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Installation and Backfill of Buried Pipe

CONTRACTOR shall comply with the "Materials", "Installation", and "Inspection, Handling and Storage" sections of ASTM D-2321, except as modified herein.

Excavation shall be as described elsewhere in these specifications and as shown on the drawings.

Install foundation and bedding as shown in the drawings and as specified herein, according to conditions in the trench bottom. Provide a firm, stable, and uniform bedding for the pipe barrel and any protruding features of its joint. Provide a minimum 4" thickness of bedding unless a greater thickness is specified.

When rock or unyielding material is present in the trench bottom, increase the thickness of bedding material to 6" minimum.

Where the trench bottom is unstable or shows a "quick" tendency, excavate all unstable material as a minimum, and replace with a foundation of material per Table I. Place and compact this foundation material in accordance with the drawings. Control of quick and unstable trench bottom conditions may also be accomplished with the use of appropriate geofabrics applied to the satisfaction of the ENGINEER and in strict accordance with the manufacturer's recommendations. For severe conditions, the ENGINEER may require a special foundation such as piles, sheeting, or concrete mats. Correction of unstable trench bottom shall not result in increased cost to OWNER.

Minimize localized loadings and differential settlement wherever the pipe crosses other utilities or subsurface structures. Provide a cushion of bedding material between the pipe and any such point of localized loading.

If the trench bottom is excavated below intended grade, fill the over-excavation with compatible foundation or bedding material and compact to a density not less than the minimum densities given in the drawings.

If trench sidewalls slough off during any part of excavating or installing the pipe, remove all sloughed and loose material from the trench.

All pipeline excavation made in one day shall have the pipe installed and backfilled the same day. Excavation of trench days ahead of pipe laying will not be permitted.

Excavations for pipeline appurtenances shall be backfilled as soon as is feasible.

Place pipe and fittings in the trench with the invert conforming to the required elevations, slopes, and alignment. Ensure uniform pipe support. In special cases where the pipe is to be installed to a curved alignment, maintain angular joint deflection or pipe bending radius, or both, as indicated in the drawings.
Adjustment in grade shall be made by scraping away or filling in along the full length of the pipe with approved bedding material, properly compacted, and not by wedging, blocking up the conduit, or supporting the conduit on mounds of earth.

The width of trench excavation is set forth in the drawings and shall not be exceeded in the area from the bottom of the trench to a point 12" above the top of the pipe.

Pipe shall be laid with the bell pointing away from the last joint. Pipe sockets and barrels shall always be clean and free from dirt.

Comply with manufacturer's recommendations for assembly of joint components, lubrication, and making of joints. When pipe laying is interrupted, secure piping against movement and seal open ends to prevent the entrance of water, mud, or foreign material.

Mark, or verify that pipe ends are marked, to indicate insertion stop position, and ensure that pipe is inserted into pipe or fitting bells to this mark. Push spigot into bell using methods recommended by the manufacturer, keeping pipe true to line and grade. Protect the end of the pipe during homing and do not use excessive force that may result in over-assembled joints or dislodged gaskets. If full entry is not achieved, disassemble, and clean the joint and reassemble. Use only lubricant supplied or recommended for use by the pipe manufacturer.

When making solvent cement joints, follow recommendations of both the pipe and solvent cement manufacturer. If full entry is not achieved, disassemble, or remove and replace the joint. Allow freshly made joints to set for the recommended time before moving, burying, or otherwise disturbing the pipe.

When the pipe joint has been checked for line and grade, the bedding material shall be applied to the springline of the pipe or as set forth in the drawings, and compacted by hand tamps or hand-held mechanical tamps, taking care not to damage or displace the pipe.

On pressure lines, all gasket joint or mechanical joint dead ends, fittings, flush valves, fire hydrants and offsets shall have Class D concrete thrust reaction blocking placed to provide for pressure reaction, as set forth in the drawings.

Where specifically called for on the drawings, additional joint restraints shall be provided.

All pipe shall then be further embedded and backfilled as set forth in the drawings and/or as described herein.

On highway right-of-way, backfill methods shall conform to the OWNER'S permits or as set forth herein and in the drawings, whichever is more restrictive.

All embedment material shall be per Table I. It shall not be the "grassed-off" overburden stripped from the site, but may be trench "tailings", provided these meet the requirements of Table I.
Where suitable embedment material, and/or suitable material for backfilling does not exist on the job site, the CONTRACTOR shall furnish such material from off the job site at his expense, and also dispose of the unsuitable material removed from the trench off of the job site, at his expense.

Place embedment materials by methods that will not disturb or damage the pipe. Work in and tamp the haunching material in the area between the bedding and the underside of the pipe before placing and compacting the remainder of the embedment in the pipe zone. Follow compaction requirements in the drawings for density requirements. Do not permit compaction equipment to contact and damage the pipe. Use compaction equipment and techniques that are compatible with materials used and location in the trench. Before using heavy compaction or construction equipment directly over the pipe, place enough backfill to prevent damage, excessive deflections, or other disturbance of the pipe. See minimum cover requirements elsewhere herein. Pipe embedment shall be compacted in maximum 8" loose lifts.

All excavations shall be backfilled to finished grades, shapes, and configurations as shown on the drawings. Finish backfill, after consolidation, shall not have a variance of over one inch in ten feet when measured with a straight edge perpendicular to the slope. Any subsequent settlement of finished areas shall be brought back to the final grade and configuration with additional material as required, so that upon the completion of the construction of the project, and for the twelve-month maintenance period, all areas shall have their final grade and shape. The CONTRACTOR, during the life of this contract, shall be responsible for so maintaining the trench and trench backfill as to permit safe passage for vehicles and pedestrians over the same. During inclement weather, he shall be responsible for removing any vehicle or livestock which may become stuck, stalled, or stranded in a trench, or in trench backfill, and shall utilize every available means to keep trenches and trench backfill across public thoroughfares and driveways safe and passable at all times.

Initial backfill, i.e., that backfill material used to a point at least 6 inches above the top of the pipe, shall be the same material as the embedment material. Unless otherwise noted on the drawings, the final backfill may be the native material removed from the trench, except that rock removed from the trench must be reduced to a size no larger than 3" maximum dimension before reuse. Broken concrete larger than 3" in maximum dimension, trees, or other lumpy materials, or materials frozen, or of a perishable, spongy, or otherwise improper nature shall never be used in the backfill.

Consolidation of cohesionless material by watering (jetting or puddling) shall only be used under controlled conditions when approved by the ENGINEER. At all times, conform to the lift thicknesses and minimum density requirements in the drawings.

To preclude damage to the pipe and disturbance to pipe embedment, a minimum depth of backfill above the pipe should be maintained before allowing vehicles or heavy construction equipment to traverse the pipe trench. For embedment materials installed to the minimum densities required in the drawings, provide cover (that is, depth of backfill above top of pipe) of at least 30 in. (0.8 m) or one pipe diameter (whichever is larger) before allowing vehicles or construction equipment to traverse the trench surface.

All pressure conduits shall have a minimum cover as follows: 3" diameter and smaller - 30"; 4" thru 8" - 36"; and 10" and larger - 42", as measured from the natural ground surface to the top of the pipe.
Pressure pipe buried in unstratified rock may be raised 6" upon authorization from the ENGINEER. Notwithstanding the above, all pipe must be buried a minimum of 36" below all highway and railroad borrow ditches.

Changes in depth of cut for pressure lines, necessitated by conflicting existing underground utilities will not be a basis for additional compensation, but will be considered as incidental work. Such changes shall not reduce the specified pipe cover.

All pressure conduit crossing creeks shall be installed by directional drilling. The minimum cover shall be 48" and the maximum shall be 60".

All gravity pipelines shall have the depth of bury specified in the detail drawings.

Provide support for vertical risers as commonly found at sewer service connections, cleanouts, and drop manholes to preclude vertical or lateral movement. Prevent the direct transfer of thrust due to surface loads and settlement and ensure adequate support at points of connection to main lines.

When excavating for a service line connection, excavate material from above the top of the existing pipe before removing material from the sides of the pipe. Materials and density of service line embedment should conform to the specifications for the existing line, or with this specification, whichever is more stringent.

Secure caps and plugs to the pipe to prevent movement and resulting leakage under test and service pressures.

Use flexible water stops, resilient connectors, or other flexible systems approved by the ENGINEER to make watertight connections to manholes and other structures.

Pipe shall be protected during handling against impact shock and free fall. No cracked or damaged pipe or joint shall be installed in the line. Handle and store pipe and fittings in accordance with recommendations of the manufacturer.

If faults, caverns, or subsidence are discovered during construction, all work shall halt, and the ENGINEER will be contacted to inspect.

<table>
<thead>
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<td>Particle Size Limitations</td>
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<td>% Passing</td>
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<tr>
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<td>100</td>
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<tr>
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<tr>
<td>#200</td>
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Plasticity Index (P.I.) less than 12

Pressure Mains Smaller Than 6”

Particle Size Limitations
<table>
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*Plasticity Index (P.I.) less than 25*

**Pressure Mains 6” and Larger**

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*Plasticity Index (P.I.) less than 12*

**Foundation Material (When Required)**

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<tr>
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<tr>
<td>#200</td>
<td>0-5</td>
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</tbody>
</table>

*Plasticity Index (P.I.) less than 9*

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**Backfill - Structural and General Area**

All structural and general-area backfill material shall be either stockpiled over-excavation material (if suitable), or "select material" as defined elsewhere. It shall not be the "grassed-off" overburden stripped from the site. Suitable material shall be stable, easily compacted, unfrozen and reasonably dry soil. Broken concrete larger than 3” in diameter, and large rocks, trees, trash, or other lumpy materials shall not be used in the backfill. Materials of a perishable, spongy, or otherwise improper nature shall not be used in backfilling.

All excavations shall be backfilled to finished grades, shapes, and configurations as shown on the drawings. Finish backfill, after consolidation, shall not have a variance of over one inch in ten feet when measured with a straight edge perpendicular to the slope. Any subsequent settlement or erosion of finished areas shall be brought back to the final grade and configuration with additional material as required, so that upon the completion of the construction of the project, and for the twelve-month maintenance period, all areas shall retain their final grade and shape.

Where suitable material for backfilling does not exist on the job site, the CONTRACTOR shall furnish such material from off the job site at his expense.

Backfill underneath pavements, sidewalks, foundations, or similar surfaces shall be mechanically compacted to minimum 95% standard proctor density (ASTM D-698), within -1 to +3 percentage points of optimum moisture, unless specifically noted otherwise. Filled areas not beneath these surfaces shall be firmly compacted and smooth, suitable for the intended use. Backfill against structural walls shall be compacted in accordance with the applicable soil investigation report, if...
same is provided, or to minimum 90% standard proctor at -1 to +3 percentage points of optimum moisture where no such report is provided.

Structural excavations shall be backfilled as soon as is practical. Structures requiring less than six feet vertical fill may be backfilled after seven days curing time for the concrete. Structures requiring more than six feet vertical fill may be backfilled after fourteen days curing time for the concrete.

Exercise extreme caution in the backfill process to prevent displacement of or damage to the adjacent structures.

Encasement Pipe

Where lines are shown on the drawings to be installed in bores and encased, the drawings set forth a bore and encasement pipe size for each carrier pipe.

Encasement pipe shall be steel, of the configuration and wall thickness shown on the drawings, or in the OWNER'S permits. Joints shall be securely welded, and the encasement shall be installed to the straightest alignment feasible.

