PART ONE-GENERAL

1.1 DESCRIPTION

1.1.1 Work included: All excavation of trenches for sanitary sewer, water or other pipelines and backfilling after the line has been properly laid, inspected and tested, shall be done according to these specifications and subsequent to clearing the ditch line.

The work required shall include the furnishing of all labor, materials, tools, equipment and machinery necessary for the stripping or removal of top soil or sod and subsoil or rock, the furnishing, placing and maintaining of all sheeting, shoring, and bracing necessary to protect the work, adjacent properties and workers; the furnishing of all pumping, bailing and draining necessary to keep the excavation free from seepage water, water from sewers, drains, ditches, creeks, and other sources; the furnishing of provision for the uninterrupted flow of sewers and surface waters during the progress of the construction; the removal, after the completion of the work, of all sheeting, shoring and bracing not ordered left in place to support the sides of the excavation; the satisfactory disposal of excess and unsuitable materials not required or which cannot be used for backfilling, tamping, compacting and refilling after settlement of all excavated areas; the restoration of all rights-of-way and other lands or structures, private or public, damaged or occupied by the Contractor in the performance of the contract to as good a condition as they were prior to the beginning of the work; and maintenance of any trench settlement that occurs within the warranty period or as otherwise specifically provided.

PART TWO - PRODUCTS

2.1 EARTHEN MATERIALS

2.1.1 "Select Backfill" material shall be native material from the trench excavation that is suitable for proper backfill as approved by the Engineer. In all cases select backfill shall be free of trash, sticks and other organic materials as well as lumps, clods or rocks larger than 6 inches in any dimension. Within one foot of the top of the pipe and the top one-foot of the trench, select material shall meet the requirements of "crumbling earth".

2.1.2 "Crumbling Earth" as used herein shall refer to select backfill material, free of rocks, lumps, roots and other objectionable matter excavated from the trench which at the time of use is in a crumbled, free-flowing condition and has such properties that it can be placed and made firm and free of voids.

2.1.3 "Bank Sand" shall be free flowing, fine-grained sand without clay lumps or rock. Bank sand shall not have more than 25 percent passing No. 200 sieve and shall not

have a plasticity index exceeding 5, when tested by standard laboratory methods. Sand shall be reasonably clean and free of large lumps of clay, loam, rubbish, vegetative matter or other deleterious substance and shall meet the approval of the Engineer.

2.1.4 "Granular Material" shall refer to the various granular, hard mineral types such as pea gravel, bank-run gravel and crushed stone with the following gradation requirements:

Sieve Size	% Passing
1"	100
1/2"	25-60
#4	0-10
#8	0-5

The characteristics of the material shall be of such quality to provide a high confined compressive strength.

2.2 CEMENT STABILIZED SAND BACKFILL

2.2.1 Mixture of bank sand, Portland cement and water. Use not less than 1-1/2 sacks of cement per cubic yard of mixture unless otherwise noted. Add required amount of water and mix thoroughly in approved type mixer. Stamp batch ticket with time of loading. Material not in place within 1-1/2 hours after loading will be rejected.

2.2.2 Portland Cement shall be ASTM C150, Type 1.

2.2.3 Water shall be clean and free from injurious amounts of oils, acids, salt, organic matter or other deleterious materials.

2.3 TRACER AND WARNING MATERIALS

2.3.1 When non metallic pipe is used for construction of sanitary sewer or water lines, it shall be marked by laying a tracer wire, direct burial cable, 14 gage THHN Stranded, directly over and running parallel to the line.

2.3.2 When metallic or non-metallic pipe is used for construction of utility lines, it shall be marked by laying plastic line marking tape directly over and running parallel to the line. The tape shall be marked with the type of line buried below it. Tape shall be "TERRA TAPE-STANDARD" as manufactured by Reef Industries or approved equal and shall act as an early warning system.

PART THREE - EXECUTION

3.1 EXCAVATION

3.1.1 GENERAL:

(1) Entry upon any private property for performance of any work thereon is prohibited until all required easements or rights-of-way have been obtained.

(2) Contractor shall perform all special construction operations and take all special precautions to adequately protect the materials and work performed, the property and landscape of the Owner and others, existing buildings and improvements, existing utilities, workers and employees, and the public in general.

