SECTION 02563

SANITARY SEWER FORCE MAINS

02563.01 GENERAL

A. Description

Sanitary sewer force main installation shall include, but not necessarily be limited to, furnishing and installing pressure rated pipe, fittings, and appurtenances of size and type shown on the Plans, installed on firm foundation true to line and grade and in accordance with the Contract Documents.

B. Related Work Included Elsewhere

1. Protection of the environment; Section 01500.
2. Trench excavation, backfill, and compaction; Section 02250.
3. Excavation Support; Section 02400
4. Dewatering; Section 02512
5. Precast concrete utility structures; Section 03400.
6. Corrosion Control; Section 02555

C. Quality Assurance

1. Materials

   The Engineer will inspect all materials before and after installation to ensure compliance with the Contract Documents.

2. Field Tests

   a. General

      1) After installation, force mains will be initially inspected by the Engineer and shall be Contractor tested for compliance with these Specifications. Initial inspections and tests will not be conducted until at least 48 hours after all concrete thrust blocks and anchors have been constructed and backfilling completed on the section of force main being tested. The Contractor shall furnish all labor, tools, materials, and equipment (except water as provided for in Section 02563, and meters, which will be furnished by the County) necessary to perform the specified tests. The contractor/his supplier shall demonstrate that all sewage air release valves, combo sewage air

valves and sewage air vacuum valves are fully functional and in proper working order prior to acceptance.

2) The force main and appurtenances shall be tested in accordance with Section 02551 except as modified herein.

3) Chlorination will not be required.

4) The Contractor shall schedule all tests with the Engineer at least 48 hours in advance of the test, and shall conduct all acceptance testing in the presence of the Engineer. On County Capital Projects, the County will witness one test at no cost to the Contractor. If the project is released for service following conditional acceptance tests, the County will perform a final inspection if required at no cost to the Contractor. Should the pipeline fail the first County witnessed test, the Contractor shall reimburse the County for all costs resulting from such additional tests so required until the pipeline passes the test(s). The Contractor shall also reimburse the County for the cost of inspection if the Contractor is not prepared for any test, or for additional tests required following the final inspection of released projects.

5) Generally force mains will be tested from end to end. Pressure and leakage tests shall be performed.

6) If the force main or any section or component thereof fails the tests and/or inspection, the Contractor shall, at his own expense, repair or replace any defective component and retest the force main until all requirements are met. Should the work be done by the County in the case of an emergency, the Contractor shall reimburse the County for the actual cost of replacing such materials and making such installations.

a) Pressure Tests: Test gradient for the pressure test shall be as indicated in the Contract Documents. Pressure test duration shall be 1 hour.

b. Testing of Polyethylene Pipe

1) Butt Fusion Testing: On every day butt fusions are to be made, the first fusion of the day shall be a trial fusion. The trial fusion shall be allowed to cool completely, and then fusion test straps shall be cut out. The test strap shall be 12" (min) or 30 times the wall thickness in length with the fusion in the center, and 1" (min) or 1.5 times the wall thickness in width. Bend the test straps until the ends of the strap touch. If the fusion fails at the joint, a new trial fusion shall be made,

cooled completely and tested. Butt fusion of pipe to be installed shall not commence until a trial fusion has passed the bent strap test.

7) Pressure Testing: Hydrostatic Pressure testing shall be conducted in accordance with ASME B31.1, ASME B31.8 Appendix N, PPI Handbook of Polyethylene Pipe, Inspections, Tests, and Safety Standards, (formerly PPI TR-31 Underground testing of Polyolefin Piping), and Manufacturer's recommendations. Pneumatic pressure testing shall not be used.

D. Submittals

1. Shop Drawings

Shop drawings shall be submitted as specified in the "General Provisions" for the following materials, and include the following information:

a. High density polyethylene pipe: product descriptions, cell certifications and other information demonstrating conformance with this specification.

b. Plug valves and appurtenances: product description, pressure rating, parts list, detailed assembly drawings, and maintenance requirements and procedures.

c. Sewage air release and combination air/vacuum valves and appurtenances: product description, pressure rating, parts list, detailed assembly drawings, and maintenance requirements and procedures.

2. Certificates of Compliance

Certificates of compliance shall be submitted as specified in the "General Provisions" for pipe and fittings stating the item supplied is in accordance with requirements of this Section or as specified in Section 02551, “Water Mains”, (depending on pipe material).