The exterior of the pipe shall be protected from corrosion with a bituminous coating.

End seals constructed of minimum ¼" Neoprene sheets and stainless steel circle clamps (applied to connect the Neoprene sheets to the pipe and to the casing) shall be used to prevent soil from washing into the annual space between the pipe and the casing. Install on both ends of casing. End seals shall not be installed if any water is in the casing.

Bores

No State or Federal highway, or railroad, shall be open cut. All crossings of these facilities, and any others so shown on the drawings, shall only be by methods approved by TxDOT, without damage to them, or disturbing their use. Such methods shall be done in strict compliance with the terms and conditions of Highway and/or Railroad Permits issued to the OWNER.

The OWNER shall furnish copies of the permits to the CONTRACTOR and it shall be this CONTRACTOR'S responsibility to place each bore at the location specified by the OWNER'S permit. Any permit revisions caused by bore mis-location will be at the CONTRACTOR'S expense.

Bores shall be for the length of the crossings as shown by the OWNER'S permits.

Bores shall not be made without adequate advance notification (minimum 48 hours) to the respective permitted facility owner's representative.

Bore diameters shall not be more than 3" greater than the encasement pipe O.D. or, 3" greater than the carrier pipe joint O.D. where the permit does not require encasement.
All bores under state or federal roadways shall be “dry” bores with encasement as shown in the drawings. Driveway bores within state right-of-way may be “wet” bores without encasement.

The Texas Department of Transportation and/or respective railroad may impose additional requirements, which will be outlined in the OWNER'S permits and are considered a portion of this contract.

Carrier Pipe

The carrier pipe installed inside the encasement pipe shall be of the same material as the main line, unless noted otherwise on the drawings.

On bell-and-spigot carrier pipes, the carrier pipe bells shall not rest on the encasement pipe flow line. Casing spacers, as per the detail drawings, shall be provided to properly position the pipe in the casings, protect the bells, and prevent carrier pipe floatation. The lengths of main line pipe joints may be adjusted to cause the minimum number of carrier pipe joints to occur inside the encasement pipe.

Casing Spacers

Casing spacers shall be used to install the carrier pipe inside the encasement pipe. Casing spacers shall fasten tightly onto the carrier pipe so that when the carrier pipe is being installed the spacers will not move along the pipeline. Casing spacers shall be doubled on each end of the encasement.

Each casing spacer shall be capable of providing support for the carrier pipe in service at a maximum spacing of 10'. Calculations shall be provided to the ENGINEER by the casing spacer manufacturer showing that the casing spacer will support the service load at the recommended spacing, including a factor of safety of two (2). Casing spacers used under this specification shall meet or exceed the specifications described herein as projection-type casing spacers.

Projection-type casing spacers shall be constructed of preformed sections of high density polyethylene. The flexible sections shall be joined around the pipe to provide a minimum of 16 plastic projections per spacer section. Projection-type casing spacers shall be "RACI" Type F/G spacers, manufactured by Recon Pipe Corporation of Vernon, British Columbia, telephone (604) 545-2227, or equivalent.

Polyvinyl Chloride (PVC) Pipe for Potable Water Mains and Wastewater Force Mains

Plastic pipe shall be manufactured from material meeting the requirements of ASTM D-1784, 12454B compounds. The finished pipe shall conform to ASTM D-2241, the gasket joint to ASTM D-3139 and the gaskets to ASTM F-477. Each joint shall bear the seal of approval of NSF, indicating that the pipe is suitable for conveying potable water. The pipe shall bear markings on each joint showing the pressure rating, type, grade and manufacturer's run or lot. Manufacturer's
certificate of test and compliance shall be furnished on all PVC pipe.

Any plastic pipe field inspected and found not to conform as to wall thickness or diameter shall be rejected, and all pipe of the same run or lot number shall be rejected and replaced with acceptable pipe at the CONTRACTOR’S expense. Field tests will be made on random samples of pipe.

14" through 36" PVC shall conform to Unibell PVC Pipe Association specification Uni-B-11 and shall have the pressure rating and DR specified on the drawings and/or bid schedule. Pipe shall have cast iron O.D. and rubber gasket joints.

6" through 12" PVC shall be either Class 160 SDR 26 gasket-joint, Class 200 SDR 21 gasket joint, or AWWA C-900 DR 18 or DR 25, whichever is specified in the drawings and/or the Bid Schedule. Where AWWA C-900 pipe is specified, it shall have cast iron equivalent O.D., and be listed by Underwriters Laboratories as well as NSF. It shall be furnished in 20' lengths, with rubber gasket joints.

3" and 4" PVC shall be Class 200 SDR 21, as shown on the drawings and/or bid schedule and shall be gasket joint. 2-1/2" and smaller PVC shall be Class 200, rubber-ring gasket joint, SDR 21, with integral bell.

All physical and chemical tests shall be made at 73 degrees Fahrenheit. These tests shall include, but are not limited to, quick burst test, sustained pressure test, acetone immersion test, vice test, and drop impact test as set forth in applicable ASTM and NSF Standards.

Plastic pipe delivered to the project well in advance of its installation shall be protected from excessive warpage, discoloration, and heat deformation. Pipe shall not be strung for laying more than thirty days in advance of the laying time. Ends of plastic pipe shall be protected so that same shall not be scratched or abraded prior to installation. Any damaged ends shall be removed prior to installation.

Pipe may be cut by using a medium tooth saw and miter box. Fine emery cloth or sandpaper shall be used to remove burrs.

No male threaded PVC pipe will be allowed. Solvent-weld pipe shall be adequately snaked to allow for expansion or contraction.

Ductile-Iron Pipe

Ductile-iron pipe, 3" in diameter and larger, shall conform to the current American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water and Other Liquids, ANSI/AWWA C151/A21.51.

All ductile iron pipe shall be "Tyler", "U.S. Pipe", "American" or approved equal.
Ductile-iron thickness shall conform in all respects to the current American National Standard for the Thickness Design of Ductile-Iron Pipe, ANSI/AWWA C150/A21.50.

For depths of cover less than or equal to 20 feet the following shall determine the pipe pressure class:

<table>
<thead>
<tr>
<th>Pipe Diameter</th>
<th>Pressure Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>4” to 16”</td>
<td>350</td>
</tr>
<tr>
<td>18” to 20”</td>
<td>300</td>
</tr>
<tr>
<td>24” to 30”</td>
<td>250</td>
</tr>
<tr>
<td>36” to 64”</td>
<td>200</td>
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</tbody>
</table>

When the depth of cover is to exceed 20 feet Pressure Class 350 shall be used for all diameters. The ENGINEER will indicate such areas on the drawings.

All ductile-iron pressure pipe shall be furnished with one of the following types of joints, as described in the drawings or bid schedule:

<table>
<thead>
<tr>
<th>Type Joint</th>
<th>AWWA Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Push-on (buried pipe)</td>
<td>AWWA C111</td>
</tr>
<tr>
<td>Mechanical Joint (buried pipe)</td>
<td>AWWA C111</td>
</tr>
<tr>
<td>Flanged Ends (required above ground)</td>
<td>AWWA C110</td>
</tr>
</tbody>
</table>

Bolts and nuts for mechanical joints or flanged ends shall be of a high-strength low-alloy corrosion-resistant steel and shall conform to AWWA C111-95.

All screwed flanges shall be ductile iron.

All ductile iron pipe used for conveying sewer flow shall be ceramic-epoxy lined on the inside and shall be standard lined with an asphalt seal coat in accordance with AWWA Standard C-104. Ceramic-epoxy lining shall be P401 as manufactured by Induron Coatings, Inc., 3333 Richard Arrington Jr. Blvd. N., Birmingham, Alabama 35234, 1-888-773-2401, or approved equal. It shall be applied to the pipe by a factory-certified applicator.

All other ductile-iron pipe shall be standard cement-mortar lined inside, with asphalt seal-coat inside and out, in accordance with AWWA Standard C-104.

All ductile-iron pipe, fittings, valves and appurtenances shall receive polyethylene encasement as specified elsewhere herein.

Hydrostatic Testing - Water and Wastewater Pressure Mains

After backfilling mains and before pavement repairs, each section of pressure line constructed shall be tested with a hydraulic test pressure of not less than 150 psi over a continuous period of not less than four hours. The CONTRACTOR shall furnish adequate equipment to make these tests. The test
pressure shall not be allowed to fall below 140 psi, at which pressure the pump will be started and the line loss measured directly by tank measurement or read off a totalizing meter. Re-pressurizing shall be done each hour, or sooner, as may be required to maintain the test pressure within the prescribed limits. The final re-pressurizing will be made at the end of the final hour of the test. Total water used will be the sum of the quantities required to re-pressurize the line to the original test pressure. 100% of the pressure mains laid will be tested. New meter service lines will be tested. Where existing service lines are reused and transferred to the new main, the connection of the corporation stop into the new main will be done before the pressure test, but the existing service line shall not be tested.

During the filling of the mains, and before applying the test pressure, all air shall be expelled from the mains.

If the test indicates a leakage in excess of a rate equal to 10 gallons per inch of diameter of the pipe per mile over a 24-hour period, then the CONTRACTOR shall be required to find the leaks and eliminate same. All known leaks shall be stopped, regardless of allowable leakage.

Tests may be combined with sterilization and shall be observed by representatives of the interested parties.

**Existing Line Abandonment**

After the new lines covered by this contract have been installed, tested, sterilized (if used for potable water applications), and placed into service, and required customer services have been transferred from existing parallel lines to the new mains, certain existing lines, where shown on the drawings, will be cut, permanently plugged (with a rubber boot and stainless steel circle clamps) and taken out of service. The abandonment of these lines is outlined on the construction drawings insofar as the piping arrangement of the existing system is known, but the existing piping arrangement is not guaranteed.

**Tapping Sleeves and Valves**

Tapping sleeves and valves shall be used where shown on the drawings, and the sleeve and valve are considered one unit for payment purposes.

Tapping valves shall meet AWWA specifications and requirements outlined for gate valves elsewhere herein, except that they shall be especially designed for use with tapping sleeve. They shall be complete with valve box and marker, and concrete blocking. Valves shall be flange by MJ, unless otherwise noted.

The tapping sleeve shall be of cast iron or ductile iron body, with corrosion-resistant steel alloy bolts. Ends shall be mechanical joint. The outlet shall be flanged, for connection to the valve. Small and large O.D. range gaskets shall be provided. The sleeve shall be designed for a minimum of 150
psi operating pressure and 250 psi test pressure. It shall be provided in two sections, which bolt together to surround the pipe circumference, with the outlet cast as an integral portion of the sleeve.

Tapping sleeves which consist of two half-circle fabricated sections of steel, gasket lined and longitudinally crimped to allow deformation by tightening the bolts and thus provide built-in range over a variety of pipe O.D.'s may also be used, providing that the main body, neck, and bolts are constructed of Type 304 stainless steel, and designed to withstand a minimum of 150 psi working pressure and 250 psi test pressure.

The tapped plug removed from the line shall be delivered to the ENGINEER.

All metallic components shall be poly-wrapped to reduce corrosion.

Trench Excavation for Sanitary Sewer and Potable Water Mains

The CONTRACTOR shall perform all necessary trench excavation. Unless otherwise specified herein, trench excavation will comply with the Trench Excavation section of ASTM D-2321.

There shall be no separate classification of excavation.