(3) Clear the entire width of the permanent easement or right-of-way but clear only such timber and brush from the temporary or construction easement as is necessary for construction of the utility system. The width of the area so cleared shall not extend outside the limits of the easement or street right-of-way as the case may be, as shown on the plans. Trees and timber removed shall be disposed in a manner approved by the Owner.

(4) Where trees, plants, shrubbery, etc., are adjacent to the line of the work and are designated not to be destroyed, the Contractor shall protect such trees, plants, shrubbery, etc.

(5) Excavate to the approved lines and grades as shown on the drawings. Excavated materials not required for fill or backfill shall be removed from the site and disposed of by the Contractor, at a location approved by the Owner.

(6) Excess excavation below the required level shall be backfilled at the Contractor's expense with earth, sand or gravel well compacted, or Class C concrete, as directed by the Engineer.

(7) Water accumulated in the excavation shall be removed by pumping or other approved means at the Contractor's expense.

(8) Unstable soil shall be removed and replaced with an acceptable backfill material as approved by the Engineer and compacted.

(9) Excavation shall be by open cut with trenching machine or back hoe. Where machines other than ladder or wheel type trenching machines are used, excavated material composed of large chunks and clods shall not be used for backfilling.

(10) When excavating through paved or otherwise improved surfaces, the Contractor shall restore such surfaces to a condition equal to or better than original, to the satisfaction of the City.

(11) Contractor shall, at his own expense, shore up and otherwise protect any building or other structure which may be endangered during the work and he shall restore all buildings, culverts, fences, walls, or other properties disturbed during the work to a condition equal to that existing before his operation. Contractor shall be responsible for any injuries to persons, for damages to existing buildings or other structures affected by the work, and City shall not be liable therefor.

(12) It shall be the responsibility of the Contractor to verify the existence and location of all underground utilities and structures along the route of the work. The omission from or the inclusion of utility locations on the plans shall not be considered as the non-existence of or a definite location of the existing underground utilities and structures.

(13) It shall be the responsibility of the Contractor to notify the respective owners when markers or facilities are encountered and to protect and support all water, gas, telephone, electric and other conduits or facilities crossed by the excavation or work to be performed by him or to arrange for their temporary removal, and subsequent replacement. In cases where an existing sanitary sewer line crosses the new trench and is either of unsuitable material or has a joint exposed in the excavation, such sanitary sewer line shall be replaced by ductile iron or SDR 26 PVC pipe of sufficient length to span into adequately encased support points on each side.

(14) At all streets, drives, walkways and other crossings where applicable, the trenches are to be promptly restored and maintained in such a manner as to prevent any serious interruption of traffic upon the roadway or sidewalks. Where trenches cannot be closed promptly, contractor shall provide temporary bridges to cross trenches when necessary to reduce nuisance and hazard to the public. Such work is to be considered part of the basic proposal item most nearly related.

(15) Contractor must provide and maintain adequate detours around the work under construction. Contractor must provide sufficient lights, warning signs, and watchmen to provide adequately for the safety of the public. All lighting, barricading and traffic control devices shall be provided by the contractor in accordance with City Specifications and the Manual on Uniform Traffic Control Devices (MUTCD), latest edition.

(16) Before leaving work for the night, or during a storm, or at other times, care must be taken to protect and securely close and protect the unfinished end of the pipe. Any earth or other materials that may find entrance into the pipe through any such open or unplugged end of the pipe must be removed at the Contractor's expense.

(17) The sides of all excavations shall be sufficiently sheeted, shored and braced so as to prevent slides, cave-ins, settlement or movement of the banks and to maintain the excavation clear of obstruction that will in any way hinder or delay the progress of the work. In wet, saturated or flowing materials, when it is necessary to install tight sheeting or cofferdams, wood or steel sheet piling of an approved design and type shall be used.

All sheeting piling, shoring and bracing shall have sufficient strength and rigidity to withstand the pressure exerted and maintain the sides of the excavation properly in place and protect all persons or property from injury or damage. When excavations are made adjacent to existing buildings or other structures, or in paved streets, particular care shall be taken to adequately sheet, shore and brace the sides of the excavation to prevent undermining of, or settlement beneath the structures or pavement. Underpinning of adjacent structures or pavement shall be done by Contractor at his own cost and expense and in an approved manner, or when required, the pavement shall be removed, the void satisfactory refilled, compacted and the pavement replaced by Contractor; the entire expense of such removal and subsequent replacement thereof shall be borne by Contractor. Sheeting, shoring and bracing shall not be left in place unless otherwise provided for in the contract or specifically authorized. The removal of sheeting, shoring and bracing shall be done in such manner as not to endanger or damage either new or existing structures, private or public properties, and so as to avoid cave-ins, or sliding of the banks. All holes or voids left by the removal of the sheeting, shoring or bracing shall be immediately and completely filled and compacted with suitable materials.