02563.02 MATERIALS

A. Materials Furnished by the County

Unless otherwise noted in the "Special Provisions," the County will make available water from its potable water system for pipeline testing to the Contractor at no charge for one test only. If subsequent testing is required, the Contractor may purchase additional water from the County's system. The Contractor shall contact the Department of Public Works, Bureau of Utilities, Meter Section, for requirements.

B. Contractor's Options

The Contractor shall furnish ductile iron pipe or high density polyethylene pipe (HDPE) for sanitary sewer force mains unless otherwise noted. Ductile iron fittings shall be furnished for use with ductile iron pipe.

C. Detailed Material Requirements

1. Tracer wire per Section 02551.

2. Washed gravel for air release and vacuum valve manhole fill shall meet the gradation requirements of AASHTO M 43, Size number 57, as specified in Section 02621.

3. Portland cement concrete for pipe buttresses and anchorages shall be Mix No. 1 as specified in Section 03310.

4. Ductile iron pipe and fittings shall be as specified in Section 02551. Pressure rating or class shall be as noted in the Contract Documents. Cement lining and coatings shall be required on ductile iron pipe (DIP) and fittings.

4. Polyethylene Pipe and Fittings

a. Qualification of Manufacturers.

The Manufacturer shall have manufacturing and quality control facilities capable of producing and assuring the quality of the pipe and fittings required by these Specifications. The Manufacturer's production facilities shall be open for inspection by the Owner or his Authorized Representative. Qualified Manufacturers shall be approved by the Project Engineer.

b. Materials

Materials used for the manufacture of polyethylene pipe and fittings shall be PE3408 high density polyethylene meeting cell classification 345444C or 345444E per ASTM D 3350; and meeting Type III, Class B or Class C. Category 5, Grade P34 per ASTM D 1248; and shall be listed in the name of the pipe and fitting Manufacturer in PPI TR-4, Recommended Hydrostatic strengths and design stresses for Thermoplastic Pipe and Fittings Compounds, with a standard grade rating of 1,600 psi at 73 degrees F. The Manufacturer shall certify that the materials used to manufacture pipe and fittings meet these requirements.

c. Typical Material Properties

Typical material properties shall be submitted to the project design engineer for analysis. These properties are to be used for engineering evaluation and are not to be misconstrued as specification minimums.

d. Interchangeability of Pipe and Fittings

Polyethylene pipe and fittings shall be produced by the same Approved Manufacturer. Products made by Subcontractors or Manufacturer's distributor are not acceptable. Pipe and fittings from different Approved Manufacturers shall not be interchanged.

e. Polyethylene Pipe

Polyethylene pipe shall be manufactured in accordance with and will be reviewed for compliance with all provisions of the latest edition of AWWA C906 Specifications. This shall included, but not be limited to, raw materials, manufacturing techniques, testing procedures, quality control, etc. The Contractor shall submit manufacturer's certification that the pipe to be supplied meets all conditions of AWWA C906. All manufacturer's quality control test procedures and results shall be maintained as a permanent record which can be made available to the Engineer upon written request. The pressure class shall be as indicated on the drawings.

1. HDPE pipe for use with low pressure sewer applications (grinder pumps and pressure mayo tanks) shall be DR 11.
2. All HDPE pipe and fittings shall be Ductile Iron Pipe Size (DIPS).

f. Polyethylene Fittings & Custom Fabrications

Polyethylene fittings and custom fabrications shall be molded or fabricated by the pipe manufacturer. Butt fusion outlets shall be made to the same outside diameter, wall thickness, and tolerances as the mating pipe. All fittings and custom fabrications shall be fully rated for the same internal pressure as the mating pipe. Pressure de-rated fabricated fittings are prohibited. The pressure class shall be as indicated on the drawings.

g. Molded Fittings

Molded fittings shall be manufactured in accordance with ASTM D 3261, Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing, and shall be so marked. Each production lot of molded fittings shall be subjected to the tests required under ASTM D 3261.

h. X-Ray Inspection

The Manufacturer shall submit samples from each molded fittings production lot to x-ray inspection for voids, and shall certify that voids where not found.

i. Fittings

All fittings, with the exception of vertical tee connections at Blowoff and Access Structures and valves, shall be butt fused HDPE or electrofused HDPE fittings unless

otherwise approved by the Engineer. Transitions to valves shall be accomplished with flanged connections in vaults or mechanical joint adaptors (for direct buried). All hardware shall be 316 stainless steel. All fittings shall be sufficiently supported so no undue stress is transmitted to the connections.

