

PART 3

SEWERAGE AND DRAINAGE

SECTION 300

GENERAL REQUIREMENTS FOR SEWERS AND RELATED WORK

300.01 GENERAL. - The Contractor shall do all excavating of pavement and earth materials, sheet piling, and lagging, all as set forth in Part 7 of these Standard Specifications, and shall do all other work, including investigation of locations, elevations and flows, traffic routing work, and salvaging of castings, necessary for the satisfactory completion of the required sewer and drainage work, all in accordance with the requirements of the Special Provisions and these Standard Specifications.

The Contractor, in accordance with the requirements of Sections 703, 707 and 109, shall do all backfilling and restore all pavements and related improvements removed, destroyed, damaged or undermined as a result of his operations.

300.02 RECORDS OF EXISTING SEWERS AND SEWER STRUCTURES.
- Certain maps and records of the existing sewers and sewer structures in the vicinity of, and interconnected with, the work are on file in the City Engineer's Office, and may be examined by the Bidder. The Bidder should note, however, that these structures may have been altered by repairs at various times and may differ from the records on file, and that no representation is made nor responsibility taken by the City as to the accuracy of the records or the locations shown thereon.

300.03 ELEVATIONS AND LOCATIONS. - Elevations and locations of existing structures, sewers, side sewers, culverts, and other facilities shown on the plans are approximate only. Exact elevations of connections must be determined in the field before commencing excavation operations. If no manhole opening or other access is readily available for determining the elevation or location of the connection points, the Contractor shall expose the existing sewer or structure, as necessary to make such determinations.

300.04 ELEVATIONAL CONTROL. - The elevational control consists of the slope and the vertical distance above or below San Francisco City Datum to the invert of the sewer or sewer structure.

Approximate Elevation (\pm) - Elevations of ground surface and inverts of sewers or sewer structures are shown for informational purposes only. Rim elevations of sewer structures are to be constructed to conform to existing street grades or to match new street grades. See existing elevation and invert/conform elevation on the plans.

Existing Invert Elevation - Elevations of inverts of existing sewers or sewer structures are approximate and are shown on the plans for informational purposes only.

Invert/Conform Elevation - Elevation of the new pipe, channel, or flow surface of sewer or sewer structure to be constructed shall coincide with elevation of the existing pipe, channel, or flow surface of sewer or sewer structure. Field adjustment may be necessary to match existing invert and to determine slope of new pipe.

Invert Elevation - Elevation of the new pipe, channel or flow surface of sewer or sewer structure to be constructed.

Slope - Invert slope of pipe or channel; construction slope of pipe between two invert elevations or invert/conform elevations. Field adjustment of slope may be necessary after verification by the Contractor of invert/conform elevations of sewers or sewer structures.

The descending order of precedence shall be as follows:

1. Invert Elevation
2. Invert/Conform Elevation
3. Slope
4. Existing Invert Elevation
5. Approximate Elevation

300.05 PAVEMENT CUTTING. - The Contractor shall use, but not limited to, pavement concrete saw cutting or vibratory pavement breaker.

The Contractor may not use any machine or device that breaks pavement by blows struck by a falling or driven hammer or weight.

Such prohibition, however, shall not be construed as barring the use of hand tools or manually operated air tools such as jackhammers.

300.06 DELIVERY OF SALVAGED CASTINGS. - The Contractor shall salvage manhole, catchbasin and storm water inlet frames, covers, and gratings, removed from the work, and not specified to be reused in the work, as City property, and deliver to the City Yard located at 2323 Army Street, San Francisco. The Contractor shall contact the Bureau of Street and Sewer Repair at Telephone No. 415-695-2096, for appointment, 24 hours prior to delivery of such castings. Upon delivery, the castings shall be placed where directed by Yard personnel.

Castings to be salvaged are Standard 26-inch Manhole Frame and Cover and Cast Iron Frame And Grating For Catchbasin Type A.

All other removed sewer castings shall be removed from the site of the work as the Contractor's property and disposed of in a legal manner.

The delivery of salvaged castings shall be done as Incidental Work.

SECTION 301

HANDLING AND DISPOSAL OF SEEPAGE, STORM WATER AND SEWAGE

301.01 GENERAL. - The Contractor shall dispose of water from all sources; shall keep excavations dry; shall do all necessary work to suitably and adequately divert all sanitary, ground water, tide water, and storm water flow; and shall furnish all necessary pumps and related equipment; all in accordance with the requirements set forth herein and in Section 700.08.

Subdrains and crushed rock, if constructed, shall be in accordance with Sections 321 and 712.

The Contractor will be responsible for familiarizing himself with sewers which are interconnected with the work. Sewer information is available as set forth in Section 300.02.

The Contractor is cautioned that any quantities of flows shown on the plans or included in the Special Provisions are estimated and are furnished to the Contractor for general guidance only, and that the City takes no responsibility for the accuracy of these estimates nor for any deductions or conclusions that the Contractor may make therefrom. In any case, the Contractor will not be relieved of any responsibility for the handling and disposal of water and sewage.

301.02 SANITARY SEWAGE. - All sanitary sewage shall be carried in closed conduits, or other means approved by the Engineer, and will not be allowed to flow exposed on the street, or in gutters, trenches, or excavations. The Contractor may use, to the limit of their capacity, subdrains in accordance with Section 321.

301.03 BACKFLOW. - Should the construction of any dam or dams cause sewage or storm water to back up and flow on private property through side sewers, or by other means, the Contractor shall immediately take corrective measures to stop the backflow, remove the sewage and storm water from the private property, clean and disinfect the premises, and repair any damage caused by backflow.

301.04 SUBDRAINS. - Where subdrains are used, side sewers cut along the line of the work shall be temporarily connected to the subdrains by means of pipes and fittings. When permanent side sewer connections are re-established, openings for temporary connections shall be sealed with brickwork or concrete, and the pipe and fittings used for such connections removed from the site by the Contractor as his property.

301.05 DIVERSIONS AND DAMS. - The Contractor shall not obstruct the normal flow in any existing sewer, but where necessary shall divert such flow around or through the work or discharge such flow into other approved sewers or places.

The Contractor shall not divert any flow from any source that will result in additional flow in sewers leading to pumping stations.

All flow including storm water flow shall be carried around or through the work by the Contractor at his own expense by diverting the

flow to other sewers, by pumping or by bypassing the work with pipes or other conduits, unless otherwise specified. All sewage flow, including storm water flow, shall be diverted to sewers leading to treatment plants and shall not be diverted to a sewer or structure leading directly to the Bay or Ocean.

The Contractor shall not construct a dam in any sewer or sewer structure without the prior written consent of the Engineer. Regardless of such consent, the Contractor shall be responsible for any damage resulting from the construction of any dam or dams in the sewerage system.

Dams, diversion devices, or other obstructions placed in sewers or manholes for diverting flow during the work, shall be removed by the Contractor at the completion of the work, or when directed by the Engineer. Any damage to sewerage or drainage facilities resulting from the Contractor's handling and disposing of seepage, storm water, and sewage, shall be satisfactorily repaired by the Contractor at his expense.

301.06 PAYMENT. - Handling and disposal of seepage, storm water, and sewage shall be done as Incidental Work and payment therefor shall be included in the price or prices bid.

SECTION 302

REMOVING, PLUGGING, AND FILLING EXISTING SEWERS AND RELATED STRUCTURES

302.01 GENERAL. - The Contractor shall remove, plug, and fill, or break open, sewers and related structures where and as shown on the plans, or where necessary for the proper completion of the work, including all excavating, backfilling, restoring pavement, and other Incidental Work.

All openings and outlets of sewers or related structures abutting sections to be removed or broken open shall be satisfactorily sealed at all open ends with brick and mortar or concrete and all contained sewage removed unless otherwise specified.

302.02 REMOVE. - Existing sewers, manholes, catchbasins, other sewerage and drainage structures, and appurtenances, including vitrified clay pipe sewers, side sewer and culverts, which have been or are to be abandoned, and lie within a sewer trench or sewer structure excavation, shall be removed from within the limits of required excavation necessary for the work.

All sewerage facilities, except side sewers and culverts, to be abandoned shall be removed to a depth at least three feet below street grade or ground surface, as the case may be, and all contained sewage removed.

302.03 BREAK OPEN. - Inverts of partially removed facilities shall be broken open to freely drain, and the facility backfilled, or, if specified, filled with slurry grout.

302.04 PLUG AND FILL. - Main sewers 12 inches or greater in diameter to be abandoned, which lie three feet or deeper below street grade or ground surface, shall be thoroughly sealed at all open ends, and at the structures in which they terminate, as applicable, and shall be filled with an approved slurry grout.

The plugging at the ends of sewers and sewer facilities to be filled with slurry grout may be accomplished by the use of temporary plugs or bulkheads which shall be removed after the slurry mix has set.

302.05 PLUG. - 6-inch and 8-inch Side sewers and 10-inch culverts to be plugged shall be sealed at all open ends and at the structures in which they terminate, as applicable, with brick and mortar or concrete plugs.

Plug thicknesses for Sections 302.04 and 302.05 shall conform to the following schedule:

<u>Pipe Diameter</u>	<u>Plug Thickness</u>
Smaller than 24"	4" Minimum
24" to 36"	8" Minimum
Larger than 36"	12" Minimum

302.06 FILL WITH SLURRY GROUT. - Sewers 12 inches or greater in diameter and related structures to be plugged and filled shall be filled with a slurry mixture containing a minimum of 2 sacks of Type II cement per cubic yard of mixture.

Filling with slurry may be accomplished by pumping or gravity, at the option of the Contractor, and will be checked by comparing the computed volume of the sewer facility with the volume of mixture used. If the computed volume is more than 10 percent greater than the actual volume of slurry used, the Contractor shall excavate two exploratory holes where directed, and shall do all work necessary to satisfactorily fill any encountered voids.