In general, all pipeline excavation shall be made by open cut from the surface of the ground and shall be no greater in width or depth than is necessary to permit the proper construction of the work. The sides of the trench shall be cut and maintained as nearly vertical as is feasible to a point at least 12 inches above the top of the pipeline. If the trench walls are to be sloped for trench safety purposes (where other forms of trench safety are not required), then sloping may begin at this point.

The entire foundation area in the bottom of the excavation shall be firm, stable and of uniform density. A soil is stable if it provides dependable support for the pipe and undergoes only slight volumetric change with variation in its moisture content.

Unstable soil conditions in trench bottoms shall be stabilized before laying the pipe. As a minimum, this is accomplished by over-excavating the trench bottom to remove the unstable material and bringing it back to grade with appropriate bedding material. Additional stabilization may be required, including French Drains, well points, concrete backfill, or other to be agreed upon by the ENGINEER. No additional compensation is allowed for stabilization.

Materials shall not be disturbed below grade, except soft, wet, disintegrated, or other unsuitable materials which shall be removed to a depth below grade as is directed by the ENGINEER. Any rock or other extremely hard materials under the foundation area shall be removed to a depth not less than 6" below grade.

Excavate trenches to ensure that sides will be stable under all working conditions. Slope trench walls or provide supports in conformance with all state and national standards for safety. Open only as much trench as can be safely maintained by available equipment. Backfill all trenches as soon as practicable, but not later than the end of each working day.
Do not lay or embed pipe in standing or running water. At all times prevent flows from sewers, storm drains, runoff and surface water from entering the trench. The providing of a proper foundation will be at the CONTRACTOR'S expense. Embedment for pipe, structure foundations, or the pipeline itself shall not be laid or poured in standing or running water, or on unstable foundations.

When standing or running water from any source is present in the work areas, dewater to maintain stability of in-situ and imported materials. Maintain water level below pipe bedding and foundation to provide a stable trench bottom. Use, as appropriate, sump pumps, well points, deep wells, geofabrics, perforated underdrains, or stone blankets of enough thickness to remove and control water in the trench. Dewatering shall be considered as incidental work and will not be paid for as separate items. When excavating while depressing groundwater, ensure the groundwater is always below the bottom of cut to prevent washout from behind sheeting or sloughing of exposed trench walls. Maintain control of water in the trench before, during, and after pipe installation, and until embedment is installed and enough backfill has been placed to prevent floatation of the pipe. To preclude loss of soil support, employ dewatering methods that minimize removal of fines and the creation of voids in in-situ materials.

Control running water emanating from drainage of surface or groundwater to preclude undermining of the trench bottom or walls, the foundation, or other zones of embedment. Provide dams, cutoffs or other barriers periodically along the installation to preclude transport of water along the trench bottom. Backfill all trenches after the pipe is installed to prevent disturbance of pipe and embedment.

Use suitably graded materials in foundation or bedding layers or as drainage blankets for transport of running water to sump pits or other drains. Use well graded materials, along with perforated underdrains, to enhance transport of running water, as required. Select the gradation of the drainage materials to minimize migration of fines from surrounding materials.

Where trench walls are stable or supported, provide a width enough, but no greater than necessary, to ensure working room to properly and safely place and compact haunching and other embedment materials. The space between the pipe and trench wall must be wider than the compaction equipment used in the pipe zone. Maximum trench widths shall be as shown on the drawings. In addition to safety considerations, trench width in unsupported, unstable soils will depend on the size and stiffness of the pipe, stiffness of the embedment and in-situ soil, and depth of cover. Specially designed equipment may enable the satisfactory installation and embedment of pipe in trenches narrower than specified above. If it is determined that the use of such equipment provides an installation consistent with the requirements of this standard, minimum trench widths may be reduced, as approved by the ENGINEER.

When supports such as trench sheeting, trench jacks, trench shields or boxes are used, ensure that support of the pipe and its embedment is maintained throughout installation. Ensure that wall sheeting is sufficiently tight to prevent washing out of the trench wall from behind the sheeting. Provide tight support of trench walls below viaducts, existing utilities, or other obstruction that restrict driving of sheeting.
Unless otherwise directed by the ENGINEER, sheeting shall not be placed in or below the pipe zone to preclude loss of support of foundation and embedment materials. When specifically allowed by the ENGINEER, sheeting may be placed in or below the pipe zone, with the top of sheeting to be cut off 1.5 feet or more above the crown of the pipe. Leave rangers, whalers, and braces in place as required to support cutoff sheeting and the trench wall in the vicinity of the pipe zone. Timber sheeting to be left in place is considered a permanent structural member and should be treated against biological degradation (for example, attack by insects or other biological forms) as necessary, and against decay if above groundwater.

Do not disturb the installed pipe and its embedment when using movable trench boxes and shields. Movable supports should not be used below the top of the pipe zone unless approved methods are used for maintaining the integrity of embedment material. Before moving supports, place and compact embedment to enough depths to ensure protection of the pipe. As supports are moved, finish placing and compacting embedment.

If the ENGINEER permits the use of sheeting or other trench wall supports below the pipe zone, ensure that pipe and foundation and embedment materials are not disturbed by support removal. Fill voids left on removal of supports and compact all materials to required densities.

If ledge rock, hard pan, shale, or other unyielding material, cobbles, rubble or debris, boulders, or stones larger than 1.5 in. (40 mm) are encountered in the trench bottom, excavate a minimum depth of 6 in. (150 mm) below the pipe bottom and replace with proper embedment material.

The CONTRACTOR shall be responsible for the satisfactory disposal of excess and unsuitable materials of any sort, and shall be responsible for backfilling, tamping, compacting, and refilling after settlement, of all excavated areas and other land, private and public, damaged or occupied by the CONTRACTOR in the performance of the contract, to as good condition as they were prior to the beginning of the work. It shall be his further responsibility to remove all surface obstruction to his work on easements or sites. He shall protect all pipes, conduits, signs, utility poles, wire, fences, building, and other public or private property improvements adjacent to or in the line of the work.

Trench backfilling as it relates to pavement repair subbase:

- Due to the varying depths of trenching and the varying types of native soils, the backfill under trenched areas that will receive pavement repair will conform to the requirements shown in the detail drawings.
- All backfill beneath trenched areas that are to receive pavement repair will be uniformly mechanically compacted in maximum 8” loose lifts to a minimum of 95% standard Proctor density at -1 to +3% of optimum moisture. The backfill material will be as shown in the detail drawings. Hand-operated pneumatic or gasoline-powered equipment will be required for adequate compaction around valve stacks, manholes, cleanouts, etc.
- In all trenched areas that are to receive pavement repair, the pipe will be installed in trenches with near-vertical walls employing OSHA-approved trench-safety methods (hydraulic wall jacks, trench boxes, etc.). Sloping the sides of the trench will not be allowed so that pavement repair at the top of the trench is minimized.
Unlike Pipe Connections (Gravity Lines Only)

Gravity lines of unlike material, of differing O.D., or incompatible type joints, shall be connected with a banded-coupling style adjustable repair coupling (ARC) with a stainless steel shear ring (stiffener) and stainless steel bands, as manufactured by Fernco, or approved equal. The adaptors shall be of the banded-coupling style, constructed of materials meeting ASTM C 1173, ASTM D 5926 and CSA B602.

Pressure lines of unlike material, differing O.D.’s, or incompatible joints, shall be connected with a standard fitting of like materials as specified for other fittings on the same line, unless a special fitting is called for on the drawings. Where standard fittings are not manufactured for the particular circumstance encountered, and no special fitting is specified, the connection shall be of the flexible coupling type, consisting of a middle sleeve with gasketed and bolted, or threaded, end sections. For 4” and larger pipelines, these connectors shall be steel, and they may be steel or PVC for 3” and smaller pipelines. The coupling shall be designed for 250 psi working pressure, and shall be corrosion protected.

Wastewater Service Laterals

This CONTRACTOR shall install the necessary fittings for customer connections to the wastewater mains laid herein and shall extend a 4" PVC service lateral to the property line. He shall not connect the customer's house to the service, nor install services on private property. Where the line is on easement instead of street right-of-way, the service lateral shall be extended to the edge of the right-of-way.

The connection shall consist of a wye in the sewer main, a 1/8” bend, 4" PVC as required, and plug. The wye shall be installed as the main is laid. Saddles will not be allowed. The end of the service fitting shall be plugged airtight.

This CONTRACTOR shall verify the location of each customer's service fitting with the customer. Any service not so verified, and mis-located, will be relocated at the CONTRACTOR'S expense.

This CONTRACTOR shall be responsible for furnishing to the OWNER one set of record drawings showing the service fitting locations. Each service fitting will be referenced along the length of the sewer line, as measured from the nearest manhole. The CONTRACTOR shall be liable for any cost incurred by the OWNER in finding any service fitting mis-referenced or not referenced, including the cost of a new service fitting, if required.

Customers will not be allowed to connect to the sewer main and its appurtenances until authorized to do so by the OWNER.

For connection of new sewer main and laterals to existing customer service lines, see Wastewater Service Transfers located elsewhere herein.

Wherever possible, the wastewater service lateral shall be placed on the uphill side of the lot.
PVC Plastic Pipe - Gravity Sewers

Polyvinyl Chloride (PVC) plastic sewer pipe shall have integral wall bells and shall be recommended by its manufacturer for use as a gravity sewer conduit. Provisions must be made for contraction and expansion at each joint, with a rubber ring. The bell shall consist of an integral wall section, stiffened with two PVC stiffening rings which securely lock the solid cross-section rubber ring into position. The rubber ring shall conform to ASTM F-477.

The pipe shall be made from clean, virgin PVC compound conforming to ASTM resin specifications D1784. Clean reworked material generated from the manufacturer's own pipe production may be used.

SDR PVC pipe furnished under this specification may be manufactured in three standard laying lengths-20 feet, 12-1/2 feet, and 10 feet and shall conform to ASTM D-3034, SDR 35. Pipe wall shall be marked as to manufacturer, SDR rating, ASTM D-3034 and run number. Pipe joints shall conform with ASTM D-3212.

Where the drawings specify new SDR 26 PVC pipe, the finished pipe shall conform to ASTM D-2241, and the gasket joint to ASTM D-3139. Each joint shall bear the seal of approval of NSF, indicating that the pipe is suitable for conveying potable water. The pipe shall bear markings on each run or lot. Manufacturer's certificate of test and compliance shall be furnished on all PVC pipe.

Minimum allowable tensile strength is 7000 PSI and cell class shall be 12454-B.

All physical and chemical tests shall be conducted at 73°F.

Pipe shall not deflect in excess of 5% of its original diameter under this project's design conditions and shall have a pipe stiffness equal to 45.0 F/Y or better.

Any plastic pipe field inspected and found not to conform to these specifications as to wall thickness, coloration, texture, or diameter shall be rejected, and all pipe of the same run or lot number shall be rejected and replaced with acceptable pipe at the CONTRACTOR’S expense. Field tests will be made on random samples of pipe.

