanitary sewer manholes and other manhole subsurface structures with respect to physical and chemical hazards which may be present. In addition the Contractor shall meet the following requirements.

1. All trenches, manhole pits, etc. shall be covered at the end of the day and made safe by the use of plates, barricades, etc.

2. No work will be performed within the drip-line of any tree without special authorization.

3. No noise levels shall be beyond the range allowed by the controlling jurisdiction.

4. When by-pass pumps are used, take all precautions possible to prevent harm to the public, i.e. fences, barricades.

5. No person shall enter a manhole without first sampling the air and providing all OSHA required protection.

Full compensation for conforming to the requirements of this section shall be considered as being included in the contract prices paid for the various items of work involved and no separate payment will be made therefore.

C1.10 HAZARDOUS MATERIALS

If the Contractor encounters material on the site which it reasonably believes may contain asbestos, polychlorinated biphenyl (PCB) or other suspected hazardous materials, the Contractor shall stop work in the affected area and shall notify the District. The Contractor shall proceed with analysis, removal, and disposal of the material according to applicable federal and state guidelines.

SECTION C2 - EARTHWORK

C2.01 SCOPE

Earthwork includes all plant, labor, equipment, appliances, and materials as required or necessary to clear and grub, sheet and shore, dewater, excavate, trench, fill, backfill, and grade for the construction of structures, sewers, and graded areas.

C2.02 GENERAL REQUIREMENTS

1. Control of Water

The Contractor shall furnish, install, and operate all necessary machinery, appliances, and equipment to keep excavations reasonably free from water during construction and he shall dispose of the water so as not to cause injury to public or private property, or to cause a nuisance or a menace to the public. He shall at all times have on hand sufficient pumping equipment and machinery in good working condition for all ordinary emergencies and shall have available at all times competent mechanics for the operation of all pumping equipment.

The control of ground water shall be such that softening of the bottom of the excavation, or the formation of "quick" conditions or "boils" shall be prevented. Dewatering systems shall be designed to operate so as to prevent the removal of the natural soils.

During excavation, installation of sewers, placing of trench backfill, and the placing and setting of concrete, the excavation shall be kept reasonably free of water. When specified, the static water level shall be drawn down below the bottom of the excavation so as to maintain the undisturbed state of the natural soil and to allow the placement of backfill to the required density. The dewatering system shall be installed and operated so that the ground water level outside the excavation is not reduced to the extent that would damage or endanger adjacent structures or property.

The release of ground water to its static level shall be performed in such a manner as to maintain the undisturbed state of the natural foundation soil, prevent disturbances of compacted backfill, and prevent floatation or movement of structures and sewers.

2. Excavated Material

Arrangements for disposing of excess excavated material unsuitable for backfill shall be made by the Contractor at his own expense. Excavated material suitable for backfill shall be stored temporarily in such a manner as will facilitate work under the contract.

3. Shoring, Sheeting and Bracing

Pursuant to state law, all open excavations greater than five feet in depth shall be constructed with bracing, shoring, and steel sheeting or other equivalent methods designed to protect life and limb.

Where sheet piling, shoring, sheeting, bracing, or other supports are necessary, they shall be furnished, placed, maintained and removed by the Contractor. At all times the rules of the California Department of Industrial Relations, Division of Industrial Accidents, with respect to excavation and construction shall be strictly observed. Sheet piling and other supports shall be withdrawn in such a manner as to prevent subsequent settlement of the pipe, or additional backfill on sewer lines which might cause overloading.

The design, planning, installation, and removal of all shoring, sheeting, and bracing shall be

accomplished in such a manner as to maintain the required excavation and trench section and the undisturbed state of the soil adjacent to the trench and below the excavated trench bottom.

4. Removal of Obstructions

The Contractor shall remove, or cause to be removed, all trees, including stumps, fences, and all structures where the proper construction and completion of the work require their removal. The Contractor shall also remove all rock, stones, debris, and obstructions or whatsoever kind or character, whether natural or artificial, encountered in the construction of the work.

Material that is removed as hereinabove specified, and is not to be incorporated in the improvement being constructed, shall be disposed of according to applicable laws by the Contractor at his expense.

C2.03 EXCAVATION AND BACKFILL FOR STRUCTURES

1. Excavation

The site shall be cleared of all natural obstructions, pavement, utilities, and other items which will interfere with construction. Unless otherwise specified, any method of excavation may be employed which, in the opinion of the Contractor, is considered best.

Ground shall not be dug by machinery closer than 3 inches from any finished subgrade without the express approval of the District Engineer. The last 3 inches shall be removed without disturbing the subgrade. Should the excavation be carried below the required lines and grades because of the Contractor's operations, the Contractor shall refill such excavated space to the proper elevation in accordance with the procedure specified for backfill, or if under footings, the space shall be filled with concrete as directed by the District Engineer.

Where, in the opinion of the District Engineer, the undisturbed condition of the natural soil is not adequate to support the structure, the District Engineer shall direct the Contractor to overexcavate to adequate supporting soil and refill the overexcavated space. The quantity and placement of such material shall be as ordered by the District Engineer.

Excavation shall extend a sufficient distance from walls and footings to allow for placing and removal of forms, installation of services, and for inspection, except where concrete is authorized to be deposited directly against excavated surfaces or against existing concrete surfaces.

2. Backfilling

After completion of foundation footings and walls, and of other construction below the elevation of the final grade, all forms shall be removed and the excavation shall be cleaned of all debris. Substructure surfaces shall be waterproofed if required and as specified. Sheet piling shall not be removed until backfilling operations are completed.

Backfill shall be composed of clean natural material or imported material acceptable to the District Engineer. Backfill shall be placed in layers not exceeding 8 inches in loose depth and compacted by tamping or rolling. Jetting is not permitted.

Regardless of the method of compaction, the final density shall not be less than 90 percent of maximum density at optimum moisture as determined by AASHTO T180 or by California Test 216. The final relative density of the backfill shall be 95 percent in paved and/or traffic areas.

C2.04 EXCAVATION AND BACKFILL FOR SEWER LINES

1. Excavation

Unless otherwise indicated on the plans or in the special conditions, excavation for sewer lines shall be by open cut. Trenching machines may be used except where their use will result in damage to existing facilities. For sewers to be constructed in filled areas, the entire area fill shall be placed and compacted to at least five feet above the proposed sewer invert before the sewer trench is excavated.

Trenches shall be excavated at least 6 inches below the barrel of the pipe and the bottom refilled with select imported material of the type specified under Article C2.04 2a - Bedding Material.

The maximum allowable width of trench measured at the top of the pipe shall be the outside diameter of the pipe, exclusive of bells and collar, plus 24 inches, and such maximum width shall be inclusive of all trench shoring. A minimum of 6 inches shall be maintained between pipe and trench wall. Whenever the maximum allowable trench width is exceeded for any reason, the Contractor shall embed or cradle the pipe in a manner satisfactory to the District Engineer.

Excavation 5.0 feet and deeper shall be supported as set forth in the rules, orders and regulations of the California Department of Industrial Relations, Division of Industrial Accidents. Sheet piling and other shoring shall be withdrawn so as to prevent subsequent settlement of the pipe, or additional backfill that might overload the pipe. No sheeting will be withdrawn from below the top of the pipe after completion of backfill to that level.

2. Trench Backfill

a. Bedding Material. After the pipe has been properly laid and inspected, select backfill material shall be placed under and around the pipe to a depth of 12 inches above the top of the pipe and shall be thoroughly consolidated to a final density of at least 90 percent of maximum density as determined by AASHTO T180 or by California Test 216. Consolidation shall be obtained by mechanical means. The select material shall be free from organic matter, and of such size and gradation that the desired compaction can be readily attained. Recycled materials shall not be permitted. The size of gradation shall fall within the following limits.

Bedding Material: Granular Bedding Requirements (ASTM D448 Size #67 and California Test 202).

SIEVE SIZE	PERCENTAGE PASSING SIEVE
1 inch	100
3/4"	90-100
3/8"	20-55
No. 4	0-10
No. 8	0-5

b. Subsequent Backfill. Above the level of bedding material, the trench shall be filled with structural backfill material as designated on the Plans and Specifications. Backfill shall be placed in layers not exceeding 8 inches in loose depth and compacted by mechanical means to a density of not less than 95 percent maximum density at optimum moisture as determined by California Test 216 or 231 (Nuclear Gauge).

The size of gradation shall fall within the following limits:

¾" Class 2 AB
(CalTrans Standard Specifications Paragraph 26-1.02 A)

SIEVE SIZE	PERCENTAGE PASSING SIEVE
1-1/2"	100
3/4"	80-100
No. 4	30-60
No. 30	5-35
No. 200	0-12

The finishing of the roadway (aggregate base and asphalt concrete) shall match the existing finishing and be constructed to the requirements of San Mateo County or the City, whichever requirements apply.

3. Geotextile Fabric

Non-woven, non-biodegradable, needle punched geotextile comprised of polypropylene fibers. Mirafi 600X or equal. Install with a minimum 6-inch overlap, unless otherwise shown on the Drawings.

4. Warning Tape

3-inch-wide, inert, fade-resistant plastic film resistant to acids, alkalis, and other components likely to be encountered in soil. Warning tape colors shall be green and follow the uniform color code per American Public Works Association (APWA). Warning tape shall bear letters "Sanitary Sewer Line Below" with 2-inch size. Warning tape shall not be placed more than 12 inches above top of pipe.

C2.05 CLEAN UP

After completing all piping earthwork, the Contractor shall leave the site in a neat and clean condition, doing such grading as is required by the Drawings, or if not called for, to restore the site to its original shape and configuration. Any existing features, improvements, structures, and other facilities damaged or affected by the work shall be replaced, repaired, or restored to their original condition or better.

SECTION C3 - CONCRETE WORK

C3.01 SCOPE

Concrete work includes the construction of all manholes, footings, slabs, walls, supports, and other concrete items, complete with metal reinforcement.

C3.02 MATERIALS

1. Cement

Cement shall conform to ASTM C150 Type II. Only one brand of cement shall be used for exposed architectural concrete throughout one structure or composite element. Insofar as possible, all cement used in the work shall be taken from stock bins at the place of manufacture.

Cement brought to the site of the work shall at all times be suitably stored and protected from exposure to the atmosphere. In the event the cement shows signs of deterioration, it shall be removed from the work unless additional tests show that it conforms to the requirements stated above.

2. Aggregate

Fine and coarse aggregate for concrete shall conform to ASTM C33 or to CalTrans Standard Specifications Section 90-2.02 "Aggregates" with the appropriate Test Methods designated therein. In reinforced concrete maximum size of aggregate shall be 1-1/2 inches except in slabs and walls 8 inches or less where 3/4 inch maximum aggregate shall be used.

3. Water

Water shall be any potable water, clean and free from injurious amounts of oil, acid, alkali, and organic materials.

4. Reinforcing Steel

Deformed bars shall conform to ASTM A615 Grade 60. Deformation shall conform to ASTM A615. Wire reinforcement shall conform to ASTM A185, with mesh and wire sizes as indicated on the plans.

5. Waterstops

Waterstops embedded in the concrete shall be 6 inch polyvinyl chloride. A sample shall be submitted to the District Engineer for approval. Waterstops shall be installed in as long lengths as possible. Joining splices and corners shall be heat fused in accordance with manufacturer's recommendations. Waterstops shall be used around plastic pipes that penetrate concrete walls or manhole bases. Waterstops for each pipe type shall be as recommended by the pipe manufacturer.

6. Joint Filler

Preformed joint fillers shall conform to ASTM D1751.

7. Joint Sealant

a. General. For below ground installation or in areas not subject to architectural consideration, joint sealers shall be of the mastic type. For above ground installations or where architectural appearance is important joint sealers shall be of the rubber sealant type.

b. Underground Sealant. For sealing non-moving underground joints, construction joints and grooves in slabs, the sealant shall be "Permapol RC-550 Sealant" as manufactured by Products Research and Chemical Corporation, Gloucester City, New Jersey, and distributed by Sherwin Williams Company, Emeryville, California, or equal. The product is a two-component, nonsag, elastomeric epoxy sealant. Color shall be black. Application shall be as recommended by the manufacturer.

c. Aboveground Sealant. For sealing exterior joints subject to structural movement, and for weathertight joints between various materials the sealant shall be "PRC Rubber Caulk 7000 Sealant" as manufactured by Products Research and Chemical Corporation, Gloucester City, New Jersey and distributed by Sherwin Williams Company, Emeryville, California, or equal. The product is a one-part low-modulus, polysulfide elastomer. Color shall match material being applied to. Application shall be as recommended by the manufacturer.

C3.03 CONCRETE

1. Quality

Concrete shall be composed of cement, natural or crushed aggregate, and water proportioned and mixed as hereinafter specified. Pozzolan and water reducing air entraining agent shall be used when specified by the District Engineer. All concrete work shall be in compliance with ACI standards. The exact proportions of cement and aggregate shall be such as to produce a workable, strong, dense, impermeable concrete having approximate consistency and strength:

a. Consistency. The quantity of water required for the proper consistency of the concrete shall be determined by the slump test, in accordance with ASTM C143. Slump allowances shall be as follows:

Vertical wall sections, columns: maximum slump, 4 inches plus or minus 1 inch tolerance.

Floor slabs, beams, and footings: maximum slump, 3 inches plus or minus 1/2 inch tolerance.

b. Strength. Compressive strength shall be determined at the end of 28 days on standard 6 X 12 inch test cylinders in accordance with ASTM C39. The minimum compressive strength shall be 3,000 pounds per square inch.

c. Tests. Test shall be made by the District Engineer of the materials and of the resulting concrete at such intervals as deemed necessary by the District Engineer. The concrete mix shall be changed whenever, in the opinion of the District Engineer such change is necessary or desirable to secure the required workability, density, impermeability, and strength.

2. Batching

Concrete batching equipment shall be provided to determine and to control accurately the relative amounts of cement, water, sand, and each individual size of coarse aggregate entering into the concrete. Sand, cement, and coarse aggregate shall be measured by direct weighing.

Water shall be determined by direct weighing or by volumetric measurement. Equipment and its operation shall be subject at all times to the approval of the District Engineer.

3. Mixing

When authorized by the District Engineer, concrete may be mixed in a batch mixer of approved type which will insure a uniform distribution of the materials throughout the mass, so that the mixture is uniform in color and homogeneous. The mixer shall be equipped with a suitable charging hopper, a water storage and water measuring device controlled from a case which can be kept locked and so constructed that the water can be discharged only while the mixer is being charged. The entire contents of the mixing drum shall be discharged before recharging. The mixer shall be cleaned at frequent intervals while in use. The volume of mixed material per batch shall not exceed the rated capacity of the mixer.

4. Transit Mixed Concrete

Transit mixed concrete shall be used, provided that all of the above requirements pertaining to batching, mixing, and placing are complied with, and provided further that the concrete shall be placed within 2 hours after water is first added to the batch. Transit mixed concrete shall comply with all provisions of ASTM C94.

C3.04 MORTAR AND GROUT

Mortar shall consist of 1 part by volume of cement and 1 1/2 parts by volume of sand. Grout shall consist of 1 part by volume of cement and 1 part by volume of sand.

Mortar and grout shall be mixed in a suitable mixer in a watertight mixing box. The material must be thoroughly mixed dry until the mass assumes a uniform color and then sufficient water added to bring the mixture to a workable consistency. No mortar or grout which has begun to set shall be used, and no retempering thereof will be permitted.

C3.05 PRECAST CONCRETE MANHOLES

Manholes shall be precast concrete and shall conform to the details shown on District Standard Drawing No. 3. Materials shall conform to ASTM C478, and CalTrans Standard Specifications Section 90-2 "Materials".