Any damage to existing facilities resulting from the use of slurry grout shall be satisfactorily repaired by the Contractor at his own expense and no direct or additional payment will be made for such repair.

Side sewers and culverts shall not be filled with slurry grout, unless specified.

302.07 PAYMENT. - The satisfactory removal, plugging, plugging and filling, or opening, of sewers and sewer structures will be paid for at the respective prices bid therefor when such work is set forth for payment in the Schedule of Bid Prices. All such work shown or specified and not so set forth shall be done as Incidental Work.

SECTION 303

CAST-IN-PLACE REINFORCED CONCRETE SEWER AND SEWER STRUCTURES

303.01 GENERAL. - The Contractor shall construct cast-in-place reinforced concrete sewer and sewer structures including all excavating, lagging, forming, waterproofing, backfilling, restoring pavement and other Incidental Work, necessary or required, for a complete, satisfactory installation, where and as shown on the plans, or where directed. Such sewer and sewer structures shall be of Class 6-3000-3/4 concrete constructed in accordance with the plans, the applicable requirements of Sections 411 and 800, and these specifications. Cement shall be Type II.

All appurtenances for structures, such as manhole-cones, frames, covers, gratings, steps, VCP stub inlets, and VCP stub inverts shall be furnished and installed where and as shown on the plans and as specified.

303.02 FORMWORK. - Lagging or shoring shall not be used as a surface against which concrete is placed unless permitted in the Special Provisions. Sufficient clearance shall be maintained between the formwork and lagging so that the alignment and cross section of the work as shown on the plans can be obtained by adjustment of such formwork.

In the event that the Special Provisions permit concrete to be placed against the lagging or shoring, a bond breaker shall be placed between the concrete and the shoring or lagging and shall be a maximum of 1/4" thick plywood, interior grade, or approved equal. Maximum overpour shall be limited to two (2) inches.

No concrete shall be placed in formwork unless such formwork is constructed to the required alignment, grade and cross sections, and is approved by the Engineer. Such approval shall in no way relieve the Contractor of the responsibility for obtaining, in the completed work, the alignment, grade and cross sections shown on the plans. The Contractor shall provide access for the Engineer to inspect reinforcements prior to pouring the concrete.

The use of twisted wire loops as form ties will not be permitted.

Smooth forms accurate held on line and grade shall be used. Forms and centers may be made of either metal or timber. The surfaces of all timber forms that come in contact with the inside surfaces of concrete sewers and sewer structures shall be laid with close joints and oiled with non-staining mineral oil.

Sharp corners shall be chamfered one inch, and 3/4-inch x 3/4-inch triangular fillets shall be used in all angles of formwork unless otherwise shown on the plans or directed by the Engineer.

303.03 INVERT FORMS. - Inverts of sewers and sewerage structures shall be formed by the use of fixed and rigid forms when the invert radius is 2'-0" or less. Inverts with a radius larger than 2'-0" and smaller than 2'-6" shall also be formed by the use of fixed and rigid forms unless the Engineer approves otherwise. Such approval will depend on the concrete's slump and its ability to satisfactorily form the

invert shape by screeding. When fixed and rigid formwork is required, shaping the inverts with screeds or other means will not be allowed.

303.04 CONSTRUCTION. - The invert of the sewer or structure, up to the key joint, shall be constructed first. The concrete shall be carefully and properly placed and vibrated. No traffic of any kind will be permitted on the invert for at least twenty-four hours after placing. Concrete for the sides and tops of sewers and sewer structures not on piles shall not be placed until at least forty-eight hours have elapsed after the placement of invert concrete; and in the case of sewers and sewer structures on piles not until at least seventy-two hours have elapsed after the placement of invert concrete.

No more wall and top section shall be started than can be completed the same day. Wall and top section construction joints with proper keyways shall be made at the end of each pour. Construction joints in invert and walls shall not be in the same plane, but shall be staggered.

Immediately after the removal of the forms and centers, all rubbish and surplus materials shall be removed from the sewer or structure in order to prevent any possibility of their entering the City's sewer system.

303.05 FORM REMOVAL. - The period of time and the strength of concrete required before the removal of forms shall be in accordance with Section 411.09 except that formwork for arch type concrete sewers and sewer structures need only remain in place for a minimum period of seventy-two hours after the placement of concrete therein. If forms are removed before a period of seven days, extra care shall be taken in the removal of forms in order not to spall the "green" concrete.

Formwork, maximum size of 1/4" plywood, may be left in place, provided it is on the outside of the sewer or sewer structure.

Invert forms shall be removed at the proper time to allow thorough steel troweling.

Unless otherwise specified, all formwork and trench support material shall be removed by the Contractor.

303.06 FINISHING. - Interior concrete surfaces of sewers and sewer structures shall be given an "Ordinary Surface Finish" in accordance with the requirement of Section 411.10, except that the completed work need not be sacked. However, such surfaces shall receive a coat of neat cement mortar applied with a brush, and shall be kept free from sewage for a minimum period of thirty-six hours after the cement has been applied.

Inverts of sewers and sewer structures shall be steel troweled to a smooth uniform surface.

The channelization shall be done with Class "B" mortar.

303.07 CURING. - Cast-in-place reinforced concrete sewers and sewer structures shall be cured by water or impervious membrane curing in accordance with these specifications.

No traffic of any kind will be allowed over the sewer during the curing period. The minimum curing period shall be seven days or until the concrete has attained a compressive strength of at least 2,500 pounds per square inch based on field cured cylinders.

Immediately after the sewer invert has been poured, it shall be covered with wet burlap and kept wet for the curing period. The Contractor may, after twenty-four hours, replace the burlap with straw, sawdust, or earth kept thoroughly wet until the expiration of the curing period.

The concrete in the top and sides of the sewer or structure shall be cured by being kept continuously moist, either by sprinkling, wet burlap, or wet earth, for the curing period.

Concrete curing by means of an impervious membrane shall be done using an approved liquid which will form an impervious, non-slippery membrane when dry. The liquid shall have a temporary color sufficient to indicate the extent of its application. The membrane shall form a hard film and thoroughly waterproof the concrete surface within thirty minutes.

No membrane will be allowed on steel reinforcement. The Contractor shall protect exposed steel reinforcement during membrane application. Any and all membrane on steel reinforcement shall be removed before additional placement of concrete will be allowed.

Membrane curing liquids shall be applied under pressure with a spray nozzle at such a rate as to seal the surface uniformly and completely. The membrane seal shall be protected from injury for ten days and any breaks in the membrane during this period shall be repaired immediately by a fresh application of the liquid.

303.08 FRAMES, COVERS, AND GRATINGS. - Cast iron frames, covers, and gratings shall be furnished and installed on sewer structures, where and as shown on the plans, or where directed. The cast iron shall be in accordance with the requirements of Section 801.01.

Each casting shall have its weight indicated thereon with white paint.

Care shall be exercised to cast the contact surfaces in a true plane and free from irregularities. These surfaces shall be machined or ground to insure uniform contact between frame and cover or grating.

303.09 TAPER CONES. - The taper cone for precast and cast-in-place manholes shall be of the eccentric type. The vertical wall of the cone shall be upstream or as otherwise directed by the Engineer.

303.10 STEPS. - All steps for sewer structures shall be fabricated from approved Class 316 stainless steel or approved polypropylene conforming to Type II, Grade 16906, and in accordance with the requirements of ASTM D2146 with 1/2-inch grade 60 steel reinforcement conforming to ASTM A615, and in accordance with the details shown on the plans.

303.11 CONSTRUCTION JOINTS. - The Contractor shall construct joints in accordance with Section 800.15, unless otherwise specified, and shall furnish and install approved keylock polyvinyl chloride waterstops and flexible silicon rubber joint filler material in all transverse construction joints. Water stops and filler material shall be omitted on longitudinal construction joints.

The Contractor shall submit for the Engineer's approval, the manufacturer's specifications for the flexible joint filler material.

303.12 PAYMENT. - Cast-in-place reinforced concrete sewer satisfactorily constructed complete, in place, as specified, will be paid for at the price bid per linear foot, measured horizontally along the centerline of sewer between the outside surfaces of structures, or to the limits as constructed, as applicable.

No deduction will be made from the length of cast-in-place reinforced concrete sewers because of manholes constructed thereon.

Cast-in-place reinforced concrete sewer structures satisfactorily constructed complete, in place, will be paid for at the respective lump sum price bid therefor. Appurtenances, such as manholes, cones, frames, covers, gratings, steps, stub inlets, and VCP inverts shall be considered as part of the structure and no direct or additional payment will be made thereof.

SECTION 304

PRECAST REINFORCED CONCRETE PIPE SEWER

304.01 GENERAL. - The Contractor shall construct precast reinforced concrete pipe (RCP) sewer including all excavating, lagging, backfilling, restoring pavement, and other Incidental Work, necessary or required, for a complete, satisfactory installation, where and as shown on the plans, or where directed.

Precast reinforced concrete pipe shall be manufactured by the Centrifugally Spun or Vertically Cast method with bell and spigot joints in accordance with the plans and ASTM "Standard Specifications for Reinforced Concrete Culvert, Storm Drain and Sewer Pipe," Designation C76, except as modified by the plans, the Special Provisions, and these specifications.

Precast pipe shall have cylindrical interior surfaces and shall be free from fractures, excessive interior surface crazing, and roughness. The interior and exterior surfaces shall be concentric at transverse cross sections.

Precast reinforced concrete pipe shall be furnished from a manufacturer who must have had at least five years experience in manufacturing such pipe. The Contractor shall, if requested by the Engineer, submit a list of representative pipe installations for which the manufacturer has furnished pipe during the last five years.