Minimum acceptable wall thicknesses for PVC gravity sewer are as follows:

<table>
<thead>
<tr>
<th>PIPE SIZE</th>
<th>SDR 35 WALL THICKNESS</th>
<th>SDR 26 WALL THICKNESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>4&quot;</td>
<td>0.120 inch</td>
<td>0.173</td>
</tr>
<tr>
<td>6&quot;</td>
<td>0.180 inch</td>
<td>0.255</td>
</tr>
<tr>
<td>8&quot;</td>
<td>0.240 inch</td>
<td>0.332</td>
</tr>
<tr>
<td>10&quot;</td>
<td>0.300 inch</td>
<td>0.413</td>
</tr>
<tr>
<td>12&quot;</td>
<td>0.360 inch</td>
<td>0.490</td>
</tr>
</tbody>
</table>
Gravity Sewer Line Tests

All gravity-flow wastewater conduit shall be checked for leaks by "Air Testing", in accordance with ASTM C828-80, ASTM C-924, ASTM F-1417, except for test lines which are to be as outlined below, after service wyes are installed and plugged. The OWNER'S representative must be present during all testing, air and mandrel. Regardless of air test results, if weir tests or other field measurements show infiltration in excess of 50 gallons per inch pipe diameter per mile of pipe per day, the CONTRACTOR must locate and repair the leaking joints.

The procedure for the low-pressure air test shall conform to the procedures described in ASTM C-828, ASTM C-924, ASTM F-1417 or other appropriate procedures, except for testing times. The test times shall be as outlined in this section. For sections of pipe less than 36" average inside diameter, the following procedure shall apply unless the pipe is to be joint tested. The pipe shall be pressurized to 3.5 psi greater than the pressure exerted by groundwater above the pipe. Once the pressure is stabilized, the minimum time allowable for the pressure drop from 3.5 lbs. per square inch gauge to 2.5 lbs per square inch shall be as indicated on the following chart.

The test may be stopped if no pressure loss has occurred during the first 25% of the calculated testing time. If any pressure loss or leakage has occurred during the first 25% of the testing period, then the test shall continue for the entire test duration as outlined in this subparagraph or until failure. Lines with a 27" average inside diameter and larger may be air tested at each joint. Pipe greater than 36" diameter must be tested for leakage at each joint. If the joint test is used, a visual inspection of the joint shall be performed immediately after testing. The pipe is to be pressurized to 3.5 psi greater than the pressure exerted by groundwater above the pipe. Once the pressure has stabilized, the minimum time allowable for the pressure to drop from 3.5 lbs. per square inch gauge to 2.5 lbs per square inch gauge shall be ten seconds.

Line segment lengths equal to or less than the minimum lengths specified below shall be tested for the minimum time shown below for the appropriate size pipe. Line segment lengths longer than the minimum lengths specified below shall multiply the length in feet by the appropriate time factor for the pipe size being tested as shown on the far right of the table below:

<table>
<thead>
<tr>
<th>Minimum Time (Seconds)</th>
<th>Length for Minimum Time (Feet)</th>
<th>Nominal Pipe Size (Inches)</th>
<th>Time for Longer Than Minimum Length (Sec.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>227</td>
<td>597</td>
<td>4</td>
<td>0.380 (L)</td>
</tr>
<tr>
<td>340</td>
<td>398</td>
<td>6</td>
<td>0.855 (L)</td>
</tr>
<tr>
<td>454</td>
<td>298</td>
<td>8</td>
<td>1.520 (L)</td>
</tr>
<tr>
<td>567</td>
<td>239</td>
<td>10</td>
<td>2.374 (L)</td>
</tr>
<tr>
<td>680</td>
<td>199</td>
<td>12</td>
<td>3.419 (L)</td>
</tr>
<tr>
<td>850</td>
<td>159</td>
<td>15</td>
<td>5.342 (L)</td>
</tr>
<tr>
<td>1020</td>
<td>133</td>
<td>18</td>
<td>7.693 (L)</td>
</tr>
</tbody>
</table>
Failure of any line segment to pass the above tests will require the CONTRACTOR, at his expense, to do such work and to furnish such materials and equipment as are required to locate and repair "leaks" in the pipeline, to the extent necessary so that, upon retesting, the pipeline will comply with these test limits. Known leaks shall be repaired by the CONTRACTOR regardless of test results.

Deflection tests shall be performed on all flexible pipes. For pipelines with inside diameters less than 27”, a rigid mandrel shall be used to measure deflection. For pipelines with an inside diameter 27" and greater, a method approved by the TCEQ shall be used to test for vertical deflections. Other methods shall provide a precision of two tenths of one percent (0.2%) deflection. The test shall be conducted after the final backfill has been in place at least 30 days. No pipe shall exceed a deflection of 5.0%. If a pipe should fail to pass the deflection test, the problem shall be corrected, and a second test shall be conducted after the final backfill has been in place an additional 30 days. The tests shall be performed without mechanical pulling devices.

The rigid mandrel shall have an outside diameter (O.D.) equal to 95% of the inside diameter (I.D.) of the pipe. The inside diameter of the pipe for the purpose of determining the outside diameter of the mandrel, shall be the average outside diameter minus two minimum wall thicknesses for O.D. controlled pipe and the average inside diameter for I.D. controlled pipe, all dimensions shall be per appropriate standard. Statistical or other "tolerance packages" shall not be considered in mandrel sizing.

The rigid mandrel shall be constructed of a metal or a rigid plastic material that can withstand 200 psi without being deformed. The mandrel shall have nine or more "runners" or "legs" as long as the total number of legs is an odd number. The barrel section of the mandrel shall have a length of at least 75% of the inside diameter of the pipe. A proving ring shall be provided and sized for each size mandrel in use.

Manholes shall be tested for leakage separately and independently of the wastewater lines by hydrostatic exfiltration testing. If a manhole fails a leakage test, the manhole must be made water tight and retested. The maximum leakage for hydrostatic testing shall be 0.025 gallons per foot diameter per foot of manhole depth per hour. Hydrostatic exfiltration testing shall be performed as follows: all wastewater lines coming into the manhole shall be sealed with an internal pipe plug, then the manhole shall be filled with water and maintained full for at least one hour. For concrete manholes, wetting period of 24 hours shall be used prior to testing in order to allow saturation of the concrete.

Regardless of test results, if a manhole shows evidence of groundwater entering through the concrete wall, joints, or floor of the manhole, the CONTRACTOR shall located the point of entrance and take whatever steps necessary to permanently stop the leak, such as drilling, chipping, or gas gouging out defective concrete of gasket material, and replacing it with equipment grout, cement grout, or other acceptable waterproofing agents.
Manhole Castings

Manhole ring and cover materials and quality shall conform to gray iron casting specifications elsewhere herein.

All manhole covers shall have two (2) recessed pick bars. Pick holes and recessed rim notches will not be permissible. The contact surface between the cover and ring shall be machined smooth.

Marking indicating "Sanitary Sewer" or "Sewer" cast onto the cover is required.

The manhole cover will have a minimum 32-inch nominal diameter. The clear opening in the ring may be as small as 30 inches to allow for seating of the cover. The height of the ring shall be no less than 4, nor no more than 6 inches. A flange will be provided for seating the manhole ring on the concrete manhole. Ribs will be cast on the underside of the cover as needed, for reinforcement.

Where manhole castings are designated on the drawings as "watertight", they shall be of the bolt-down variety, with a neoprene or rubber gasket between the ring and cover. The bolt-down ring and cover combination shall have a minimum weight of 300 pounds and shall be secured by not less than 2 nor more than 4 stainless steel bolts.

Other manhole castings need not be gasketed or bolted but shall have a machined contact between ring and cover. The combined ring and cover weight shall not be less than 300 pounds.

All watertight manhole castings on the project shall be identical to each other in size, weight, and design; and all other manhole castings shall be identical to each other in size, weight, and design.

Both ring and cover shall have a traffic load rating of H-20 or higher.

Manholes

Manholes shall be circular in shape and of the size, configuration, slope, and depth as shown in the drawings.

The manhole shall be constructed over the centerline of the sewer, unless field located otherwise by the ENGINEER.

The minimum clear opening in the concrete cone shall be 30". The minimum inside diameter of the manhole barrel shall be 48".

The reinforced poured-in-place concrete base shall be of Class A concrete, with a minimum O.D. of the manhole O.D. plus 12 inches, a thickness of 8", and top and bottom mats of #4 reinforcing steel on 12" c.c. both ways. The base may be poured integrally with the manhole structure or separately, but in either event the joining of the wall to the base shall be watertight.
The CONTRACTOR may elect to use pre-cast concrete bases. Such bases shall be constructed to meet or exceed ASTM C-478. The minimum base thickness shall be 8". The base O.D. shall equal the manhole O.D. plus 12".

All sewage flow shall be carried in smoothly constructed "U" shaped channels, constructed integrally with the base. The side height of the channel for sewer pipe up to 15" shall be at least 2/3 of the largest pipe diameter entering the manhole. For 15" to 24" pipe, the channel depth should be 3/4 the largest pipe, and for 24" diameter pipe or greater, the channel depth shall be equal to the largest pipe entering the manhole. The top of the finished manhole invert shall have a minimum of ½ inch per foot slope from the wall to the channels. Where more than one sewer enters or leaves the manhole, the intersecting channels shall be merged smoothly. Preferably the sewer pipe, with necessary fittings, will be laid through the manhole before the concrete base is built, and after the invert is constructed, the top one-half of the pipe inside the manhole will be removed. Water shall not pond in manhole inverts to a depth greater than 1/4 inch.

The manhole base and its connecting sewer lines shall be placed on undisturbed ground. Should the foundation under the sewer line be disturbed, it shall be replaced with compacted gravel. Where the pipe passes through the wall, it shall be made watertight by concrete manhole adapters (water-stops) or large diameter water-stops for pipes entering manhole walls as manufactured by Fernco or approved equal, allowing for differential settlement. Pipe-to-manhole connections shall conform to ASTM C-923.

For poured-in-place manholes, where the manhole is required to have a concrete pad around the top, the ring and cover shall be poured-in-place with the pad. Grout shall be installed between the manhole ring, grade rings, and manhole top. It shall consist of Portland cement, sand, and water, and shall include acrylic polymer and modifier agent ("Octoblen" I.P.A. Systems, Phila., Pa., or equal) to promote greater adhesion, substantially increase flexural strength, and improve freeze-thaw resistance. Add the acrylic in strict accordance with manufacturer's directions. Ring shall rest on a solid seat. Its top shall be level or conform to the slope of the finished surfaces. It shall protrude 1/8" to 1/4" above street pavements and 1 inch to 2 inches above natural ground unless shown otherwise on the drawings.

All manholes constructed on this project shall be furnished with an inflow insert in the ring and cover, meeting specifications for Inflow Insert elsewhere herein.

The manholes shall not have steps.

The manhole walls shall be poured in place, Class A, non-reinforced, formed concrete or, pre-cast manhole sections. Manhole forms shall be adequately braced, and the concrete so placed that its vertical alignment shall be within 6" of plumb. The concrete shall be mechanically vibrated during placement. All voids in the cement surface will be repaired immediately after the form removal. Lifting holes in pre-cast sections shall be repaired with Conshield Joint Set non-shrink grout prior to manhole testing.

Where pipelines of differing diameters enter and leave a manhole, the pipelines shall be installed so that the top of the incoming line, or lines, will be the same elevation as the top of the outgoing line.
If, after the manhole has been backfilled, the walls or invert show evidence of groundwater entering the manhole, the leak shall be repaired. Repairs shall be made by gouging out the defect in the concrete and repairing it with Conshield Joint Set non-shrink grout.

Where manhole depth is measured for payment, the payment shall be measured from the top of the cast iron cover to the outlet flowline of the manhole. Where manholes are a unit price item, the item shall include the inflow insert as specified elsewhere herein.