j. Polyethylene Flange and Mechanical Joint Adapters

Flange and mechanical joint adapters shall be made with sufficient throughbore length to be clamped in a butt fusion joining machine without the use of a stub end holder. The sealing surface of the flange adapter shall be machined with a series of small v-shaped grooves to provide gasketless sealing, or to restrain the gasket against blowout.

k. Back-up Rings & Flange Bolts

Flange adapters shall be fitted with lap flanges pressure rated equal to or greater than the mating pipe. The lap joint flange bore shall be chamfered or radiused to provide clearance to the flange adapter radius. Flange bolts and nuts shall be 316 stainless steel.

l. Manufacturer's Quality Control

The pipe and fitting manufacturer shall have an established quality control program responsible for inspecting incoming and outgoing materials. Incoming polyethylene materials shall be inspected for density, melt flow rate, and contamination. The cell classification properties of the material shall be certified by the supplier, and verified by Manufacturer's Quality Control. Incoming materials shall be approved by Quality Control before processing into finished goods. Outgoing materials shall be checked for:

- Outside diameter, wall thickness, and eccentricity as per ASTM D2122 at a frequency of at least once/hour or once/coil, whichever is less frequent.
- Out of Roundness at a frequency of at least once/hour or once/coil whichever is less frequent.
- Straightness, inside and outside surface finish, markings and end cuts shall be visually inspected as per ASTM F714 on every length of pipe.

Quality Control shall verify production checks and test for:

- Density as per ASTM D1505 at a frequency of at least once per extrusion lot.
- Melt Index as per ASTM D1238 at a frequency of at least once per extrusion lot.
- Carbon content as per ASTM D1603 at a frequency of at least once per day per

extrusion line.

- Quick burst pressure (size thru 4") as per ASTM D1599 at a frequency of at least once per day per line.

- Ring Tensile Strength (sizes above 4" equipment permitting) as per ASTM D2290 at a frequency of at least once per day per line.

- ESCR (size permitting) as per ASTM F1248 at a frequency of at least once per extrusion lot.

X-ray inspection shall be used to inspect molded fittings for voids, and knit line strength shall be tested. All fabricated fittings shall be inspected for joint quality and alignment.

m. Permanent Records

The Manufacturer shall maintain permanent QC and QA records.

n. Compliance Tests

Manufacturer's inspection and testing of the materials. In case of conflict with Manufacturer's certifications, the Contractor, Project Engineer, or Owner may request retesting by the Manufacturer or have retests performed by an outside testing service. All retesting shall be at the requester's expense, and shall be performed in accordance with the Specifications.

o. Spare Parts/Materials

As a part of this contract, the Contractor is required to provide all materials necessary to enable the Owner to complete two (2) separate repairs to the HDPE pipeline. The materials shall include the following:

1. Four (4) electrofusion couplings for HDPE Pipe of a DR equal to that specified and provided, by Central Plastics Company, Friatec Gas & Water, Inc., or equal for each pipe diameter installed under this contract.

2. Two assemblies consisting of (1) flange adapter fused to a 5 foot section of HDPE pipe of a DR equal to that specified and provided and one (1) ductile iron back-up ring for each pipe diameter installed under this contract.

3. 20-foot length of HDPE pipe for each pipe diameter installed under this contract.

5. Plug Valves

a. Plug valves for force main isolation service shall be non-lubricated type designed for a minimum working pressure of 175 psi and suitable for buried service. The valve shall be suitable for tight closure with pressure on either side of plug. Buried valves shall have mechanical joint ends. Valves installed in vaults shall have flanged ends unless otherwise noted. The body shall be semi-steel. The plug shall be semi-steel, resilient type neoprene faced for use in raw sewage service. The plug seat may have an overlay of machined nickel, fusion-bonded Nylon II, or other suitable material on all surfaces in contact with the plug face. The port area of the valve shall not be less than 100% of pipe area. The upper trunnion shall be sealed with either permanent "0"-ring type seals, or packing held in place by an adjustable packing gland. Packing shall be replaceable without disassembly of operator or valve. The upper and lower journals shall be fitted with replaceable permanently lubricated stainless steel sleeve type bearings. Stem extensions and actuators shall be supplied by the valve manufacturer. Valves shall be either handwheel or 2-inch square nut operated as indicated on the Plans. Plug valves shall be manufactured by the DeZurik Unit of General Signal Corp. External fasteners shall have 316 SS bolts.

b. All plug valves shall be furnished with buried service type gear operators. Buried valves shall be furnished with a roadway valve box and an extension stem securely fastened (no shear pin will be allowed as bolts) to the operator to position a 2-inch square operating nut welded to the top of the stem within 12 inches of the ground surface. If shear pin protection is required, a separate device shall be placed at ground level area to facilitate quick replacement during emergency situations. An open and closed indicator shall be provided on all valves at the operating nut. Valves shall open left (counterclockwise). Spacer discs or rods shall be installed in the valve box as required to center the extension stem. Extension stem shall be of the size recommended by the valve manufacturer. Provide marker discs for ¼ turn valves.

