



SEWER UTILITY

“SPECIFICATIONS”

2007

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HMUA
SANITARY SEWER STANDARD SPECIFICATIONS

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ITEM 1 - FOR EXCAVATION AND BACKFILL

1.00 Work Included

For the respective unit prices bid per cubic yard under the various subdivisions of this Item, the Contractor shall do all excavation work required for the pipe and structures, as shown on the Contract Drawings, or as required by the Engineer.

The prices bid shall include all; excavation and backfill; storage in temporary spoil banks; compaction; furnishing, placing, and removal of sheeting; removal of water from the excavation; dewatering; protection of existing pipe lines and structures; selection and placing of all suitable material in fill around the structures; disposal of surplus and unsuitable materials; and cleaning up of the site; and any additional work as may be required to complete all excavation and backfill for pipe and structures.

The prices bid shall also include all; clearing and grubbing; cutting and removal of trees; removal of brush and debris; stripping, storing, protecting and replacing topsoil; cutting and removal of pavement; and removal and disposal of existing pipe and structures encountered within the limits of the work which will not be incorporated in the finished work.

1.01 Character of Material

Ground elevations are shown on the Contract Drawings. The Contractor shall, by inspection, by test pits or borings made by him or by other adequate methods, satisfy himself regarding the character and amount of the various classes of material to be encountered in the work to be performed. If quicksand is encountered, no separate classification will be made, and such excavation will be paid for under pertinent depth classifications Items 1a to 1c.

1.02 Excavation, Clearances and Trimming

Excavation shall be of sufficient width to permit work to be done competently, in the manner and of the size specified and shown, and limits shall be such as to permit the use of outside forms, unless permission for alternate procedure is specifically granted. In no case shall excavations be carried below grade by machine and backfill be used to bring foundations to the grade of bottom slabs, footings or pipelines.

All excavations for pipe in boulders, rock masonry, or other similar materials shall be excavated to a level at least six (6) inches below the invert of the pipe, and carefully refilled with clean 3/4-inch broken stone.

Rock or boulders shall be removed from sides of trenches to a plane twelve (12) inches outside the inside wall of the pipe, unless permission to do otherwise is expressly given.

Excavation lines shall, in general, conform with paylines for various classes of excavation. The trench width just above the top of the pipe shall be maintained as narrow as possible and in general shall not exceed the inside diameter of pipe plus two (2) feet.

1.03 Unauthorized Excavation

If any excavation is caused by the Contractors' error, or wherever the excavation is carried beyond or below the lines and grades given by the Engineer, the Contractor shall, at his own expense, refill all such excavated space with such material and in such manner as may be directed, in order to insure the stability of the various structures. Beneath all structures, space excavated without authority shall be refilled with Class "C" (3000 lb.) concrete by the Contractor and at his own expense.

Whenever the term "concrete" is used herein, it is understood to mean a homogeneous mixture of cement, sand and coarse aggregate with the proper amount of water. The class of concrete shall be designated by strength. The strength shall refer to the unit compressive stress required to fracture the concrete in accordance with the Standard Methods of making Compression Tests of Concrete, as defined by the American Society for Testing Materials (Serial Designation C-39, latest revision).

Concrete shall have a compressive strength at the end of 28 days of not less than 3,000 pounds per square inch, as determined by tests described herein. Concrete shall have a cement content not less than 6 bags per cubic yard, a water content not exceeding 5.0 gallons per bag of cement, shall contain 2% entrained air and shall contain coarse aggregate such that the hardened concrete weight is 145 lbs./cu.ft., $\pm 3\%$. Unless otherwise approved by the Inspector, all concrete under this item shall be ready-mixed. Cement shall be Type II Domestic portland cement conforming to the requirements of "Specifications for Portland Cement", ASTM Designation C150, latest revision.

1.04 Sheeting and Bracing

Where necessary, particularly to prevent disturbance, damage, or settlement of adjacent structures, pipelines, utilities, improvements, or paving, excavation shall be adequately sheeted and braced. In areas where specifically designed sheeting is not designated, the Contractor shall submit to the Engineer a sketch showing details and installation procedures of all sheeting and bracing for excavations exceeding five (5) feet in depth. Said plan, details, and procedures shall be submitted well in advance of the start of excavation. This sketch shall be accompanied by a signed and sealed certificate from a currently licensed New Jersey Professional Engineer, stating that the sheeting and bracing design shown on the sketch meets all the latest requirements of the New Jersey Construction Safety Code and the Federal Occupational Safety and Health Act.

Any damage to new or existing structures occurring through settlement, water or earth pressure, or other causes due to inadequate bracing, or through negligence or fault of the Contractor in any other manner, shall be repaired by the Contractor at his own expense.

1.05 Removal of Water and Protection from Flooding

The Contractor shall remove all water from the excavation promptly and continuously throughout the progress of the work and shall keep the excavation dry at all times by approved methods such as sumps, underdrains, or well points until the structures to be built therein are completed. Pumping shall be continuous if necessary or ordered by the Inspector to protect the work and/or to maintain satisfactory progress.

The Contractor shall be solely responsible for the type and size of dewatering equipment necessary for maintaining a dry excavation. The Contractor shall be solely responsible for interpreting this data, and for verifying the data as necessary prior to development of his dewatering plan. The Contractor shall also be required to adhere to all general, specific, or other requirements as detailed by the NJDEP whether or not a dewatering permit has been issued. If a dewatering permit has been issued it shall be maintained at the office of the Engineer for inspection.

All labor, equipment, and material, including coarse aggregate, used for dewatering shall be included in the unit price bid under this item, and no additional payment will be made for dewatering.

Precautions shall be taken to protect uncompleted work from flooding during storm or from other causes. All pipelines or structures not stable against uplift during construction or prior to completion shall be thoroughly braced or otherwise protected.

All necessary precautions shall be taken to prevent disturbance of and to properly drain the areas upon which concrete is to be poured, and upon which pipe is to be laid.

Contractor's plant and equipment shall be adequate to keep all concrete work dry until properly set.

When dewatering will occur in the vicinity of structures or potable wells, the Contractor must monitor for adverse effects to structures or wells due to dewatering and will be responsible to remedy same to the satisfaction of the Department.

All discharges from dewatering activities to surface waters, wetlands or storm sewers shall be free of sediment. Care shall be taken not to damage or kill vegetation by excessive watering or by damaging silt accumulation in the discharge area. If discharges are sediment laden, techniques shall be employed to remove sediment prior to discharge. A sedimentation basin shall be constructed and used as specified, where necessary, to protect vegetation and to achieve environmental objectives.