Should the CONTRACTOR elect to use precast bases, they shall conform in dimension and construction to the poured-in-place bases outlined above. The CONTRACTOR shall be responsible for any additional cost incurred if field conditions necessitate a change in manhole depth after the pre-cast units are ordered.

All new/replacement manholes shall be vacuum tested as described elsewhere herein.

The use of brick for manhole construction is not allowed in this project. Similarly, the use of bricks to adjust manhole rings to grade is not acceptable. Where the adjustment of manhole ring elevation is required, the CONTRACTOR shall utilize the precast concrete adjustment rings for this purpose.

Concrete and cementitious repair products shall use Conshield additive for corrosion resistance. Install in accordance with the manufacturer's recommendations.

Sewer Cleanouts

Where shown on the drawings, sewer line cleanouts shall be provided. The upturned pipe rising to the surface shall be standard pipe and fittings, topped with a Bass and Hayes 404 Cleanout Body, consisting of a gray cast iron cleanout box and access cover. The finished height above surrounding surfaces will be similar to that specified for manhole covers. The upturned pipe section and casting will be embedded in a 24" x 36" x 6" concrete pad. A gasket-to-threaded, line size x 6" adaptor and a 6" screw-in plug will be installed in the end of the upturned pipe, to prevent inflow.

The Bass and Hayes 404 Cleanout Body shall be manufactured by Bass and Hayes Foundry, Inc. 238 S Bagdad Rd, Grand Prairie, TX 75050, 1-800-258-2278, https://basshays.com/

Manhole Drop Structure

All drop structures shall be outfitted with inside drop components. The bowl shall be installed as per manufacturer’s instructions using stainless steel fasteners. The PVC drop pipe shall be securely attached to the manhole wall using stainless steel fasteners and associated stainless steel clamping brackets. The drop pipe shall be the same size as the pipe entering the manholes.

The inside drop bowl system shall be a RELINER (model as shown in the table below) as manufactured by Duran Inc., telephone number 1-800-508-6001, or approved equal.
A flexible coupling with stainless steel clamps (as described elsewhere herein) shall connect the drop bowl to the drop pipe.

A 90° bend will be fastened to the bottom of the vertical drop pipe and rest upon the top of the invert bench at the wall. The bend shall be pointed in the direction of the manhole outlet.

Outside drop structures will not be acceptable.

Inflow Inserts for Manholes

The CONTRACTOR shall install manhole inflow inserts on all existing and new manholes indicated for installation of inflow insert. The insert shall be a "Rain Sentry" watertight inflow insert, as manufactured by Improved Construction Methods, Inc., Jacksonville, Arkansas; or "RainGuard", by LF Manufacturing, Giddings, Texas; complete with 1 psi relief valve, nylon strap handle, and closed cell neoprene gasket. Relief valve shall not have a water leak down rate in excess of 5 gallons per day.

Manhole Rehabilitation Techniques - General

Manholes scheduled for rehabilitation will be receiving one or more types of rehab. The drawings provide the location of each manhole and give the manhole repair type number(s) appropriate for each.

It is the CONTRACTOR'S responsibility to verify and/or obtain all required dimensions for ordering necessary projects and materials.

The CONTRACTOR shall be responsible for removal and disposal of all excess materials and debris as a result of all manhole rehab or replacement.

The following will provide a repair type number and technical specifications for each rehab technique utilized for this project. Any pavement repair necessary due to manhole repair should be

<table>
<thead>
<tr>
<th>INLET AND DROP PIPE SIZE (INCHES)</th>
<th>MODEL NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FLAT WALL</td>
</tr>
<tr>
<td>4</td>
<td>A4FDB</td>
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<tr>
<td>6</td>
<td>A6FDB</td>
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<td>12</td>
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<td>30/18FDB</td>
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<td>36/21FDB</td>
</tr>
<tr>
<td>24</td>
<td>48/24FDB</td>
</tr>
</tbody>
</table>
included in the bid unit price for the appropriate repair type. No separate bid item is included for pavement repair around rehabilitation manholes.

- **Type 1 Manhole Repair - Install Inflow Insert**

The CONTRACTOR shall install an inflow insert on all existing manholes indicated for "Repair Type 1". The inflow insert shall conform to the technical specification "Inflow Inserts for Manholes", elsewhere herein.

- **Type 2 Manhole Repair - Seal Isolated Defects in Manhole Wall**

The CONTRACTOR shall seal isolated holes and/or pipe entrances in manhole wall where indicated by "Repair Type 2". The holes and/or pipe entrances shall be sealed working from inside the manhole. Each defect shall have all broken, loose or foreign matter thoroughly removed, providing a clean and firm surface to apply high strength, corrosion-resistant, waterproof, epoxy grout or hydraulic cement (see separate technical specifications). The finished surface shall be smooth and flush with manhole wall providing a watertight seal. The sealing material shall be applied to the full thickness of the void.

- **Type 3 Manhole Repair - Install Watertight Ring and Cover**

The CONTRACTOR shall replace the existing ring and cover with an approved ring and cover on all existing manholes indicated for "Type 3 Manhole Repair". Remove the existing manhole ring and cover completely from the top portion of the manhole. The surfaces of the manhole wall/grade ring and cover shall be thoroughly cleaned prior to setting the ring. The ring shall be centered over the manhole and within 1/2" of being level across 24" ring. Waterproof, non-shrink epoxy grout (see technical specifications) shall be installed full width between ring and manhole wall, to thickness shown on construction detail. The watertight ring and cover shall conform to Manhole Castings specifications included elsewhere herein.

- **Type 4 Manhole Repair - Raise Top Portion of Manhole**

Remove existing manhole ring and cover completely from the top of the manhole. The top portion of the manhole (brick or precast) shall be raised 6" to 12" as designated by the ENGINEER in the field. The existing ring and cover, if salvageable, shall be reinstalled and the ring grouted in place. The surfaces of the manhole wall/grade ring and cover shall be thoroughly cleaned prior to resetting ring. The ring shall be centered over the manhole and within 1/2" of being level across 24" ring. Waterproof, non-shrink epoxy grout (see technical specifications) shall be installed full width between ring and manhole wall, to thickness shown on construction detail. If the existing ring or cover is damaged by the CONTRACTOR during remodel, this item shall include the replacement of the existing ring and cover.

- **Type 5 Manhole Repair - Manhole Replacement**

The CONTRACTOR shall replace existing manhole with new precast or pour-in-place concrete manhole meeting the technical specifications for "Manholes" elsewhere herein and construction
details for these repair types. The existing ring and cover, if salvageable, shall be thoroughly cleaned and reinstalled in accordance with the specifications and construction details.

The CONTRACTOR shall maintain sewage flow during construction of new manhole. Two possible ways of accomplishing this are described herein. CONTRACTOR may propose alternate methods for approval of the ENGINEER. First option would be to install a temporary piping arrangement that is like the "Temporary Piping around Replacement Manhole During Construction" construction detail. Second option would be to pump around manhole under construction. This would require locating each upstream manhole for each sewer line flowing into manhole under construction, plugging each line out of each upstream manhole to prevent sewage flow out of manholes and then installing portable pump at each upstream manhole, capable of pumping sewage flows entering manhole, in a temporary discharge line to first manhole downstream of manhole under construction. If the second option is used, the CONTRACTOR shall provide full time personnel monitoring the various pumps and piping to ensure all are operating properly, and discharge hoses shall not obstruct traffic.

Whichever option is chosen to maintain sewage flow, the CONTRACTOR is solely responsible for the installation, operation, maintenance and removal of all pieces of equipment, materials or products used. Furthermore, the CONTRACTOR shall, at no time, allow the flow of sewage from new or existing manholes and existing or temporary piping to be discharged into or onto any structure or surface which has not been installed for the specific purpose of carrying sewage flows. Such illegal discharge would be grounds for withholding payment.

Due to varying depths of replacement manholes, "Type 5 Manhole Repair" shall be bid on a vertical foot basis. The minimum payment for each "Type 5 Manhole Repair" shall be 6 vertical feet. Measurement of vertical feet shall be made from flowline to top of ring.

Existing Manhole Abandonment

Following the successful testing of new lines, manholes so noted on the plans shall have the top 2 to 3 feet removed, then the remaining structure will be filled with select material and compacted. The existing frame and cover shall be removed, and the pavement repaired. Frame and covers in good condition shall be delivered to the City. CONTRACTOR shall dispose of all unwanted frames and cover. Downstream lines shall be plugged with non-shrink grout.

Manhole Frame Grout

The frame and cover may be poured-in-place or set in acrylic modified grout after the manhole walls are in place. The grout shall fully encase the exterior of the manhole frame, as shown on the detail drawings. It shall consist of Portland cement, sand, and water, and shall include acrylic polymer and modifier agent ("Octoblen" I.P.A. Systems, Phila., Pa., or equal) to promote greater adhesion, substantially increase flexural strength, and improve freeze-thaw resistance. Add the acrylic in strict accordance with manufacturer's directions. It shall rest on a solid seat. Its top shall be level or
conform to the slope of the finished surfaces. It shall protrude 1/8" to 1/4" above street pavements and 1" to 2" above natural ground unless shown otherwise.

Wastewater Service Transfer Stubouts

This CONTRACTOR shall install the necessary wye fitting for customer connections to the wastewater mains laid herein and shall extend a 4" PVC service lateral to the property line or permanent easement line. He shall connect the customer's house to the service at the property line or permanent easement line.

The connection shall consist of a wye in the sewer main, one or two 45° bends, 4" PVC as required, and plug. The service line and all fittings shall be the same type as the main line. The wye shall be installed as the main is laid. Saddles will not be allowed. The end of the service fitting shall be plugged before testing.

This CONTRACTOR shall be responsible for furnishing to the OWNER one set of record drawings showing the service stubout locations. Each service stubout will be referenced along the length of the sewer line, as measured from the nearest manhole. The CONTRACTOR shall be liable for any cost incurred by the OWNER in finding any service stubout mis-referenced or not referenced, including the cost of a new service stubout, if required.

A far side service stubout is defined as one that must cross the centerline of the road. Near side service stubouts do not cross the road centerline.

A long service is used where a sewer line is being installed on an easement and not on a road. It is defined as being greater than 20' in length.

This work item shall include all necessary pavement repairs.

Payment for service stubouts shall be made once the stubout has been successfully tested. No partial or percentage payments shall be allowed.

Manhole Removal

Where it is indicated on the construction drawings to REMOVE MANHOLE, the CONTRACTOR shall remove the existing manhole structure in its entirety. All sewer lines connected to the manhole shall be plugged with non-shrink grout. Testing of the new line shall be completed before taking the existing manholes out of service. Manhole frames and covers in good condition shall be delivered to the City. The CONTRACTOR shall dispose of debris and unsalvageable frames and covers at a location off-site. The remaining excavation shall be backfilled and mechanically tamped, and all pavement repaired as per the construction drawings.
Wastewater Service Transfer

This CONTRACTOR shall install the necessary fitting for customer connections to the wastewater mains laid herein and shall extend a 4" PVC service lateral to the property line or permanent easement line. He shall connect the customer's house to the service at the property line or permanent easement line.

The connection shall consist of a wye in the sewer main, one or two 45° bend, 4" PVC as required, and cleanout. The service line and all fittings shall be the same type as the main line. The wye shall be installed as the main is laid. Saddles will not be allowed. The end of the service fitting shall be plugged for testing with an inflatable plug inserted at each cleanout at each service for the entire line segment being tested. Once the testing (pressure and mandrel) is complete, the plug shall be removed, and the CONTRACTOR shall install the necessary pipe and fittings to connect to the existing service line at the property line or easement line. This CONTRACTOR shall verify the location of each customer's service fitting with the customer. Any service not so verified, and mis-located, will be relocated at the CONTRACTOR'S expense.