   1) Plug valves to be installed per the manufacturer's recommendations.

   2) Orientation of buried plug valves: in the plug valve "shut" position, the flow of sewage is against the face of the plug; in the valve "open" position, the plug rotates up 90-degrees to open.

c. The exterior of the valve, operator, and extension stem shall be bituminous coated unless otherwise noted.

5. Valve boxes shall be as specified in Section 02552except the covers shall be labeled "SEWER".

6. Sewage Air-Vacuum Valves

   Sewage Air-Vacuum Valves shall allow unrestricted venting or re-entry of air through the valve body during filling or draining of the forcemain. The valve shall

automatically open to prevent the formation of a vacuum within the pipeline. Two manufacturers are listed below, or equal:

a. Valve shall be Sewage Air Vacuum Valve APCO Series 400 SAVV.

1) Sewage Air-Vacuum Valves shall have an elongated cast iron body and cover. The valve shall incorporate two stainless steel floats connected by a stainless steel float guide, guide bushing, baffle, and Buna-N seal.

2) All materials of construction shall be certified in writing to conform to ASTM specifications as follows:

PART	MATERIAL	SPECIFICATION
Body & cover & baffle	Cast Iron	ASTM A126 GR.B
Lower Float	Stainless Steel	ASTM A240 T304
Stem, Guide Bushing	Stainless Steel	Series T300
Seat	Buna-N	Nitrile Rubber
Exterior Paint	Phenolic Primer Red Oxide	FDA Approved for Potable Water

b. Valve shall be Crispin Sewage Air Vacuum Valve S or X (Universal Head) Series.

1) All valve parts are stainless steel with a stainless steel circular clamp to secure the valve head to the body.

2) Valve internals are attached to the head; the body is standard to the three color coded head combinations.

3) Valve meets the testing requirements of ANSI/AWWA CS12 standards.

c. The valve manufacturer shall furnish installation and maintenance manuals with each valve.

d. An isolating valve shall be installed between the forcemain and air release valve. The valve shall be a plug valve meeting the requirements of paragraph C.4 of Section 02563.02.

Plug isolation valves shall be equipped with gear actuators and adapters for 2-inch operating nuts. The valve shall also be equipped with an extension stem bringing the operating nut to within 12-inches of the ground surface. The installation shall meet the requirements of paragraph C.4 of Section 02563.02.

e. Sewage air vacuum valves shall be installed in easily accessible pre-cast vaults. The vault shall be sized to properly house the valve assembly as well as providing sufficient lateral and vertical clearances to facilitate valve removal and maintenance.

Where possible, the vault shall be drained to an adjacent sanitary manhole.

Vaults shall be adequately vented to meet air release valve requirements.

f. All internals shall be easily removed through the top cover without removing the valve body from the forcemain.

7. Sewage Air Release Valves

Sewage air release valves shall be of the type designed to operate while the pipeline is in service (under pressure) and shall automatically release pressurized air, gas, or vapor through the orifice without spillage or spurt. Two manufacturers are listed below, or equal:

a. Valve shall be Sewage Air Release Valve APCO Series 400 SARV.

1) Sewage air release valves shall have an elongated cast iron body and cover. The internal linkage, float and stem shall be constructed of stainless steel. The valve body and float shall withstand a minimum shell test pressure of 500 psi.

2) All materials of construction shall be certified in writing to conform to ASTM specifications as follows:

PART	MATERIAL	SPECIFICATION
Body & cover	Cast Iron	ASTM A126 GR.B
Internals	Stainless Steel	Series T300
Float	Stainless Steel	ASTM A240 T304
Seat	Buna-N	Nitrile Rubber
Exterior Paint	Phenolic Primer Red Oxide	FDA Approved for Potable Water

b. Valve shall be Crispin Sewage Air Release Valve SL or X (Universal Head) Series.

1) All valve parts are stainless steel with a stainless steel circular clamp to secure the valve head to the body.

2) Valve internals are attached to the head; the body is standard to the three color coded head combinations.