(18) Contractor shall immediately remove all surface or seepage water from sewers, drains, ditches and other sources which may accumulate during the excavation and construction work by providing pumping, bailing, or draining. Contractor shall have available at all times sufficient equipment in proper working order for doing the work herein required. All water removed from excavations shall be disposed of in an approved manner, so as to not create unsanitary conditions, nor to cause injury to persons or property or damage to the work in progress, nor to interfere unduly with the use of streets, private driveways or entrances.

(19) Tracer wire shall be laid prior to backfilling operations next to the pipe. A monitoring station shall be installed approximately every 500 feet of pipe. Tracer wire and monitor station cost shall be included as part of the linear foot cost of the pipe.

(20) Warning tape shall be placed during backfill operations at a depth of 6 to 8 inches below final grade or pavement subgrade.

3.1.2 Trench Excavation:

(1) The trench sides shall be cut vertical from the bottom of the trench to a point one foot above the top of the pipe.

In material that may cave, trench sides shall be braced or cut to a stable slope as determined by the material characteristics. Contractor shall be solely responsible for maintaining the trench in a stable condition to prevent slides, cave-ins, settlement or movement of the banks. Contractor shall provide a trench safety system sealed by a Registered Professional Engineer in the State of Texas as described in the City Standard Specifications "Trench Safety System" and as required by State and Federal law.

(2) Complete and shape trench to provide free working space and to permit thorough tamping of backfill around pipe. The width of the trench shall be 6 inches minimum and 12 inches maximum on each side of pipe bells. In no case shall the upper portions of the trench be of less width than the bottom.

(3) Where bedding is not required, grade bottom of trenches accurately to the curvature of pipe to provide uniform bearing on firm soil along entire length of each pipe section.

(4) Remove rubbish, rock, or debris encountered at grade to depth of at least 6 inches below bottom of pipe and reshape and compact trench bottom.

(5) Bell holes shall be of ample size to make the joint and relieve the bell of all load. When the joint has been made, the void under the bell shall be filled with bedding material to provide uniform support to the pipe throughout its length.

(6) Keep excavated material piles so that it will not endanger work or obstruct roads and driveways. Keep drainage channels clear or provide other satisfactory means for drainage.

(7) Pipe shall have been laid in all trenches that have been opened and the trench backfilled at the end of each day's work, except with written permission to do otherwise.

(8) Trenches for pressure line shall be of such depth as to give thirty-six (36) inches cover over the top of the pipe to natural grade and at street crossings thirty (30) inches cover over the top of the pipe to street subgrade. In drainage ditches and bar ditches the pipe shall have a minimum of thirty (30) inches cover or be concrete encased. Lines installed in highway or railroad rights-of-way shall conform to the requirements of the applicable owner or agency.

Trench depth for sewer lines shall be such that the sewer pipe flow line will be as shown on the Construction Drawings when the pipe has been installed in accordance with these specifications.

3.1.3 Rock Excavation: When excavation is in rock, it shall be undercut four (4) inches and then brought back to grade with bank sand or other approved granular bedding material. This material shall be compacted and shaped as required and specified for pipe bedding. Rock excavation shall include removal of boulders larger than 1/3 cubic yard in volume, of ledge rock, concrete or masonry structures or foundations that require drilling or blasting.

3.1.4 Bracing, Sheathing and Shoring: Bracing, sheathing and shoring shall be provided as shown on the plans or required in the trench safety system.. Sheathing designated by the Engineer to remain in place shall be cut off 1 foot below the natural ground line and left in the trench. All sheathing not designated to remain in place shall be removed prior to backfilling the trenches.

3.1.5 Temporary Bridges: Temporary bridges or crossings shall be provided by the Contractor as required to maintain traffic. Such bridges or crossing shall be designed by a Registered Professional Engineer in the State of Texas.