Pipe stubs for lateral sewers shall be built into the structures as required; the outer ends shall be sealed securely by a cap or stopper of the same material as the branch. In laying pipe up to the structures, the pipe shall not project beyond the inside of the wall of the structure and in no case shall the socket of a vitrified clay pipe be built into the wall of a structure.

Joints in precast manhole shafts shall be made by buttering with mortar the joint space previously laid. After placing the next section, excess mortar squeezed from joint shall be removed and the joint area troweled smooth. Special precautions shall be taken to see that the entire joint space is filled with mortar.

Joints for precast manhole pipe sections may also be sealed by using "Ram-Nek", a preformed plastic material manufactured by K.T. Snyder Co., Houston, Texas, following the company's recommendations and Federal Specification SS-S-00210 (GSA-FSS).

Where the vertical distance from the pipe invert to finished grade is less than 3 feet, the manhole shall be constructed from reinforced concrete in a manner acceptable to the District Engineer.

C3.06 SPECIAL CONCRETE STRUCTURES

1. Forms

Forms for concrete construction shall be of wood or steel. For surfaces not exposed to view, such as backfilled walls, the forms may be metal or smooth boards free from large or loose knots. For other surfaces, the forms shall be waterproof plywood, tongue and groove sheeting, or metal. All forms shall be true, rigid, tight, thoroughly braced, and sufficiently strong to carry all loads.

Bolts, rods, or single wires shall preferably be used for internal ties and if used shall be so arranged that when the forms are removed no metal shall be within 1 inch of any surface. Twisted wire ties will not be permitted in the forms for any wall later to be subject to water pressure. The Contractor shall take due precautions to prevent future leakage or seepage along ties in all walls which will be subject to water pressure. Ties used in all such walls shall be cut back into the face of the wall at least 1 inch and the resulting holes pointed up with 1:1 1/2 mortar, cement to sand by volume.

2. Placing Reinforcing Steel

Reinforcing steel, before being positioned, shall be cleaned thoroughly of mill and rust scale or other coatings that will destroy or reduce the bond. Reinforcement appreciably reduced in section shall be rejected. Where there is delay in depositing concrete, reinforcement shall be inspected and, when necessary, cleaned. All bars shall be bent cold, shall be positioned accurately, and secured against displacement by using annealed iron wire or suitable clips.

3. Inserts

Where pipes, castings, or conduits are to pass through concrete walls, the Contractor shall place such pipes or castings in the forms being poured in the concrete, or in special cases, with the express consent and approval of the District Engineer, shall build approved boxes in the forms to make cored openings for subsequent insertion of such pipes, castings, or conduits, To withstand water pressures and to insure watertightness around openings so formed, the boxes or cores shall be provided with continuous keyways with waterstops all around, and they shall have a slight flare to facilitate grouting and the escape of entrained air during grouting.

Additional reinforcement shall be provided around such openings, if large, to meet the approval of the District Engineer. The pipes, castings, or conduits, as specified, shall be grouted in place by pouring in grout under a head of at least 4 inches. The grout shall be poured and rammed or joggled into place to completely fill the space between the pipes, castings, or conduits, and the sides of the openings, so as to obtain the same watertightness as the wall itself. The grouting materials so placed shall be surfaced when the forms are removed to give a uniform appearance to the wall if such wall will be exposed to view.

The Contractor shall accurately set and hold in exact position the forms until the concrete is poured, and set all thimbles, special castings, or other metal parts that are to be embedded in the concrete. He shall furnish and accurately set all inserts and anchors or other bolts necessary for the attaching of piping, valves and equipment.

4. Depositing Concrete

Concrete shall not be placed until the forms and reinforcements have been approved by the District Engineer.

5. Curing

Unformed concrete surfaces shall be covered with wet burlap mats as soon as the concrete has set sufficiently and shall thereafter be kept wet under burlap until backfilled or for 14 days after the concrete is placed. Formed surfaces, both interior and exterior, shall be similarly water-cured under burlap mats or by water sprays beginning as soon as the forms are stripped. At the option of the Contractor, concrete surfaces may be cured by the curing-compound method as defined below. Where wooden forms are used they shall be wetted immediately after concreting and shall be kept moist until removed, or may be treated with an approved form sealer before pouring.

Concrete curing compounds, if their use is permitted by the District Engineer, shall be of a nature and composition not deleterious to concrete, and thinned to a working consistency, either with a volatile solvent or by emulsification with water. The curing compound shall be of a standard and uniform quality ready for use as shipped by the manufacturer. At the time of use, the curing compound shall be in a thoroughly stirred condition. Curing compound shall not be diluted by the addition of solvent or thinners or be altered in any manner without the specific approval of and in a manner prescribed by the manufacturer.

The curing compound shall, when tested in accordance with ASTM C156, be effective in limiting the water loss in the concrete test specimens to 3 1/2 percent when applied at the coverage rate recommended by the manufacturer. Any compound proposed by the Contractor shall be tested by a recognized testing laboratory at the Contractor's expense, and 3 certified copies of the test report shall be furnished to the District Engineer.

Curing compound shall form a continuous, unbroken membrane which will adhere to moist concrete and which will not peel from the surface or show signs of such deterioration within 30 days after application under actual weather and working conditions.

The compound shall be sufficiently transparent and free from color so that there will be no permanent change in the color of the concrete. The compound shall contain however, a temporary hue of sufficient color to make the membrane clearly visible for a period of at least 4 hours after application.

6. Protection and Repair of Concrete Construction

All surfaces shall be protected against injury. During the first 72 hours after placing the concrete, wheeling, working, or walking on the concrete shall not be permitted. All slabs subject to wear shall be covered with a layer of sand or other suitable material as soon as the concrete has set. "Sisalcraft" paper or other similar tough waterproof paper may also be used, provided all joints between adjacent strips of paper are carefully sealed. This does not alter the requirements for proper curing as specified in Article C3.06.5, above.

No concrete shall be placed during rain period. All concrete placed within the preceding 12 hours of a rainstorm shall be protected with waterproof canvas or other suitable coverings.

All concrete construction shall be protected from excessive loadings. Installation of mechanical and electrical equipment shall be accomplished by employing shores, bearing places, frames, cranes, and temporary beams.

Immediately after the removal of forms all concrete shall be inspected, and all poor joints, rough sections, or rock pockets containing loose materials shall be repaired by cutting back to solid concrete and making an opening of such size and shape as will form a 1 inch key for cement mortar fill. All form tie holes and small imperfections shall be kept wet for 2 hours and then coated with neat cement paste. The fill for small imperfections and form ties shall consist of cement mortar composed of 1 part cement well mixed with 1 1/2 parts of fine aggregate by volume and just enough water so that the mortar will stick together on being molded into a ball by slight pressure of the hands. This mortar shall be thoroughly compacted into place. Where the area and volume of

defective concrete is large, it shall be repaired by reforming the surface and filling the opening with concrete. For such major repairs, the filling shall be reinforced and doweled securely to old concrete and shall be neatly finished to match the surface, color, and texture of the adjacent concrete. All patches shall be kept damp for 7 days.

Where the work requires concrete of existing structures to be removed, the existing concrete and steel shall be cut accurately to the lines required under the supervision of the District Engineer. The cutting shall be accomplished in a manner that preserves, free from cracks or other injuries, those parts of the existing structure that are to remain. Where the cut surface is to be left exposed, it shall be cleaned, sprayed with water, faced with 1:1 1/2 mortar, and finished to match adjacent surfaces.

7. Finished or Formed Surfaces

All finished or formed surfaces shall conform accurately to the shape, alignment, grades, and sections required. The finished surface shall be free from fins, bulges, ridges, offsets, honeycombing, or roughness of any kind, and shall present a finished, smooth continuous hard surface. All sharp angles, shall be rounded or beveled, where required. Any formed surface to be painted shall be free of any material that will be detrimental to the paint.

SECTION C4 - METALWORK

C4.01 SCOPE

Metalwork includes the providing of pipe handrails, stair treads, grating, plating, seat angles, stop gates, manhole frames and covers, anchor bolts and all other structural steel, miscellaneous metalwork, and castings.

C4.02 STRUCTURAL STEEL

1. Material

Structural steel shall conform to ASTM A36, Structural Grade, or as specified in the Contract Drawings.

2. Fabrication

Fabrication and workmanship shall be done in accordance with AISC "Specifications for Fabrication and Erection". Welding shall be done by welders who have been qualified by tests as prescribed by the American Welding Society in "Standard Qualification Procedure" to perform the type of work required. The quality of welding shall conform to "Code for Arc Welding in Building Construction", Section 4, Workmanship. Reinforcing rods to be welded shall be preheated to minimum of 212° F at a distance of 3 inches each side of the weld and then welded using a low hydrogen type welding rod.

3. Galvanizing

Fabricated steel items such as brackets, hangers, seating angles, door protectors, housings, and similar small items shall be galvanized after fabrication. Large structural steel items such as roof trusses shall be galvanized only if specifically required. Steel work to be of the following standard specifications as applicable: ASTM A123, A384, A385 and A386.

4. Bolted Connections

All bolted connections shall be AISC Standard "B" Series.

C4.03 PIPE HANDRAIL

Pipe handrail shall be standard 1¼ inch black steel pipe made up by welding. Railing shall be shop fabricated into easily handled units and galvanized after fabrication. Filed joints shall be welded or ground smooth to match adjacent pipe and shall be coated with molten Galvo-Weld or approved equal.

Aluminum handrails shall be made from 1½ -inch diameter aluminum pipe Schedule 40, alloy 6063 – T6 temper handrail grade, or 6061 – T6 where required for bending. The fabricator and installer must be State Licensed in specialty welding of anodized architectural aluminum railings.

C4.04 PIPE COLUMNS

Steel for pipe columns shall conform to ASTM A53, Grade B.

C4.05 FLOOR GRATES, PLATES AND SUPPORTS

Gratings and floor plates shall be galvanized steel or aluminum designed for the live load required. The minimum design live load shall be 100 pounds per square foot. Floor plates and grates shall be adequately stiffened or shall be of sufficient thickness so that the maximum deflection at the design load does not exceed 1/240 of the span. Gratings shall be completely banded, and both gratings and plating shall be field measured for proper cutouts and size. No single pieces of grating or floor plate shall weigh more than 100 pounds. Gratings and plating shall be supported on steel seats and shall be set flush with the floor. Gratings, plating, and seat angles shall be galvanized after fabrication in accordance with ASTM A386.

C4.06 SAFETY STAIR TREADS

All concrete steps shall have safety treads 4 inches wide and extending to 3 inches from each side of the step. Safety treads shall be American Abrasive Metals Company, Feralum Style A, or equal.

C4.07 ANCHOR BOLTS

Anchor bolts shall be fabricated as specified by the equipment manufacturer and, unless otherwise indicated, shall be galvanized. Anchor bolts shall be secured in place with the forms before pouring concrete.

C4.08 IRON CASTINGS

Iron castings shall be made from properly prepared patterns and molds and shall conform to ASTM A48. Small castings shall be galvanized. Large castings shall be galvanized only if specifically required.

C4.09 ALUMINUM SLIDE GATES

Aluminum for slide gates shall conform with American Society of Civil Engineers Specifications for Structures of Aluminum, Alloy 6061-T6. Gate guides shall be fabricated from standard aluminum shapes and shall also be Alloy 6061-T6. Aluminum to be in contact with concrete shall be coated with coal tar epoxy. Stems shall be of stainless steel ASTM A-276 Type 316 and guides shall be fitted with polyethylene bearing strips.

SECTION C5 - PIPELINES AND SEWERS

C5.01 SCOPE

Pipelines and sewers include the furnishing, installing, and testing of pipe, pipe supports, anchors, fittings, valves, special accessories, and all necessary appurtenances to make the work complete and operable.

Attention by the Contractor is directed to Article C 1.09 Safety and Health Provisions, of these Specifications with respect to CAL OSHA rules and regulations to follow before entering manholes.

C5.02 MATERIALS

1. Scope

All pipe materials which may be used are covered under this section. The inclusion of all acceptable material does not infer that any of the materials listed below may be used on any project for any set of conditions. Refer to Article B2.02 of these District Standard Specifications for limitations on the use of various types of pipe materials. In all cases, lateral sewers shall be of the same material as the main sewer to which they are connected.

2. Plastic Pipe

Plastic pipe, fittings and joint materials specified herein consist of Poly-Vinyl Chloride, hereinafter referred to as PVC and Polyethylene, hereinafter referred to as HDPE. All materials incidental to plastic pipe installations such as gaskets, joint lubricants, cement, etc., shall be supplied by the pipe manufacturer. All plastic pipe required in odd lengths shall be cut using a proper cutting tool and guide that insures true line cut on planes perpendicular to the pipe axis. No bevel cuts for pipeline alignments will be permitted.

The inside diameter of an installed section of plastic pipe shall not be allowed to deflect more than five (5%) percent. The pipe deflection shall be checked by means of the deflection gauge in the presence of the District Engineer after the placement of all trench backfills, aggregate subbase (if specified) but prior to installation of aggregate base and/or asphalt concrete.

Poly-Vinyl Chloride (PVC)

All PVC pipe and fittings shall, at a minimum, conform to the requirements of ASTM Designation D 3034 as they apply to type PSM SDR 26 PVC. Sewer Pipe shall be installed using an Elastomeric Gasket Joint in a bell and spigot assembly system. Rubber sealing gaskets shall meet the requirements of ASTM Designation D-1869. Alternate pipe types include AWWA C900 Class 150 PVC (SDR 18) and Class 200 PVC (SDR 14), which are required under special circumstances. No solvent cement joints will be permitted.

All PVC pipe entering or leaving a concrete structure shall have a rubber sealing gasket, as supplied by the pipe manufacturer, firmly seated perpendicular to the pipe axis, around the pipe exterior and cast into the structure base or near the structure wall center as a water stop. Said water stop may also consist of a manhole coupling with rubber sealing rings cast into structure base.

PVC pipe joining may occur at any convenient distance beyond and/or between structures.

PVC force-laterals shall be approved by the District Engineer.

Repairs to PVC pipe shall utilize double bell unions.

Polyethylene Pipe (HDPE)

Polyethylene pipe shall be HDPE with minimum wall thickness of SDR 17 and conform to the specifications of ASTM D 3350. The polyethylene pipe shall meet the PE345434C cell classification per ASTM 3350.

The polyethylene pipe shall provide leak-free, butt-fused connections suitable for the purpose intended. Polyethylene pipe fittings shall be fused to the pipe.

Force-lateral fittings to be used with 1.25" to 1.5" HDPE shall be the compression type, shall be of commercial quality, and shall be recommended by the pipe manufacturer. Fittings shall have female sockets with an internal barb to provide a positive pipe-to-fitting connection that will not separate at the designed pressure.

A Certificate of Compliance for the polyethylene pipe shall be furnished to the District Engineer, upon request.

HDPE force-laterals shall be approved by the District Engineer.

Repairs for HDPE pipe shall utilize an electrofusion couplings on one or both ends and butt-fusing the other, as necessary.

3. Cast Iron and Ductile Iron Pipe

Cast iron pipe shall comply with ANSI A 21.6 (AWWA C106) for pipe cast in metal molds or ANSI A21.8 (AWWA C108) for pipe cast in sand-lined molds.

Ductile iron pipe shall comply with ANSI A21.51 (AWWA C151).