Each section of pipe shall be plainly painted on the inside surface, at the spigot end, with letters and numerals not less than 1-1/2 inches in height designating the following:

- Project specification number;
- Date of manufacture;
- Method of manufacture;
- "D-Load" or "Class" rating;
- Top Center (when elliptical reinforcement is used), or alternative markings as approved by the Engineer.

The Contractor shall notify the Engineer in writing a minimum of 5 days prior to beginning the manufacture of the pipe to be supplied. To facilitate inspection and testing, each day's run of pipe shall be marked

and stored so that pipe manufactured on any particular day may be easily identified.

The strength requirements of the pipe shall be designated in terms of "D-Load" or "Class". "D-Load" is defined as the load, in pounds per square foot of projected internal diameter, that the pipe will withstand under the standard ASTM 3-edge bearing test before any crack having a width of 0.01 inch or more, and a length of 12 inches or more, occurs.

If precast RCP is specified by Class, the D-Load shall be as follows:

Class	D-Load
I	800
II	1000
III	1350
IV	2000
V	3000

The minimum "D-Load" shall be 2000-D unless otherwise specified.

304.02 CONCRETE. - Cement shall be Type II in accordance with Section 800.02. Concrete shall be in accordance with ASTM Standard Specifications, Designation C76 and shall contain 6 sacks of cement per cubic yard of concrete as therein specified. Pipe shall not be transported from the plant until the full design strength is developed. Each section of pipe shall be steam or water cured, or cured using a combination of the two methods, and shall be kept continuously moist for at least 7 days. Curing shall commence within three hours following fabrication. Compression test specimens shall be made, cured in the same manner as the pipe, and tested in accordance with requirements of ASTM "Standard Specifications for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe," Designation C76, except as modified by the testing specifications of Section 304.13.

304.03 CENTRIFUGALLY SPUN. - Pipe manufactured by the centrifugally spinning method shall have smooth interior surfaces free from excessive brush marks or other rough textures. Float rock or other light materials appearing on the inside surface of the pipe will be cause for rejection, unless such imperfections are repaired to the satisfaction of the Engineer.

304.04 VERTICALLY CAST. - Pipe manufactured by the vertical cast method shall have smooth interior surfaces, relatively free from pits and airholes. The concrete shall be placed between rigid internal and external forms extending the full length of the pipe and compacted by high frequency vibration.

The vibrators shall be rigidly attached to the exterior of the form by bolting, clamping, or welding. The vibrators shall be adequate in size and number and of sufficient frequency to properly compact the concrete.

The vibrators shall be operating at all times during the placement of concrete.

304.05 DIMENSIONS AND TOLERANCES. - Pipe shall be furnished in lengths not less than 6 feet; except for the closing sections to structures, where cast or cut lengths not less than 3 feet in length may be used.

Pipe sections 6 feet in diameter and larger, in which manhole openings are provided, shall be not less than 7 feet long.

The minimum wall thickness of pipe, unless otherwise specified, shall be "B Wall" thickness in accordance with ASTM "Standard Specifications for Reinforced Concrete Culvert, Storm Drain and Sewer Pipe," Designation C76. Pipe 42 inches in diameter and larger shall have a minimum protective covering of concrete over steel reinforcement of 1-1/2 inches from the outer surface and one inch from the inner surface.

The minimum thicknesses of bells at the base and spigots shall be in accordance with the following schedule:

12-inch diameter through 24-inch diameter, inclusive: Pipe bells and spigots each shall be at least 1-3/4 inches thick.

27-inch diameter through 60-inch diameter, inclusive: Pipe bells and spigots each shall be at least 2-1/4 inches thick.

63-inch diameter and larger size diameters, inclusive: Pipe bells and spigots each shall be at least 45 percent of the thickness of the respective pipe barrel wall.

In determining minimum thicknesses no reduction will be made from the thickness of spigots because of normal gasket grooves. However, in any case, gasket grooves shall not be made so as to leave less than 3/4-inch of concrete cover on reinforcing steel.

304.06 CONTRACTOR TO FURNISH DETAILS. - The Contractor shall furnish to the Engineer for approval six copies of the complete design details of the precast reinforced concrete pipe, including joints, and where applicable, cross-bracing, he intends to furnish.

304.07 HANDLING AND STORING. - Pipe shall be handled and stored so as to prevent damage thereto, or to existing improvements. Pipe, when stored, shall be properly secured to prevent rolling.

Any pipe which, in the opinion of the Engineer, has been damaged to the extent of being beyond repair, will be marked "rejected" and shall be immediately and permanently removed from the site of the work by the Contractor.

Cross-bracing is required for all precast pipes six feet in diameter and larger. The cross-bracing shall be placed inside the pipe such that no deformation will occur. The cross-bracing shall be installed prior to any transportation or handling of the finished pipe. The cross-bracing shall not be removed until the trench has been fully backfilled and compacted. In no case shall there be less than two sets of cross-bracing installed per pipe length.

304.08 CUTTING PIPE. - Cut lengths of pipe shall be neatly cut to a smooth transverse edge with a masonry saw or other approved means in such manner as to not spall the concrete from the surfaces of the pipe or unnecessarily expose the reinforcing steel.

Any pipe damaged by cutting to an extent that it is unsatisfactory shall be replaced with a new and undamaged length of pipe by the Contractor at his expense, or if allowed by the Engineer, shall be repaired in an approved manner. Spalled areas to be repaired shall be satisfactorily filled with Class "A" mortar and reinforcing steel shall be cut back where necessary and the holes filled, also with Class "A" mortar, so that the mortar covering the steel is not less than 2-1/2 inches thick, measured from the cut face of the pipe.

Hand cutting of pipe will be permitted if holes outlining the line of the cut are cleanly drilled and the intervening concrete satisfactorily cut out with approved hand tools. Light pneumatic chipping hammers that, in the opinion of the Engineer, will cut satisfactorily without shattering the adjacent concrete, may be used. The use of sledge hammers or pneumatic jack hammers will not be permitted.

304.09 JOINTS: GENERAL. - Pipe joints shall be bell and spigot. Spigot ends shall be reinforced concrete with an annular groove formed into the outer surface containing a continuous round neoprene gasket compressed therein by the inner surface of a reinforced concrete bell. The joint shall be self-centering and designed so as to prevent the neoprene gasket from supporting the weight of the pipe.

Each joint shall be watertight, (without imperfections), and approved by the Engineer before another section of pipe is installed. The location of the neoprene gasket within the completed joint will be determined by the use of a feeler gauge.

While joining sections of pipe, the Contractor shall use a "comealong" to seat the pipe section being installed.

The joint gap on the inside of the sewer between sections of pipe shall not exceed 3/4 inch. If the joint gap is 3/8 inch or more, the Contractor shall fill such gap with an approved epoxy mortar, mixed to stiff consistency, and finished flush with the pipe walls.

Joints connecting pipes to structures shall be integrally cast with the structure or made with Class "A" cement mortar. Imperfections of cast joints shall be repaired with Class "A" cement mortar.

Cement mortar shall be in accordance with the requirements of Section 800.09.

The pipe section that cannot be laid to give a proper joint with the approved overlap shall be replaced with a suitable pipe section or the joint shall be reinforced with an approved concrete collar not less than 6 inches thick and 12 inches long, containing not less than 3-circumferential No. 4 steel reinforcing bars with suitable spacers. The outside surface of the pipe at the joint shall be roughened to provide satisfactory bond with the collar.

A cut end of pipe may only be used for the closing connection with concrete structures and manhole bases. The cut end shall extend into the wall of the structure or manhole base. The wall of the structure or manhole shall be placed around the end of the cut length of pipe.

304.10 BELL AND SPIGOT ENDS OF PIPE. - The outside surfaces of the spigot, and the inside surfaces of the bells, shall be accurately formed to provide readily made close fitting joints, the average clearance of which shall not exceed 0.08 inch.

The taper on the conic surface of the inside of the bell and the outer surface of the spigot shall not be more than 3 degrees measured from a longitudinal trace on the inside surface of the pipe.

The joint lap distance at each spigot shall be at least 3-3/8 inches.

The bell reinforcement and the spigot reinforcement shall each be at least equal in quantity and quality to the steel in the pipe barrel wall with extra steel being added, as necessary, to reinforce ends of pipe against normal construction and shipping stresses.

304.11 BEVEL JOINTS. - Bevel joints, when specified in the Special Provisions, shall be of the bell and spigot type as set forth in Section 304.09 and the horizontal deflection thereof shall not exceed 5 degrees. The longitudinal centerline of pipe at each bevel joint shall be located on the indicated centerline of the sewer. Horizontal deflections will be permitted only at bevel joints or within structures.

304.12 NEOPRENE GASKETS. - Each gasket shall be continuous ring of such size and cross section as to completely fill the groove in the spigot when the pipe joint is assembled. The gasket shall make the joint watertight under normal conditions of service including expansion, contraction, and normal earth settlement. Neoprene gaskets shall be made in accordance with ASTM "Standard Specifications for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets," Designation C443.

Each gasket, the groove containing it, and the inside surface of the bell or collar compressing it, shall be coated with an approved manufacturer's recommended lubricant immediately prior to installation.

304.13 MATERIAL TESTING. - The Contractor shall make available testing equipment and samples, and shall test or have tested precast reinforced concrete pipe by standard 3-edge bearing and compression tests in accordance with ASTM "Standard Specifications for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe." Designation C76, except as modified by the plans and these specifications.

The Contractor shall furnish the Engineer with Compression Test results for each manufacturer's run, size, and "D-Load" of pipe specified. If the test cylinder fails to reach the design strength, the Contractor shall at his own expense provide core samples where directed by the Engineer. The core shall be cut and tested in accordance with the requirements of Methods ASTM C497. The core holes shall be plugged and sealed in accordance with ASTM C76.