Sewer inlets within construction areas shall be provided with perimeter haybales or other appropriate siltation control measures.

1.06 Topsoil

In unpaved areas, all topsoil shall be carefully removed from the site of the work over the entire width of the Contractor's operations, including areas used for heaping excavated material and over which equipment will be driven. Topsoil shall be stored separately and replaced in the final grading and embankments to the designated lines and grades, in an approved manner, without further payment than is included in various excavation items.

1.07 Compacting Foundations

Wherever the development of suitable foundation conditions requires it, the Contractor shall take the proper means of compacting such foundation material. After excavation to grade, the surface shall be tamped, or otherwise consolidated to adequately prepare the bottom for the loads to come upon it, the method depending upon the quality and condition of the material. Where so required, screened gravel, furnished and paid for under another item, shall be placed on the surface and shall be compacted into the sub-grade in such thickness as may be required by the Engineer. All work of compacting foundations shall be included in the prices bid for excavation, with the exception that broken stone or other material used for such work will be paid for under appropriate items.

1.08 Additional Excavation

Wherever, in the opinion of the Inspector, the material found at the grades shown on the plans for the slabs, footings, structures, or pipe inverts, is not satisfactory, the Contractor shall make any additional excavations as directed by the Inspector, and shall refill the same to required grade with Size No. 57 clean broken stone.

1.09 Backfilling

As soon as practicable, after the pipe or masonry has been placed and **visually inspected** and the masonry has acquired a suitable degree of hardness, the backfilling shall begin and shall thereafter be prosecuted expeditiously.

The Inspector shall have the right to make such selection of the material for various portions of the backfill as may be required for the satisfactory execution of the work.

Only such material as is suitable for backfilling shall be used. All boulders, rock or other unsuitable material shall be disposed of by the Contractor.

In general, backfill in easements shall be with existing excavated material, and backfill within existing roadways, road shoulders, driveways, and parking areas shall be quarry processed stone.

All lumber, rubbish, and braces shall be carefully removed from behind walls or other structures, unless ordered left in place by the Engineer. Backfill under PVC pipe and up to the top of the pipe shall be with compacted Size No. 57 broken stone as shown on the Typical Bedding Detail. Backfill around RCP and DIP pipe and above the top of PVC pipe and up to a cover of at least

18 inches over the top of the pipe shall be Quarry Processed Stone (QP), unless otherwise ordered. Backfill under pipe haunches, around pipe and up to a cover of at least 18 inches over the top of the pipe shall be placed by hand in 12-inch layers, each layer to be thoroughly compacted by mechanical tampers of an approved type. Compaction and tamping shall be as directed to the end that the pipe shall be securely bedded and protected at the end of each day's operation.

All trenches or excavations shall then be backfilled in mechanically compacted and vibrated 12-inch layers to the original surface of the ground or up to such grades as shall be directed. The backfilling shall be done as completely as possible in such a manner as to prevent after-settlement around all structures and pipelines. No heavy stones or boulders shall be allowed to drop into the trench. The trenches and excavations shall be wet down as required to obtain optimum density while the backfilling is being carried out.

In rights-of-way and paper streets, backfill between a plane 18 inches above the top of the pipe and the finished surface grade shall be so placed as to keep settlement to a minimum and the Contractor shall restore to proper grade such settlement that might occur.

All backfill in embankments shall be thoroughly compacted by rollers of approved size and weight or by other approved methods.

1.10 Disposal of Material

Material excavated shall be disposed of in backfilling, building embankments, making fills and grading around the work as may be directed, and to the lines and grades established by the Engineer.

Excess material shall be disposed of by the Contractor in locations outside of the working areas under this Item without additional payment. The areas shall be selected by the Contractor. The Contractor shall abide by all State, County and local laws and ordinances, shall secure all permits and disposal fees as necessary.

So far as possible, the excavated material may be temporarily disposed of on the site of the work and used as fill where possible in other sections of the work, but it shall not be done in a manner to interfere with the satisfactory carrying out of the work, nor shall it be dumped in such a location as to cause pressures against newly placed masonry.

The disposal of excess excavated material in wetlands, stream corridors and floodplains is strictly prohibited, even if the permission of the property owner is obtained. The Contractor shall be responsible to remove any fill improperly placed by the Contractor at the Contractor's expense and restore the area impacted.

If excess excavated material is placed on private property the Contractor shall obtain a hold harmless release in favor of the local government unit and the Department from the property owner.

Erosion by wind and water of excess excavated materials disposed of on private lands by sewer contractors is a concern. Therefore, when obtaining releases from private property owners, the Contractor shall include a statement from the property owner that he or she has been apprised by the Contractor of this need for erosion control and accepts complete responsibility for its implementation.

In streets or adjacent to private property, material shall be stored at such locations as will not unduly interfere with traffic of any nature, and in no case shall material be stored in locations which will cause damage to existing improvements.

1.10a Solid Waste Disposal

The Contractor is directed to Public Law NJAC 7:26-1 et seq. Rules of the Bureau of Solid Waste Management, 1974. In general, this law requires that all solid wastes (concrete, black top, demolition or construction debris, etc.) must be disposed in an approved, licensed landfill site. Also, any truck hauling this type of material to a landfill must have a permit issued by the Bureau of Solid Waste Management.

1.11 Temporary Bridges and Crossings

The Contractor shall, where required to expedite the work, or where required to maintain traffic, or where otherwise ordered by the Inspector, construct temporary bridges, or walkways, of adequate sized members to safely carry the loads which may reasonably be anticipated, and the sizes of the members used shall meet with the approval of the Inspector.

1.12 Protection and Restoration of Existing Structures and Pipe Lines

The Contractor shall carefully protect all existing structures, both above and underground, including poles, curbs, driveways, roadways, parking areas, privately owned pavements, signs, sumps, pits, catch basins, manholes, underground tanks, and building foundations; pipelines, including gas mains, water mains, hydrants, drain lines, storm sewers, sanitary sewers; service connections, conduits and miscellaneous underground pipelines; and shall restore same to a condition equivalent to conditions existing prior to his operation.

The Contractor is specifically directed to the requirements of protecting all trees along the route of the work in an approved manner.