All new sewer lines will be tested in accordance with testing requirements listed elsewhere herein – even lines that are installed in the same location as the existing line. The CONTRACTOR shall provide whatever equipment and means necessary to achieve compliance by regulatory-mandated sewer line (and service) testing. Equipment may include but is not limited to by-pass pumping and piping, manhole and service cleanout plugs, etc.

This CONTRACTOR shall be responsible for furnishing to the OWNER one set of record drawings showing the service fitting locations. Each service fitting will be referenced along the length of the sewer line, as measured from the nearest manhole. The CONTRACTOR shall be liable for any cost incurred by the OWNER in finding any service fitting mis-referenced or not referenced, including the cost of a new service fitting, if required.

A far side service transfer is defined as one that must cross the centerline of the road. Near side service transfers do not cross the road centerline.

A long service is used where a sewer line is being installed on an easement and not on a road. It is defined as being greater than 20' in length.

This work item shall include all necessary pavement repairs.

Payment for service transfers shall be made once the service transfer has been successfully tested. No partial or percentage payments shall be allowed.

Concrete Admixture – Corrosion Prevention

All manholes, grade rings, and wetwells shall be constructed of concrete that has been enhanced by the addition of a concrete admixture for the prevention of microbial induced corrosion (MIC).
Antimicrobial additive ConShield shall be used to render the concrete uninhabitable for bacteria growth. The additive shall be used at a rate of 1 gallon per cubic yard of concrete. This volume shall be included in the total water content of the concrete mix design. A concrete batch design must be provided to the ConShield representative to make sure that the batch and the additive are compatible. Mixing time in the drum of the concrete truck must be at least twenty (20) minutes after the additive has been introduced to the concrete.

The liquid antimicrobial additive shall be EPA registered material and the registration number shall be submitted prior to use in the project.

Active ingredient of the antimicrobial shall be silicone quaternary ammonium salt and shall not contain heavy metals.

The antibacterial additive shall have successfully demonstrated prevention of MIC in sanitary sewers for a minimum of 15 years.

The antimicrobial shall only be used by ready mix producers or precasters that have been certified by the manufacturer of the microbial additive.

ConTint shall be added to the batch as a color identifier-indicator.

Any field-applied concrete used for building inverts, patching, leveling grade rings, etc. shall use the same admixture and tint.

Use ConShield admixture (with ConTint coloring agent) as manufactured by APM LLC or pre-approved equal. Or equal products must be submitted 21 days prior to bid opening. The local representative is Don Yonts with McIntire Management Group, 214-729-7890, don@mmgonline.net.

Reset Existing Ring and Cover Outside Pavement

The CONTRACTOR shall reset existing ring and cover on all existing manholes indicated. The surfaces of the manhole wall/grade ring and cover shall be thoroughly cleaned prior to resetting ring. The ring shall be centered over the manhole and within 1/4" of being level across 24" ring. If there are existing grade rings that have shifted, they shall also be centered and re-grouted. Non-shrink grout shall be installed between ring and manhole wall to thickness shown on construction detail.

The CONTRACTOR shall backfill around the manhole as necessary to ensure proper drainage away from manhole.

Reset Existing Ring and Cover Inside Pavement or Concrete

The CONTRACTOR shall reset existing ring and cover on all existing manholes indicated. The surfaces of the manhole wall or grade ring, and cover, shall be thoroughly cleaned prior to resetting
ring. The ring shall be centered over the manhole and within 1/4" of being level across 24" ring. If there are existing grade rings that have shifted, they shall also be centered and re-grouted. Non-shrink grout shall be installed between ring and manhole wall to thickness shown on construction detail.

The CONTRACTOR shall seal ring to manhole by installing a new square concrete pad surrounding the manhole ring and top of manhole wall. This slab shall be installed as shown on construction detail.

The CONTRACTOR shall install the concrete pad around the manhole to ensure proper drainage away from manhole.

Install New Ring and Cover Outside Pavement

The CONTRACTOR shall install new ring and cover on all existing manholes indicated. Ring and covers shall be a standard ring and cover as specified in Manhole Castings elsewhere herein. All other procedures and requirements of this repair type are same as Reset Existing Ring and Cover Outside Pavement. This bid item includes the new ring and cover and all installation, complete and in place. If reusable, deliver the old ring and cover to location designated by OWNER.

Install New Ring and Cover Inside Pavement

The CONTRACTOR shall install new ring and cover on all existing manholes indicated. Ring and covers shall be a standard ring and cover as specified in Manhole Castings elsewhere herein. All other procedures and requirements of this repair type are same as Reset Existing Ring and Cover Inside Pavement. This bid item includes the new ring and cover, concrete pad, and all installation, complete and in place. If reusable, deliver the old ring and cover to location designated by OWNER.

Manhole Replacement

The CONTRACTOR shall replace existing manhole with new precast or poured-in-place concrete manhole meeting the technical specifications for Manholes elsewhere herein and construction details for these repair types. Removal of the existing manhole is part of this work item, and not a separate pay item.

The CONTRACTOR shall maintain sewage flow during construction of new manhole. Two possible ways of accomplishing this are described herein. CONTRACTOR may propose alternate methods for approval of the ENGINEER. First option would be to install a temporary piping arrangement like a temporary piping around replacement manhole during construction detail. Second option would be to pump around manhole under construction. This would require locating each upstream manhole for each sewer line flowing into manhole under construction, plugging each line out of each upstream manhole to prevent sewage flow out of manholes and then installing portable pump at each upstream manhole, capable of pumping sewage flows entering manhole, in a
temporary discharge line to first manhole downstream of manhole under construction. If the second option is used, the CONTRACTOR shall provide full time personnel monitoring the various pumps and piping to ensure all are operating properly, and discharge hoses shall not obstruct traffic. Whichever option is chosen to maintain sewage flow, the CONTRACTOR is solely responsible for the installation, operation, maintenance and removal of any and all pieces of equipment, materials or products used. Furthermore, the CONTRACTOR shall, at no time, allow the flow of sewage from new or existing manholes and existing or temporary piping to be discharged into or onto any structure or surface which has not been installed for the specific purpose of carrying sewage flows. Such illegal discharge would be grounds for withholding payment.

Construction shall consist of standard 6' deep replacement manhole with standard ring and cover, Bass and Hayes BH VRM-30, or approved equal. Each replacement manhole shall include an inflow insert as specified elsewhere herein.

CONTRACTOR shall reconnect all gravity lines from the existing gravity lines to the manhole. Hydraulic cement shall be used for pipe connections to manhole. These reconnections are part of this work item, and not a separate pay item.

Additional manhole depth in excess of standard 6' depth, from the top of the ring to the outlet flowline, shall be paid for under the specific bid item for this work. Additional depth shall be measured and rounded to the nearest one-half foot, payable under this item.

Construction of manhole drop structure in conjunction with replacement manhole shall be per the construction details and shall be paid for under the specific bid item for this work. Construction of concrete slab around replacement manhole and pavement repair around concrete slab shall be required if the existing manhole had asphalt or concrete around it and shall be paid for under the specific bid item for this work. See construction detail drawing. This bid item shall include construction of a 4' x 4' x 12" thick concrete slab around the completed replacement manhole and shall include all pavement repair required for the replacement manholes, regardless of actual dimension.

Manhole frames and covers in good condition shall be delivered to the OWNER. The CONTRACTOR shall dispose of all debris and unsalvageable frames and covers at a location off-site.

Manholes shall be vacuum tested as specified elsewhere herein.

**Point Repair**

The locations for this repair type are given in the drawings.

The CONTRACTOR shall uncover the existing gravity sewer exposing a minimum of 20 feet. The CONTRACTOR shall identify the deteriorated pipe to be replaced to the OWNER'S representative. The replacement segment shall be 20 feet in length or as close to 20 feet, but not more, with a location on both ends where the existing pipe is able to have the replacement segment connected.
The replacement pipe shall be the same diameter SDR 26 ASTM D3034 PVC. The replacement pipe segment shall be installed as per the technical specification elsewhere herein that pertain to excavation, placement, embedment, and backfilling. Connection of the replacement segment to the existing pipe shall be as per the Unlike Pipe Connections technical specification elsewhere herein.

New Sewer Line Installation – Water and Sewer Utilities in Close Proximity

The CONTRACTOR shall comply with the following rules that apply to installations of potable water distribution lines and wastewater collection lines, wastewater force mains, and other conveyances/appurtenances identified as potential sources of contamination. Furthermore, all ratings specified shall be defined by ASTM or AWWA standards unless stated otherwise.

No physical connection shall be made between a drinking water supply and a sewer line. Any appurtenance shall be designed and constructed to prevent any possibility of sewage entering the drinking water system.

When new sanitary sewers are installed, they shall be installed no closer to waterlines than nine feet in all directions. Sewers that parallel waterlines must be installed in separate trenches. Where the nine-foot separation distance cannot be achieved, the following criteria shall apply.

A. Waterline/New Sewer Line Separation

1. Where a sanitary sewer parallels a waterline, the sewer shall be constructed of cast iron, ductile iron, or PVC meeting ASTM specifications with a pressure rating for both the pipes and joints of 150 psi. The vertical separation shall be a minimum of two feet between outside diameters and the horizontal separation shall be a minimum of four feet between outside diameters. The sewer shall be located below the waterline.

2. Where a sewer crosses a waterline and the sewer is constructed of cast iron, ductile iron, or PVC with a minimum pressure rating of 150 psi, an absolute minimum distance of six inches between outside diameters shall be maintained. In addition, the sewer shall be located below the waterline where possible and one length of the sewer pipe must be centered on the waterline.

3. Where a sewer crosses under a waterline and the sewer is constructed of ABS truss pipe, similar semi-rigid plastic composite pipe, clay pipe, or concrete pipe with gasketed joints, a minimum two-foot separation distance shall be maintained. The initial backfill shall be cement stabilized sand (two or more bags of cement per cubic yard of sand) for all sections of sewer within nine feet of the waterline. This initial backfill shall be from one quarter diameter below the centerline of the pipe to one pipe diameter (but not less than 12 inches) above the top of the pipe.

4. Where a sewer crosses over a waterline, all portions of the sewer within nine feet of the waterline shall be constructed of cast iron, ductile iron, or PVC pipe with a pressure rating of at least 150 psi using appropriate adapters. In lieu of this procedure, the new conveyance may be encased in a joint of 150 psi pressure class pipe at least 18 feet long and two nominal sizes larger than the new conveyance. The space around the carrier pipe shall be supported at five feet intervals with spacers.
or be filled to the spring line with washed sand. The encasement pipe should be centered on the crossing and both ends sealed with cement grout or manufactured seal.

B. Waterline Manhole Separation

Unless sanitary sewer manholes and the connecting sewer can be made watertight and tested for no leakage, they must be installed to provide a minimum of nine feet of horizontal clearance from an existing or proposed waterline. Where the nine-foot separation distance cannot be achieved, a carrier pipe as described in item (A.4) of this section may be used where appropriate.

Mechanically Tamped Backfill

Where specifically called for in these specifications or on the drawings, the material used in the backfill process shall be uniformly, mechanically tamped, with hand-operated pneumatic or gasoline tools in 6" to 8" loose lifts, to 95% of standard Proctor density (ASTM 698) at slightly above optimum moisture. Mechanical compaction shall extend to the finished ground surface.