At the option of the Engineer, the Contractor shall furnish complete test data of the pipe he intends to furnish, two standard concrete cylinders, and two core samples from each run, size, and "D-Load" of the specified pipe for testing by the City.

The Engineer may select from each size, "D-Load," or 400-linear feet of pipe one length for 3-edge bearing testing, and at the Engineer's request all tests shall be performed in his presence. The minimum length for 3-edge bearing testing shall be 6-linear feet. For each pipe that fails to meet the "D-Load" requirements two additional lengths of the same run, size, and "D-Load" shall be tested. If these pipes meet the "D-Load" requirements the shipment will be accepted. If these pipes do not meet the "D-Load" requirements, testing shall be continued as determined by the Engineer until he approves or rejects the shipment.

For precast pipe sizes larger than 108-inch diameter the 3-edge bearing test will not be required. In lieu thereof, the Contractor shall submit to the Engineer notarized certificates obtained from the pipe manufacturer to verify:

- 1) The 28-day strength of the concrete, as determined from crushing tests in accordance with ASTM Designation C76 on (a) standard concrete cylinders, or (b) core samples; the latter being in addition to the former and at the option of the Engineer;
- 2) The density of the concrete as in the finished pipe product;
- 3) The strength and type of steel used;
- 4) That production of the pipe is in compliance with ASTM Designation C76, except as modified by the plans and these specifications.

In addition to the samples, tests, and test results required herebefore, the City reserves the right to require additional samples, tests, and test results to properly examine the precast reinforced concrete pipe.

304.14 PAYMENT. - Precast reinforced concrete pipe sewer satisfactorily constructed complete, in place, as specified, will be paid for at the price bid per linear foot, measured horizontally along the centerline of sewer, exclusive of manholes and structures, between the outside surfaces of manholes and structures, or to the limits as constructed if the sewer does not terminate in manholes or structures.

Precast reinforced concrete pipe sewer connecting to a manhole or structure by a collar or boss shall be measured to the outside surface of such collar or boss at the point of connection with the pipe.

No deduction will be made from the measured length of precast reinforced concrete pipe sewer because of collars constructed thereon to reinforce the joint between sections of precast pipe. The collars constructed to reinforce the joint shall be done as Incidental Work.

No deduction will be made from the measured length of precast reinforced concrete pipe sewer because of manhole cones constructed thereon.

SECTION 305

VITRIFIED CLAY PIPE SEWER

305.01 GENERAL. - The Contractor shall construct vitrified clay pipe sewer (including encasement in reinforced concrete, plain concrete base, or reinforced concrete foundation, as the case may be) including all excavating, lagging, backfilling, restoring pavement, and other Incidental Work, necessary or required for a complete, satisfactory sewer installation, where and as shown on the plans, or where directed.

305.02 PIPE. - Vitrified Clay Pipe (VCP) shall conform to the ASTM "Standard Specifications for Extra Strength Clay Pipe," Designation C700, except as modified by the plans, the Special Provisions and these specifications.

VCP main sewers and fittings for pipe diameter larger than 12 inches shall be of the bell and spigot type.

The minimum thickness of the pipe barrel shall conform to the Regional Western Standard of the Clay Pipe Institute.

305.03 JOINTS. - Bell and spigot joints shall be constructed with factory fabricated compression type gasket joints in accordance with ASTM "Standard Specification for Vitrified Clay Pipe Joints Using Materials Having Resilient Properties," Designation C425. Joints shall be made up in the field in accordance with the manufacturer's recommendations. All joints shall be tight fitting, watertight, and without imperfections. Only factory recommended lubricants shall be used.

Joints connecting pipes to manhole structures shall be made with a short stub. The straight segment of stub barrel may not exceed 6-inch maximum from face of the structure.

Joints for VCP plain-end pipe sewers 12-inch or smaller in diameter may be rubber compression couplings with stainless steel bands type 316. Rubber compression couplings with Class 316 stainless steel bands shall be in accordance with the requirements of ASTM designation C425.

305.04 TESTING. - The Contractor shall test vitrified clay sewer pipe and joints, if required by the Special Provisions, in the presence of the Engineer. The Contractor shall notify the Engineer, at least 48 hours in advance, of the time and place of such tests.

Vitrified clay pipe shall be tested for strength, absorption, and acid resistance, in accordance with ASTM "Specification for Extra Strength Clay Pipe", Designation C700, except that the number of pipes to be tested shall be one.

Joints in VCP pipes shall be tested in accordance with ASTM "Specification for Compression Joints for Vitrified Clay Bell and Spigot Pipe", Designation C425, except that:

- 1) The number of joints to be tested shall be one;
- 2) Duration of hydrostatic shear test shall be 10 minutes;
- 3) The field performance tests will not be required;
- 4) In the event of a failure of a test, two additional joints from the same lot of pipe shall be tested.

305.05 CONTRACTOR TO FURNISH DETAILS. - The Contractor shall furnish to the Engineer for approval prior to shipment of the VCP pipes six copies of the certified report of the actual test results meeting the requirements of ASTM C700.

305.06 HANDLING AND STORING. - Pipe shall be handled and stored so as to prevent damage thereto, or to existing improvements. Pipe, when stored, shall be properly blocked to prevent rolling.

305.07 CONSTRUCTION. - Pipe sections of the main sewer shall be ordered in short lengths, as necessary if "T" or "Y" branches will be used, in order that such branches will be located opposite or within 2 feet down downstream of existing side sewer locations.

Pipe sewers shall be so constructed and the sections so installed that the sections of pipe laid together form a continuous uniform line of pipe with a smooth regular interior surface. Pipe shall be laid uphill from structure to structure with the bell end upgrade. Each pipe shall be laid in the proper position, on a firm 4-inch deep sand bed, and shall have uniform support and bearing for its entire length. Bells shall be cleaned before the spigot of the succeeding pipe is inserted. A bell hole shall be dug at the end of each pipe to accommodate the bell and facilitate the making of the joint.

Pipe sewers shall be laid in conformity to the prescribed lines and grades, which shall be obtained for each pipe by measuring from a tightly stretched line running parallel with the grade and supported over the center line of the sewer by bars placed across the trench. The pipe sections shall be tightly fitted together. All adjustments of pipe to line and grade shall be made by scraping away or filling in and tamping the earth under the body of the pipe, not by blocking or wedging up. Supporting blocks shall not be used under the pipe. Pipe shall not be laid within 4 inches of any rock or other rigid object.

The Contractor shall not lay pipe in water and he shall use crushed rock, subdrains, or some other method approved by the Engineer to maintain an appropriately dry trench.

Crushed rock bedding for pipe sewers shall be uniformly graded from No. 4 to 3/4-inch sieve size. Compaction shall be obtained by shovel slicing, using care not to disturb the pipe. Jetting will not be allowed to get proper compaction of the crushed rock bedding.

Pipe sewers in encasements or on foundations shall have the bottom reinforcing steel of the encasement or foundation run continuously through all sewerage structures constructed along or at the end of such sewers.

When pipe is being encased in reinforced concrete, the Contractor shall support the pipe during placement of the concrete encasement, shall prevent any "floating" or movement of the pipe, and shall carefully maintain the required line and grade. The support and method thereof shall be approved by the Engineer prior to placing encasement but such approval will not relieve the Contractor of his responsibility for execution of the work so that the pipe will be true in line and grade and satisfactory in every respect.

305.08 PAYMENT. - Vitrified clay pipe sewer (including encasement in reinforced concrete, plain concrete base, or reinforced concrete foundation, as the case may be) satisfactorily constructed complete, in place, as specified, will be paid for at the price bid per linear foot, measured horizontally along the centerline of the sewer, exclusive of manholes and structures, between the outside surfaces of manholes and structures, or to the limits as constructed if the sewer does not terminate in manholes or structures. Supporting piles, and the driving thereof, will not be included for payment under a Bid Item for vitrified clay pipe sewer, but will be paid for under the appropriate Bid Items.

Vitrified clay pipe sewer connecting to a manhole or structure by a collar or boss shall be measured to the outside surface of such collar or boss at the point of connection with the pipe.

No deduction will be made from the measured lengths of vitrified clay pipe sewer because of side sewer connections.

SECTION 306

VITRIFIED CLAY PIPE CULVERT

306.01 GENERAL. - The Contractor shall construct vitrified clay pipe culvert (including encasement in reinforced concrete, plain concrete base, or reinforced concrete foundation, as the case may be) including all excavating, lagging, backfilling, restoring pavement, and other Incidental Work, necessary or required for a complete, satisfactory installation, where and as shown on the plans, or where directed.

306.02 PIPE. - Vitrified clay pipe for culvert shall be the same as specified for main sewers in Section 305.02, except that the culvert and related fittings may be of the spigot type using composition couplings and stainless steel bands to make the joints.

306.03 JOINTS. - Joints for vitrified clay pipe culverts shall be the same as specified for main sewers in Section 305.03, except that rubber compression couplings with stainless steel bands may be used for the applicable joints. Rubber compression couplings with Class 316 stainless steel bands shall be in accordance with the requirements of ASTM "Tentative Specifications for Compression Couplings for Vitrified Clay Plain-end Pipe", Designation C425.

306.04 CONTRACTOR TO FURNISH DETAILS. - The Contractor shall furnish to the Engineer for approval six copies of the certified report of the actual test results meeting ASTM C700 and design details of the rubber compression couplings.

306.05 HANDLING AND STORING. - Pipe shall be handled and stored so as to prevent damage thereto, or to existing improvements. Pipe, when stored, shall be properly secured to prevent rolling.