3) Valve meets the testing requirements of ANSI/AWWA CS12 standards.

c. The valve manufacturer shall furnish installation and maintenance manuals with each valve.

d. An isolating valve shall be installed between the forcemain and air release valve. The valve shall be a plug valve meeting the requirements of paragraph C.4 of Section 02563.02.

e. Sewage air release valves shall be installed in easily accessible pre-cast vaults. The vault shall be sized to properly house the valve assembly as well as providing sufficient lateral and vertical clearances to facilitate valve removal and maintenance.

Where possible, the vault shall be drained to an adjacent sanitary manhole.

Vaults shall be adequately vented to meet air release valve requirements.

f. All internals shall be easily removed through the top cover without removing the valve body from the forcemain.

8. Combination Sewage Air Valves

Combination sewage air valves shall be of the single body, double orifice design. The combination valve shall allow large volumes of air to escape or re-enter the force main through the large orifice during filling or draining of the line. While the main is under pressure, the combination valve shall automatically release pressurized air, gas or vapor through the small orifice without spillage. The small and large orifices shall act independently of each other. Two manufacturers are listed below, or equal:

a. Valve shall be combination sewage air valve APCO series 440 SCAV.

1) The sewage combination air valve shall have an elongated cast-iron body and cover. The float and internal stem shall be stainless steel supported by a Delrin or cast iron leverage frame. All internals shall be easily removed through the top cover without removing the valve body from the force main.

2) All materials of construction shall be certified in writing to conform to ASTM specifications as follows:

PART	MATERIAL	SPECIFICATION
Body & Cover	Cast Iron	ASTM A126 GR.B
Float	Stainless Steel	ASTM A240 T304
Stem	Stainless Steel	Series T300
Seat	Burna-N	Nitrile Rubber
Plug	Brass or Stainless Steel	ASTM A240 T304

Leverage Frame	Delrin or Cast Iron	ASTM D1233, ASTM A126 GR.B
Exterior Paint	Phenolic Primer Red Oxide	FDA Approved for Potable Water

b. Valve shall be Combination Air Release Valve Crispin S/SL or X (Universal Head) Series.

1) All valve parts are stainless steel with a stainless steel circular clamp to secure the valve head to the body.

2) Valve internals are attached to the head; the body is standard to the three color coded head combinations.

3) Valve meets the testing requirements of ANSI/AWWA CS12 standards.

c. The valve manufacturer shall furnish installation and maintenance manuals with each valve.

d. An isolating valve shall be installed between the force main and combination sewage air valve. The valve shall be a plug valve meeting the requirements of paragraph C.5 of Section 02563.02.

Plug isolation valves shall be equipped with gear actuators and adapters for 2-inch operating nuts. The valve shall also be equipped with an extension stem bringing the operating nut to within 12-inches of the ground surface. The installation shall meet the requirements of paragraph C.4 of Section 02563. Combination sewage air valves shall be installed in easily accessible pre-cast vaults. The vault shall be sized to properly house the valve assembly as well as providing sufficient lateral and vertical clearances to facilitate valve removal and maintenance.

Where possible, the vault shall be drained to an adjacent sanitary manhole.

Vaults shall be adequately vented to meet air release valve requirements.

9. Combination sewage air valve for use on low pressure sewers will be as manufactured by ARI model D-025.

02563.03 EXECUTION

A. Trench excavation, foundation preparation, backfill, and compaction shall be as specified in Section 02250.

B. Force main installation shall be as specified in Section 02551, "Water Mains", except chlorination is not required.

C. Joining Polyethylene Pipe

1. Heat Fusion Joining

Joints between plain end pipes and fittings shall be made by butt fusion, and joints between the main and saddle branch fittings shall be made using saddle fusion using only procedures that are recommended by the pipe and fitting Manufacturer. The Contractor shall ensure that persons making heat fusion joints have received training in the Manufacturer's recommended procedure. The Contractor shall maintain records of trained personnel, and shall certify that training was received not more than 12 months before commencing construction. External and internal beads shall not be removed. Pipe shavings shall be removed from pipe prior to fusing.

2. Heat Fusion Training Services

Upon request, the Manufacturer shall provide training in the Manufacturer's recommended butt fusion and saddle fusion procedures to the Contractor's installation personnel, to inspectors representing the Owner, and to the Owner's operational personnel. Training by the Manufacturer's representative to include both new installation and repair techniques.