Cast and ductile iron pipe joints shall comply with the following requirements for the types specified on the plans or in the Specifications:

Type of Joint	Specifications
Rubber Gasket Push-on Joint	ANSI A21.11 (AWWA C111)
Mechanical Joint	ANSI A21.11 (AWWA C111)
Flanged Joint	ANSI B16.1, B16.2, and A21.10 (AWWA C110)
Flanged Joint (Threaded Flanges)	ANSI B1.1

Flange gaskets shall be 1/16 inch for pipe 10 inches and less and 1/8 inch for large pipe. Flange assembly bolts shall be standard square head machine bolts with heavy, hot pressed, hexagon nuts. Threads shall conform to ANSI B1.1 coarse thread series, Class 2 fit. Bolt length shall be such that after joints are made up, the bolts shall protrude through the nut, but no more than 1/2 inch. Bolts for use in submerged services shall be 316 stainless steel.

Flexible couplings shall be Smith-Blair flexible steel coupling series 411 or Dresser style 38 with the stop removed on middle ring. Exposed metal surfaces shall receive a protective coating as specified in Section C6 - Painting.

All rubber gasket, push-on, mechanical and flanged joint fittings for cast iron or ductile iron water

pipe shall be manufactured in accordance with ANSI A21.10 (AWWA C110).

Unless otherwise specified, the internal surfaces of cast iron and ductile iron pipe and fittings shall be lined with a uniform thickness of cement mortar then sealed with a bituminous coating in accordance with ANSI A21.4 (AWWA C104). The outside surfaces of cast iron and ductile iron pipe and fittings for general use shall be coated with a bituminous coating 1 mil (0.025mm) thick in accordance with ANSI A21.6 or ANSI A21.51. Exposed surface shall be coated as specified in Section C-6 Painting.

The manufacturer shall furnish a certified statement that the pipe has been manufactured and tested in accordance with these specifications.

Buried cast iron or ductile pipe shall be encased in polyethylene and installed in accordance with the requirements of ANSI A21.5 (AWWA C105).

4. Vitrified Clay Pipe and Fittings

Vitrified Clay pipe (VCP) and fittings when permitted for use by the District Engineer shall be extra strength, unglazed, conforming to ASTM C700, and shall be furnished with bell and spigot ends or plain ends.

Pipe joints shall be of a mechanical flexible compression type. Joints for bell and spigot pipe shall be made of plasticized polyvinyl chloride compound, bonded to the pipe, molded, and cured to uniform hardness so as to form a tight coupling when assembled. Joints for bell and spigot pipe shall be Wedge Lock and Speed Seal Mainline. Joints for plain end pipe shall be rubber couplings secured with stainless steel bands. Joints for plain end pipe shall be Band Seal as manufactured by Mission Clay Products Company or equal. Rubber couplings are generally not allowed on mainlines unless approved by the District Engineer.

5. Manholes

Manholes shall be constructed of precast reinforced concrete pipe sections as specified in Article C3.05 of these specifications.

6. Backwater Overflows and Check Valves

The type of backwater overflow device or check valve shall be provided by the contractor. Detail drawings of such devices and the method of connection shall be submitted to the District Engineer for approval. Actual design shall conform with Standard Drawing No. 13.

C5.03 INSTALLATION

1. Pipe Laying

Pipe laying shall include the installation and jointing of the pipe. Pipe shall be laid with uniform bearing under the full length of the pipe. In general, pipe laying shall proceed upgrade with the bell end facing upstream and spigot pipe pointing in the direction of flow. Each piece shall be laid true to line and grade and in such manner as to form a close concentric joint with the adjoining pipe and to prevent sudden offsets in the flow line. As the work progresses, the interior of the sewer shall be cleared of all dirt and debris. Where cleaning after laying is difficult because of small pipe size, a suitable swab or squeegee shall be kept in the pipe and pulled forward past each joint immediately after jointing has been completed. Pipe shall not be laid when the condition of the trench or the weather is unsuitable. At times when work is not in progress, open ends of pipe and fittings shall be closed.

2. Pipe Jointing

a. Vitrified Clay Pipes. For vitrified clay pipe with flexible compression joints, the mating surfaces shall be wiped clean of dirt and foreign matter, and an approved lubricant as recommended by the pipe manufacturer shall be applied to the joint surfaces. the spigot shall then be positioned inside the bell and the joint shoved home. For small diameter pipe this operation may be done by hand, but on large diameter pipe a lever attachment, or a bar cushioned with a wooden block, shall be used to shove the joint into place.

Rubber Band-Seal joints shall be made in accordance with the manufacturers' instructions and only installed where permitted by the District Engineer.

b. PVC Pipes. PVC gaskets on the bell ends shall be wiped clean and lubricated with a lubricant acceptable to the manufacturer. Spigot ends shall be clean, free of burrs and marked at the point of full penetration. The spigot joint shall be inserted inside the bell to the point marked on the spigot end.

c. HDPE Pipes. HDPE pipe requires extra care during the pipe laying stage to ensure a consistent and accurate slope. HDPE pipe is typically fused prior to pipe laying. Fusing HDPE pipe shall be done in accordance with the manufacturer's recommendations.

d. Cast Iron and Ductile Iron Pipe. For mechanical pipe (joint), the bell and spigot shall first be cleaned thoroughly, and then the mating surfaces shall be brushed with soapy water. With the gland and the gasket on the spigot end, the pipe shall be seated into the bell. The gasket shall be pressed firmly and evenly into the bell and the gland positioned. When tightening the bolts, the gland shall be brought up evenly at all points around the bell flange.

For rubber gasket joints, the gasket and bell shall be thoroughly cleaned before inserting the gasket into the bell. After the gasket is positioned, a thin film of approved lubricant shall be applied to the exposed surface of the rubber gasket. After wiping the spigot clean, it shall be shoved home into the bell. If pipe is field cut, the spigot end shall be tapered with a file to about 1/8 inch back at an angle of 30 degrees with the centerline of the pipe.

C5.04 CONNECTIONS TO EXISTING MANHOLES

Pipe connections to existing manholes shall be made in such a manner that the finished work shall conform as nearly as practicable to the applicable requirements specified for new manholes, including all necessary concrete work, cutting, and shaping. Pipe penetrations shall match existing flowlines in the manhole base.

C5.05 CONNECTIONS TO EXISTING PIPES

Fittings or adapters required to connect new pipe to existing pipe shall be provided by the Contractor. Detail drawings of such fittings or adapters and the method of connection shall be submitted to the District Engineer for approval. New pipe shall be the same pipe type as existing pipe for mainline extensions.

C5.06 SIDE SEWER CONNECTIONS TO MAIN SEWERS

1. Concurrent Construction

Where side sewers are constructed concurrently with main sewers, connections shall be made with regularly manufactured wye or tee branches. the ends of the side sewer shall be securely stopped with plugs or caps which can easily be removed without damage to the pipe end. The ends of the side sewers shall be marked with a 2 x 4 redwood stake extending from the sewer invert to finished

grade. In the case of new subdivision work, curbs shall be imprinted with a "s" directly over the side sewers.

2. Side Sewer Connection to Existing Main Sewer

Side sewer connections to existing sewers shall be made at a wye or tee branch. Where, in the opinion of the District Engineer it is impractical to connect to an existing wye or tee branch, the connection shall be made by the use of special fittings as described below.

a. Vitrified Clay Pipe Main Sewer. Connections to existing vitrified clay main sewer shall be made by one of the two following alternative methods:

i. Cut out a section of the main sewer and install a plain-end wye branch using banded rubber seal sleeves with stainless steel bands. This method shall be used whenever the side sewer is the same size as the main sewer. Concrete encase the banded rubber sleeves.

ii. Core a neat trim opening in the upper portion of the main sewer and install a special drilled fitting (i.e., "tap tight") to complete the side sewer connection.

b. PVC Main Sewer. Connections to existing PVC main sewer shall be made by one of the following alternative methods:

i. Core a neat trim opening in the upper portion of the main sewer and install a special drilled fitting (i.e., "tap tight" or “inserta-tee”) to complete the side sewer connection.

ii. Cut out a section of the main sewer and install a wye branch with plain-end stub-outs and use double bell unions to connect to the main. This method shall be used whenever the side sewer is the same size as the main sewer.

c. HDPE Main Sewer. Connections to existing HDPE main sewer shall be made by one of the following alternative methods:

i. Side-fuse a saddle to the main sewer and butt-fuse the lateral to the saddle.
ii. Use a double-banded saddle with wide straps around the main sewer. Silicon seal the saddle to the main sewer to prevent leaks.
iii. Cut out a section of the main sewer and fuse a prefabricated TEE. This method may be used whenever the side sewer is the same size as the main sewer.

C5.07 BORING AND JACKING

Where permitted by the District Engineer, highway or railroad crossing may be made by boring or jacking.

If installed by boring, the bored hole shall be not greater than 2 inches in diameter larger than the largest outside diameter of the steel casing pipe to be installed.

If installed by jacking, sufficient jacking capacity shall be provided to insure a successful operation.

If the sewer is to be installed in a bored or jacked conductor pipe, it shall be subject to all material and jointing requirements hereinbefore specified. The sewer shall be installed true to line and grade on wood blocks, or rails, secured to the invert of the casing pipe. After installation of the sewer, the ends of the conductor pipe shall be sealed with an approved casing seal. After installation of the sewer, the annular space between the casing and sewer pipe shall be filled with sand or grout and the ends of the casing pipe sealed with an

approved casing seal. The annular space outside of the casing pipe shall be grouted with cementitious material.

C5.08 PIPEBURSTING METHOD AND EQUIPMENT

The Contractor shall be licensed by and pay all royalties to holder of the patent, if any, for the trenchless replacement system used by the Contractor. The Contractor shall hold the District harmless in any legal action resulting from patent infringements.

The method approved for replacement of existing sanitary sewers by pipebursting and installation of new polyethylene pipe is pneumatic bursting, static bursting, or equal.

The main components of a pipe bursting system consists of a pipe bursting tool or head, to which the new pipeline is connected, and a pulling machine or a pulling winch. The bursting head is inserted into the sewer section to be replaced, and is pulled by a pulling machine or pulling winch located in the pulling pit, located at a certain distance along the alignment of the sewer section under consideration, away from the device insertion location. The bursting head shall pull behind it the new sewer pipe to be placed along the same horizontal and verticals alignments of the existing sewer. The backside of the bursting head shall be firmly connected to the new sewer pipe to be pulled into place of the existing sewer.

For gravity-type wastewater pipeline applications (12-inches in diameter or smaller) where reception excavations are either impractical or undesirable, the winching system shall be installed within a standard manhole so as to receive the bursting head and the new replacement pipe.

Upon commencement, pipe insertion shall be continuous and without interruption from one manhole to another, except as approved by the District.

1. BURSTING HEAD

The pipebursting head shall be designed and manufactured to force its way through existing pipe materials by fragmenting the pipe and compressing the old pipe sections into the surrounding soil as it progresses. The bursting unit shall provide smooth, controlled power to burst and compact the existing pipe. Vibrations from the bursting equipment shall not damage the surroundings utilities structure. Follow manufacturer's specifications for what size tool should be used in what diameter of pipe, as well as parameters of tool size when upsizing pipe.

a. The design and shape of the head shall be such that the existing pipe will be broken into many small fragments.

b. The method of connection of replacement pipe to the unit shall be such that stresses transmitted to the replacement pipe are not damaging to the pipe and will not exceed the tensile capacity of the pipe.

c. Provisions shall be made in the equipment to remotely start and stop the unit should it become necessary to temporarily cease operation.

d. Measures shall be taken to ensure that the pipe does not become separated from the bursting head.

e. The bursting head shall incorporate a shield/expander to prevent collapse of the hole ahead of PE pipe insertion.

2. WINCH OR PULLING UNIT

The winch shall be attached to the front of the bursting unit. The winch or pulling unit shall be operated to provide constant pull to the bursting unit in order that it may operate in an efficient manner with a minimum of recoil. It shall directionally stabilize the bursting head by keeping it in line with the unit.

a. The winch shall be constant tension, variable speed type fitted with a direct reading load gauge to measure the winch load.

b. For static bursting, the winch shall be fitted with a device to automatically disengage the winch when loading exceeds a preset maximum load, or the rated pressure of the bursting head.

c. The bursting head shall be connected to a pipe known as the "weak link" which will break before the maximum load on the replacement pipe is reached.

d. Contractor shall supply sufficient cable in one continuous length so that the pull may be continuous between winching points.

e. The winch, cable and cable drum shall be provided with safety cage supports.

f. The Contractor shall provide a system of guide pulleys and racing at each manhole to minimize contact of cable with the existing sewer between manholes.

g. Supports to the trench shoring in the insertion pit shall remain completely separate from the pipe support system and shall be so designed that neither the pipe nor the winch cable shall be in contact with them.

h. Proper clearance shall be provided below the existing pipe to allow for the proper use of a winch.

3. TREATMENT OF PIPE

a. At intermediate manholes

When the pipes pass through an intermediate manhole, it shall be cut in an approved manner so that 2 inches protrudes into the manhole. The pipe shall be cut out using a small compressed air disc cutter or other similar suitable tools. At existing manholes, existing pipe shall be chipped out of the manhole prior to inserting the new sewer pipe to protect the manhole from the stresses caused by the trenchless replacement method. The invert of the manhole shall be broken out to a depth of 1½ inches and rebenched using concrete.

b. At upstream and downstream manholes

At the upstream and downstream manholes the ends of the pipe shall be cut in an approved manner so that 2 inches protrudes into the manhole. The invert of the manhole shall be suitably prepared such that a smooth transition shall be made from the existing pipework to the new pipe. The existing pipe shall be chipped out of the manhole prior to the new sewer pipe being installed to protect the manhole from the stresses caused by the trenchless replacement method, as necessary.

c. Relaxation period

The Contractor shall allow the pipe to "relax" for the manufacture's recommended amount of time, but not less than four (4) hours for pneumatic bursting or twelve (12) hours for static bursting, after trenchless replacement has been completed. A minimum of 2 feet of pipe shall remain in the manhole during the relaxation period.

d. Sealing pipe in manhole

Following the relaxation period, to seal the PE pipe in the manholes at the entry and exit points, the ends of the pipe shall be surrounded in non-shrink grout, which forms part of the manhole base after water stops are installed.

e. Insertion and pulling pits

The size, location and method of excavation and shoring of all pits on site shall be determined prior to the start of the project. In considering locations for access pits, the contractor shall consider the size of the sewer, locations, obstructions and services, pulling distances, traffic conditions, and locations of utilities and sewer laterals. When possible, intermediate access excavations can coincide with building service connection excavations or critical obstructions in the sewer. The locations of the excavation pits should be such as to minimize traffic disruption.

The insertion pit shall be large enough to allow the new pipe to enter the existing pipeline alignment on-grade. The pipeline shall not enter the existing pipeline alignment at an angle.

The end of the launch pit on which the pulling forces are exerted shall be supported using beams or plates of sufficient surface area to allow the forces to be dissipated into the surrounding soil.

4. PIPE INSERTION

a. The installation forces on the pipe shall be kept to a minimum. Maximum force to be within stress limits of the pipe.

b. Rollers shall be provided at the insertion pit so that no pipe drags along the ground surface.

c. A roller or rub shoe shall be installed at pipe entry to prevent pipe chatter as the pipe enters the existing line.

d. Where a device is employed to exert force on the rear of the inserted pipe lengths, the force applied to the inserted pipe shall be evenly distributed around the wall of the pipe.

e. Where lengths of pipe are jointed and a device is employed to exert force to the rear of the inserted pipe lengths, precautions shall be taken by the Contractor to ensure that no bucking, crushing or twisting of the pipe occurs.

f. Lubrication may be used as recommended by the manufacturer.

5. MAINTENANCE SEWER SERVICE

The Contractor shall be responsible for maintaining all flows within the system. He shall bypass the flows around the sections of the pipe to be replaced. The Contractor shall comply with the bypassing guidelines listed in Section C9.04.