306.06 CONSTRUCTION. - Vitrified clay pipe culvert shall be constructed in accordance with the requirements for main sewers as specified in Section 305.07. Culvert shall be laid on a grade of not less than 2 percent (approximately 1/4-inch per foot). Horizontal and vertical bends in side sewer runs shall not exceed 45 degrees (1/8 bend), using approved mitered joints.

306.07 PAYMENT. - Vitrified clay pipe culvert (including encasement in reinforced concrete, plain concrete base, or reinforced concrete foundation, as the case may be) satisfactorily constructed complete, in place, as specified, will be paid for at the price bid per linear foot, measured horizontally along the centerline of the culvert, between the outside surfaces of sewerage and drainage structures, or to

the limits as constructed if the culvert does not terminate in sewerage or drainage structures.

SECTION 307

VITRIFIED CLAY PIPE SIDE SEWER

307.01 GENERAL. - The Contractor shall construct vitrified clay pipe side sewer, including all excavating, lagging, backfilling, restoring pavement and other Incidental Work necessary, or required for a complete, satisfactory installation, where and as shown on the plans, or where directed.

307.02 PIPE. - Vitrified clay pipe for side sewers shall be the same as specified for main sewers in Section 305.02, except that the side sewers and related fittings may be of the spigot type.

307.03 JOINTS. - Joints for vitrified clay pipe side sewers shall be the same as specified for main sewers in Section 305.03, except that rubber compression couplings with Class 316 stainless steel bands may be used for the applicable joints. Composition couplings with Class 316 stainless steel bands shall be in accordance with the requirements of ASTM "Tentative Specification for Compression Couplings for Vitrified Clay Plain-End Pipe", Designation C425.

307.04 HANDLING AND STORING. - Pipe shall be handled and stored so as to prevent damage thereto, or to existing improvements. Pipe, when stored, shall be properly blocked to prevent rolling.

307.05 CONTRACTOR TO FURNISH DETAILS. The Contractor shall furnish to the Engineer for approval six copies of the certificate of compliance to ASTM C700 and design details of the rubber compression couplings.

307.06 CONSTRUCTION. - Vitrified clay pipe side sewers shall be constructed in accordance with the requirements for main sewers specified in Section 305.07. Side sewers shall be connected to the main sewer in accordance with the requirements for side sewer connections as specified in Section 316.

Where side sewers are connected to concrete sewers a stub of the proper size shall be installed in the main sewer and the side sewer connected thereto.

Where the diameter of the existing side sewer is smaller than the diameter of a specified connection, such connection shall be made with an appropriate size increaser.

Horizontal and vertical bends in side sewer runs shall not exceed 45 degrees (1/8 bend), using approved mitered joints. Normal joints shall not be deflected greater than that recommended by the manufacturer.

Side sewers shall be laid on a straight grade which grade shall in no case be less than 2 percent (approximately 1/4-inch per foot).

The upper end of each side sewer shall be 12 inches behind the curb line at a depth sufficient to provide adequate sewerage for the

property served. In no case shall the depth of the invert of a side sewer at the curb line be less than 4 feet below curb grade.

In connecting new side sewer to existing side sewer, the new side sewer shall be laid on a straight grade from the main sewer to the point of junction with the existing side sewer. The deflection angle at the junction shall not exceed 45 degrees, using approved mitered joints.

The ends of side sewers not in service before the side sewer trenches are backfilled shall be closed with a VCP stopper and marked by the letter "S" placed on the top of the curb directly over the side sewer. The end of each such side sewer shall also be marked by a 2-inch x 2-inch redwood stake running vertically from the bottom of the trench to a point 6 inches below the surface of walk or ground. In new concrete curbs the "S" shall be stamped in the fresh concrete. In the tops of other curbs it shall be neatly cut.

Before marking the "S" on the curb the Contractor shall verify the location of the side sewer by excavating to the top of the redwood stake. If for any reason the stake is not found, the Contractor shall excavate and expose the pipe. In no case shall probing with a bar, or other method, be permitted as a substitute for actual exposure of the stake or pipe.

307.07 PAYMENT. - If the Proposal contains a side sewer Bid Item, all side sewers necessary or required for the reconnection of existing side sewers within the main sewer trench and to the limits of 12 inches outside the lagging or 12 inches outside the limits of excavation for the main sewer, if not lagged, shall be constructed as Incidental Work. Side sewer, outside such limits, satisfactorily constructed complete, in place, as specified, will be paid for at the price bid per linear foot, measured horizontally along the centerline of the side sewer, from the above limits to the end of the side sewer.

If the Proposal does not contain a side sewer Bid Item, side sewers necessary or required for reconnection of existing side sewers (i.e., replacement of side sewer removed by the operations of the Contractor) within the main sewer trench and to the limits of 12 inches outside the lagging or 12 inches outside the limits of excavation for the main sewer if not lagged, shall be constructed as Incidental Work. Side sewer necessary or required for reconnection outside such limits will be paid for as Extra Work in accordance with Section 112.

If the Proposal does not contain a side sewer Bid Item, the two lengths of side sewer required by Section 316.05 at inlets and branches not in service shall be furnished and installed as Incidental Work.

SECTION 308

DUCTILE IRON PIPE

308.01 GENERAL. - The Contractor shall furnish and install ductile iron sewer pipe, where and as shown on the plans or where directed, including all excavating, lagging, backfilling, pavement restoration, and all other related Incidental Work necessary, or required, for a complete satisfactory sewer installation.

308.02 DUCTILE IRON SEWER PIPE. - Ductile iron sewer pipe shall be bell and spigot, rubber gasketed, water main pipe conforming to the applicable requirements of ANSI/AWWA Standards C101, C104, C106, C110, C111, C150 and C151. Side sewer connections shall be made with fittings or approved saddles.

308.03 CONTRACTOR TO FURNISH DETAILS. - The Contractor shall furnish to the Engineer for approval six copies of the complete design details of the ductile iron pipe, including joints, he intends to furnish.

308.04 PAYMENT. - Ductile iron sewer pipe satisfactorily constructed complete, in place, as specified, will be paid for at the respective prices bid per linear foot for the type and size of pipe installed, measured horizontally along the centerline of the sewer between the outside surfaces of manholes and structures, or to the limits as constructed if the sewer does not terminate in manholes or structures. In the case of connections of these pipes to a manhole or structure by a collar or boss measurement will be to the outside surface of such collar or boss.

No deductions will be made from the measured length of the pipe due to fittings and saddles.

SECTION 309

CORRUGATED METAL PIPE CULVERT

309.01 GENERAL. - The Contractor shall furnish and install galvanized corrugated metal pipe, complete with coupling bands, paving, coating, lining, fittings and end sections, as the case may be, including all excavating, lagging, backfilling, restoring pavement, and other Incidental Work, necessary or required for a complete, satisfactory installation, where and as shown on the plans, or where directed.

309.02 MATERIALS. - Corrugated metal pipe materials shall be galvanized and shall conform to the specifications of AASHTO Designation M36.

The paving of inverts, bituminous coating and lining of pipes shall conform to the specifications of AASHTO Designation M190.

309.03 IDENTIFICATION. - Each section of a pipe shall bear the name of the sheet manufacturer, the brand, or trade mark, and the gauge. This identification shall be stamped on the sheets by the manufacturers of the sheet. Pipe having any sections not so stamped shall be rejected. The manufacturer of the pipe shall roll the sheet so that the identification shall appear on the outside of each section.

309.04 MANUFACTURE. - All pipes shall be circular, unless otherwise specified, of lap joint construction, and all joints shall be fabricated by riveting, welding, or using a continuous lock seam so that jointed pipe shall be straight and rigid.

The corrugations shall be not more the 2-3/4 inches wide and not less than 1/2-inch deep.

309.05 DIMENSIONS AND WEIGHT. - The sheet length before forming, the gauge of the uncoated metal, and the weight per foot of the finished pipe, shall not be less than shown in the following Table. A maximum variation of plus or minus 5 percent will be allowed from the weight specified in the Table.

Nominal Diameter Inches	Length of Sheet Before Forming-Inches	Min. Gauge U.S. Standard Uncoated Metal	Weight Per Foot Finished Culver-Pounds
12.....	41	16	10.8
15.....	50	16	13.1
18.....	60	16	19.3
24.....	79	14	25.4
30.....	98	14	43.6
36.....	117	12	52.0
42.....	136	10	75.6
48.....	156	10	88.1
60.....	298	8	136.8

Where pipe is to be placed under fills 20 feet or more in depth, the gauge of the sheets may be increased, such increase to be noted on the plans or in the Special Provisions.

309.06 RIVETING. - Rivets shall not be less than 5/16-inch in diameter for 14-gauge sheets or lighter, and they shall not be less than 3/8 inch for sheets heavier than 14-gauge. All rivets shall be thoroughly galvanized or sherardized.

Longitudinal joints shall be riveted in each outside groove, and for pipes of 30-inch diameter or larger, double riveted in each outside groove. In the transverse joints, rivets shall be placed uniformly not more than 6 inches apart.

Round heads of rivets shall have a diameter of not less than 1.5 times the diameter of the rivet, plus 1/8-inch, and flat heads shall have a thickness of not less than 3/5 of the diameter of the rivet.

309.07 COUPLING BANDS. - Field connections shall consist of bands not less than 12 inches in width, made from the same material as the pipe. They may be fitted with malleable cast iron lugs, or with angles having minimum dimensions of 1 1/2-inches x 1 1/2-inches and of a length equal to the full width of the band, and provided with galvanized bolts not less than 1/2-inch in diameter. The coupling bands shall be fabricated so that connections may be easily made in the field. A continuous band-type neoprene gasket not less than 7 inches wide by 3/8-inch thick shall be placed between the coupling band and abutting sections.