The work of protecting and restoring existing utilities and facilities and including trees where no definite physical interference exists, or where the interference is avoidable, shall be done under this Item without additional payment.

Ample precautions shall be taken to prevent settlement of existing improvements.

The work will be located so as to avoid interference to the greatest degree practicable, based upon data available as to depth and location of existing utilities and other existing facilities.

The Contractor shall, insofar as possible, determine in advance of excavating by trenching machines, the location of all utilities and other subsurface structures and facilities and shall accurately mark same so that they may be avoided by the machine.

Where existing utilities or other subsurface facilities adjacent to the trench or crossing through the trench, require temporary support or protections, the work shall be done under this Item without additional payment.

Where definite physical interference would be unavoidable in the final work and necessitates the removal, alteration, replacement or extension of existing facilities, the Contractor shall make all excavations for such work under this Item and shall cooperate with other forces engaged in the work.

The labor, pipe and other material necessary for removing, altering, replacing, or extending such utilities, other than for excavation, will, unless otherwise ordered, be done by the respective utility companies or other owners involved. In specific cases the Contractor may be ordered to perform such work.

1.13 Removal and Restoration of Pavement, Curbing, Sidewalks and Fencing

The removal of pavement, curbing, sidewalks and fencing as necessary for construction shall be included under this item.

All sidewalks, curbs, lawns, fences, private driveways, pavement, and other improvements damaged or removed due to the Contractor's operations shall be restored to a condition at least equivalent to conditions existing prior to the Contractor's operations. Replacement or restoration shall be done in accordance with applicable provisions of this Specification and in conformity with the requirements of the authorities in charge; all work to be done to the satisfaction of the Inspector.

Concrete Sidewalk - The Contractor shall remove a sidewalk required for construction at existing expansion joints. Should no expansion joint exist within a distance of 10 feet on either side of the construction area, the contractor will saw cut existing sidewalk and remove the existing sidewalk in a neat and workmanlike manner. It is the Contractor's responsibility to protect all sidewalks not removed for the duration of the construction period. Concrete sidewalks shall be 4-inch thick with Class B 4,000 lb. concrete, air-entrained.

Bituminous Sidewalk - The Contractor shall saw cut the existing sidewalk and remove the existing sidewalk within the construction area in a neat and workmanlike manner. It is the Contractor's responsibility to protect all sidewalks not removed for the duration of the construction period. Bituminous sidewalk shall be 4-inch thick bituminous concrete Mix No. 5.

Fencing - Fencing materials shall be removed in sections as determined by the length of existing fabric material. After sewer installation and restoration items have been completed, fencing materials shall be restored to a condition equal to or better than original and to the satisfaction of the homeowner.

The Contractor shall replace curbing damaged or removed during the work, to the following specifications.

The existing curb shall be saw cut so that no broken concrete remains. Should the saw cut be within five (5) feet of an expansion joint, the curb shall be removed and replaced up to that expansion joint.

All sidewalks and pavements, including pavements on roads, shall be maintained during the period of trench consolidation, and the Contractor shall be expected to keep his trench adequately protected at all times.

Pavement cutters shall be used prior to excavation to reduce the pavement disturbance to a minimum.

The Contractor shall use barricades and lights and adequate signs to indicate that the trench is soft, and upon settling of the trench shall immediately bring the trench up to the required grade. Where the trench has reached some degree of settlement and may be used for vehicular traffic, the Contractor shall fill in any holes or ruts with road stone to maintain a safe and satisfactory condition at all times.

1.14 Work in Lawn Areas/Easement Areas

Where the work is in easements located within privately owned lawn areas, rear yards, etc., the Contractor shall make every effort to minimize disturbance to the area. All trees shall be boxed or otherwise protected. Excavated material shall be stored on tarpaulins or other means used to prevent it from being spread on the ground. Backfill shall be completed on the same day. Only under unusual circumstances shall a trench be allowed to remain open overnight. Topsoil shall be removed and stored separately, and upon completion of backfill shall be evenly spread over the disturbed area. If settlement occurs, the Contractor shall bring in additional topsoil of an approved variety, to bring the trench up to grade.

All disturbed areas, including lawns, trees, shrubs, bushes, planting, fences, walls, driveways, walkways, etc., shall be restored to the satisfaction of the Owner.

No work shall be commenced within any easement area without the express consent of the Inspector, nor will any work within such areas be allowed to continue should the Inspector direct curtailment due to inclement weather or other unsatisfactory conditions.

Also, the Contractor shall be aware that he is only authorized to work in designated easements and in road right of ways as shown on the Contract Drawings. If the Contractor desires to work on private property, it shall be up to the Contractor to negotiate with the property owner for the required easements at no further cost to the Owner. However, the Contractor must restore all property to conditions existing prior to construction.

The Contractor shall provide to property owners access to sheds, garages, etc. beyond the easement area.

Note that within easements, house roof drains, sump drains, etc., may be encountered. If these are disturbed the Contractor shall immediately repair same in kind without additional payment.

1.15 Methods

Methods of excavation and construction must be in accordance with the State of New Jersey, Department of Labor & Industry, Bureau of Engineering & Safety, CONSTRUCTION SAFETY CODE, dated July 1, 1968 and all latest revisions.

Methods of excavation shall be as required by job conditions; in general, excavation may be done by suitable power equipment, but in cases where working room is limited or where necessary to prevent damage to existing structures, hand methods shall be used without further payment than is included in the prices bid.

In cases where tunneling is adopted, either by option of the Contractor or by requirements of a utility or governmental authority having jurisdiction, and with the approval of the HMUA, and in accordance with the requirements of these Specifications.

1.16 Tunneling

Proposed methods and schedule for tunneling operations shall be submitted to the HMUA for approval, and shall meet all requirements of the authority having jurisdiction.

Tunneling operations shall be conducted in such a manner as to prevent settling or other damage to the roadway or other surface improvements. Shoring shall be provided and installed as required by ground conditions to prevent settling or loss of ground. Tunnel cross section shall be held to a minimum practicable size.

Immediately following installation and testing of the section of the pipe in the tunnel, the entire tunnel shall be solidly backfilled with a stiff sand-cement mixture containing not less than two (2) bags of cement per cubic yard of mixture. Extreme care shall be taken to insure that all voids are filled. The backfill mixture shall be rammed in place from both sides, working progressively from the center to the ends of the tunnel. No additional payment shall be made for the tunnel backfill, and payment for tunnel excavation shall be deemed to include full compensation for the backfill work.