6. PIPE JOINING

Pipe shall be butt welded in accordance with ASTM D2657. The joints shall be leakproof, thermal, butt joints. Threaded or solvent-cement joints and connections are not permitted.

All fusing shall be done using tools recommended by the pipe supplier and approved by the District Engineer. Operators shall be certified by the pipe manufacturer and/or fusing equipment supplier.

The butt-fused joint shall be true alignment and shall have uniform rollback beads resulting from the use of proper temperature and pressure. The joint shall be allowed adequate cooling time before removal of pressure. The fused joint shall be watertight and shall have tensile strength equal to that of the pipe. Joints shall be smooth on the inside and internal protection beads shall be greater than 3/16-inch.

All joints shall be subject to acceptance by the District Engineer prior to insertion. All defective joints shall be cut out and replaced at no cost to the District. A specimen of pipe cut across the butt fusion joints shall be tested in accordance with ASTM D638.

A copy of the required butt fusion parameters listed below shall be kept at the job site so that the temperatures and pressures of the jointing process are known and can be checked on site. Specific information includes the following:

a. The temperature at the surface of the heating plate (the fusion temperature);

b. The pressure used to push the pipe against the heating plate;

c. The time when the pipe ends are in contact with the heating plate but no pressure is being applied (soak time);

d. The pressure used to push the pipe ends together after heating (the fusion pressure);

e. The time of application of this butt fusion pressure (fusion cooling time);

f. Allowable bead height and width range.

7. LATERALS

All lateral connections will be located by the Contractor, disconnected prior to bursting, and then permanently reconnected to the new pipe after bursting has been completed.

The Contractor shall expedite the reconnection of services so as to minimize any inconvenience to the customers.

Reconnection of laterals shall be accomplished from the ground surface by excavating a small opening and utilizing appropriate shoring so the connections can be made safely. The finished connection shall be made flush with the new sewer and shall provide a smooth transition to the existing lateral pipework.

The Contractor shall connect laterals using sidewall saddle fusion. The following steps must be followed.

a. Rough up area on pipe and end of fitting to be fused with sandpaper and wipe off with clean rag.

b. Preheat iron to 500 degrees and place on pipe. Hold on pipe until melt pattern is achieved, Place fitting on iron and hold for 90 seconds. After 90 seconds, pop fitting off iron and then remove iron from pipe.

c. Drill out service connection

d. Deburr

Three (3) feet of the existing lateral shall be replaced when the lateral is reconnected. The new section of lateral shall be constructed of the same type of material as the new mainline. One non-shear type coupling with stainless steel bands shall be used to connect the new lateral to the existing vitrified clay pipe lateral. The root treatment system shall be applied to both joints of the coupling attached to an existing lateral. Couplings are NOT allowed on the mainline.

8. EXCAVATION AND BACKFILL

Insertion trenches shall be prepared and backfilled in accordance with sound bedding practices ASTM D2774 and ASTM D2321.

C5.09 ACCEPTANCE TESTS

All gravity sewers, including manholes, shall be tested for leakage and inspected for obstructions (Clean and TV inspection), pipe deformation (mandrel), and alignment problems (visually). All side sewers shall be tested for leakage and inspected for obstructions and alignment problems. All force mains shall be tested for leakage and inspected for obstructions, deformation, and alignment. These are minimum test requirements. The District Engineer reserves the right to require additional testing, if he deems it necessary. The Contractor shall provide all labor, tools, equipment, waste disposal, and utilities necessary to meet the acceptance test requirements.

1. Obstructions

After backfilling and compacting, but before repaving, all main sewers shall be cleaned and TV inspected for obstructions. If the televised line appears to be deformed the Contractor shall test for specification conformance by the sewer ball method. Means shall be provided for intercepting all grit, rocks, and other flushed debris to keep debris from entering the existing sewerage system.

2. Leakage

The program of testing shall fit the conditions as mutually determined by the District Engineer and the Contractor. The Contractor shall take all necessary precautions to prevent any joint from opening while the pipeline and its appurtenances are being tested. The Contractor shall, at his own expense, correct any excess leakage resulting from or caused by this test. Where the actual leakage exceeds the allowable, the Contractor shall discover the cause and remedy it before the test is accepted. If the leakage is less than the allowable and leaks are observed, such leaks shall be repaired at the District Engineer's direction.

a. Main Sewers: After main sewers have been inspected and cleared of obstructions and following backfill, but prior to repaving, they shall be tested for leakage. Each section of the sewer shall be tested between successive manholes by closing the lower end of the sewer to be tested and the inlet sewer of the upper manhole with stoppers. At the Contractor's option either the hydrostatic or air test may be used.

Hydrostatic Test - Fill the pipe and manhole with water to a point four feet below the ground surface of the upper manhole, but in no case less than four feet above the pipe

invert. If ground water is present, the water surface in the upper manhole shall be at least four feet above the level of the ground water. The line shall be filled at least one hour prior to testing and shall be tested at least 2 hours by maintaining the head specified above with measured additions of water. The sum of these additions of water in the two-hour period shall be the leakage amount for the test period.

The maximum allowable head of water above any portion of sewer being tested shall be 15 feet. Where the difference in elevation between successive manholes exceeds 15 feet a test tee shall be installed between manholes, and testing shall be carried on between the tee and the manhole.

The allowable leakage shall not exceed 0.1 gallons per minute per inch diameter, per 1000 feet of main line sewer being tested.

Where media other than water is used for testing, the allowable leakage shall be as mutually agreed to be between the District Engineer and Contractor.

Air Test - Air test shall be applied to each length between adjacent manholes, and the procedure shall be as follows:

Pressurize the test section to 3.5 p.s.i. and hold above 3.0 p.s.i. for not less than 5 minutes. Add air if necessary to keep the pressure above 3.0 p.s.i. At the end of this 5 minute saturation period, note the pressure (must be 3.0 p.s.i. min.) and begin the timed period. If the pressure drops 0.5 p.s.i. in less than the time given in the following table the section of pipe has not passed the test.

SIZE	MINIMUM TIME IN SECONDS
4"	125
6"	185
8"	245
10"	310
12"	370
15"	460
18"	555

SIZE	TIME IN MINUTES
21"	10
24"	12
27"	14
30"	16
36"	18
42"	20
48"	23
54"	26

If the time for the pressure to drop 0.5 p.s.i. is 125% or less of the time indicated, the line shall immediately be repressurized to 3.0 p.s.i.g. and the test repeated. If, during the 5 minute saturation period, the pressure drops less than 0.5 p.s.i. after the initial pressurization and air is not added, the section undergoing the test shall have passed.

If the test is not passed, the leak shall be found and repaired to the satisfaction of the District Engineer, and the section retested.

When the prevailing ground water is above the line being tested, air pressure shall be increased 0.43 p.s.i. for each foot the water table is above the invert of the line. If the air pressure exceeds 5 psi, the District Engineer may require hydrostatic test at his own discretion.

The pressure gauge used shall be supplied by the contractor, shall have minimum divisions of 0.10 p.s.i., and shall have an accuracy of 0.04 p.s.i. Accuracy and calibration of the gauge shall be certified by a reliable testing firm when requested by the District Engineer, or at six (6) month intervals.

b. Manhole Testing - After completion of manhole construction, all manholes shall be tested for leakage. The Contractor shall furnish all labor, tools, and equipment necessary to make the tests and to perform any work incidental thereto. He shall, at his own expense, correct any excess leakage and repair any damage to the pipe and its appurtenances or to any structures resulting from or caused by these tests.

The Contractor shall, at his own expense, correct any excess leakage and repair any damage to the pipe and its appurtenances or to any structures resulting from or caused by these test. Each manhole shall be tested using the water test or vacuum test method.

Water Test – Each manhole shall be tested by inserting inflatable plugs in all sewer inlets and outlets of the manhole, and filling the manholes with water to a point six inches below the base of the manhole frame.

The manhole shall be filled at least one hour in advance of the official test period to allow time for absorption. The loss of water may be determined by measuring additions of water required to maintain the specified water level, but the level shall not be allowed to fall more than 25% of the manhole depth.

The allowable leakage shall be determined by the following formula:

Em = .0002 x L x square root H

where Em = amount of allowable leakage in gallons per minute.
L = depth of manhole from top to bottom. (feet)
H = head of water in feet, as measured from the sewer line invert or from prevailing ground water against outside of manhole barrel. The lesser height governs.

Vacuum Test – Each manhole shall be tested by inserting inflatable plugs in all sewer inlets and outlets of the manhole and using a vacuum test apparatus. The vacuum test apparatus shall be sized to seal no more than the top 6" of the manhole measured from finished grade and capable of pumping out a manhole to -10 in Hg.

Pump out the manhole to -10 in Hg. If the vacuum does not drop in excess of 1 in Hg over the specified time in the table below, the manhole passed the test.

Manhole Depth-Feet	DIAMETER INCHES		
	48	60	72
4	10 sec.	13 sec.	16 sec.

8	20 sec.	26 sec.	32 sec.
12	30 sec.	39 sec.	48 sec.
16	40 sec.	52 sec.	64 sec.
20	50 sec.	65 sec.	80 sec.
24	**(A)** 60 sec.	**(B)** 78 sec.	**(C)** 96 sec.
* Deeper than 24 ft	**(A')** 5.0 sec.	**(B')** 6.5sec	**(C')** 8.0 sec.
***Test time=A, B or C respectively + (MH Depth - 24) x 1/2 x A', B' or C'.respectively**. (The values listed above have been extrapolated from ASTM designation C924-85)			

Where the actual leakage in a manhole exceeds the allowable, the Contractor shall discover the cause, remedy it, and retest the manhole before the manhole is accepted. If the leakage is less than allowable and leaks are observed, such leaks shall be repaired.

As an alternative to the above procedures, the Contractor may fill the manhole with water prior to backfill and repair all visible leaks provided there is no ground water above the manhole base. Any visible leaks into or out of a manhole shall be repaired. Alternative methods of manhole testing will be considered by the District Engineer.

Where media other than water is used for testing, the allowable leakage shall be as mutually agreed to by the District Engineer and Contractor.

c. Side Sewers: Side sewers shall be tested before being connected to the main sewer. The side sewer shall be plugged at its end and filled with water through the cleanouts. The water level in the cleanouts shall be maintained throughout the test period as high as possible. One hour after filling the pipe with water, the entire line shall be visually examined for leakage. All leaks shall be repaired in an acceptable manner. The trench shall not be backfilled until the complete inspection has been made. Following approval by The District Engineer, the plug shall be removed, the water disposed of, and the connection at the main sewer completed.

d. Force Mains: Force mains shall be tested for leakage in conformance with applicable portions of Section 13, American Water works Association C600, for test pressure of 150 percent of the specified working pressure for the pipe. The test shall last at least one hour at the required pressure measured at the test pump. The allowable leakage shall be computed by the following formula:

$$L = \frac{ND(P)^{1/2}}{1850}$$

where

L = allowable leakage, gallons per hour
N = number of joints in test section
D = nominal pipe diameter, inches
P = average test pressure, pounds per square inch.

SECTION C6 - PAINTING

C6.01 SCOPE

Painting shall include the furnishing of all labor, equipment, appliances and material, and the performing of all operation in connection with the preparation of surfaces, application of all paint or other materials, and the manufacture of paints, paint materials, and miscellaneous materials incidental thereto. Surface to be painted shall receive the treatment and the number of coats prescribed in the Painting Schedule.

Attention by the Contractor is directed to Article C1.09, Safety and Health Provisions, of these Specifications with respect to CAL OSHA rules and regulations to follow before entering manholes.

C6.02 STANDARD PRODUCTS

All materials, supplies, and articles furnished shall, whenever practicable, be the standard product of a recognized, reputable manufacturer. The standard products of manufacturers other than those specified will be acceptable when it is proved to the satisfaction of the District Engineer that all paint materials comply fully with the specification.

Precautions concerning the handling and the application of paint shall be shown on the label of paint and solvent containers in accordance with the Construction Safety Orders and General Industry Safety Orders of the State of California.

C6.03 CLEANING AND PREPARATION OF SURFACES

Surfaces to be painted shall be clean before applying paint or surface treatments. Oil, grease, dirt, rust, loose millscale, old weathered paint, and other foreign substances shall be removed except as herein after specified. The removal of oil and grease shall, in general, be accomplished by blast cleaning. Minor amounts of grease and oil contaminants will be tolerated on the surface prior to blast cleaning, provided that abrasive is not reclaimed and reused.

Clean cloths and clean fluids shall be used in solvent cleaning to avoid leaving a thin film of greasy residue. Cleaning and painting shall be so programmed that dust or spray from the cleaning process will not fall on wet, newly painted surfaces. Hardware and similar accessories shall be removed or suitably masked during preparation and painting operations, or shall otherwise be satisfactorily protected.

In all cases, the recommendations of the paint manufacturer shall be rigidly followed.

C6.04 PAINT APPLICATION

1. Workmanship

In general all painting shall be done as specified herein and as set forth in CalTrans Standard Specifications Section 59 "Painting" applicable provisions.

All work shall be done in a workmanlike manner so that the finished surfaces will be free from runs, drops, ridges, waves, laps, and unnecessary brush marks. All coats shall be applied in such manner as to produce an even film of uniform thickness completely coating all corners and crevices. All painting shall be done by thoroughly experienced workman. Care shall be exercised during spraying to hold the nozzle sufficiently close to the surface being painted to avoid excessive evaporation of the volatile constituents and loss of materials into the air, or the bridging over of crevices and

corners.

Spray equipment shall be equipped with mechanical agitators, pressure gauges, and pressure regulators. Nozzles shall be of proper size. Floors, roofs, and other adjacent areas and installations shall be satisfactorily protected by drop cloths or other precautionary measures. All overspray shall be removed by approved method or the affected surface repainted.

2. Atmospheric Conditions

Except as specified or required for certain water-thinned paints, paints shall be applied only to surfaces that are thoroughly dry and only under such combination of humidity and temperature of the atmosphere and surfaces to be painted as will cause evaporation rather than condensation. In no case shall any paint at all be applied during rainy, misty weather, or to surfaces upon which there is frost or moisture condensation without suitable protection as approved by the District Engineer. Where painting is permitted during damp weather, or when the temperature is at or below 50 degrees fahrenheit, the surface shall be heated to prevent moisture condensation thereon. Bare metal surfaces, except those which may be warped by heat, may be dehydrated by flame-heating devices, immediately prior to paint application. While any painting is being done, the temperature of the surfaces to be painted and of atmosphere in contact therewith, shall be maintained at or above 50 degrees fahrenheit, except where paints are being used which dry solely by evaporation, in which case temperature of the air and surface may be 35 degrees fahrenheit or as approved by the District Engineer. All paint when applied shall be approximately the same temperature as that of the surface on which it is applied.

3. Protection of Painted Surfaces

Where protection is provided for paint surfaces, such protection shall be preserved in place until the paint film has properly dried, and the removal of the protection is approved. Items which have been painted shall not be handled, worked on, or otherwise disturbed until the paint coat is completely dry and hard. After delivery at the site, all shop coated metalwork shall be repainted or retouched from time to time with specified paint whenever, in the opinion of the District Engineer, it becomes necessary to maintain the integrity of the film.

4. Method of Paint Application

The specified primer or first coat of paint shall be applied by brush to ferrous surfaces which have not been blast cleaned, except as hereinafter specified. All subsequent coats for all ferrous surfaces may be brushed or sprayed. All coats for miscellaneous ferrous metal surfaces may be either brush or spray applied.