309.08 CONTRACTOR TO FURNISH DETAILS. - The Contractor shall furnish to the Engineer for approval six copies of the complete design details of the corrugated metal pipe, including joints, and connections, he intends to furnish.

309.09 CONSTRUCTION. - The pipe shall be carefully handled to prevent damage to the galvanizing, and shall in no case be dragged along the ground. Such damage will be sufficient cause for rejection of the pipe. If permitted by the Engineer, small areas, on which the galvanizing is damaged or destroyed, may be repaired by the application of two coats of hot asphaltic paint. The pipe shall be laid on a 4-inch thick sand bed and the trench backfilled in accordance with Section 703.

309.10 PAYMENT. - Corrugated metal pipe satisfactorily constructed complete, in place, as specified, will be paid for at the price bid per linear foot, measured horizontally along the centerline of the corrugated metal pipe between the outside surfaces of structure, or to the limits as constructed, as applicable.

SECTION 310

MANHOLES

310.01 GENERAL. - The Contractor shall construct manholes complete with cones, frames, covers, gratings, steps, VCP stub inlets, and including excavating, lagging, backfilling, restoring pavement and other Incidental Work, necessary or required for a complete satisfactory installation, where and as shown on the plans, or where directed.

Manholes shall be constructed to conform to the improved street surface. In unimproved areas if the ground surface is below the official grade, the manhole shall be constructed to conform to such official grade unless otherwise indicated on the plans; and if the ground surface is above the official grade, the manhole shall be so constructed that the internal diameter, at the proper elevation to conform to the official grade, is 24 1/2 inches, and shall be continued upward, with the same diameter, to conform to the ground surface.

Manholes shall be constructed of precast concrete sections in accordance with the requirements of ASTM "Standard Specifications for Precast Reinforced Concrete Manhole Sections", Designation C478, or cast-in-place in accordance with the applicable requirements of Section 303. Precast concrete manholes shall be supported on a cast-in-place concrete base.

The Contractor shall submit for approval detail drawings of any equivalent alternative method that he may propose, other than that shown on the plans, for installing, anchoring and protecting the required steps in precast manholes.

310.02 SPECIAL MANHOLES. - Drop manholes and other special manholes shall be constructed as shown on the plans and in accordance with the requirements set forth herein. Drop manholes shall include the drop connection and drop pipe as part of its structure.

310.03 MANHOLE FRAMES, COVERS, GRATINGS, TAPER CONES, AND STEPS. - Cast iron manhole frames, covers, gratings, and taper cones, Class 316 stainless steel or polypropylene Type II, Grade 16906 with 1/2-inch grade 60 steel reinforcement steps shall be furnished and

installed as shown on the plans and as specified in Sections 303.08, 303.09 and 303.10.

310.04 PAYMENT. - Manholes, including special manholes, satisfactorily constructed complete, in place, as specified, will be paid for at the unit price bid therefor.

The unit price bid for a manhole on a reinforced concrete sewer shall include all expense due to such manhole, over and above the cost of the sewer without the manhole.

Appurtenances, such as manhole cones, frames, covers, gratings, steps, stub inlets and VCP inverts will be considered part of the manhole and no direct or additional payment will be made therefor.

SECTION 311

FURNISH AND INSTALL FRAMES AND COVERS ON EXISTING MANHOLES

311.01 GENERAL. - The Contractor shall remove and salvage, as City property, the frames and covers from existing manholes, and shall furnish and install in place thereof new manhole frames and covers in accordance with the requirements of Section 303.08, all where and as shown on the plans, or where directed, including all Incidental Work necessary, or required, for a satisfactory installation.

311.02 PAYMENT. - Manhole frame and cover furnished and installed on an existing manhole, complete in place, as specified will be paid for at the price bid for a set, consisting of one frame and one cover.

SECTION 312

CATCHBASINS

312.01 GENERAL. - The Contractor shall construct catchbasins complete with curb inlets, frames, gratings, traps, and including excavating, lagging, backfilling, restoring pavement, and other Incidental Work, necessary or required for a complete satisfactory installation, where and as shown on the plans, or where directed.

Catchbasins shall be constructed of Class 6-3500-1 1/2 concrete precast sections in accordance with the applicable requirements of Section 304 or cast-in-place in accordance with the applicable requirements of Section 303. Precast catchbasins shall be supported on a cast-in-place concrete base.

Unless otherwise shown on the plans, catchbasin gratings shall be 9 inches below curb grade, except that catchbasin gratings to be installed in travel lanes shall conform to the gutter elevations.

312.02 CURB INLETS. - Curb inlets shall be constructed as shown on the plans and shall comply with the requirements for concrete curbs.

When two inlets are specified for catchbasins with multiple curb inlets, the center inlet shown on the Standard Plan shall be eliminated.

The curb inlets, or slabs, as the case may be, shall conform to the adjacent curb and sidewalk.

312.03 CATCHBASIN FRAMES, GRATINGS, AND TRAPS. - Cast iron catchbasin frames, gratings, and traps shall be furnished and installed on catchbasins as shown on the plans. The cast iron shall be in accordance with the requirements of Section 801.01.

Each casting shall have its weight indicated thereon with white paint.

Care shall be exercised to cast the contact surfaces in a true plane and free from irregularities. These surfaces shall be machined or ground to insure uniform contact between the grating and frame.

312.04 PAYMENT. - Catchbasin satisfactorily constructed complete in place, as specified, will be paid for at the unit price bid therefor.

SECTION 313

FURNISH AND INSTALL FRAMES AND GRATINGS ON EXISTING CATCHBASINS

313.01 GENERAL. - The Contractor shall remove and salvage, as City property, the frames and gratings from existing catchbasins, and shall furnish and install in place thereof new catchbasin frames and gratings in accordance with the requirements of Section 312.03, all where and as shown on the plans, or where directed, including all Incidental Work, necessary, or required, for a satisfactory installation.

313.02 PAYMENT. - Catchbasin frame and grating satisfactorily furnished and installed on an existing catchbasin, complete in place, as specified, will be paid for at the price bid for a set, consisting of one frame and one grating.

SECTION 314

STORM WATER INLETS

314.01 GENERAL. - The Contractor shall construct storm water inlets complete with frames, gratings, and including excavating, lagging, forming, backfilling, restoring pavement, and other Incidental Work necessary or required for a complete, satisfactory installation, where and as shown on the plans, or where directed.

Storm water inlets shall be concrete unless otherwise specified.

314.02 CONCRETE STORM WATER INLETS. - Concrete storm water inlets shall be constructed of cast-in-place Class 6-3500-1 1/2 concrete in accordance with Sections 411 and 800. Construction shall be in accordance with the applicable requirements of Section 303.

314.03 BRICK STORM WATER INLETS. - Brick storm water inlets shall be constructed of common bricks and Class "B" mortar in accordance with Sections 320 and 800.09. The entire inner surface of the brickwork shall be plastered with a smooth coat of Class "A" mortar, which shall be at least 1-inch thick on the invert and 3/8-inch thick on the walls. In soft ground, the foundation slab shall be constructed of Class 6-3500-1 1/2 concrete.

314.04 STORM WATER INLET FRAMES AND GRATINGS. - Storm water inlet frames and gratings shall be furnished and installed where and as shown on the plans and in accordance with section 312.03.

314.05 PAYMENT. - Storm water inlet satisfactorily constructed complete, in place, as specified, will be paid for at the unit price bid therefor.

SECTION 315

FURNISH AND INSTALL FRAMES AND GRATINGS ON EXISTING STORM WATER INLETS

315.01 GENERAL. - The Contractor shall remove and salvage, as City property, the frames and gratings from existing storm water inlets, and shall furnish and install in place thereof new storm water inlet frames and gratings in accordance with the requirements of Section 312.03, all where and as shown on the plans, or where directed, including all Incidental Work, necessary, or required, for a satisfactory installation.

315.02 PAYMENT. - Storm water inlet frame and grating satisfactorily furnished and installed on an existing storm water inlet, complete in place, as specified, will be paid for at the price bid for a set, consisting of one frame and one grating.

SECTION 316

VCP SIDE SEWER CONNECTIONS TO MAIN SEWERS

316.01 GENERAL. - The Contractor shall connect each side sewer to the main sewer by using:

in VCP main sewer, at his option, a VCP T-branch, a VCP Y-branch, or by tapping the main sewer by drilling a hole and securing therein a VCP stub;

in precast concrete pipe main sewer, a VCP stub inlet; and,

in cast-in-place sewers and sewer structures, a VCP stub inlet;

in each case including all Incidental Work necessary or required for a complete satisfactory installation, where and as shown on the plans or where directed.

VCP stubs and stub inlets shall be vitrified clay and in accordance with the requirements of Section 305.02.

Tapping a VCP sewer will be permitted only where the diameter of the main sewer is at least twice the diameter of the side sewer.

T-branches, Y-branches and stub inlets shall be not less than 6 inches in diameter in residential districts, and not less than 8 inches in diameter in industrial and commercial districts. If any existing side sewer is of larger diameter, the branch inlet shall be of such diameter.

316.02 T-BRANCH OR Y-BRANCH. - T-branches and Y-branches shall be made of vitrified clay in accordance with the applicable requirements of Section 305.02, and installed in accordance with the applicable requirements of Section 305.

316.03 VCP STUB IN TAPPED VCP MAIN SEWER. - The Contractor, in lieu of using T-branches or Y-branches in VCP main sewers, may connect side sewers by drilling the proper size neat round hole in the wall of the main sewer, inserting therein either a rubber and plastic compression fitting with VCP stub or a VCP stub in place with epoxy mortar. The VCP stub shall be cut to fit flush with the inside surface of the main sewer. The clearance between the outside diameter of the stub and the drilled hole shall be such as to properly contain the epoxy mortar and produce a strong, watertight joint.