3.1.6 Pipe Bedding:

(1) Concrete Encasement: The bottom of the trench shall be under cut to a depth of one-fourth the inside diameter of the pipe or a minimum of six (6) inches. Reinforcing shall be No. 4 bars longitudinally, spaced 12 inches on-center (minimum) around the pipe. No. 2 ties placed 24 inches on-center circumferentially shall be used to maintain proper location of the reinforcement. Concrete shall be a 4-sack mix and shall be poured in the trench to proper grade and pipe shall be placed in the concrete at the proper line and grade. After the initial concrete has sufficient set to support the additional load without disturbing the alignment and grade of the pipe, additional concrete shall be placed around the pipe extending up to a height of one-fourth the inside diameter or a minimum of six (6) inches above the top of the pipe. Backfill above this point shall conform to these specifications but shall not proceed until concrete has achieved a compressive strength of 75 percent of its design strength, or 3 days, whichever is greater.

(2) Cement Stabilized Sand Backfill: The bottom of the trench shall be undercut to a depth of one-fourth the inside diameter of the pipe or a minimum of four (4") inches. Cement stabilized sand shall be placed in the trench to proper grade and pipe shall be placed on this material at the proper line and grade. After the initial stabilized sand has sufficient set to support the additional load without disturbing the alignment and grade of the pipe, additional cement stabilized sand shall be placed in uniform layers around the pipe extending up to a minimum height of twelve (12") inches above the top of the pipe. Minimum compaction to this level

shall be 90 percent Standard Proctor (ASTM-698). Backfill above this level shall be uniform layers not exceeding twelve (12") inches of cement stabilized sand to the top of the trench. In roadway or proposed pavement areas, the backfill from a point twelve (12") inches above the top of the pipe to the top of the trench can be approved road base material placed in layers not to exceed (12") inches. Compaction above the pipe zone shall conform to these specifications.

(3) Class "A" Bedding (Concrete Cradle): The bottom of the trench shall be undercut to a depth of one-fourth the inside diameter of the pipe or a minimum of four (4") inches. Concrete shall be a 4-sack mix and shall be poured in the trench to proper grade and pipe shall be placed in concrete at the proper line and grade. After the initial concrete has sufficient set to support the additional load without disturbing the alignment and grade of the pipe, additional concrete shall be placed around the pipe extending up to a height of at least one-fourth the pipe outside diameter. Backfill above this point shall conform to these specifications but shall not proceed until concrete has achieved a compressive strength of 75 percent of its design strength, or 3 days, whichever is greater.

(4) Class "AA" Bedding (Concrete Arch): The bottom of the trench shall be undercut to a depth of one-fourth the outside pipe diameter or a minimum of four (4") inches. The pipe shall be bedded in granular material extending up the sides of the pipe to the spring line and compacted to 90 percent Standard Proctor (ASTM D-698). The top half of the pipe shall be covered with a monolithic concrete arch having a thickness of at least four (4") inches or one-fourth the outside pipe diameter. Concrete shall be a minimum 4-sack mix. Backfill above this point shall conform to these specifications.

(5) Class "B" Bedding: The bottom of the trench shall be undercut to a depth of one-eighth the outside diameter or a minimum of four (4") inches. Granular material or bank sand shall be placed and compacted to the proper line and grade before the pipe is laid. After the pipe has been laid additional granular material or bank sand shall be placed and compacted to the spring line of the pipe. Compaction shall be 90 percent of Standard Proctor (ASTM D-698). Care shall be taken not to disturb the grade and alignment. Backfill above this point shall conform to these specifications.

(6) Class "B Modified" Bedding: The bottom of the trench shall be undercut to a depth of one-eight the outside pipe diameter or a minimum of four (4") inches. Granular material or bank sand shall be placed and compacted to the proper line and grade before the pipe is laid. After the pipe has been laid additional granular material or bank sand shall be placed and compacted around the pipe to a minimum of six (6) inches above the top of the pipe. Compaction shall be 90 percent of Standard Proctor (ASTM D-698). Care shall be taken not to disturb the grade and alignment. Backfill above this shall conform to these specifications. SPECIAL "HAUNCHING" REQUIREMENT - Care shall be taken to ensure that sufficient

material has been worked under the "haunch" of the pipe (bottom of pipe to spring line of pipe) to provide adequate side support. Take precautions to prevent movement of the pipe during placing of the material under the pipe haunch.

(7) Class "C" Bedding: The bottom of the trench shall be undercut to a depth of one-eighth the outside pipe diameter or a minimum of four (4") inches. Granular material shall be placed and compacted to the proper line and grade before the pipe is laid. After the pipe has been laid, the same bedding material shall be placed and compacted to a minimum height of one-sixth the outside pipe diameter. Compaction shall be 90 percent of Standard Proctor (ASTM D-698). Care shall be taken not to disturb the grade and alignment. Backfill above this shall conform to these specifications.