5. Coverage and Film Thickness

The actual surface area covered per gallon of oil or varnish vehicle paint for various types of surfaces shall not exceed those listed in the following table. The first coat on metal surfaces refers to the first full paint coat and not to conditioning or other pretreatment applications. Bituminous type coating shall be applied to the thickness and in accordance with instructions contained elsewhere in these specifications. Specified coverage rates do not include spraying and other losses of material resulting from the conditions under which coating is applied.

On atmosphere exposed steel and other metal surfaces:

1st coat	500 sq ft/gal
2nd coat	500 sq ft/gal
3rd coat	550 sq ft/gal
4th coat (where required)	550 sq ft/gal

In no case shall the average total thickness (dry) of the completed protective coating system on exposed metal surfaces be less than 1.25 mils per coat as determined by G. E. film thickness gauge. The minimum thickness at any point shall not deviate more than 25 per cent from the required average.

6. Continuity

In testing for continuity about welds, projections, such as bolts and nuts, and crevices, the District Engineer shall determine the minimum conductivity for smooth areas of like coating where the dry mil thickness has been found adequate. This conductivity shall then be taken as the minimum required for these rough, irregular areas. All pin holes and holidays shall be repainted to the required coat coverage. All ferrous metal surfaces shall meet minimum continuity requirements.

C6.05 PAINT MATERIALS

Specifications of primers, washcoats, and paints are as follows:

1. Paints for Metal

IDENTIFICATION NUMBER	PAINT SPECIFICATION
P1	CALTRANS STD. SPECS. SEC. 91-2.07; Pretreatment, Vinyl Wash Primer (State Specification 8010-31A-27) For application prior to painting clean aluminum, galvanized surfaces, or blast-cleaned steel.
P2	CALTRANS STD. SPECS. SEC. 91-2.10; Vinyl Primer, Red Iron Oxide Type (State Specification 8010-31A-23) For use on metal surfaces treated with Vinyl Wash Primer, P1, above.
P3	CALTRANS STD. SPECS. SEC. 91-2.22; White Tintable Vinyl Finish Coat (State Specification 3010-31A-35) For use on metal surfaces, treated with Vinyl Wash Primer, P1, above; primarily for spray application.
P4	CALTRANS STD. SPECS. SEC. 91-2.08; Aluminum Paint, Finish Coat (State Specification 8010-31A-45) For use as a finish coat on steel, above and below water.

2. Paints for Wood

P5 CALTRANS STD. SPECS. SEC. 91-3.01; Wood Primer, Latex-Base (Federal Specification TT-P-001984, Latest Revision)
For use on unpainted wood.

P6 CALTRANS STD. SPECS. SEC. 91-3.02; Paint, Latex-Base for Exterior Wood, White and Tints (Federal Specification TT-P-96D)
For wood subject to outside exposures, previously treated with wood primer, P5, above.

3. Miscellaneous Paints

P7 SHERWIN-WILLIAMS CO., CLEVELAND, OHIO; Coal Tar Epoxy C-200; or RUST-OLEUM CORP., VERNAN HILLS, ILLINOIS; Coating No. 9578 Coal Tar Epoxy; or equal.
Two-coat application on iron and steel exposed underground and/or to moisture or sewage.

P8 CALTRANS STD. SPECS. SEC. 91-4.05; Paint, Acrylic Emulsion Exterior White and Light and Medium Tints (Federal Specification TT-P-19)
For use on exterior masonry.

P9 SHERWIN-WILLIAMS CO., CLEVELAND, OHIO; Enamel, Gloss, Industrial (No. 1354).
For use where high gloss enamel is desired, for exterior and interior primed wood and metal surfaces.

C6.06 PAINTING SCHEDULE

The previous Article C6.05 indicated the types of surfaces to be covered by each paint. In general, the following items shall be painted: exposed iron and steel surfaces in underground pipelines; iron and steel surfaces in above ground pipelines; exterior woodwork; all visible surfaces of equipment, bolts, nuts, hangers, clamps and similar metal devices; and all galvanized surfaces, except gratings and floor plates.

Notes:

1. For exposed iron and steel surfaces in underground pipe installation prime coat may be brush applied in shop. Touch up prime coat as required in field. Prime shall be allowed at least 72 hours drying time in good weather before recoating. All coats may be brush or spray applied. Allow at least 2 days for drying between coats.

2. For iron and steel surfaces in above ground pipe installation the surface shall be blast cleaned. Apply paint with brush or spray. Mil thickness for first two coats, 1.2 mils per coat and 1.0 mil per coat for last two coats. Second and third coats to be tinted.

3. For exterior woodwork, apply paint with brush or spray.

4. For iron and steel exposed to moisture or sewage apply coal tar epoxy a minimum of two brush coats to give a minimum of 25 mils total film thickness. Brush each coat perpendicular to strokes of

preceding coat. Drying time between coats shall be as recommended by the manufacturer.

C6.07 TESTING

Testing will be conducted in accordance with the latest test methods of American Society of Testing Materials and of the Federal Test Method Standard No. 141, as applicable.

SECTION C7 - RESURFACING

C7.01 SCOPE

Resurfacing includes the furnishing and installation of all materials, equipment, and labor necessary for the replacement and restoration of all streets, roads, highways, sidewalks, curbs, gutters, driveways, and similar surfaces.

C7.02 GENERAL

Any concrete or bituminous paved surface that is broken, removed, or damaged by the Contractor's operations shall be restored at least to the condition existing prior to beginning work. Not withstanding the provisions of this section, all work will be subject to the requirements of the entity having jurisdiction over the affected area. The Contractor shall familiarize himself with the requirements of said entity and shall comply in all respects with these requirements. Wherever there is a conflict between the requirements of the entity having jurisdiction and the requirements of this Section C7, the more restrictive of the two shall be the requirement with which the Contractor shall comply.

C7.03 MATERIALS

1. Concrete

   Concrete shall be as hereinbefore specified in Section C3.

2. Aggregate Base Course

   Aggregate base course shall conform to the requirements of CalTrans Standard Specifications, Section 26 and shall be ¾ " Class 2 AB maximum size.

3. Prime Coat

   Prime coat shall conform to the requirements of CalTrans Specifications, Section 39. Liquid asphalt grade for prime coat shall be as specified in the Special Conditions.

4. Asphalt Concrete Surfacing

   Asphalt concrete surface shall conform to the requirements of CalTrans Specifications, Section 39, and shall be Type B, 1/2 inch maximum size. Paving asphalt shall conform to the provisions in Section 92 and shall be of the penetration range specified in the Special Conditions.

C7.04 PREPARATION OF SUBGRADE

After backfill has been properly placed in the trench and other affected areas, in accordance with the provisions of Section C2.04 of these standard specifications, the surface shall be rolled or tamped until the subbase is firm and unyielding. Mud or other soft or spongy material shall be removed and the space filled with gravel and rolled or tamped in layers not exceeding 4 inches in thickness. The edges of all existing surfaces shall be saw cut and square prior to placement of the base course and final surface.

C7.05 BASE COURSE

In the absence of any requirements to the contrary by an agency having jurisdiction over the pavement replacement, the base course shall consist of a lean concrete base. Lean concrete base shall conform to the provisions of Section 90 of CalTrans Standard Specifications except that the cement content shall be not less

than 2 1/2 and not more than 3 1/2 sacks per cubic yard.

Concrete base shall be placed to a depth of 6 inches (minimum) and shall extend six inches (minimum) outside of the trench line.

Aggregate base may be used for a base course at the following locations:

1. When the trench is entirely within the shoulder, gutter, or sidewalk on a public street.

2. When the trench is located in a paved area which is not a public street. Aggregate base course shall be placed to a compacted thickness equal to that which existed prior to construction or to a minimum compacted depth of 6 inches. Spreading and compacting shall be in accordance with the applicable portions of CalTrans Standard Specification, Section 26.

C7.06 CONCRETE SURFACES

Reconstruction of concrete curbs, gutters, driveways, and sidewalks shall be of the same kind of material and in not less than the same dimensions as the overall work. In the case of concrete slabs, the minimum thickness shall be 4 inches. Repairs shall be made by removing and replacing the entire portions between joints or scores and not merely by refinishing the damaged part. All work shall match the appearance of the existing improvements as nearly as practicable.

C7.07 ASPHALTIC SURFACES

After the base course has been compacted, plant-mix surfacing shall be applied to a minimum depth of 2 inches, but in no case less than the thickness of the existing pavement. Before placing the plant-mix surfacing, a prime coat of asphaltic emulsion shall be applied over the area to be resurfaced. Proportioning, mixing, spreading, and compaction of asphalt concrete shall conform to applicable portions of CalTrans Standard Specification, Section 39, except that a self-propelled mechanical spreading and finishing machine need not be used.

C7.08 SURFACE TREATMENTS

If special surface treatment such as seal coat, armor coats, or fog seal are required by the jurisdictional authority, they shall be done to the requirements of the authority.

C7. 09 RESTORATION OF SURFACE MARKERS

Traffic markers or other surface markings painted on the roadway surface, which have been damaged or destroyed shall be replaced in strict accordance with the requirements of the jurisdictional authority. Traffic loops when damaged by the construction shall be replaced as soon as possible after damaging. The Contractor must notify the District, Police Department and Fire Department immediately after damage occurs. The Contractor shall replace the damaged loops in strict accordance with the requirement of the jurisdictional authority.

SECTION C8 - SEWER LINE CLEANING

C8.01 INTENT

The Contractor should understand the purpose and intent of any sewer line cleaning specified in the contract in relation to the degree of cleaning and inspection required. Attention by the Contractor is directed to Article C1.09, Safety and Health Provisions, of these Specifications with respect to CAL OSHA rules and regulations to follow before entering manholes.

Examples of cleaning purposes and associated cleaning requirements follow.

1. Removal of Blockages: This is usually emergency cleaning. The requirement is to remove or relieve a particular blockage and prevent sewage back-up, overflow, and property damage.

2. Routine Maintenance: This often involves moderate root removal or the removal of light to heavy debris preventing adequate flow. The intent is to prevent blockages and restore the sewer to near-full capacity and self-scouring velocity. Cleaning requirements are not usually stringent if the purpose appears to have been achieved.

3. Cleaning Prior to TV Inspection: Cleaning in preparation for TV inspection must be performed more thoroughly than for routine maintenance. Pipe walls must be clean enough for the camera to discern structural defects, misalignment and points of infiltration. Small amounts of debris left on the sewer invert, such as sand, stone or sewage solids, may not interfere with effective inspection.

4. Cleaning in Preparation for Sewer Pipe Joint Sealing or Pipe Lining: Cleaning must be much more thorough than for sewer maintenance. All sand, rocks, gravel, grease, mud, sludge and other debris must be removed from the sewer invert to permit operation of a sealing packer. Roots usually enter the top portion of the pipe and should be removed to the extent necessary to effectively seal the joints.

   It is usually desirable to perform the cleaning immediately prior to joint sealing or pipe lining operations to preclude the buildup of materials from infiltration and inflow sources and the shoaling of wastewater debris.

C8.02 MATERIALS TO BE REMOVED

The bulk of sewer cleaning is involved with the removal of sludge, mud, sand, gravel, rocks, bricks, grease, and roots from pipes, manholes, and wet well. Other material may be found in combined sewers. Removal of bricks, pieces of tile and clean sand or soil indicates structural problems such as broken or collapsed pipe (see Cleaning Precautions, Article 8.09 of these specifications).

C8.03 SEWER CLEANING PROCEDURES

Sewers are generally cleaned downstream starting at the upstream manhole section of the area to be cleaned. Selection of equipment and methods often depends on the conditions at the time the work commences. The equipment should be capable of removing dirt, grease, rocks, sand, and other materials and obstructions from the sewer lines and manholes. If cleaning of an entire section cannot be successfully performed from one manhole, the equipment may be set up on the other manhole and cleaning again attempted. If, again, successful cleaning cannot be performed or the equipment fails to traverse the entire manhole section, it may be assumed that a major blockage exists and the cleaning effort should be terminated. The Contractor should make note of the indicated location (footage) of the blockage in anticipation of excavation which may be required. The Contractor should make note of the sewage flow and determine if the blockage is causing a

sewage back-up which requires near-term or emergency action by the District. The Contractor should immediately report the need for appropriate action to the District.

C8.04 PIPE DAMAGE PREVENTING CLEANING OPERATIONS

The Contractor should recognize that there are some conditions such as broken pipe and major blockages that prevent cleaning from being accomplished or where damage would result if cleaning were attempted or continued. Should such conditions be encountered, the Contractor should not be required to clean those specific manhole sections. The Contractor should be knowledgeable of and alert for any conditions which warrant termination of cleaning activities.

Example: The removal of large quantities of fresh soil with a jet cleaner may indicate broken or collapsed pipe.

Example: The removal of bricks from a brick sewer with a bucket machine may indicate more harm is being done than good.

C8.05 DEBRIS REMOVAL

Sludge, dirt, sand, rocks, grease, and other solid or semisolid material resulting from the cleaning operation should be removed at the downstream manhole of the section being cleaned. Passing material from manhole section to manhole section, which could cause line stoppages, accumulations of sand in wet wells, or damage pumping equipment, should not be permitted by the Contractor.

C8.06 CLEANING TASKS

The Primary tasks performed in sewer cleaning are:

1. Dislodge materials.

2. Transport materials to a point of access.

3. Remove materials from the sewer system.

4. Transport materials to a disposal site.

Most cleaning techniques require access for men and equipment at the downstream manhole where materials are to be removed. Some cleaning techniques require equipment access to both ends of a manhole section. Access to manholes may be a source of difficulty to the Contractor. The District Engineer can often play an important part in helping the Contractor gain the required access by interfacing with the District and/or property owner to overcome problems such as terrain, undergrowth, trees, fences, easements, etc.

C8.07 CLEANING METHODS

The Contractor should be familiar with the methods and techniques generally used with each type of sewer cleaning equipment.

1. Rodding Machine

Rotating-rod sewer cleaning equipment is practical and useful for returning clogged sewers to service. The rods are generally 3/8- to 1/2-inch in diameter and may be sectional or continuous. Rods are made of high-strength, oil-tempered spring steel.

A sewer rodding machine can push the rod through a sewer for a distance as great as 800 feet. It can

also be used in curved sections.

The rodding machine should be set up in close proximity to the downstream manhole and positioned so that the flexible rod guide (containing the rotating rod) makes a gentle curve from the machine to the entrance of the sewer pipe at the bottom of the manhole. The rod is usually pushed upstream so that the flow will help bring the debris back toward the machine.

The rod can be fitted with a variety of tools. To open a line that is completely plugged, the operator can place a small spear or a corkscrew device on the end of the rod. The rodding machine will push and rotate the rod into the blockage to make an opening large enough to permit wastewater to start flowing.

The operator can then replace the corkscrew with an auger. Augers are spiral-shaped cutting devices with diameters smaller than that of the pipe to be cleaned. The rodding machine rotates the rod and the auger, forcing the auger upstream into the sewer to grab as much of the clogging material as it can, and then retrieves the rod, pulling the debris back downstream.

The operator should set the footage meter on the machine to zero before pushing the rod up the sewer. This zero setting indicates how far the cleaning tool is into the line.

The operator can move the rod forward without rotating it, but it should be rotated in larger pipes or if debris is encountered to prevent buckling the rod. If the line is fairly clean, the rotating rod can be moved quickly and easily. When cleaning becomes difficult, increasing hydraulic system pressure and the sound and speed of the machine alert the operator. Cleaning can continue if the hydraulic pressure is within limits, but the forward speed should be reduced and the rod rotation speed maintained. The machine must have a pressure (or mechanical) overload device to prevent the rod from being twisted off if the tools should stop rotating in the sewer.