The epoxy mortar used for bonding the VCP stub and main sewer shall have a set time or curing time not to exceed thirty minutes regardless of temperature. The manufacturer's specifications for epoxy mortar shall be submitted in writing to the Engineer for approval.

Substitute methods or devices for tapping the VCP main sewer and installing a side sewer connection shall be submitted to the City Engineer for approval. The submittal must include manufacturer's specifications and details.

The clear length of VCP main sewer, between drilled holes, or between a drilled hole and the spigot end, shall be not less than 18 inches.

Each length of VCP main sewer that has been drilled shall be inspected before being placed in the trench and will be rejected if it does not "ring true" when tapped with a hammer. Before VCP main sewer is laid in the trench, the Contractor shall set each VCP stub in the holes in such pipe with an approved epoxy resin joint material applied in accordance with the manufacturer's instructions.

Each VCP stub shall be the proper size for the tapped main sewer and for the side sewer. Aluminum stubs will not be allowed.

316.04 STUB INLET IN CONCRETE SEWER OR STRUCTURE. - Each stub installed in a sewer or structure shall be mortared in place with Class "A" cement mortar, or an approved epoxy mortar.

Stub inlets shall be set with the back of the bell placed as close as practicable to the outside surface of the sewer or manhole, and shall be of such length that the inner spigot end shall be flush with the inside surface. They shall be securely fastened in the formwork of cast-in-place sewers and sewer structures so that they will not be displaced from their correct positions during placing of the concrete. All holes in precast concrete pipe for stub inlets shall be cut in accordance with the plans and the requirements of Section 304.08; the method specified in Section 316.03 may be used. Reinforcing bars within the hole shall be cut so as to clear the stub by not less than one inch.

Where the edge of the hole is less than 18 inches from the end of a pipe, or where the clearance between two holes is less than 18 inches, a ring bar of No. 5 reinforcing steel shall be welded to each cut bar. The hole shall be cut sufficiently large to provide a 1-inch clearance between the ring bar and the stub. Clearance between two cut holes or between a cut hole and the end of the pipe shall not be less than 6 inches.

316.05 STUB INLETS AND BRANCHES NOT IN SERVICE TO BE CLOSED AND MARKED. - The Contractor shall furnish and install two lengths of VCP side sewer connected to the bell ends of all VCP stub inlets, stubs, and branches not in service before backfilling, and shall close the resulting bell ends with vitrified clay stoppers properly secured and made watertight. Each such stoppered bell end to which no connection is made, shall be marked by a 2-inch x 2-inch redwood stake, running vertically from the bottom of the trench at the stoppered bell to a point one foot below the surface of the street. Care shall be taken to maintain the stake in its correct position during backfilling. In addition to the redwood stake, the letter "Y" shall be stamped or neatly chipped in the top of the curb opposite each stoppered bell from which a side sewer has not been constructed.

316.06 SIDE SEWER INVESTIGATION. - The Contractor shall confirm that each property has been provided with a satisfactory connection for all its side sewers.

The Contractor shall perform the following for all side sewers:

1. Confirm connection points of active side sewers by dye-testing at sidewalk vents.
2. Investigate, locate, and confirm active side sewers not identified by sidewalk vents by dye-testing at building fixtures and/or rodding.
 - a) Side sewers rodded to show lengths short of one (1) foot behind the curb shall be considered as inactive.
 - b) Side sewers rodded to show lengths beyond one (1) foot behind the curb are to be assumed as active and shall be connected to the new sewer.
3. Record locations of active side sewers and provide the City with a copy of the record.

316.07 PAYMENT. - VCP side sewer connection to main sewer made by T-branch, Y-branch, VCP stub secured in drilled hole in VCP main sewer, or VCP stub inlet in RCP or cast-in-place main sewer, satisfactorily completed and in place, as specified, and including, if the Proposal does not contain a side sewer Bid Item, furnishing and installing the two lengths of side sewer required at inlets and branches not in service, will be paid for at the unit price bid for a side sewer connection for the respective kind and size of main sewer and size of side sewer.

No deduction in the measured length of main sewer will be made for VCP side sewer connections.

Connection of side sewers to the hereinbefore specified side sewer connections and to existing side sewers shall be done as Incidental Work.

Investigation, locating by dye-testing, abandoning inactive side sewers, if any, and rodding of side sewers shall be done as Incidental Work.

SECTION 317

CONNECTIONS TO AND BETWEEN SEWERS, STRUCTURES AND CULVERTS

317.01 GENERAL. - The Contractor shall make all connections to and between sewerage and drainage structures, sewers, and culverts, where and as shown on the plans, including constructing stub inlets for culverts, and doing all other work necessary or required in order that the completed work will function as an integral part of the sewerage system.

Connections shall be constructed in a manner to produce smooth junctions, and those of new to existing concrete shall be done in accordance with the applicable requirements of Section 800.15.

Unless otherwise specified, where pipe sewer is to be connected to a brick or concrete sewer or structure, the Contractor shall keep the opening therefor to a practicable minimum, and shall make the joint with Class "A" cement mortar.

Stubs and stub inlets for culvert connections to catchbasins, storm water inlets, manholes and sewer structures shall be 10 inches in diameter unless otherwise specified, and shall be in accordance with the applicable requirements of Section 316.

317.02 PAYMENT. - Connections to and between sewers, sewerage and drainage structures and culverts, including constructing stubs and stub inlets for culverts, shall be done as Incidental Work and payment therefor shall be included in the price and prices bid.

SECTION 318

SIDE SEWER TRAP

318.01 GENERAL. - The Contractor shall furnish and install new vitrified clay pipe side sewer traps, complete with vitrified clay air vent risers, cast iron inlet frames with malleable iron gratings, fittings, connections, extensions, and appurtenances; and including excavating, backfilling, restoring pavement and all other Incidental Work, necessary or required for a complete, satisfactory installation, where and as shown on the plans, or where directed.

Fittings and soil pipe extensions on the house side of the trap connecting the trap to existing facilities shall be of the same type material as existing facilities or of vitrified clay pipe. Extensions connecting side sewer traps to existing facilities shall not extend beyond the property line.

318.02 INSTALLATION. - Traps shall have spigot ends and connections shall be made with rubber compression couplings with Class 316 stainless steel bands as specified for vitrified clay pipe side sewer in Section 307.03, or an approved equal joint connection.

318.03 PAYMENT. - Side sewer trap satisfactorily constructed complete, in place, as specified will be paid for at the unit price bid therefor.

SECTION 319

LOW PRESSURE TESTING

319.01 GENERAL. - The Contractor shall do all low pressure testing specified in the Special Provisions or indicated in the plans, including all Incidental Work, necessary or required, to satisfactorily demonstrate watertightness of the installed system.

319.02 INSPECTION AND TESTING. - The Engineer and the Contractor shall make a visual inspection of each pipe joint prior to backfill. Joints deemed unsatisfactory by the Engineer shall be repaired or remade to a proper standard of workmanship and appearance.

Upon approval by the Engineer the Contractor shall backfill the sewer, leaving the joints exposed, and perform a low pressure, 10 p.s.i.g. hydrostatic test on the pipe for a duration of at least 30 minutes without adding test fluid. The Contractor shall provide all equipment necessary to perform the test. Failure to maintain the test pressure shall be cause for the Engineer to order additional tests and order the remaking of joints and additional tests until all leaks are eliminated.

Balloon plugs may be used at side sewer connections to limit tests to main sewer joints.

If approved by the Engineer, the Contractor may substitute an approved equivalent air test in lieu of the hydrostatic test.

319.03 PAYMENT. - Low pressure testing satisfactorily completed, as specified will be paid for at the price bid therefor when such work is set forth for payment in the Schedule of Bid Prices. Low pressure testing specified on the plans or in the Special Provisions and not set forth for payment in the Schedule of Bid Prices shall be done as Incidental Work, and no direct or additional payment will be made therefor.

SECTION 320

BRICKWORK FOR SEWERS

320.01 GENERAL. - The Contractor shall do all brickwork for sewers, as specified, including all Incidental Work, necessary or required for complete satisfactorily constructed masonry, where and as shown on the plans, or where directed.

Brickwork shall be done in accordance with the requirements of Section 416 and this Section 320.

Mortar for brickwork shall be Class "B" or "C" as required by Section 800.09 and these specifications.

320.02 BRICK. - Brick shall conform to the requirements of ASTM "Standard Specifications for Sewer and Manhole Brick (Made From Clay or Shale)", Designation C32. Inverts and side walls shall use brick graded either "SS" or "SM":

Grade SS - Brick intended for use in structures requiring imperviousness and resistance to the action of sewage carrying large quantities of abrasive material at velocities exceeding 8 ft. (2.4 M)/S.

Grade SM - Brick intended for use in structures requiring imperviousness and resistance to the action of sewage carrying abrasive materials at velocities less than 8 Ft. (2.4 M)/S.

Grade of sewer brick shall be as specified in the Special Provisions. Manhole cone risers and frame supports shall use brick grade "MS".

320.03 CONSTRUCTION. - Excavations for brick shall be sufficient to leave a clear space of not less than 6 inches between the brickwork and the side of the excavation or lagging, to give ample room for plastering.

The brick shall be clean and well wetted before being laid, and every brick shall be laid in a full joint of mortar on bed, end, and side in one operation. Every fifth course of brick shall be a header course, and vertical joints shall be broken. Horizontal mortar joints shall be as uniform as possible, and shall not exceed 3/8-inch in thickness. The bottom of the structure shall consist of a first course of brick laid flat and close on an even surface. This course shall be grouted with thin grout composed of equal parts cement and sand.

Subsequent courses shall be laid in mortar as hereinbefore specified.