Water and Sewer Utilities in Close Proximity

The CONTRACTOR shall comply with the following rules which apply to installations of potable water distribution lines and wastewater collection lines, wastewater force mains and other conveyances/appurtenances identified as potential sources of contamination. Furthermore, all ratings specified shall be defined by ASTM or AWWA standards unless stated otherwise.

When new potable water distribution lines are constructed, they shall be installed no closer than nine feet in all directions to wastewater collection facilities. All separation distances shall be measured from the outside surface of each of the respective pieces.

Potable water distribution lines and wastewater collection lines or force mains that form parallel utility lines shall be installed in separate trenches.

No physical connection shall be made between a drinking water supply and a sewer line. Any appurtenance shall be designed and constructed so as to prevent any possibility of sewage entering the drinking water system.

Where the nine foot separation distance cannot be achieved, the following criteria shall apply.

A. New Waterline Installation - Parallel Lines

A.1. Where a new potable waterline parallels an existing, non-pressure or pressure rated wastewater line/force main or lateral and the licensed professional engineer licensed in the State of Texas is able to determine that the existing wastewater main or lateral is not leaking, the new potable waterline shall be located at least two feet above the existing wastewater main or lateral, measured vertically,
and at least four feet away, measured horizontally, from the existing wastewater main or lateral. Every effort shall be exerted not to disturb the bedding and backfill of the existing wastewater line.

A.2. Where a new potable waterline parallels an existing pressure rated wastewater main or lateral and it cannot be determined by the licensed professional engineer if the existing line is leaking, the existing wastewater main or lateral shall be replaced with at least 150 psi pressure rated pipe. The new potable waterline shall be located at least two feet above the new wastewater line, measured vertically, and at least four feet away, measured horizontally, from the replaced wastewater main or lateral.

A.3. Where a new potable waterline parallels a new wastewater line/force main, the wastewater main or lateral shall be constructed of at least 150 psi pressure rated pipe. The new potable waterline shall be located at least two feet above the wastewater main or lateral, measured vertically, and at least four feet away, measured horizontally, from the wastewater main or lateral.

B. New Waterline Installation - Crossing Lines

B.1. Where a new potable waterline crosses an existing, non-pressure rated wastewater main or lateral, one segment of the waterline pipe shall be centered over the wastewater main or lateral such that the joints of the waterline pipe are equidistant and at least nine feet horizontally from the centerline of the wastewater main or lateral. The potable waterline shall be at least two feet above the wastewater main or lateral. Whenever possible, the crossing shall be centered between the joints of the wastewater main or lateral. If the existing wastewater main or lateral is disturbed or shows signs of leaking, it shall be replaced for at least 9 feet in both directions (18 feet total) with at least 150 psi pressure rated pipe.

B.2. Where a new potable waterline crosses an existing, pressure rated wastewater main or lateral, one segment of the waterline pipe shall be centered over the wastewater main or lateral such that the joints of the waterline pipe are equidistant and at least nine feet horizontally from the centerline of the wastewater main or lateral. The potable waterline shall be at least six inches above the wastewater main or lateral. Whenever possible, the crossing shall be centered between the joints of the wastewater main or lateral. If the existing wastewater main or lateral shows signs of leaking, it shall be replaced for at least 9 feet in both directions (18 feet total) with at least 150 psi pressure rated pipe.

B.3. Where a new potable waterline crosses a new, non-pressure rated wastewater main or lateral and the standard pipe segment length of the wastewater main or lateral is at least 18 feet, one segment of the waterline pipe shall be centered over the wastewater main or lateral such that the joints of the waterline pipe are equidistant and at least nine feet horizontally from the centerline of the wastewater main or lateral. The potable waterline shall be at least two feet above the wastewater main or lateral. Whenever possible, the crossing shall be centered between the joints of the wastewater main or lateral. The wastewater pipe shall have a minimum pipe stiffness of 115 psi at five percent deflection. The wastewater line shall be embedded in cement stabilized sand (see clause B6 of this subparagraph) for the total length of one pipe segment plus 12 inches beyond the joint on each end.
B.4. Where a new potable waterline crosses a new, non-pressure rated wastewater main or lateral and a standard length of the wastewater pipe is less than 18 feet in length, the potable water pipe segment shall be centered over the wastewater line. The materials and method of installation shall conform with one of the following options:

B.4.I. Within nine feet horizontally of either side of the waterline, the wastewater pipe and joints shall be constructed with pipe material having a minimum pressure rating of 150 psi. An absolute minimum vertical separation distance of two feet shall be provided. The wastewater main or lateral shall be located below the waterline.

B.4.II. All sections of wastewater main or lateral within nine feet horizontally of the waterline shall be encased in an 18 foot (or longer) section of pipe. Flexible encasing pipe shall have a minimum pipe stiffness of 115 psi at five percent deflection. The encasing pipe shall be centered on the waterline and shall be at least two nominal pipe diameters larger than the wastewater main or lateral. The space around the carrier pipe shall be supported at 5 foot (or less) intervals with spacers or be filled to the springline with washed sand. Each end of the casing shall be sealed with water tight non-shrink cement grout or a manufactured water tight seal. An absolute minimum separation distance of six inches between the encasement pipe and the waterline shall be provided. The wastewater line shall be located below the waterline.

B.4.III. When a new waterline crosses under a wastewater main or lateral, the waterline will be encased as described for wastewater lines in subclause (II) above or constructed of ductile iron or steel pipe with mechanical or welded joints as appropriate. An absolute minimum separation distance of 1 foot between the waterline and the wastewater main or lateral shall be provided. Both the waterline and wastewater main or lateral must pass a pressure and leakage test as specified in AWWA C600 standards.

B.5. Where a new potable waterline crosses a new, pressure rated wastewater main or lateral, one segment of the waterline pipe shall be centered over the wastewater line such that the joints of the waterline pipe are equidistant and at least nine feet horizontally from the centerline of the wastewater main or lateral. Whenever possible, the crossing should be centered between the joints of the wastewater main or lateral. The wastewater pipe shall have a minimum pressure rating of at least 150 psi. The wastewater main or lateral shall be embedded in cement stabilized sand (see clause B6 of this subparagraph) for the total length of one pipe segment plus 12 inches beyond the joint on each end. The potable waterline shall be at least six inches above the wastewater main or lateral.

B.6. Where cement stabilized sand bedding is required, the cement stabilized sand shall have a minimum of 10 percent cement per cubic yard of cement stabilized sand mixture, based on loose dry weight volume (at least 2.5 bags of cement per cubic yard of mixture). The cement stabilized sand bedding shall be a minimum of six inches above and four inches below the wastewater main or lateral. The use of brown coloring in cement stabilized sand for wastewater main or lateral bedding is recommended for the identification of pressure rated wastewater mains during future construction.

C. Waterline and Wastewater Main or Lateral Separation.
The separation distance from a potable waterline to a manhole or cleanout shall be a minimum of nine feet. Where the nine-foot separation distance cannot be achieved, the potable waterline shall be encased in a joint of at least 150 psi pressure class pipe at least 18 feet long and two nominal sizes larger than the new conveyance. The space around the carrier pipe shall be supported at five-foot intervals with spacers or be filled to the spring line with washed sand. The encasement pipe shall be centered on the crossing and both ends sealed with cement grout or manufactured seal.

D. Location of Fire Hydrants

Fire hydrants shall not be installed within nine feet vertically or horizontally of any wastewater main, wastewater lateral, or wastewater service line, regardless of construction.

E. Location of Potable or Raw Water or Suction Lines

Suction mains to pumping equipment shall not cross wastewater mains, wastewater laterals, or wastewater service lines. Raw water supply lines shall not be installed within five feet of any tile or concrete wastewater main, wastewater lateral, or wastewater service line.

F. Proximity of Septic Tank Drainfields

Waterlines shall not be installed closer than ten feet to septic tank drainfields.

Grouting - Voids and Honeycomb

Minor voids or honeycomb in concrete slabs, structural members, panels, beams, walls, and similar, shall be filled with a natural concrete-colored, non-shrink, flowable grout, chloride free, containing only natural aggregates, which shall have a seven day compressive strength, at flowable consistency, of 4500 psi. It shall be placed in a neat and workmanlike manner. The product is to be furnished in original sealed and labeled containers. Its finished surface shall be of compatible texture and color to the concrete surface. Major voids and honeycombing are grounds for rejection of the pour. The grout shall be mixed and applied in strict accordance with the manufacturer's instructions. This grout shall be "Set Grout", manufactured by Master Builders Technologies, or approved equal.

Inspections

All inspections outlined in the technical specifications or otherwise requested by the OWNER shall be conducted by the City of Bonham or approved representative.

Curb Crossing

Where sewer mains and sewer service lines are installed under existing or proposed concrete street curbs, markers shall be placed on the face of the curb. The mark shall be a two inch by two inch “S”. This mark shall be made by sawcut or chisel in clean lines not to disturb the surrounding curb. This mark shall be visible from the centerline of the street. This mark shall be directly above the installed line as allowed, and no mark shall be placed along the curb at a distance greater than one foot from the installed line’s location.
CONSTRUCTION STANDARDS

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1. WHERE WATERTIGHT MANHOLE CASTINGS ARE SPECIFIED ON THE DRAWINGS, THEY SHALL BE OF THE BOLT-DOWN VARIETY WITH A NEOPRENE OR RUBBER GASKET BETWEEN THE RING & COVER (SEE SPECS)
2. ANTI INFILTRATION INFLOW RING & COVER
3. SET GRADE-RINGS (IF ANY) AND FRAME IN A BED OF GROUT. CAP SHOULDERS WITH NON-SHRINK GROUT.
MANHOLE INSIDE DROP STRUCTURE

SCALE: N.T.S.
FINISHED GROUND

PRE-CAST OR POURRED IN PLACE CONCRETE MANHOLE

NON-SHRINK GROUT AND RUBBER GASKET

STANDARD TEE-WYE

GRAVITY SEWER

UNDISTURBED GROUND OR SELECT FILL COMPACTED TO 95% STD. PROCTOR

CLASS "B" CONCRETE BLOCKING MIN. THICKNESS EQUAL TO O.D. OF PIPE PLUS 12"

90° LONG RADIUS BEND

COLD JOINT

MONOLITHIC CLASS "A" CONCRETE BASE FOR MANHOLE SHALL EXTEND UNDER DROP TO SUPPORT SAME.

#4 BARS @ 12" C.C. BOTH WAYS TOP & BOTTOM.

SEE MANHOLE STANDARD ALSO.

MANHOLE OUTSIDE DROP STRUCTURE

SCALE: N.T.S.
FOR EXISTING MANHOLES, CORE DRILL HOLE 4” LARGER THAN PIPE O.D., INSTALL RUBBER BOOT TO CENTER OF WALL, THEN PACK ANNULAR SPACE ON BOTH SIDES WITH NON-SHRINK GROUT.

FORCE MAIN CONNECTION INTO MANHOLE

SCALE: N.T.S.
MANHOLE MARKER

SCALE: N.T.S.

ORIENT PER OWNER'S INSTRUCTIONS

1/4" TAMPER-PROOF BOLT, NUT AND LOCK WASHER (OR STRIP BOLT THREAD AFTER ASSEMBLY.)