If the rod and the cutter appear to be making no forward progress and high hydraulic system pressure is indicated, the cutter probably has encountered a heavy mass of roots or other obstruction. The operator should reverse the rotation, retrieve the rod and cutter, clean the cutter of entangling roots, and then run the rod and cutter back to again attack the obstruction.

The rod can be pulled back without rotating, but in general it should not be. Spring-blade cutters can be attached at the upstream manhole and pulled back with the cutter rotating at maximum speed.

Many cleaning tools can be used by rodding machines. Among them are:

- Root saws.

- Expandable cutters with two or three knife blades that can adjust to the diameter of the sewer being cleaned.

- Sand cups are rubber discs designed to permit passage of a portion of the wastewater flow through holes in the disc, thereby creating jets which flush the debris toward the downstream manhole.

2. Bucket Machine

Bucket machines are strong, powerful pieces of equipment. They can open heavily blocked sewers clogged with large masses of roots, sand, or clay. When a crew completes its cleaning using this type of machine, the sewer should be in good flowing condition, unless it contains broken pipe.

The crew must first thread the cable through the length of sewer to be cleaned. One method is to float or flush a light rope through the pipe, assuming that the flow is sufficient and there are no blockages or root curtains. A more positive method is to pull the cable through using a rodding machine or jet cleaner.

A bucket machine setup consists of two powered winches, each equipped with sufficient steel cable to reach between two manholes, generally not over 750 feet. The cleaning crew will center the machines over the two manholes.

A specially designed bucket serves as the connecting link between the two cables permitting the machines to pull the bucket in either direction. The bucket is designed so that one end opens and closes. One of the machines pulls the bucket into the sewer with the bucket end open. When the bucket is full, the other machine pulls it back. When the bucket is pulled back, the "clam shell" end automatically closes.

Most models can draw the bucket completely out of the manhole and, by use of a swinging boom or chute, discharge the debris into a dump truck.

After the operators have removed the bulk of the debris from the sewer line, they can replace the bucket with a "porcupine". This is a cleaning tool with stiff wire cables protruding outward. By drawing it back and forth in the sewer, the operator can remove roots and grease deposits. For a final, wiped-clean finish, the operator can replace the porcupine with a rubber "squeegee".

3. High-Velocity Jet Machine

High-velocity jet sewer cleaning using water pressure can produce excellent results. Under favorable conditions, jet cleaning has demonstrated the ability to clean a line faster and with greater efficiency than any of the other methods.

There are many advantages. Operation is at street level without requiring the crew to enter the manhole. Little time is required for setup. An operator can quickly and thoroughly clean a small-diameter sewer 500 feet long.

Although the method uses water at high pressure, tests have shown that the water jets do not harm pipe joints. A jet cleaner can clean curved lines where buckets and rotary cutters would harm the pipe.

The cleaning unit carries a supply of water, generally 1000 to 2000 gallons. The pump usually has a capacity of 50 to 100 gpm delivering water at a pressure of 1000 to 2000 psi. The cleaner usually is supplied with 500 to 600 feet of high-pressure hose.

The nozzle provides the cleaning action. The nozzle has a backward spray that propels the hose up the sewer to be cleaned. When the operator retrieves the hose, the water jets scour the sewer and move the debris to the downstream manhole.

4. Hydraulically Propelled Equipment

(a) Cleaning Ball:

Over the years, the use of a rubberized ball to clean flowing sewers has proved its effectiveness. An experienced operator will hold back the ball to permit wastewater to pass around its lower perimeter, thus flushing the debris ahead to the downstream manhole.

To use sewer balls, a crew should be equipped with:

- At least 600 feet of 0.5-inch synthetic-fiber rope mounted on a winch. For balls over 15 inches in diameter, steel cable is preferred.

- A swivel and clevis that serves to attach the rope or cable to the ball.

- 400 feet of fire hose and a gate valve fitted with connections to attach to a hydrant.

- A downhole roller having a free-running wheel to be fitted into the upstream manhole for the rope or cable.

- Rubber buckets, appropriate shovels, boots, and safety harnesses for use when crew members enter the manhole.

The downhole roller is placed in the upstream manhole and set firmly in place. The wheel should be above and opposite the outgoing sewer opening which serves as the entry point for the ball. This wheel location permits the cleaning crew to insert the ball into the downstream pipe.

An elbow trap is placed in the outgoing pipe of the downstream manhole to confine debris flushed out by the ball and permit passage of wastewater downstream. The rope or cable is passed under the roller and secured to the ball. The ball is then inserted into the outgoing pipe. Finally, hydrant water is introduced at an upstream manhole to raise the level in the upstream manhole to a depth of approximately 3 feet.

A few tugs on the rope, permitting some water to escape around the perimeter of the ball, will start the ball moving. Most of the water will escape around the lower surface of the ball since the ball's buoyancy will hold it against the top of the pipe. The static head will then force the ball to move downstream. The operator must keep the rope or cable tight to prevent it from overriding the ball if the ball is not inflated to a snug fit.

The ribbed ball flutters, rather than spins, in the pipe. It will develop about 6 inches of turbulent water on the downstream side, and this water will lift the debris and flush it toward the downstream manhole, where it can be shoveled out or removed by debris removal equipment.

If the ball stops moving, it is pulled back, increasing the flow around the ball, which levels the debris and allows the ball to proceed.

In general, the ball is inflated with enough air to make it fit snugly in the pipe, although some conditions can require the ball to be underinflated. The operators must learn through experience how much inflation is required.

The cross-sectional area of a cleaning ball increases with the square of its diameter. Thus, a 30-inch ball has four times the area of a 15-inch ball. With the same head of water behind

it, the 30-inch ball will have four times the propulsive force of a 15-inch ball and nine times the force of a 10-inch ball. Large cleaning balls are hard to control and difficult to handle.

(b) Hinged-Disc Cleaner:

The hinged-disc cleaner operates in a manner similar to that of the ball. The device is inserted into the outgoing sewer line. Flow is reduced and the resulting head causes the machine to roll down the pipe until debris is encountered. The scooter will then stop, causing the water to rise upstream. A cable attached to the device is then pulled back, causing the upper half of the disc to rotate backward and release the accumulated head. The velocity of the released water is generally several times the normal velocity of the sewage and washes the debris downstream, where it is removed at the next manhole.

When heavy debris is encountered, the device is pulled back, causing the flushing action, and then released. This operation results in a completely clean pipe.

The hydraulic force available increases with the square of the pipe diameter, while the amount of debris increases in proportion to the diameter. As a consequence, the scooter's ability and efficiency increase in larger pipe, but a large amount of water is required.

5. Plain Flushing

Plain flushing is a simple technique that can be justified only in flat areas where solids tend to settle out and become septic. Flushing requires only a hose connected to an upstream hydrant. The technique gives no assurance of good cleaning between manholes.

C8.08 CLEANING EQUIPMENT

There are five types of cleaning equipment:

a. Rodding machines

b. Bucket machines

c. High-velocity jet machines

d. Hydraulically propelled equipment

e. Debris removal equipment (including combination machines)

Cleaning equipment is available with characteristics ranging from light to heavy duty. Each type of equipment can utilize special attachments, tools, and methods to expand its capabilities. Cleaning equipment will be evaluated here with emphasis on its primary application.

The Contractor should not be concerned with the type of equipment used provided that the specified results are obtained, unless the Contractor's equipment is likely to cause pipe damage, flooding of private property, or unless the type is specified in the contract.

The applications, advantages and limitations of each type of sewer cleaning equipment are summarized on the following pages.

1. Rodding Machines

Materials removed:

Most effective for dislodging roots and relieving blockages.

Applicable for dislodging and transporting sludge, mud, and grease using appropriate accessory tools and adequate flushing water.

Pipe size range:

Generally 6-inch to 18-inch pipes due to the limited pulling power and the tendency of the rod to bend in larger pipes.

Technique advantages:

Access to the downstream manhole only is required.

Can be used at the upstream manhole under surcharge conditions.

Threading the sewer line is not necessary; often used for threading sewer lines for other cleaning or inspection equipment.

Fast response to emergency stoppages.

Technique limitations:

Generally ineffective for cleaning heavy solids.

A large quantity of water is required for "brush and flush" cleaning.

Does not provide for removal of materials from the manhole.

Rod and/or tool can be broken off in the sewer line.
Operation is moderately hazardous.

2. Bucket Machines

Materials removed:

Most effective for dislodging, transporting and removing heavy solids such as gravel, rocks, bricks, and roots.

Applicable for dislodging and transporting mud, sand, and grease.

Pipe size range:

Generally 18-inch to 36-inch pipes make the best use of the available power although 8-inch to 15-inch pipes can be cleaned.

Technique advantages:

Provides the "iron and power" for removal of large amounts of heavy solids and roots.

Effective in large-diameter pipe.

Various buckets, scrapers, brushes, and squeegees are available.

Can remove materials from the manhole.

Technique limitations:

Access to both manholes is required.

Threading the sewer line is necessary.

Time consumed is longer than for other methods for light cleaning.

Uses heavy tools and has the power to damage the pipe.

Curved pipe, structurally damaged pipe, off-set joints, and intruding service connections can preclude the use of bucket machine tools.

Bucket machines are hazardous to transport, set up and operate.

3. High Velocity Jet Machines (capabilities depend on size of machine)

Materials removed:

Most effective for cleaning pipes of light solids such as sludge, mud, sand, and gravel.

Applicable for dislodging and transporting rocks and grease.

Capable of cutting light root growth by using special tools in pipes generally up to 12 inches in diameter. Some larger tools are available.

Effective for cleaning manholes using a scouring gun.

Pipe size range:

Most effective in 6-inch to 18-inch pipes. The effectiveness in larger pipes is reduced, especially on grease.

Materials can be cleaned from the invert of larger pipes by using a weighted nozzle.

Technique advantages:

Access to the downstream manhole only is required.

Threading the sewer line is not necessary; often used for threading sewer lines for other cleaning or inspection equipment.

Setup is fast.

Fast method for light cleaning and removal of blockages.

Operation is comparatively easy.

Effective for final cleaning prior to rehabilitation work.

Low pipe damage potential except in badly deteriorated pipe.

Few operator safety hazards are involved.

Jet cleaning provides ventilation when the upstream manhole cover is removed.

Technique limitations:

Water must be available reasonably near the work site.

Least effective on large and heavy materials such as roots, rocks, bricks.

Can cause cavitation of backfill outside broken pipe.

Does not provide for removal of materials from the manhole.

4. Hydraulically Propelled Equipment (cleaning ball, hinged-disc cleaner)

Materials removed:

Most effective for cleaning pipes of light solids such as sludge, mud, and sand.

Fair applicability for dislodging and transporting gravel, rocks, and grease.

Pipe size range:

Generally 8-inch to 36-inch pipes.

Best in intermediate sizes, with extreme caution required in large pipes (see Cleaning Precautions, Section 8.09 of these Specifications).

Technique advantages:

Crew access only to upstream and downstream manholes.

Minimum equipment requirements.

Operation is easy.

Few safety hazards are involved, except manhole entry.

Technique limitations:

A large quantity of water is required at or upstream of the site.

Basement flooding is a real possibility; may be used only where head in sewer will not exceed basement drain elevations.

Not applicable for removal of blockages .. sewer must be flowing.

Does not provide for removal of materials from the manhole.

Caution is required when using hydraulically propelled devices in large pipes due to the large propulsive force and the possibility of getting the equipment stuck in the sewer line with dig-up becoming the only solution.

5. Debris Removal Equipment (including combination machines)

Vacuum machines are primarily used for catch-basin cleaning and are often used for removal of materials from manholes when other cleaning equipment is used to dislodge and transport the materials to the access point. Some vacuum machines can remove heavy materials such as bricks. Most machines can separate solid materials from cleaning water and transport the debris to a dump site.

Note: A vacuum machine in combination with a jet machine is called a "combination machine."

Trash pumps are frequently used to remove sludge, mud, sand, and gravel from manholes.

Trailers (sometimes containing pumps, tanks and settling baffles) are frequently used to separate solid materials from cleaning water and to transport the debris to a dump site.

C8.09 CLEANING PRECAUTIONS

The Contractor should be aware of several precautions to be taken during cleaning operations.

Eroded, corroded, or otherwise structurally deteriorated pipe may collapse during cleaning operations. Visible inspection must be used to ascertain the advisability of cleaning. Sometimes a television inspection must be made prior to cleaning in such situations.

Clean soil and pieces of broken tile observed in a manhole trough are strong indications of broken, crushed, or collapsed pipe in the upstream section. Exercise due caution.

Full gage cleaning tools are subject to getting "hung up" on off-set joints, intruding service connections, root masses, and other obstructions. A tag cable and winch should be used when practical to retrieve cleaning tools and devices.

Pipe damage is possible any time powerful cleaning equipment is used. Cleaning equipment and tools should be matched to both the job and pipe conditions to avoid pipe damage.

When bucket machines are used, downhole cable rollers should always be employed. Properly installed, the lower "V" of the roller should be just below the top of the sewer pipe so the cable does not rub or catch on the entrance to the pipe. The roller must be high enough to permit free passage of the bucket into and out of the sewer pipe.

When hydraulically propelled cleaning tools (which depend on water pressure to provide their cleaning force) or any equipment which retards the flow in the sewer is used, a real possibility of a sewage back-up resulting in flooding and property damage exists. When a hydraulically propelled cleaning tool stops moving downstream for any reason (e.g., stopped by a roller in a downstream manhole), a sewage back-up starts to take place, especially if water is being added from an upstream hydrant. The Contractor should be on the lookout for such a situation.

C8.10 DISPOSAL OF MATERIALS

Solids or semisolids resulting from the cleaning operations should be removed from the site and disposed of at a site designated by the District. All materials should be removed from the site at the end of each workday. The Contractor may be allowed to accumulate debris at the work site beyond the stated time in enclosed containers and as approved by the District.

C8.11 ROOT REMOVAL

Roots should be removed in the designated sections where root intrusion is a problem. Special attention should be used during the cleaning operations to assure almost complete removal of roots from the joints prior to joint sealing. Roots which could prevent the seating of the packer or could prevent the proper application of chemical sealants must be removed. Procedures may include the use of mechanical equipment such as rodding machines, bucket machines and winches using root cutters, root saws, porcupines, and jet machines equipped with hydraulically driven cutters.

C8.12 CHEMICAL ROOT TREATMENT

To aid in the control of roots, manhole sections that have root intrusion may be treated with an Environmental Protection Agency (EPA) registered herbicide. The application of the herbicide to the roots should be done in accordance with the manufacturer's recommendations and in such a manner to preclude damage to surrounding vegetation. Damaged vegetation shall be replaced by the Contractor at no additional cost to the District. Safety precautions as recommended by the manufacturer should be adhered to concerning handling and application of the herbicide.

C8.13 CHEMICAL ROOT TREATMENT METHODS

With the following application methods, roots absorb the killing agent and inhibitor. Soil in the sewer joints absorbs the inhibitor allowing it to be effective for as much as three years in open joints.

The material may be applied by the "soak" method by plugging the lower end of the line to be treated, filling it with a 1 percent fumigant solution for an hour or longer, and then allowing the solution to flow downstream to the next manhole section to be treated.

The preferred method of treating roots with a foam fumigant is as follows: The foam generator is set up at the downstream manhole. The fumigant hose is pulled through the sewer to the upstream manhole. The foam generator is then started and run until foam shows at the upstream manhole. The hose is then retrieved at a rate given on a chart provided by the equipment supplier (approximately 0.7 foot per second or 42 feet per minute in an 8-inch pipe). Foaming is terminated when foam appears at the downstream manhole. No plugs need to be used as the sewage will flow under the foam and does not rapidly wash it away. The foam tends to cling to the upper portion of the sewer giving the roots time to absorb the fumigant.