1.17 Blasting

In general, blasting will not be permitted at locations near existing structures or near water, sewer, drain, oil, gas, cable or other utilities. Where blasting is permitted, the Contractor shall take every precaution to protect all portions of the work already constructed or being constructed and shall use small charges and give ample notice so as to not to endanger persons or property.

Limited blasting may be permitted within the project area provided that the Contractor obtains approval from the appropriate utility companies having services in the area. The Contractor shall ascertain where blasting is permitted, and to what extent prior to submitting a bid.

Notice shall be submitted to the HMUA and the appropriate utility companies at least one (1) week prior to the start of blasting operations. If the Contractor fails to give the required notice, the HMUA can delay the start of blasting. It shall be the Contractor's responsibility to obtain all permits, post all bonds, etc., as required relating to blasting operations and pay all costs pertaining thereto. The Contractor shall also pay the wages of any inspectors required by the utility companies as necessary during the work. In addition, the Contractor shall comply with all requirements of utility companies regarding charge size and type.

The Contractor shall monitor all blasting by use of approved seismic instrumentation to insure that the frequency and peak particle velocity standards are strictly adhered to in accordance with local and NJ State regulations and standards.

The Contractor, in addition to observing all of the requirements set forth and all municipal ordinances and State laws relative to the transportation, storage, handling and use of explosives, shall also conform to any further regulations which the Engineer may deem necessary in this respect. The Contractor shall be liable for damage to persons or property caused by blast or explosion, as provided under the articles of the Contract and shall hold the HMUA and Engineer harmless from any claims resulting therefrom.

Blasting on New Jersey Department of Transportation property is generally not permitted. Should rock be encountered on Department of Transportation property, and/or right-of-way, the rock shall be removed by air driven hammers, ripping methods, rock splitting methods, etc. Should the above methods prove unfeasible, the Contractor shall obtain written approval from the Department of Transportation, prior to any blasting. This approval shall be submitted to the HMUA at least one week prior to any blasting operations.

Satisfactory insurance certificates shall be submitted to the HMUA by the blasting contractor prior to undertaking any blasting work.

Prior to the start of any blasting work, the Contractor shall retain the services of a Consultant for the purpose of performing a pre-excavation and pre-blasting survey. The Consultant shall have a background of at least five (5) years in this type of work.

The Consultant shall perform this survey, internal and external, of all structures, including houses and garages, directly adjacent to the new sanitary sewer utilities to be installed under this Contract where blasting is to occur and within two hundred feet (200') of either end of a trench that is to be blasted. He shall voice tape record his findings at each structure and shall take photographs of existing conditions at each structure, to the extent necessary, based on his past experience on this type survey. He shall maintain these records in his possession for a minimum of three (3) years.

The Consultant shall prepare a brief overall summary report, one (1) or two (2) typed pages and a set of 8" X 10" glossy color "contact prints" made directly (not enlarged) from the negatives of all photographs taken. The brief overall summary report and glossy color "contact prints" are to be submitted to the HMUA and/or the Engineer for approvals prior to any blasting.

In the event that a subsequent claim is filed for blast damage to a particular structure, the Consultant shall inspect the structure again and prepare an individual report for the particular structure and take photographs of the claimed damage. Using this new data and the previously obtained voice tape recordings and photographs, a separate individual detailed report shall be prepared for the structure in question which shall include, as deemed necessary by the Consultant, 8" X 10" glossy color prints of the photographs taken before and after the blast damage claim. Two copies of each individual report prepared, including 8" X 10" glossy color prints, shall be provided to the HMUA and at least one more copy for the prime Contractor.

The Consultant is to notify each property owner, in a mailed letter, prior to his visits to the property. He is to include in this letter, as a minimum, who he is, a description of the project to be constructed and the reasons for his visit. The letters are to be mailed certified, return receipt requested.

* * * *

ITEM 2 - FURNISHING, LAYING AND JOINTING PVC GRAVITY SEWER PIPE

2.00 Work Included

The Contractor shall furnish, lay, joint, test, flush and TV inspect PVC gravity sewer pipe, as described herein and shown or specified on the Contract Drawings.

The work shall include all labor, tools, materials, and equipment including couplings and jointing materials.

2.01 Pipe

All pipe shall be best quality unplasticized polyvinyl chloride sewer pipe, adequate for the external loading conditions shown on the Drawings, with joints providing flexibility and watertightness under service conditions. Smooth internal surfaces, producing high carrying capacity obtainable with best standard practice and best workmanship, will be required. Pipe shall be in accordance with ASTM Specification D3034, latest revision, for sizes 4-inch through 15-inch, and ASTM F679, latest revision, for sizes greater than 15-inches, and shall meet the requirements for extra strength minimum of SDR-35 section of the above noted ASTM Specification.

The pipe shall be accurate and of uniform dimensions. All pipe shall be straight and true to form without bulges, dents, cracks, tears, or other defects which will affect strength, and shall have no bulges or dents on interior surfaces which will result in a noticeable variation in diameter from that obtained on adjacent unaffected portions of the surface. Each pipe shall not vary in length more than 1.0 inch in a length of 12½- feet measured as mid-ordinate. Materials properties shall meet the test requirements of ASTM D1784 (latest revision).

Shop drawings shall be submitted for the Engineer's review prior to ordering any materials under this item.

2.02 Joints

Joints shall be of the bell and spigot type with rubber ring. Joints shall be manufactured in accordance with ASTM D3212, latest revision. The bell shall consist of an integral wall section with a solid cross-section rubber ring factory assembled. The ring groove shall be so designed as to prevent ring displacement. Size shall be as shown on the Contract Drawings or as required by field conditions. Jointing shall be in accordance with recommendations of the manufacturer.

2.03 Laying

All pipe shall be carefully laid to true alignment and grade with bell end facing upgrade.

All pipe shall be carefully examined for dents, excessive deflection, or bowing, and other defects. No pipe known to be defective shall be laid. If any pipe is found to be broken or defective after being laid, it shall be removed and replaced by sound pipe. Joint surfaces shall be protected from damage and shall be carefully examined before jointing. No damaged joints shall be used in the work.

The minimum pipe cover shall be three (3) feet unless otherwise approved by the Inspector. Where pipe cover is less than three (3) feet or greater than 18 feet, Ductile Iron Pipe shall be used.