(8) Class "D" Bedding: The bottom of the trench shall be accurately graded to support the bottom of the pipe to provide uniform bearing and support for each section of pipe. Backfill above this shall conform to these specifications.

(9) Class "D Modified" Bedding: The bottom of the trench shall be accurately graded and rounded to support the bottom quadrant of the pipe to provide uniform bearing and support for each section of pipe. Backfill above this shall conform to these specifications.

(10) Designation and Bedding Required: Standard bedding for the various types of pipe shall be as shown in the chart below and shall be used unless otherwise noted on the plans or as directed by the Engineer. When unsuitable trench conditions are encountered during construction the next higher class of bedding shall be required.

Pipe Type	Standard Bedding Class
Corrugated Metal Pipe* (CMP), Aluminum or Steel	C
Ductile Iron Pipe (DIP) Less than 30" I.D.	D
Ductile Iron Pipe 30" I.D. and Larger	C
Reinforced Concrete Pipe (RCP)	D
PVC (SDR 26 and higher rated)	B

*Large diameter circular arch-pipe or structural plate CMP shall follow manufacturer's recommendations for bedding, as approved by the Engineer.

3.1.7 Excavation of Appurtenances: Excavation for manholes and similar structures shall be sufficient to leave at least 2 feet clearance between the outer surfaces and the embankment or timber that may be used to hold and protect the banks. Any over-depth excavated below such appurtenances that has not been directed will be considered unauthorized and shall be refilled with sand, gravel, or concrete, as directed, at no additional cost to the Owner.

3.2 BACKFILLING

3.2.1 General: After pipe joints have been inspected and approved by the Engineer, backfill trench to lines and grades indicted on the drawings. Suspend backfill operations during times of inclement weather or other unsatisfactory conditions in field when satisfactory results cannot be obtained.

3.2.2 Open Areas:

(1) Pipe Zone: Backfill material shall be deposited in 6 inch maximum thickness layers and compacted to 90 percent Standard Proctor Density, ASTM D-698, until there is a cover of not less than 1 foot over the top of the pipe. The backfill material in this portion of the trench shall conform to the designated bedding classification and be placed at optimum moisture content. Special care shall be taken not to damage the coating or wrapping of pipes. No rocks, clods, or debris shall be allowed.

(2) Above Pipe Zone: Deposit select backfill materials in uniform layers not to exceed 8 inches, compacted to 90 percent Standard Proctor Density, ASTM D-698. In no case shall completed backfill be at a density less than surrounding undisturbed soil. Excess material from the excavation shall be uniformly mounded over the trench unless otherwise directed by the Owner.

3.2.3 Pavement Sections:

(1) Pipe Zone: Backfill material shall be deposited in 6 inch maximum thickness layers and compacted with mechanical hand tampers to 90 percent Standard Proctor Density, ASTM D-698, until there is a cover of not less than 1 foot over the top of the pipe. The backfill material in this portion of the trench shall conform to the designated bedding classification and be placed at optimum moisture content. Special care shall be taken not to damage the coating or wrapping of pipes. No rocks, clods or debris shall be allowed.

(2) Above Pipe Zone: Deposit select backfill materials in uniform layers not to exceed 8 inches, compacted to 96 percent Standard Proctor Density, ASTM D-689, to within two feet of final grade and to 98 percent Standard Proctor Density within the top two feet.

3.3 TESTING

3.3.1 Laboratory Services: Contractor shall be responsible for the services of a certified, commercial testing laboratory to perform density testing. Contractor is responsible for testing required by the Owner to verify that bedding and backfill materials meet or exceed specifications.

PART FOUR - MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

Measurement of pipeline installed shall be by the lineal foot along the centerline for each pipe size shown in the bid schedule. Measurement for other bid items shall be by the units specified in the bid schedule

4.2 PAYMENT

Payment for pipeline installed shall be at the unit price bid per lineal foot as shown in the bid schedule. This payment shall not include the cost of pipeline materials supplied by the Owner. No direct payment shall be made for clearing, installation of fittings, blocking, testing and other related work and materials required to complete the work. Payment for other bid items shall be at the prices bid as shown in the bid schedule for the work, complete in place.