SLOW-MOVING VEHICLE EMBLEM ON BOTH SIDES

1" x 1/8" GALVANIZED ANGLE

FIN. GR.
MAIN LINE SEWER CLEANOUT

CAST IRON SEWER CLEANOUT BOX WITH WATER-TIGHT LID FLUSH WITH STREET OR 1" ABOVE NATURAL GROUND SET IN CLASS "B" CONCRETE

24" X 36" CONCRETE BASE

FINISHED SURFACE

UNDISTURBED GROUND

4" SCREW-IN WATERTIGHT PLUG

LINE SIZE X4" REDUCER

45° BEND

WYE MAY BE USED IN LIEU OF BEND. UNUSED WYE OPENING TO BE RIGIDLY PLUGGED.
DOUBLE SEWER SERVICE CLEANOUT

CAST IRON SEWER CLEANOUT BOOT WITH WATERTIGHT LID FLUSH WITH STREET OR 1" ABOVE NATURAL GROUND SET IN CLASS "B" CONCRETE (TYP.)

PROPERTY LINE

FINISHED SURFACE

24" x 36" CONCRETE BASE

UNDISTURBED GROUND

4" SCREW-IN WATERTIGHT PLUG

4" SERVICE LINE
**AN "S" SHALL BE CUT INTO THE CURB WHERE THE SANITARY SEWER SERVICE CROSSES A CURB**

**MAIN**

- SDR 35 PVC
- SDR 26 CLASS 160 PVC—PRESSURE RATED

**45° BEND**

- SDR 35 PVC
- SDR 26 CLASS 160 PVC

**PIPE**

- SDR 35 PVC
- SDR 26 CLASS 160 PVC

**ARC ADAPTOR**

- SDR 35 TO EXISTING
- SDR 26 CLASS 160 TO EXISTING

**SEWER WYE**

- SDR 35 PVC
- SDR 26 CLASS 160 PVC

**CLASS U**

- CONCRETE FILL

**EXISTING CUSTOMER SERVICE**

**UNDISTURBED GROUND**

**SEWER LINE TRENCH**

**EMBEDMENT MATERIAL**

**CAST IRON CLEANOUT**

**CUSTOMER SEWER SERVICE TRANSFER WITH CLEANOUT**

**SCALE—N.T.C.**

**GENERAL NOTES**

1. SANITARY TEE'S OR T-Y'S WILL NOT BE PERMITTED
2. TAPPING EXISTING LINES WILL REQUIRE TAPPING SADDLE
3. CONTRACTOR SHALL FURNISH SEWER MAIN STATION NUMBERS ON ALL TAPS
4. SEE TECHNICAL SPECIFICATIONS FOR ADDITIONAL DETAILS/REQUIREMENTS
5. TRACER TAPE REQUIRED ON HIGHWAY R.O.W.
CUSTOMER SEWER SERVICE STUBOUT

SCALE: N.T.S.

GENERAL NOTES
1. SANITARY TEE'S OR T-Y'S WILL NOT BE
   PROVIDED
2. TAPPING EXISTING LINES WILL REQUIRE
   TAPPING ADAPTOR
3. CONSTRUCTION SHALL FURNISH SEWER MAIN
   STATION NUMBERS ON ALL TAPS
4. SEE TECHNICAL SPECIFICATIONS FOR
   ADDITIONAL DETAILS/REQUIREMENTS
5. TRAFFIC DEMPER REQUIRED ON HIGHWAY R.O.W.
6. SERVICE DIP AND FITTINGS SHALL MATCH
   MAIN LINE TYPE

1. SEWER MAIN - SEE PLAN & PROFILE
   PAGES FOR FOR SIZES, DEPTHS & GRADES
2. 4" PVC CAP - GASKET
3. 4" PIPE - LENGTH AS REQUIRED ON 1:1 SLOPE
4. CLASS "D" CONCRETE FILL
5. UNDISTURBED GROUND
6. SEWER LINE TRENCH
7. SEWER WYE WITH WYE POINTING UPSTREAM
8. EMBEDMENT MATERIAL
9. 45° BEND
NOTES:
1. SANITARY TEES OF T-Y FITTINGS WILL NOT BE ALLOWED AS ALTERNATE FOR STD. WYE AND 45° BEND.
2. CUSTOMERS SERVICE SHALL BE CONNECTED TO ONLY THE WATERTIGHT LINE BETWEEN HOUSE AND SEPTIC TANK. UNDER NO CONDITIONS SHALL THE SERVICE BE CONNECTED TO A SEPTIC TANK FIELD LINE.

NEW CUSTOMER SERVICE FROM EXISTING SEPTIC TANK

SCALE: N.T.S.

DETAIL "A"

DETAIL "B"

CAST IRON SEWER CLEANOUT BOX WITH WATER-TIGHT LID FLUSH WITH STREET OR 1" ABOVE NATURAL GROUND SET IN CLASS "B" CONCRETE

FINISHED SURFACE

24" x 36" CONCRETE BASE

CLASS "B" 6"

4" SCREW IN WATERTIGHT PLUG

UNDISTURBED GROUND

4" 45° BEND

CLEANOUT

SCALE: N.T.S.

SAN. SEWER MAIN

FLOW

45° BEND

STD WYE

FLOW

SEE CUSTOMER SEWER SERVICE TRANSFER DETAIL

ADAPT TO CUSTOMER'S EXISTING LINE

ADAPTER W/SS STIFFENER

FROM HOUSE

FLOW

NEW 4" CUSTOMER SERVICE

PERFORATED FIELD LINES

SEPTIC TANK

NEW CUSTOMER SERVICE

SANITARY SEWER MAIN

FLOW

STREET OR EASEMENT
ADJUSTABLE REPAIR COUPLING (ARC)  
W/ STAINLESS STEEL CENTER STIFFENER

CONCRETE OR YCP - BELL

PVC, ABS, OR C.I.

8" MIN

STAINLESS STEEL FULL CIRCLE HOSE CLAMPS

VARIED TYPES OF GRAVITY SEWER PIPE CONNECTION

SCALE: N.T.S.
1. INSTALL TEMPORARY PIPING PRIOR TO REMOVAL OF EXISTING MANHOLE.
2. INSTALL PVC PIPE ON CONC. BACKFILL OR D.I.P. IF GROUND IS DISTURBED FROM EXISTING PIPE END INTO REPLACEMENT MANHOLE ONCE COMPLETE.
3. TEMPORARY PIPING, FITTINGS AND ADAPTORS MAY BE REUSED FOR OTHER TEMPORARY PIPING ARRANGEMENTS AS LONG AS THEY CONTINUE TO PROVIDE LEAK-PROOF SERVICE.
4. PIPING ARRANGEMENT MAY VARY WITH VARYING ON-SITE CONDITIONS AND LINE SIZES.
5. CONTRACTOR SHALL COORDINATE WITH ENGINEER PRIOR TO MANHOLE REPLACEMENT TO ENSURE UNINTERRUPTED SERVICE.

TEMPORARY PIPING AROUND REPLACEMENT MANHOLE DURING CONSTRUCTION

SCALE: N.T.S.
CREEK CHANNEL

LINE

STEEL ENCASEMENT

MECHANICALLY TAMPED BACKFILL TO 95% STD. PROCTOR DENSITY

STOCKPILE EXIST. TOPSOIL AND RE-DISTRIBUTE ALONG DISTURBED AREAS

PLAN

RE-ESTABLISH CHANNEL SLOPES TO ORIGINAL CONTOURS

EXIST. GROUND

10' FROM TOP OF BANK

MECHANICALLY TAMPED BACKFILL TO 95% STD. PROCTOR DENSITY

UNDISTURBED SOIL

STEEL ENCASEMENT

GRAVITY SEWER LINE

SECTION

GRAVITY SEWER LINE CREEK CROSSING

SCALE: N.T.S.
SEWER LINE ABANDONMENT NOTE:
WHERE "PLUG/ABANDON" IS SHOWN ON THE PLANS, CUT OUT A SEGMENT OF THE EXISTING LINE. INSTALL NON-SHRINK GROUT IN THE PORTION(S) TO BE ABANDONED TO PREVENT INFLOW AND INFILTRATION.

INSTALL END-OF-LINE CLEANOUT

EXISTING PIPE

NON-SHRINK GROUT

EXISTING PIPE

TO REMAIN IN SERVICE → REMOVE → TO BE ABANDONED

PLUG/ABANDON SEWER LINE

SCALE: N.T.S.
ENGINEER SHALL TALK WITH OWNER ABOUT POSSIBLY EXTENDING THE WARRANTY FOR TRENCH SETTLEMENT AND PAVEMENT REPAIR TO TWO YEARS TO ACCOMMODATE POSSIBLE SETTLEMENT.

BACKFILL NOTES:

1. ON HIGHWAY RIGHT-OF-WAY, BACKFILL METHODS SHALL CONFORM TO THE OWNER'S PERMIT IF MORE RESTRICTIVE THAN NOTED ABOVE.

2. SEE "STREET, DRIVEWAY, AND SIDEWALK REPAIRS" STANDARD FOR WEARING SURFACE, BASE AND SUBBASE REQUIREMENTS FOR TRENCHES BENEATH SURFACED OR PAVED AREAS.

3. TRENCHES BENEATH STRUCTURES SHALL BE BACKFILLED SAME AS UNDER SURFACED AREAS.

4. PIPE SHALL NOT BE LAYED ON UNSTABLE FOUNDATION. THE CONTRACTOR SHALL REMOVE SUCH UNSUITABLE MATERIAL AND REPLACE IT WITH ACCEPTABLE MATERIAL.

5. FOR TRENCHING IN UNPAVED AREAS, IN THE AREA 12" OR MORE ABOVE THE TOP OF THE PIPE, THE EXCAVATED TRENCH WIDTH AND BACKSLOPE MAY VARY TO COMPLY WITH APPROPRIATE SAFETY PRACTICES AND REGULATIONS.

5A. IN ALL TRENCHED AREAS THAT ARE TO RECEIVE PAVEMENT REPAIR, THE PIPE WILL BE INSTALLED IN TRENCHES WITH NEAR VERTICAL WALLS employing GSHA-APPROVED TRENCH SAFETY METHODS (WALL JACKS, TRENCH BOXES, ETC). SLOPING THE SIDES OF THE TRENCH WILL NOT BE ALLOWED SO THAT PAVEMENT REPAIR AT THE TOP OF THE TRENCH WILL BE MINIMIZED.

BACKFILL FOR SANITARY SEWER (GRAVITY AND PRESSURE) AND FOR 6" OR LARGER POTABLE WATER MAINS

SCALE: N.T.S.
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<th>SIZE</th>
<th>TRENCH WIDTH</th>
<th>MINIMUM</th>
<th>MAXIMUM</th>
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<td>12&quot;</td>
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(1) THESE BURIES ARE APPLICABLE TO GRAVITY PIPELINE WHERE NO DEPTH IS SPECIFIED IN THE PLAN/PROFILE DRAWINGS, AND TO PRESSURE PIPELINES. IN ADDITION, NO PRESSURE LINE SHALL BE LESS THAN 36" DEEP UNDER BORROW DITCHES OR CREEK BOTTOMS. WHERE SPECIFIED ELEVATIONS ARE SHOWN ELSEWHERE FOR GRAVITY LINES, SUCH AS IN PLAN/PROFILE DRAWINGS, THOSE GRADES SHALL GOVERN.

**TRENCH WIDTH AND BURY**

**GRAVITY AND/OR PRESSURE LINES**

**SCALE: N.T.S.**