Pipe shall be thoroughly cleaned and ample precautions shall be taken to prevent entrance of dirt and debris into the pipe after laying. Exposed ends of the sewer shall be provided with temporary plugs or covers.

All connections to the existing sanitary sewer shall be plugged until written permission to operate the facility is given by the H.M.U.A. Board.

All pipe shall be carefully laid to true alignment and grade and installed in accordance with ASTM D2321, latest revision.

The trench bottom shall be carefully graded to the proper elevation, and the maximum practical solid bearing area shall be provided throughout its entire length, prior to swinging the pipe into place. Requirements for proper bedding shall also adhere to the Authority's standard bedding details.

Care shall be taken not to excavate below grade. Material excavated below adopted grade shall be replaced by material which meets with the approval of the Inspector.

All pipe shall be accurately centered prior to jointing and then thoroughly driven home.

Where foundation conditions so require, the pipe shall be laid on screened gravel or broken stone not exceeding ¾-inch diameter. All trenches shall be dewatered prior to laying pipe. Immediately after the pipe is brought to final position, it shall be thoroughly secured and properly bedded, and ample support shall be provided to prevent settlement or disturbances. Bedding and backfill requirements for PVC pipe shall conform to the details as shown on the Authority's standard details.

Pipe shall be protected during construction against possible flotation due to pouring of concrete cradle or in case the trench becomes flooded prior to placing the backfill.

2.04 Jointing

Pipe shall be carefully jointed in conformity with the best practice and the detailed instructions of the manufacturers. All pipe ends shall be thoroughly cleaned prior to and during the jointing operation. The pipe end shall be thoroughly lubricated in accordance with the recommendations of the manufacturer.

Actual details of required jointing practice will depend upon the particular type adopted, but shall in all cases, involve approved practice and shall be such as to produce the required results, particularly with regard to watertightness.

2.05 Leakage and Testing

If an inspection of the completed sewer or any part thereof shows any manholes, pipes, or joints which allow the infiltration of water in a noticeable stream or jet, the defective work or material shall be replaced or repaired as directed.

After the correction of any visible leakage, two independent tests shall be performed upon the proposed sewer as described herein. Failure to meet the requirements of any test shall be cause for the Inspector to direct the Contractor to take corrective measures. The tests to be performed are as follows:

Low Pressure Air Test

The Contractor shall furnish all equipment and personnel to conduct an acceptance test using low pressure air. The test shall be conducted on all main line sewers following the installation of building connection run outs to the edge of the easement, or two (2) feet beyond the edge of pavement or curb. Branch connections shall be provided with plugs or caps as necessary to withstand the specified air test.

The Contractor shall first clean and flush all lines, and all debris flushed out shall be removed at each downstream manhole.

All test plugs, gauges, an air compressor, and personnel for conducting the acceptance test shall be furnished by the Contractor. The test shall be observed by the Authority or its representative.

The section of line being tested shall be securely plugged at each manhole. All stoppers shall be adequately braced.

For the acceptance test, air shall be slowly supplied to the plugged section of pipe to be tested until the internal air pressure reaches 4.5 psi greater than the average back pressure of any groundwater that may submerge the pipe. At least two minutes shall be allowed for temperature stabilization before proceeding further. The back pressure of any groundwater caused by the water head above the invert of the pipe must be determined by

a method approved by the Engineer. The back pressure must be added to the standard test pressures to compensate for the groundwater effect on the air test.

Following the stabilization period for which a possible loss of 1 psi is allowable, the rate of air loss shall then be determined by measuring the time interval required for the internal pressure to decrease from 3.5 psi to 2.5 psi greater than the average back pressure of any groundwater that may submerge the pipe. The pipeline shall be considered acceptable, when the allowable 1.0 psi pressure drop occurs in a period of time which is not less than the holding time listed in the air test table on Page S2-13.

If the pipe installation fails to meet these requirements, the Contractor shall determine at his own expense the source or sources of exfiltration, and he shall repair or replace all defective materials or workmanship. The complete pipe installation shall meet the requirement of this test.

Vertical Deflection Limitations

The contractor shall also furnish all equipment and personnel to conduct deflection testing on all PVC pipe installed. The total vertical wall deflection of the PVC sewer pipe shall not exceed seven and one-half percent (7½ %) of the inside pipe diameter. Deflection testing shall not be conducted earlier than seven (7) days after placement and compaction of the backfill. In addition, the groundwater level shall be kept below the invert of the pipe during the deflection testing.

The vertical deflection shall be checked by manually pulling a go, no-go deflection testing mandrel through the pipe. The mandrel shall be specifically designed for this purpose, and the Contractor shall submit shop drawings to the HMUA detailing the type of mandrel to be used. The mandrel shall be as manufactured by Armco, Inc. or approved equal, and shall have the specified accuracy in all positions of rotation.

Note that the deflection device shall be pulled through the pipeline using only the force of one (1) man without aid of any devices other than the rope/chain attached to the deflection device.

The Contractor shall conduct all deflection testing in the presence of the Inspector. Should any pipe section exceed the maximum deflection specified, the Contractor shall undertake any remedial action as required to reduce the deflection to within that limit as directed by the Inspector.

2.06 Flushing and Internal Inspection of Gravity Sewers

All newly installed gravity sewers shall be internally inspected by closed circuit TV following the completion of acceptable air and deflection testing and, if in roadway, after base course paving has been performed. The video report shall document the locations of all lateral connections and pipeline distances between manholes. The internal inspection

shall be observed by the Authority or its Engineer and a video tape of the entire inspection and a written report of the same shall be provided to the Authority.

Cleaning Procedures and Equipment

The Contractor shall clean the designated sanitary sewers, prior to internal inspection, utilizing cleaning equipment approved for use by the HMUA.

Cleaning equipment may consist of a hydraulic high pressure jet machine or combination jet vacuum machine capable of removing all sand, grease, and other debris, including roots (where ordered by the Inspector) from the sewer line to allow adequate internal inspection (in the opinion of the Inspector) of all internal surfaces. The equipment used shall suit the conditions and size of the sewer to be cleaned. Access difficulties at some ROW sewers may preclude deployment of large jet or combination jet vacuuming machines, so the Contractor shall use a smaller trailer-mounted jet machine (or other equipment and/or procedures approved by the Inspector) that can be deployed effectively.