C8.14 FINAL ACCEPTANCE

Acceptance criteria for sewer line cleaning shall be as specified in the contract. The District Engineer should be satisfied that the degree of cleaning is adequate for the purpose and intent of the contract. Acceptance of sewer cleaning shall be made upon the successful completion of the television inspection if specified in the contract. If TV inspection shows the cleaning to be unsatisfactory, the Contractor should reclean and reinspect the sewer line until the cleaning is shown to be satisfactory. If internal sealing is to follow the television inspection, particular attention should be given to the adequacy of the cleaning to insure that proper seating of the sealing packer can be achieved.

C8.15 VARIABLES WHICH AFFECT THE DIFFICULTY OF SEWER CLEANING

The Contractor should be familiar with the many variables which may have impact on his performance, production and cost on any particular sewer cleaning job. Some variables apply to each manhole section to be cleaned.

1. Locating, exposing, removing manhole covers.

2. Access to manholes, terrain, traffic control requirements.

3. Condition of the manholes -- steps, cleanliness, structure.

4. Depth of the sewer -- difficulty of entry and debris removal.

5. Size of the pipe.

6. Depth and velocity of sewage flow.

7. Structural integrity of the pipe.

8. Off-set joints, intruding service connections, curved pipe.

9. Availability of hydrant water at or upstream of the site.

10. Depth of deposition in the pipe.

11. Type of solid materials to be removed, arranged in order of increasing difficulty -- sludge, mud, sand, gravel, rocks, grease, bricks and roots. Roots are difficult to remove completely and may be a significant factor.

12. Degree of cleanliness required -- see Intent, Article C8.01 of these specifications.

13. Productivity differences in cleaning successive vs. random manhole sections.

14. Requirements for transportation and disposal of solid materials and distance to the disposal site.

SECTION C9 - SEWER FLOW CONTROL

C9.01 INTENT

Most cleaning, inspection, joint testing, joint sealing, sewer lining and excavation operations require minimal, or at least acceptable, depth of flow in order to be performed effectively. The Contractor should be aware that excessive depth of flow will inhibit and may even prevent some cleaning, inspection and rehabilitation procedures. The Contractor should know the provisions, requirements, specifications and responsibilities for sewer flow control (if any) that are contained in the contract. Attention by the Contractor is directed to Article C1.09, Safety and Health Provisions, of these Specifications with respect to CAL OSHA rules and regulations to follow before entering manholes.

C9.02 DEPTH OF FLOW

For effective television inspection, joint testing and/or sealing operations, the depth of flow at the upstream manhole of the manhole section being worked should (where practical) be within the recommended limits given below:

Recommended Maximum Depth of Flow for Television Inspection:

6" - 10"	Pipe	20% of pipe diameter
12" - 24"	Pipe	25% of pipe diameter
27" & up	Pipe	30% of pipe diameter

When depth of flow is greater than recommended for television inspection, joint testing and/or sealing, the flow may be reduced by operation of pump stations, plugging, or by pumping and bypassing of the flow.

C9.03 PLUGGING

A sewer line plug may be installed upstream of the section being worked. The plug should be designed to permit a portion of the sewage to be released. After the work has been completed, sewage flow should be restored to normal.

Sewer plugs are always installed in the upstream (incoming) pipe of a manhole. It is desirable that the plug be equipped with an airhose to permit deflation from above ground. A strong rope should be attached to enable the plug to be quickly pulled out of the manhole. Care must be taken to prevent a plug from being pushed into the outgoing pipe when the backed-up sewage is released.

C9.04 PUMPING AND BYPASSING

When pumping and bypassing is required, pumps, conduits, and other equipment are needed to bypass the flow of sewage around the manhole section in which work is to be performed. The bypass system should have sufficient capacity to handle the existing flow plus additional flow that may occur. The bypass system capacity shall be approved by the District Engineer prior to implementation.

C9.05 FLOW CONTROL PRECAUTIONS

When the flow in a sewer line is reduced, plugged, or bypassed, precautions must be taken to insure that the operations do not cause flooding or damage to public or private property. The Contractor should closely monitor sewer surcharging upstream of the manhole section being worked and be alert for situations such as residential flooding that would be likely to occur, particularly where there are steep sewers serving houses with basements having floor drains or toilet facilities.

SECTION C10 - TELEVISION INSPECTION

C10.01 EQUIPMENT AND TV PICTURE QUALITY

The TV camera shall be specifically designed for sewer inspection: small, rigged, and waterproof. The camera shall have its own light source suitable to provide a clear picture of the entire periphery of the pipe and defects. The camera shall be able to rotate and look directly into the laterals, providing clear sharp images.

The camera, television monitor, and other components of the video system shall be capable of producing a picture quality which is adequate for the purpose of inspection as stated in the contract.

Attention by the Contractor is directed to Article C1.09, Safety and Health Provisions, of these Specifications with respect to CAL OSHA rules and regulations to follow before entering manholes.

C10.02 TV INSPECTION PROCEDURES

Clean the designated sewer lines prior to conducting closed circuit television inspections.

The camera shall be moved through the line in either direction at a moderate rate no greater than 30 feet per minute, stopping when necessary to permit proper documentation of the sewer condition. For a detailed inspection, the camera shall not travel a speed greater than 30 feet per minute. Manual winches, power winches, TV cable power rewinds, self-propelled cameras or other approved methods shall be used to move the camera through the sewer line.

Conduct a television inspection of each designated sewer line to determine obstructions, pipe deficiencies, infiltration locations, lateral locations, and any other abnormalities. At each such location pan the camera to the side to view the area in more detail. Also take a still digital photo of each problem area.

Each photographic image shall be saved in a JPEG file format and named with the footage of the event to the nearest tenth of a foot without a decimal point followed by an abbreviation indicating the type of event. The files shall be stored within file folders named for the upstream manhole numbers. Make a general assessment of the general conditions of each sewer section, and each manhole used for setup, relative to other sewer sections and manholes.

Contractor shall provide a video log of each section of pipe televised stating the date televised, direction of camera, pipe size and type, manhole inverts, conditions of manholes and pipe and commentary on findings. Locate where still photographs were taken on the logs.

Contractor will provide digital images on CDs.

Contractor will provide labeled videotapes of the inspections in VHS-format.

If, during the inspection operation, the television camera will not safely pass through the entire sewer section, the Contractor shall set up his equipment so that the inspection can be performed from the opposite manhole. If, again the camera fails to pass through the entire sewer section, the inspection of the sewer section is considered complete for purposes of payment.

C10.03 DISTANCE MEASUREMENTS

The Contractor shall record reasonably accurate distance measurements for the purpose of locating defects. Distance measurements shall be made above ground by means of a meter device (footage meter) on the TV cable. The footage meter shall have an error not to exceed +/-2% or 2 feet per 100 feet.

The Contractor shall check that the crew sets the footage meter to indicate the distance from the center of the near manhole to the pipe location which is in clear focus on the television monitor. This shall be done by the following procedure:

1. Measure the length of the pipe to the first or second joint outside the manhole.

2. Move the camera into the pipe and secure the TV cable roller in place.

3. Take the slack out of the TV cable and move the camera into the pipe until the measured joint appears in clear view and focus on the television monitor.

4. Add the radius of the manhole (usually 2 feet) to the measured joint distance and set this initial number on the footage meter.

The Contractor shall check the accuracy of the distance measurements when corrective action or a dig-up may be required by the District. The accuracy of the footage meter shall be checked by taking a reading at the entrance to the away manhole and comparing with a surface measurement made with steel tape or walking meter (Roll-A-Tape).

C10.04 DOCUMENTATION

Documentation of television inspection by the Contractor shall be performed in accordance with the specifications. The documentation (entering data on inspection logs) shall be properly, accurately and legibly done during (not after) the TV inspection of each manhole section. TV reports can be assembled elsewhere, but documentation must be done in the field.

The following methods of documentation shall be used in combination:

1. Television Inspection Logs: Written records show the location in relation to an identified manhole of each infiltration point observed during inspection. In addition, other points of significance such as locations of building sewers, unusual conditions, roots, storm sewer connections, broken pipe, presence of scale and corrosion, and other discernible features are recorded and a copy of the records is supplied to the District.

2. Videotape and Digital Photos Recordings: The purpose of tape recording and Digital Photos is to obtain a visual and audio record of the pipe conditions that may be replayed at a later time.

TV inspection logs should contain the following information:

-District’s name
-Inspector’s Name
-Crew Chief’s Name
-Date
-From MH No. _located at _
-To MH No. _located at _
-Direction of Flow
-Type of Pipe
-Type of Joints, if apparent
-Joint Spacing
-Cleanliness

-Manhole Conditions
-Section Length
-Pipe Size
-Depth of Pipe
-Direction of Inspection (camera movement)
-Locations where digital photos were taken.

Pipe defects shall be located by footage and clock reference and shall be described using the following terms:

Cracked Pipe-	crack lines visible, pieces still in place
Open Crack-	crack openings visible, pieces still in place
Broken Pipe-	pieces displaced, some pieces may be missing
Crushed Pipe-	extensively broken and out-of-round pipe
Collapsed Pipe-	all structural integrity lost, pipe flattened
Circumferential Defect-	a circular defect
Longitudinal Defect-	parallel to the pipe axis
Erosion-	pipe worn away by the flow, generally at the bottom
Corrosion-	pipe deteriorated by acid attack, generally at the top
Dip-	a divergence in the alignment of pipes
Misalignment-	a divergence in the alignment of pipes
Offset Joint-	the spigot is not concentric with the bell
Off-set Lateral	
Separated joint-	longitudinal displacement of pipes
Plugged or Broken Lateral	
Infiltrating Joint-	groundwater entering pipe at joint

C10.05 TERMS USED IN INSPECTION REPORTS

The Contractor shall be familiar with the terms used to describe and document sewer construction and pipe conditions, at least to the extent required for adequate and accurate interpretation of reports by the District. Generally accepted terminology follows:

Manhole Components:

Aprons (bench) -	standing room at the bottom of the manhole, containing the trough
Base-	the structural foundation of the manhole

Corbel-	that portion of a manhole structure which slopes upward and inward from the barrel of the manhole to the manhole frame
Depth of Invert-	the distance from the top of the manhole ring (street surface) to the sewer invert
External Drop-	incoming sewage drops to the trough in a vertical pipe outside the manhole wall
Internal Drop-	incoming sewage free-falls in the manhole to the trough
Invert-	the floor, bottom or lowest point of a conduit (sewer)
Invert Elevation-	the height above sea level of the sewer invert
Manhole Ring (frame)-	usually an iron casting used to top off the manhole and to act as the base for the cover
Trough-	the channel at the bottom of the manhole through which sewage flows
Walls-	the vertical (usually cylindrical) portion of the manhole

C10.06 TYPES OF PIPE (Abbreviations)

Acrylonitrile-butadiene-styrene (ABS)
Asbestos-Cement (AC)
Brick Pipe (BP)
Cast Iron Pipe (CIP)
Concrete Pipe (CP)
Corrugated Metal Pipe (CMP)
Polyethylene (PE)
Polyvinyl Chloride (PVC)
Reinforced Concrete (RC)
Reinforced Plastic Mortar (RPM)
Steel Pipe (SP)
Vitrified Clay Pipe (VCP)

C10.07 TYPES OF SEWER PIPE JOINTS

Asphaltic/Bituminous
Cement Mortar
Compression Gasket (e.g. O-ring, molded elastomeric seal)
Solvent Weld (e.g. ABS & PVC pipe)
Thermal Weld (e.g. Polyethylene pipe)

C10.08 TYPES OF SERVICE CONNECTIONS

Intruding Service Connection –	is a building sewer pipe inserted into the street sewer (often through a hole broken through the side of the street sewer) which intrudes into the sewer
Saddle Tap–	is a device used for a cut–in connection.
Tee–	manufactured pipe fitting, enters pipe at 90º angle.

Wye– manufactured pipe fitting, enters pipe at less than 90º angle.

C10.09 VARIABLES WHICH AFFECT THE DIFFICULTY OF TV INSPECTION

The Contractor should be familiar with the many variables which may have impact on his performance. Some variables applying to each manhole section to be inspected are as follows:

1. Locating, exposing, removing manhole covers.

2. Access to manholes, terrain, traffic control requirements.

3. Condition of the manholes, steps, cleanliness, structure.

4. Depth of the sewer, difficulty and safety of entry.

5. Depth and velocity of sewage flow.

6. Availability of water for threading the sewer line.

7. Plugging requirements--ability to plug, necessity to bypass.

8. Presence of explosive gas or combustible liquid.

9. Off-set joints, intruding joint materials, intruding service connections, curved pipe, crushed pipe and other obstructions which could prevent the passage of the camera.

10. Cleanliness of the pipe and the presence of root curtains or grease, which could foul the camera lens.

11. Size of the pipe, 6 and 8-inch pipe is tight and may involve equipment clearance problems; 10 to 21-inch pipe is best for inspection; 24 to 36-inch pipe may require special illumination and skids.

12. Production is sensitive to the number of setups required; it is possible to televise 1000 feet in one direction from a single location when inspecting successive manhole sections. Random inspection of single manhole sections is more time-consuming.

13. Requirements for documentation by means of monitor photographs and videotape recording.

14. Weather conditions--rain affects the production rate.

SECTION C11 - SMOKE TESTING

C11.01 EQUIPMENT

The Contractor shall provide a portable blower designed and built specifically for the use of smoke testing. The blower shall be self-contained and powered by a minimum three (3) horsepower (HP) gasoline engine and be capable of producing a minimum of 1800 cubic feet of air per minute. In addition to the blower, the Contractor shall provide all other equipment and tools and incidentals required to perform smoke testing as required by these specifications.

Attention by the Contractor is directed to Article C1.09, Safety and Health Provisions, of these Specifications with respect to CAL OSHA rules and regulations to follow before entering manholes.

C11.02 SMOKE BOMB

The smoke bombs shall produce a chemical reaction generating white gray smoke, leaving no residue, and shall be non-toxic and non-explosive. Each bomb shall be capable of producing 100,000 cubic feet of smoke within five (5) minutes.

Manufacturer's literature on the smoke bombs to be used in this project shall be provided by the Contractor for review by the District Engineer prior to commencement of any work.

C11.03 PERSONNEL

The Contractor's employees performing the smoke testing under the provisions of these Specifications shall be properly trained in the use of the equipment and procedures. As a minimum, they shall have at least five (5) days of previous testing experience. The five (5) days of experience shall have been acquired within a maximum of six (6) months prior to the date of award of this contract, unless specifically waived by the District. A list of employees to be used shall be provided to the District upon request.

C11.04 PROCEDURE

Upon award of the Agreement by the District and PRIOR TO COMMENCING ANY WORK, the Contractor shall provide a complete WORK SCHEDULE to the District Engineer for review and approval. The Work Schedule shall be typed and shall indicate the planned progress for the proposed work.

The Work Schedule shall indicate the following:

a. Street Name (In easements – the names of the abutting streets).
b. Street Limits (Cross streets or property addresses).
c. Upstream and Downstream Manhole Numbers (from District Maps).
d. Date of Testing.
e. Starting Time.
f. Ending Time.

The Contractor shall not commence testing before 8 a.m. and shall terminate testing no later than 4 p.m. each day. If the Contractor wishes to test before 8 a.m. in commercial areas of the District, such testing shall be shown on the submitted WORK SCHEDULE and is subject to the approval of the District Engineer. Smoke Testing shall not be performed on weekends or holidays without prior approval of the District Engineer.

Once the WORK SCHEDULE is approved by the District Engineer, the Contractor shall not make any revisions or modifications to it without the WRITTEN APPROVAL of the District Engineer.

The Contractor shall not perform smoke testing on days that, in the opinion of the District Engineer, will hinder the results of the test.