Particular care must be taken in forming the channels and shelves of the structures along pipe sewers; they shall be built in strict accordance with the plans, and must conform to the bottoms of the existing sewers. Brick channels shall be built of selected bricks set on edge, laid in Class "C" mortar, and well bonded. The structure floor and the channels shall be plastered with Class "C" mortar 1/2-inch thick, the channels being finished to a true and smooth circular section.

A bull's eye with one rowlock course of brick shall be built into the structure for each entering pipe.

The joints in the brickwork on the inside of the structure shall be neatly struck, and the outside shall be plastered with Class "B" mortar at least 1/2-inch in thickness.

When a brick invert is specified, the brick shall be vitrified brick, and shall be placed as soon as the concrete is sufficiently set, though not less than twenty-four hours after the placing. The brick shall be laid with the better surface exposed, in a full joint of mortar on bed, end, and side in one operation.

The Contractor shall construct brick inverts of new sewers to conform to the inverts of existing sewers so as to provide smooth, straightline changes in invert grades and smooth flow surfaces.

The bricks shall be laid as stretchers, and shall break joints with those of the adjoining courses. The courses shall be kept straight and parallel to the axis of the sewer, and at a true grade, by the use of a template.

Brickwork shall not be constructed upon a concrete foundation until at least twenty-four hours after such foundation has been placed. No brick shall be laid in water, nor shall water be permitted to stand or run on any brickwork until the mortar has thoroughly set.

Upon completion, brick masonry shall be kept continuously damp for at least 2 days.

320.04 PAYMENT. - Brickwork shall be done as Incidental Work and payment therefor shall be included in the price or prices bid.

SECTION 321

VITRIFIED CLAY PIPE SUBDRAIN

321.01 GENERAL. - The Contractor shall furnish and install subdrains complete with tees, risers, burlap, oakum, mortar, concrete, crushed rock, including the subsequent removal or plugging of such facilities, as the case may be, and all other Incidental Work, necessary or required for a complete satisfactory installation, where and as shown on the plans or where directed.

When a Bid Item or Items for subdrains of a specified size or sizes are included in the Proposal, the Engineer will, under such Bid Items, order sufficient subdrains, in his opinion, to maintain an appropriately dry excavation, free from ground water, and to temporarily carry the flow of cut side sewers, if any. Main sewer flow and storm water flow shall be diverted as required in Section 301, except that excess capacity of ordered subdrains may be used to temporarily carry main sewer flow.

Additional or larger subdrains may be used by the Contractor if he so desires but no payment will be made on account of such increase in extent or size of subdrains.

321.02 PIPE. - Subdrain pipe and fittings shall be in accordance with the requirements of Section 305.02.

321.03 CONSTRUCTION. - Subdrains for pipe sewers shall be located at one side of the sewer trench, and subdrains for encased pipe sewers and pipe sewers on concrete foundations shall be located either at one side of the sewer trench or beneath such main pipe sewer. Subdrains for cast-in-place concrete sewers shall underlie or be below and adjacent to the sewer and be connected to the invert by tees and risers placed in a manner which will allow plugging the subdrain upon completion of the sewer.

Upon conclusion of the need therefor, subdrains for pipe sewers, unless specifically required to remain as permanent subdrains, shall be removed or plugged with concrete at intervals not greater than 100 feet.

Subdrains underlying a cast-in-place concrete sewer shall be temporarily connected to the sewer invert by vitrified clay pipe tees and risers of the same diameter as the subdrain at intervals not greater than 100 feet. Before the sewer is put into service the subdrains at the risers, and the risers, shall be permanently plugged with concrete.

Subdrain pipe laid in soil other than sand shall be covered with crushed rock extending at least 6 inches laterally from each side of the pipe and 12 inches vertically above the top of the pipe. Where subdrains pass through areas free of ground water, the joints shall be filled with lean mortar and crushed rock may be omitted. Crushed rock shall be uniformly graded from No. 4 to 3/4-inch sieve size.

When required in the Special Provisions, the aforementioned crushed rock shall be completely dammed with a concrete cutoff wall at specified intervals so as to prevent any possibility of continuity of ground water flow along the line of the sewer or structure. Cutoff walls shall be not less than one foot thick, shall block the entire width of the rock fill, and shall extend not less than one foot into the ground below the crushed rock. Concrete used for this purpose shall be Class 4-2000-1 1/2 or better. Where tees and risers have been installed, the cutoff walls shall be located at the tees and risers. If the crushed rock is specifically required to remain in use in conjunction with a permanent subdrain no cutoff walls will be required.

Open subdrains joints shall be wrapped with burlap and, in addition, when the pipe is laid in sand, shall be loosely packed with oakum.

321.04 SIDE SEWERS. - Side sewers cut along the line of the work shall be temporarily connected to the subdrain by means of pipes and fittings. When side sewers are permanently reconnected, temporary connections shall be removed from the site by the Contractor as his property and the subdrains shall be plugged with concrete and brickwork at the temporary connection openings.

321.05 PAYMENT. - Vitrified clay pipe subdrain satisfactorily constructed, as specified, will be paid for at the price bid per linear foot, measured horizontally along the centerline of the subdrain within the limits ordered by the Engineer.

No deduction will be made in the measured length because of fittings.

SECTION 322

POLYETHYLENE PIPE SEWER

322.01 GENERAL. - The Contractor shall do all excavating, lagging, backfilling, restoration, and other Incidental Work necessary or required for a complete, satisfactory polyethylene pipe (PEP) sewer liner installation, all where and as shown on the plans, or where directed by the Engineer. Installation plans and procedures shall be submitted for review and approval prior to start of work.

322.02 PEP AND FITTINGS. - The sewer liner pipe and fittings shall be made of a polyethylene pipe compound that meets the requirements for Type III, Class C, Category 5, Grade 34, as defined in ASTM D1348 and D3350.

322.03 JOINTS FOR PEP SEWER. - Joints for PEP sewer shall be made on the job site by butt-fusion in accordance with ASTM D2657 and ASTM D3350, using equipment and procedures recommended by the manufacturer. Closing joints required within the installation pits may be made using rubber compression couplings with Class 316 stainless steel bands, butt fusion, or shrink sleeves, at the Contractor's option.

322.04 CERTIFICATE OF COMPLIANCE. - Tests for compliance with this specification shall be made as specified herein and according to the applicable ASTM specification.

Upon request, a certificate of compliance with this specification shall be furnished by the manufacturer for all material furnished under this specification.

322.05 SEWAGE DIVERSION. - The Contractor shall divert the sewage around the section or sections of the line that are to be sliplined if the annular space and pulling head openings are incapable of handling the flow.

At the end of each working day, temporary tie-ins shall be made between the relined section and the existing system and the by-pass plug removed.

322.06 LINE OBSTRUCTIONS. - Prior to sliplining, the Contractor shall clean the line that is to receive the polyethylene liner to clear the line of any protruding service connections or solids that might prevent the pulling of the lines through the existing sewer.

322.07 INSERTION TRENCH. - Insertion trench will be required at intermediate manholes, or other intermediate points, where the liner pipe will be "fed" into the existing sewer or where there are minimum utility conflicts.

Where excavations for insertions of the polyethylene liner are made in a line section between two manholes, the polyethylene pipe shall be joined together with a circle seal clamp such as neoprene connector with Class 316 stainless steel bands, or equivalent connection. The exposed liner and clamp shall then be encased with one foot of slurry grout per Section 302.06.

322.08 INSERTION OF LINER PIPE. - Where installation of liner pipe is to be made through an access shaft, the top of the existing main shall be exposed to springline for the full length of the shaft prior to removal of the crown portion of a section of the existing main.

A power winch shall then be connected to the end of the liner by use of a pulling head, so the liner can be fed into the existing sewer. Precautions shall be taken not to damage the liner or break any of the joints.

Length of the liner pipe to be pulled into an existing sewer at any one time shall be governed by the size of sewer being sliplined and condition of the existing sewer.

322.09 SIDE SEWER CONNECTIONS TO PEP SEWER. - After the liner has been pulled into place and secured in the manhole walls and pressure tested, each existing side sewer connection shall be reconnected to the new liner. A portion of the existing sewer around each side sewer connection shall be removed to expose the liner pipe and provide sufficient working space for making the new service connection.

Side sewer connections to PEP sewer shall be made using polyethylene saddles strapped to the line with Class 316 stainless steel bands or fused to the main line as recommended by the pipe manufacturer.

322.10 PEP CONNECTIONS TO MANHOLES. - The PEP sewer shall be connected to manholes with butt-fused flanges or by removing the top of the liner throughout the length of the manhole.

322.11 STABILIZATION OF LINER. - The polyethylene liner may contract after insertion because of residual stresses imposed during pulling, and thermal stresses from temperature differences between the liner and sewer. Residual stresses can be relieved by pushing or pounding on the end of the liner at the entrance pit until the tension at the winch is relieved. The liner should be allowed to stabilize for 12 hours before grouting the annular space between the existing sewer and the PEP liner, or connecting existing side sewers.

322.12 PLUG AND FILL THE ANNULAR SPACE WITH SLURRY GROUT. - The annular space between the existing sewer and the polyethylene liner shall be plugged at both ends and filled with slurry grout per Section 302.06.

The plugging at the ends of the annular space to be filled with slurry grout may be accomplished by the use of temporary plugs or bulkheads which shall be removed after the slurry mix has set.

322.13 PAYMENT. - PEP sewer satisfactorily furnished and installed complete, in place, as specified, will be paid for at the price bid per linear foot, measured horizontally along the centerline of the PEP sewer between the outside surfaces of manholes and structures, or to the limits as constructed if the sewer does not terminate in manholes or structures.

Plugging and filling of the space between the existing sewers and the new PEP with slurry grout shall be done as Incidental Work.

END PART 3