In general, cleaning shall proceed in a downstream direction to minimize the release of materials into previously cleaned reaches. *All sludge, dirt, sand, grease, roots and other materials within each sewer reach shall be transported to the downstream manhole for removal.* An approved dam or weir shall be inserted in the downstream manhole to detain all materials removed from the manhole by manual or mechanical means. Passing the material from reach to reach will not be permitted. The Contractor shall exercise extreme care that wastewater and debris is not discharged to storm sewers.

No diverting of sewage to adjacent streams, ditches, or storm sewers during the cleaning operation shall be permitted. Cleaning shall be performed in the 72-hour period immediately preceding internal video inspection.

The Contractor shall follow all safety precautions outlined in the Contract Documents, or required by agencies having jurisdiction, during cleaning operations. The cost of such precautions shall be included in the price bid for this Item.

When conducting cleaning operations, the Contractor shall make every effort to protect buildings connected to the sewer line. Damage to property resulting from surcharged sewers created by or otherwise attributed to cleaning operations shall be the Contractor's responsibility. Should such property damage be reported, the Contractor shall promptly inspect the reported damage and submit a written report to the HMUA describing the Contractor's findings and the actions taken by the Contractor and/or the Contractor's insurance carrier.

Cleaning Precautions and Emergency Procedures

All precautions shall be taken by the Contractor to protect the sewer line from damage that might result from the use of unsuitable equipment or improper use of approved cleaning equipment. The Contractor shall monitor the quantity and quality of material removed from each sewer line. If pieces of broken pipe or clean sand and gravel are being removed, the cleaning operation shall be halted if it is suspected that damaged pipe exists within the sewer line. The Engineer and the Owner shall be promptly notified when and why cleaning operations have been suspended. Any sewers damaged during the cleaning as a result of the Contractor's operation shall be promptly repaired by and at the expense of the Contractor to an acceptable condition (as determined by the Inspector). If the Contractor's cleaning equipment becomes immobilized within a sewer line, exits the sewer line through broken pipe or portions break off within a sewer line, said equipment shall be retrieved at the Contractor's expense. The Contractor shall act immediately to remedy problems created by the cleaning procedure that represent a hazard to the general public, such as the blockage of sewage flow or the collapse of the ground surface above a sewer line. If equipment retrieval requires excavation, the Contractor shall be responsible for accomplishing the work at its own expense. Following removal of the equipment, the Contractor shall restore the sewer line and the site in accordance with the construction specifications of the HMUA.

Water Procurement

The Contractor is responsible for the timely procurement of water in quantities sufficient to perform all contract work to the satisfaction of the Inspector and within the time limit set for its completion. The procurement of water shall be arranged through the HMUA.

Disposal of Debris

All sludge, dirt, sand, roots, and other materials resulting from the cleaning operations shall be removed from the downstream manhole of the sewer section being cleaned. Under no circumstances shall sewage or solids be disposed of by dumping onto the ground surface, into ditches, catch basins or storm drains. Debris removed from the sewers and appurtenances shall not be piled on the ground surface pending removal, but shall be placed in trucks or suitable containers immediately until removed from the site by the Contractor. The streets in the work area shall be kept clean and swept and hosed down as required.

Trucks hauling solids or semi-solids from the site shall be tight so that no spillage or leakage will occur. The Contractor shall bear the costs of transporting all debris removed from the sewers.

Video Inspection Equipment

The video inspections will be performed with a color, pan-and-tilt camera. The camera shall have the following features:

- Lens sensitivity - 3 lux (minimum)
- Rotation - 360°
- Pan-and-tilt - 240° (minimum)
- Vertical resolution - 400 lines (minimum)
- Lighting - head and camera mounted
- Camera adjustment - remote focus and iris adjustment
- Camera realignment - auto centering to axial viewing

Lighting for the camera shall be suitable to allow a clear picture of the entire periphery of the pipe. When the pan-and-tilt capabilities are used, head-mounted lighting shall be adequate to illuminate defects and the interiors of tributary pipes and service connections within range.

The camera shall be operational in 100% humidity conditions. The camera, video monitor, and other components of the video system shall be capable of producing picture quality to the satisfaction of the Inspector; unsatisfactory equipment shall be removed and no payment will be made for an unsatisfactory inspection.

In the event that the primary camera is incapable of performing in a manner deemed satisfactory by the Inspector, the contractor shall be able to procure and use a back-up camera, with capabilities at least equal to those described above, within 24 hours of its requirement. In addition, the contractor shall use an alternative non-pan-and-tilt camera within sewers that have conditions (protruding service connections, severely offset joints, structurally damaged pipe, etc.) that prevent the effective use of a pan-and-tilt camera. The alternative camera shall be a radial view or fixed view camera capable of inspecting problematic sewers.

Inspection Procedures

The inspections can be performed over multiple sewer reaches where there is minimal flow in the sanitary sewer or the flow will not interfere with the inspection. Sewer reaches that require intermittent sewer plugging to provide a satisfactory view of the pipe interior shall be inspected one sewer reach at a time.

The camera shall be moved through the sewer in either direction at a moderate rate, stopping as needed to view and document sewer conditions and connections. In no case will the camera be pulled at a speed greater than 30 feet per minute.

The preferred camera deployment shall be by self-propelled crawler. A power winch or sewer jet may also be used to move the camera during inspections. When a sewer jet is used, excellent communications shall be used to insure the camera operator maintains control of the camera.

The use of the camera's pan-and-tilt capabilities shall be used to monitoring features listed below:

- Internal condition of manholes.
 - **A complete video inspection of the manhole is required;** the camera head shall be moved *slowly*, and the camera itself moved around, to provide a complete inspection of the entire inside of the manhole.
 - Lighting will be adjusted to compensate for outside light entering through manhole cover vent and pick holes, or through open manholes, especially when the camera head is pointed upward.
 - Within buried manholes, every effort will be made to provide a *count* of the pre-cast sections or the courses of bricks or blocks; the goal is to use this information to determine the depth of the buried manhole.
- Condition of pipe periphery at beginning of inspection and at intervals of approximately 50 feet thereafter when no structural defects are apparent.
- All service connections (SC) to the inspected pipe.
 - Begin observation as the camera approaches the SC; do not wait until the camera head is immediately adjacent to the opening.
 - While slowly approaching the SC, pan-and-tilt the camera head as necessary to maintain a constant view of the opening.
 - When the camera head is adjacent to the SC opening, pan-and-tilt and adjust the camera position to record as much of the SC opening into the collector sewer and as much of the interior as possible.
 - Maintain proper lens focus throughout the SC inspection.
 - Describe conditions in service connection (e.g., capped, joints, roots, grease, etc.).
- Any possible adverse sewer conditions, including, but not limited to, corrosion, structural damage, leaks, holes, etc.
- All suspected leaks shall be observed and recorded for at least a minute to allow for a rate to be established. When the inflow from a stormwater pump is suspected, the flow shall be observed and recorded for a sufficient time (at least five (5) minutes) to determine if the it is cyclical.
- Utilities that intrude into the pipe.
- Drop Connections.
 - Begin observation as the camera approaches the drop connection vertical; do not wait until the camera head is immediately adjacent to the opening.