C11.05 NOTIFICATION AND PUBLIC INFORMATION

1. The Contractor shall notify all providers of emergency service by phone daily of the area to be tested the next day of work. Notification shall be 24 hours in advance of the testing.

   Providers of emergency services shall include the police, fire and medevac agencies which serve the area being smoke tested.

   It shall be the Contractor's responsibility to keep adequate records of all notifications to emergency services and to produce them upon request by the District. Failure to comply with this requirement may be cause for the District to suspend the Contractor's operations until compliance is achieved.

2. The Contractor shall notify, by hand delivery of a notification letter to each address, all RESIDENCES AND BUSINESSES in the area to be tested 48 hours in advance of the testing.

3. The Contractor shall require all personnel to demonstrate good judgement in performing the testing. The Contractor shall take appropriate action to insure that his employees are polite to the public in all aspects of the work and that immediate assistance is provided to property owners if needed.

C11.06 RECORDS

1. The Contractor shall prepare and submit 2 bound report copies of the smoke testing to the District Engineer. The report shall contain a typed log that clearly identifies each sewer main tested. For each sewer main tested, the log shall identify each point of smoke exfiltration from:

   a. Roof gutters
   b. Sewer Cleanouts
   c. Leakage in house laterals
   d. Patio or area drains
   e. Storm drain cross connections
   f. Any other source not stated above

2. The points of exfiltration, as identified above, shall be referenced to permanent landmarks and/or house or lot numbers. Record the magnitude and locations of smoke emissions using a laser measuring system, digital camera and field work sheets.

   All smoke testing information shall be accurately and neatly recorded on field worksheets and on 200 scale maps (1 in. = 200 ft.) or other maps of suitable scale as provided by the District. The form of the field worksheet shall be approved by the District Engineer prior to the commencement of work by the Contractor.

   Provide two (2) complete copies of a bound report including a copy of the photographs, descriptions of the smoke emissions and maps showing the location of each emission. Also provide digital images on CDs.

C11.07 SAFETY

The Contractor and his personnel shall be aware of and follow all Federal, State and Local safety laws and regulations. Specific attention is directed to Article C1.09 Safety and Health Provisions of these specifications.

Prior to placing any smoke bombs into a manhole, the Contractor shall first evacuate the system with a blower.

The area of work shall at all times be protected by means of an adequate number of cones, barricades, flags or whatever means is necessary to properly and safely protect both vehicular and pedestrian traffic.

Any condition deemed to be an unsafe condition shall be immediately corrected by the Contractor. The failure of the District Engineer or its representatives to bring a potentially dangerous situation to the Contractor's attention shall not relieve the Contractor from his responsibility for providing a safe work area.

SECTION C12 - PRIVATE PUMPING SYSTEMS

C12.01 SCOPE

Private pumping systems include the furnishing, installing, and testing of pumps, pumping appurtenances, supports, anchors, fittings, valves, specials, and all necessary appurtenances to make the work complete and operable.

C12.02 MATERIALS

1. Scope

Pumping materials that may be used are covered under this section. The inclusion of all acceptable material does not infer that any of the materials listed below may be used on any project for any set of conditions.

This section covers materials for a complete factory-built and tested Grinder Pump Station(s). Each station consists of grinder pump(s) suitably mounted in a basin constructed of fiberglass or high density polyethylene (HDPE), electrical quick disconnect (NEMA 6), pump removal system, shut-off valve, anti-siphon valve, and check valve assembled within the basin, electrical alarm/disconnect panel, and all necessary internal wiring and controls.

2. Grinder Pump System

Private grinder pumps shall be semi-positive displacement pumps that allow predictable flows and tolerance of widely varying system pressures. Also, pumps shall allow quick and easy servicing and reliable service.

The pump shall have a single mechanical seal. The rotor shall be through hardened, highly polished stainless steel. The stator shall be of a specifically compounded ethylene propylene synthetic elastomer enclosed in cast iron suction housing for durability. Buna N is not an acceptable stator material. The material shall be suited for domestic wastewater service. Its physical properties shall include high tear and abrasion resistance, grease resistance, water and detergent resistance, temperature stability, exceptional aging properties, and outstanding wear resistance.

Grinder pumps shall meet the following minimum design characteristics:

0’ TDH @ 15 gpm
138’ TDH @ 9 gpm (60 psig)

The pump shall be capable of running at negative total dynamic head without overloading the motor. Under no conditions shall inline piping or valving be used to create a false apparent head.

A. Grinder:
The grinder shall be capable of reducing all components in normal domestic sewage. This includes a reasonable amount of "foreign objects", such as paper, wood, plastic, glass, rubber and the like, to finely-divided particles which will pass freely through the passages of the pump and the 1-1/4" diameter discharge piping. All components must be of durable materials to withstand shock loading from grinding of solid objects.

B. Electric Motor:
At a minimum, the motor shall be a 1 HP, 1725 RPM, 240 Volt 60 Hertz, 1 Phase, capacitor start, ball bearing, squirrel cage induction type with a low starting current not to exceed 30 amperes and high starting torque of 8.4 foot pounds. Running current at maximum head is not to exceed 8.0 amps.

C. Tank & Integral Accessway:
The tank shall be made of high density polyethylene of a grade selected for environmental stress cracking resistance. Corrugated sections are to be made of a double wall construction with the internal wall being generally smooth to promote scouring. Corrugations of outside wall are to be of minimum amplitude of 1 1/2" to provide necessary transverse stiffness. Any incidental sections of a single wall construction are to be a minimum .250 inch thick. All seams created during tank construction are to be thermally welded and factory tested for leak tightness. Tank wall and bottom must withstand the pressure exerted by saturated soil loading at maximum burial depth. All station components must function normally when exposed to maximum external soil and hydrostatic pressure at burial depth.

The station shall have all necessary penetrations molded in and factory sealed. No field penetrations shall be acceptable.

All discharge piping shall be constructed of 304 Series Stainless Steel and terminate outside the accessway bulkhead with a stainless steel, 1 1/4 inch female NPT fitting. The discharge piping shall include a stainless steel ball valve rated for 200 psi WOG. The bulkhead penetration shall be factory installed and warranted by the manufacturer to be watertight.

The accessway shall include a single NEMA 6 electrical quick disconnect for all power and control functions, factory installed with accessway penetrations for electrical cable warranted by the manufacturer to be watertight. The accessway shall also include a 2-inch PVC vent to prevent sewage gases from accumulating in the tank. The tank shall have a lockable cover.

D. Check Valve:
The pump discharge shall be equipped with a factory installed, gravity operated, flapper-type integral check valve built into the stainless steel discharge piping. The check valve will provide a full-ported passageway when open, and shall introduce a friction loss of less than 6 inches of water at maximum rated flow. Working parts will be made of a 300 series stainless steel and fabric reinforced synthetic elastomer to ensure corrosion resistance, dimensional stability, and fatigue strength. A non-metallic hinge shall be an integral part of the flapper assembly providing a maximum degree of freedom to assure seating even at a very low backpressure. The valve body shall be an injection-molded part made of glass filled PVC.

Each grinder pump station shall also include one separate check valve for installation in the 1 1/4" service lateral between the grinder pump station and the sewer main, see District Standard Detail No. 15.

E. Core Unit:
The Grinder Pump Station shall have cartridge type easily removable core assemblies containing pump, motor, grinder, all motor controls, check valve, anti-siphon valve, electrical quick disconnect and wiring. The watertight integrity of each core unit, shall be established by 100% factory test at a minimum of 5 PSIG.

F. Controls:
All necessary controls shall be located in the top housing of the core unit. The top housing will be attached with stainless steel fasteners.

Non-fouling waste water level detection for controlling pump operation shall be accomplished by monitoring the pressure changes in an integral air-bell level sensor connected to a pressure switch. The level detection device shall have no moving parts in direct contact with the wastewater.

High-level sensing will be accomplished in the manner detailed above by a separate air-bell sensor and pressure switch of the same type.

To assure reliable operation of the pressure sensitive switches, each core shall be equipped with a breather assembly, complete with a suitable means to prevent accidental entry of water into the motor compartment.

The grinder pump will be furnished with a length of 6 conductor 14 gauge, type SJOW cable, pre-wired and watertight to meet UL requirements.

G. Alarm/Disconnect Panel:
Each grinder pump station shall include a NEMA 3R, UL listed alarm/disconnect panel suitable for wall or pole mounting. The NEMA 3R enclosure shall be manufactured of thermoplastic to assure corrosion resistance. The enclosure shall include a hinged, pad lockable cover, secured dead front and component knockouts. The enclosure shall not exceed 7.5"W x 8.75"H x 3.75"D.

For each core, the panel shall contain one (1) - 15 amp, double pole circuit breaker for the power circuit and one (1) 15 amp single pole circuit breaker for the alarm circuit. The panel shall contain terminal blocks, integral power bus, push to run feature and a complete alarm circuit.

The alarm/disconnect panel shall include the following features: audio & visual alarm, push to run switch, and high level (redundant) pump starting control.

The alarm sequence is to be as follows:

1. When liquid level in the sewage wet-well rises above the alarm level, visual and audio alarms will be activated. The contacts on the alarm pressure switch will close. The redundant pump starting system will be energized.
2. The audio alarm may be silenced by means of the externally mounted, push-to-silence button.
3. Visual alarm remains illuminated until the sewage level in the wet-well drops below the "off" setting of the alarm pressure switch.

The visual alarm lamp shall be inside a red fluted lens at least 2 5/8" in diameter and 1 11/16" in height. Visual alarm shall be mounted to the top of the enclosure in such a manner as to maintain NEMA 3R rating. For duplex units, in addition to the above, two high-level indicator lights shall be mounted behind the access cover. During a high level alarm condition the appropriate light will illuminate to indicate which pump core requires servicing.

The audio alarm shall be a printed circuit board in conjunction with an 86 dB buzzer with quick mounting terminal strip mounted in the interior of the enclosure.
The audio alarm shall be capable of being de-activated by depressing a push-type switch, which is encapsulated in a weatherproof silicone boot and mounted on the bottom of the enclosure.

The entire Alarm/Disconnect Panel as manufactured, shall be listed by Underwriters Laboratories, Inc.

H. Serviceability:
The grinder pump core unit shall have two lifting hooks complete with nylon lift-out harness connected to its top housing to facilitate easy core removal when necessary. All mechanical and electrical connections must provide easy disconnect accessibility for core unit removal and installation. A push to run feature will be provided for field trouble shooting. All motor control components shall be mounted on a readily replaceable bracket for ease of field service. A stainless steel ball valve handle in the open position shall envelop the core stainless steel discharge piping to require valve to be closed before core can be removed.

I. Factory Test:
Each grinder pump shall be submerged and operated for 5 minutes (minimum). Included in this procedure will be the testing of all ancillary components such as, the anti-siphon valve, check valve, discharge line, level sensors and each unit's dedicated controls. All factory tests shall incorporate each of the above listed items. Actual appurtenances and controls , which will be installed in the field, shall be particular to the tested pump only. A common set of appurtenances and controls for all pumps will not be acceptable. Certified test results shall be available upon request showing the operation of each grinder pump at two (2) different points on its curve, with the maximum pressure no less than 60 psi.

All completed stations shall be factory leak tested to assure the integrity of all joints, seams and penetrations. All necessary penetrations such as inlets, discharge fittings and cable connectors shall be included in this test along with their respective sealing means (grommets, gaskets etc.).

J. Manufacturer:
The grinder pump system shall be manufactured by Environment One or equal.

3. Piping

Laterals shall be constructed of HDPE SDR 11 or Schedule 80 PVC.

C12.03 INSTALLATION

Earth excavation and backfill are specified under Section C2, but are also to be done as a part of the work under this section, including any necessary sheeting and bracing. The Contractor shall be responsible for handling ground water to provide a firm, dry subgrade for the structure, and shall guard against flotation or other damage resulting from general water or flooding. The Grinder Pump Stations shall not be set into the excavation until the Engineer has approved the installation procedures and excavation.

The basin will be supplied with a standard 4" inlet grommet (4.50" OD) for connecting the incoming sewer line. Appropriate inlet piping must be used. The basin may not be dropped, rolled or laid on its side for any reason.

Installation shall be accomplished so that 1" to 4" of accessway, below the bottom of the lid, extends above the finished grade line. The finished grade shall slope away from the unit. The diameter of the hole must be large enough to allow for the concrete anchor.

A 6" inch (minimum) layer of naturally rounded aggregate, clean and free flowing, with particle size of not less than 1/8" or more than 3/4" shall be used as bedding material under each unit. A concrete anti-flotation collar, as detailed on the drawings, and sized according to the manufacturer's instructions, shall be required and shall be pre-cast to the grinder pump or poured in place. Each Grinder Pump Station with its precast

anti-flotation collar shall have a minimum of three (3)-lifting eyes for loading and unloading purposes. The unit shall be leveled, and filled with water, to the bottom of the inlet, to help prevent the unit from shifting while the concrete is being poured. The concrete must be manually vibrated to ensure there are no voids. If it is necessary to pour the concrete to a level higher than the inlet piping, an 8" sleeve is required over the inlet prior to the concrete being poured.

The electrical enclosure shall be furnished, installed and wired to the Grinder Pump Station. An alarm device is required on every installation, there shall be NO EXCEPTIONS. It will be the responsibility of the Contractor and the Engineer to coordinate with the individual property owner(s) to determine the optimum location for the "Alarm/disconnect Panel."

Mount the alarm device in a conspicuous location, as per national and local codes. The Alarm/disconnect Panel will be connected to the Grinder Pump Station by a length of six-(6) conductor 12 gauge TC type cable as shown on the contract drawings. The power and alarm circuits must be on separate power circuits.

C12.04 START-UP AND FIELD TESTING

All equipment and materials necessary to perform testing shall be the responsibility of the Contractor. This will include, as a minimum, a portable generator (if temporary power is required) and water in each basin.

Testing shall be done per the County or City requirements.

Upon completion of the installation, the following test is recommended on each station:

1. *Make certain the discharge shut-off valve is fully open. This valve must not be closed when the pump is operating. In some installations, there may be a valve(s) at the street main that must also be open.*

2. *Turn ON the alarm power circuit.*

3. *Fill the wet well with water to a depth sufficient to verify the high level alarm is operating. Shut off water.*

4. *Turn ON pump power circuit. Initiate pump operation to verify that the automatic "on/off" control is operative. Pump should immediately turn ON. Within one (1) minute alarm light will turn OFF. Within three (3) minutes the pump will turn OFF.*

END PART C

PART D

STANDARD DRAWINGS

STD NO.	
1	MANHOLE FRAME AND COVER
2	PRESSURE TYPE MANHOLE FRAME AND COVER
3	STANDARD MANHOLE
4	MANHOLE DROP INLET
5	STANDARD BACKFILL DETAIL
6	CONCRETE CAP
7	TRENCH PLUG
8	FLUSHING INLET
9	TYPICAL SERVICE LATERAL CLEANOUT
10	LATERAL RECONNECTION DETAIL NEW SEWER MAIN CONSTRUCTION
11	LATERAL CONNECTION TO VCP MAIN TYPE 1 & TYPE 2
12	LATERAL CONNECTION
13	BUILDING CLEANOUT AND BACKWATER OVERFLOW DEVICE
14	BACKWATER CHECK VALVE AND SHUTOFF SYSTEM
15	TYPICAL GRINDER PUMP INSTALLATION
16	GRINDER PUMP SYSTEM CONNECTION TO COMMON FORCE MAIN
17	GRINDER PUMP SYSTEM CONNECTION TO GRAVITY MAIN SYSTEM
18	GREASE & SAND INTERCEPTOR