3. Mechanical Joining

Polyethylene pipe and fittings may be joined together or to other materials by means of flanged connections (flanged adapters and back-up rings). It is the intent of these plans and specifications to use no mechanical couplings. Should it be necessary to use a coupling, the coupling shall be a fully pressure rated electrofusion coupling specifically manufactured for use with DR 11 HDPE pipe, manufactured by Central Plastics Company, Friatec Gas & Water, Inc., or equal.

D. Installation of Polyethylene Pipe

1. General

The Manufacturer shall package products for shipment in a manner suitable for safe transport by commercial carrier. When delivered, a receiving inspection

shall be performed, and any shipping damage shall be reported to the Manufacturer. Installation shall be in accordance with Manufacturer's recommendations, and this specification. All necessary precautions shall be taken to ensure a safe working environment in accordance with applicable codes and standards.

2. Excavation

Trench excavations shall conform to this Specification, the plans and drawings, as otherwise authorized in writing by the Project Engineer or his Approved Representative, and in accordance with all applicable codes. Excess groundwater shall be removed by the Contractor. Where necessary, trench walls shall be shored or reinforced.

3. Mechanical Joint & Flange Installation

Mechanical joints and flange connections shall be installed in accordance with the Manufacturer's recommended procedure. Flange faces shall be centered and aligned to each other before assembling and tightening bolts. In no case shall the flange bolts be used to draw the flanges into alignment. Bolt threads shall be lubricated and flat washers shall be fitted under the flange nuts. Bolts shall be evenly tightened according to the tightening pattern and torque step recommendations of the Manufacturer. The final tightening torque shall be 100 ft-lbs or less as recommended by the Manufacturer.

4. Pipe Handling

When lifting with slings, only wide fabric choker slings shall be used to lift, move or lower pipe and fittings. Wire rope or chain shall not be used. Slings shall be of sufficient capacity for the load, and shall be inspected before use. Worn or defective equipment shall not be used.

5. Final Backfilling

Final backfill shall be placed in accordance with Section 02250 of the County Standard Specifications.

C. Pipe bedding, thrust and anchor blocks, and force main appurtenances shall be installed in accordance with the Standard Details for Water.

D. Plug valve installation shall be as specified in Section 15210 of the Sewer Pumping Station Special Provisions and the following:

1. The valve shall be installed so that the plug seats when closed against the normal direction of flow.

2. Under no circumstances shall the valve be installed such that the plug is in the lower portion of the valve body when the valve is in the open position.

E. Sewage air release and combination air release/vacuum valves shall be installed in accordance with the Standard Details for Sewage.

02563.04 METHOD OF MEASUREMENT

A. Force Main

Measurement for furnishing and installing force main pipe and fittings will be made horizontally along the centerline of the pipe through all fittings and appurtenances.

B. Isolation, Sewage Air Release and Combination Air/Vacuum Valves

Measurement for isolation, sewage air release and combination air/vacuum valve will be made of the number of each size and type of valves installed complete.

02563.05 BASIS OF PAYMENT

A. General

1. Payment will be made at the unit and/or lump sum prices bid. The prices bid shall include furnishing all labor, tools, equipment, and materials necessary to complete the work as shown, specified, and in strict accordance with the Contract Documents, and accepted by the Engineer.

2. Payment for furnishing and installing force main pipelines and appurtenances will include the following:

   a. Trench excavation, backfill, compaction and incidental items as specified in Section 02250.

   b. Furnishing and installing granular material for air release and vacuum valve manhole fill as shown on the Standard Details and as required elsewhere in the Contract Documents.

3. Payment will be made for contingent items when ordered by the Engineer. Payment will be as specified in Sections 02951, 02952, 02953, 02954, 02955, 02956, and 02957.

B. Force Main

Payment for furnishing and installing force main pipelines, complete and operational, will be made per linear foot of the size and type installed. The price(s) bid shall include furnishing and installing all pipe, fittings, and jointing materials; furnishing materials for and constructing all

concrete anchorages and buttresses; strapping of fittings; connecting to existing pipelines or structures; testing; and all other incidental items of work necessary to satisfactorily complete and make the force main operational.

C. Isolation, Sewage Air Release and Combination Air/Vacuum Valves

Payment for furnishing and installing isolation, sewage air release and combination air/vacuum valves, complete and operational, will be made for each size and type of valve installed. The price(s) bid shall include furnishing and installing roadway valve boxes, precast or cast-in-place vaults and/or manholes; manhole frames and covers; and all other incidental work necessary to satisfactorily complete and make the valves operational.