- While slowly approaching the drop connection, pan-and-tilt the camera head as necessary to maintain a constant view of the opening.
- When the camera head is adjacent to the drop connection, pan-and-tilt and adjust the camera position to record as much of the drop connection opening into the horizontal pipe and as much of the interior as possible.
- Maintain proper lens focus throughout the drop connection inspection
- After inspection of the drop connection, continue camera forward to complete the inspection of the sewer pipe and begin the inspection of the manhole; **the camera will not fall into the drop connection drop tube.**
- T-Connections
 - Complete inspection, using techniques similar to those for manholes (above).
- Items designated by the Engineer/Inspector

Record of Inspection

The Contractor will log the results of all observations and prepare whatever data may be required for record purposes; this log shall be submitted to the Engineer. Measurement to location features along the pipe alignment shall be at ground level by means of a counting meter to be provided and operated by the Contractor. The meter shall be mounted on the video cable winding assembly. The meter shall be equipped with a local mechanical readout for use at the rear of the inspection vehicle and an electronic counter that is connected to the data view system for display on the recording. Markings on cables, or the like, which would require interpolation for depth of manhole, will not be allowed. The meter shall accurately record the distance, in feet, that the video cable has traveled. The measurement will be accurate to three-tenths (0.3) of a foot per 100 feet of inspected sewer reach length.

The Contractor shall furnish all equipment for digitally recording of all sewer inspections for future reference. *Video recordings shall be made on DVDs in MPEG-1 format.*

The video recording shall begin at the center of the manhole of camera entry. The Contractor shall describe all features encountered while moving the camera from the center of the entry manhole to the distance in the pipe where he sets the footage meter. An audio recording of estimated footages shall be made for all features described prior to setting the footage meter. The recording shall include an audio description of all defects, service connections, joints, discharges or other features considered important by the Engineer. The date of the inspection and the distance that the camera has traveled through a particular sewer reach shall be continuously displayed on the recording. All recordings shall be turned over to the Engineer within one week of the inspection(s) recorded thereon.

All costs for DVDs shall be included in the prices bid. If the recording is not complete or quality not satisfactory, the sewer shall be re-inspected at the Contractor's expense.

Obstructions

Obstructions may be encountered during the course of the internal inspection that prevent the travel of the camera. Each occurrence shall be considered separately. Generally, however, the Contractor shall first attempt to pass the obstruction and, if failing in this attempt or if equipment damage may occur, withdraw the equipment and attempt internal inspection from the opposite end of the sewer under inspection (reversal). Should additional obstructions be encountered after the first redeployment, the alternative camera described in above shall be used. If, despite these efforts, no means are available for passing the obstructions without damage to the equipment, the un-inspected sewer shall be excluded from the work requirements.

Should the Contractor's internal inspection equipment become immobilized within a sewer line, said equipment shall be removed from the sewer line. If excavation is required to retrieve the Contractor's equipment, the excavation shall be accomplished by the Contractor at its expense. Following removal of the equipment, the Contractor shall restore the sewer line and the site in accordance with the construction specifications of the HMUA.

Sewer Plugging and Flow Restriction

All internal video inspections shall be performed with sewer plugs inserted in tributary sewers, as necessary, to prevent tributary flow from entering the inspected sewers.

When the Contractor conducts sewer plugging the following measures shall be taken:

- Evaluate location of buildings in immediate vicinity of manhole where plugging is proposed to assess whether a backup would occur.
- Insert plug(s) after all other preliminary inspection setup tasks have been completed.
- Record time of plug insertion.
- Limit plugging interval as needed by intermittently releasing plug to prevent sewage backups.
- Monitor upstream manhole to determine status of possible sewer surcharging.
- Plug at manhole other than the upstream manhole if appropriate. An alternate site may have flatter gradient with less chance of sewage backup.

If the flow rate precludes total sewer plugging during the daytime, the Contractor shall perform the internal inspections by doing the following:

- Schedule inspection work for a low flow period (nighttime).
- Partially restrict flow entering the inspected pipe.
- Bypass-pump all or part of the flow.

The Contractor shall be responsible for any liability caused by flow restriction or sewer plugging operations. There will be no transfer of liability to the Owner or the Engineer relative to sewer plugging or flow restriction.

Ventilation to Clear Steam and Vapors

At some locations, steam or vapors within the sanitary sewer may occur which will obscure the televised view of the sewer. When this situation arises, the Contractor shall use an air blower to ventilate the line and improve visibility within the sewers.

De-watering Sewer Sags

During the video inspection process every effort shall be made to obtain the specified view of the pipe interior. For instances where the camera lens becomes submerged or where a large portion of the pipe shall contain water and these conditions persist for significant portions of the sewer being inspected, the Contractor shall attempt to de-water the pipe. The Inspector shall determine when de-watering procedures are necessary.

De-watering can be accomplished with a pump and a discharge hose or by the nozzle of a hydraulic high-pressure jet machine. If the jet machine is used, it shall precede the video camera through the sewer pipe. The nozzle of the jet machine shall work in conjunction with the video camera's motion and shall be positioned so that the camera can view several feet of pipe length. The de-watering procedure shall move standing or ponded water out of the ponded or sagged section of sewer being inspected. If the camera noticeably emerges from a sagged section of sewer, which can be perceived by camera movement or staining on the pipe walls, the Contractor shall stop de-watering.

Internal TV inspections conducted with water levels exceeding the maximum levels listed below will be deemed unacceptable.

Pipe Diameter (Inches)	Maximum Water Level (Inches)
8 to 12	1/2
14 to 18	1
20 to 24	1-1/2

S2-11

2.07 Pipe Couplings and Repair Clamps

Where it is necessary to join pipes of different material with differing outside diameters, and where directed by the inspector, transition sleeve couplings shall be used to fit over the ends of plain end or spigot end pipe. The couplings shall be appropriately sized to join any two sewer pipe materials of compatible outside diameters. The couplings shall be Dresser Style 253 with stainless steel nuts and bolts and Buna N gaskets, or approved equal.

Where a pipeline repair includes the insertion of a section of new pipe, and where directed by the inspector, the butt joint at each end shall be accomplished using a sleeve type coupling. Sleeve couplings for all sanitary sewer pipe materials shall be Dresser Style 253 with stainless steel nuts and bolts and Buna N gaskets, or approved equal. For PVC pipe, solid sleeves may be used and shall be Class SDR-35 with rubber ring joints, Ring-Tite Double Bell Coupling, as manufactured by JM Eagle, or approved equal in accordance with Sections 2.01 and 2.02 of these specifications.

Where it is necessary to repair a pipe line defect without cutting the pipe, and where directed by the inspector, a full circle band type repair clamp may be used. Repair clamps shall be Series 261, single band, full circumference, all stainless steel construction as manufactured by Smith Blair or approved equal. All parts including the band, lugs, keeper bars, bridge plate, stud bolts and nuts shall be Type 304 stainless steel. The gasket shall be Nitrile (Buna N). Repair clamps shall be sized for diameter and length as necessary to suit the repair.

MINIMUM HOLDING TIME REQUIRED FOR
PRESSURE TO DROP FROM 3-1/2 TO 2-1/2 PSIG

1 Pipe Dia- meter (in.)	2 Minimum Time (min: sec)	3 Length Time for Minimum Time (ft)	4 for Longer Length (sec)	Minimum Time for Length (L) Shown (min:sec)								
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft	
4	3:46	597	.380 L 3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46	
6	5:40	398	.854 L 5:40	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:24	
8	7:34	298	1.520 L	7:34	7:34	7:34	7:34	7:36	8:52	10:08	11:24	
10	9:26	239	2.374 L	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48	
12	11:20	199	3.418 L	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38	
15	14:10	159	5.342 L	14:10	14:10	17:48	22:15	26:42	31:09	35:36	40:04	
18	17:00	133	7.692 L	17:00	19:13	25:38	32:03	38:27	44:52	51:16	57:41	
21	19:50	114	10.470 L	19:50	26:10	34:54	43:37	52:21	61:00	69:48	78:31	
24	22:40	99	13.674 L	22:47	34:11	45:34	56:58	68:22	79:46	91:10	102:33	
27	25:30	88	17.306 L	28:51	43:16	57:41	72:07	86:32	100:57	115:22	129:48	
30	28:20	80	21.366 L	35:37	53:25	71:13	89:02	106:50	124:38	142:26	160:15	
33	31:10	72	25.852 L	43:05	64:38	86:10	107:43	129:16	150:43	172:21	193:53	
36	34:00	66	30.768 L	51:17	76:55	102:34	128:12	153:50	179:29	205:07	230:46	

REF: UNI-BELL PLASTIC PIPE ASSOCIATION, PUB. UNI-B-6-79
"RECOMMENDED PRACTICE FOR LOW-PRESSURE AIR TESTING OF INSTALLED SEWER PIPE"

ITEM 3 - FOR FURNISHING AND INSTALLING
DUCTILE IRON GRAVITY SEWERS

3.00 Work Included

The Contractor shall furnish and install ductile iron gravity sewers and branch connections as shown on the Drawings or as directed by the Inspector. In general, ductile iron pipe shall be furnished when depth of cover is 3 feet or less, at stream crossings and where directed by the HMUA.

The work shall include all labor, tools, materials and equipment, including jointing materials, and such additional work as may be required to install the sewer to the line and grade shown on the drawings or as required to meet field conditions. The work shall also include all extra work and materials required for connections to existing sewers, and manholes.

3.01 Ductile Iron Pipe Material

Ductile iron pipe shall be centrifugally cast cement-lined and shall conform with AWWA C151-latest revision (ANSI A21.51-latest revision), Ductile Iron Pipe Centrifugally Cast in Metal Molds or Sand-Lined Molds for Water or Other Liquids. Cement lining shall conform with AWWA C104-latest revision (ANSI A21.4-latest revision), Cement Mortar Lining for Cast Iron and Ductile Iron Pipe and Fittings for Water and shall include a bituminous seal coat. Pipe exterior shall receive a standard foundry coal tar dip coating in accordance with AWWA C151-latest revision. Pipe may be furnished in 18 or 20-foot nominal laying lengths.

Joints shall be of the push-on type with a rubber gasket conforming with ANSI A21.11 (AWWA C111), latest revision thereof. Pipe plain ends shall be suitably beveled to permit easy entry into the bell. Pipe joints shall be "Tyton" as manufactured by United States Pipe and Foundry Company, "Fastite" as manufactured by American Cast Iron Pipe Company, "Super Bell-Tite" as manufactured by Clow Cast Iron Pipe and Foundry Company, "Tyton Joint" as manufactured by Griffin Pipe Products Company, or equal.

Each pipe delivered to the job shall have clearly marked, the weight, class designation and sampling period. In addition, each pipe shall have cast on the face of the bell the manufacturer's mark and the year the pipe was produced.

Pipe shall be minimum Class 52 (Pressure Class 250) unless otherwise indicated on the Contract Drawings.

Ductile iron fittings shall be cement lined, mechanical joint, meeting the American National Standard for Ductile Iron Compact Fittings for Water Service, ANSI/AWWA C153 /A21.53 latest revision thereof. Mechanical joints shall conform with ANSI/AWWA C111/A21.11, latest revision for Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings. Cement lining shall conform to ANSI/AWWA C104 /A21.4, latest revision, Cement Mortar Lining

for Ductile Iron Pipe and Fittings for Water and shall include a bituminous seal coat. The exterior surface of fittings shall receive a standard foundry coal tar dip coating, product to meet with EPA approval.

Ductile iron tees to be used for branch connections for services on gravity sewers shall be push-on joint.

Ductile iron pipe fittings in stream and stream crossings shall be furnished with MegaLug retainer glands as manufactured by EBAA Iron. Gland bolts for fittings shall be uniformly tightened using torque limiting ratchet wrenches properly set to the foot pound of torque as recommended by the Manufacturer. Pipe shall be properly aligned to line and grade. Where necessary to change direction, pipe may be deflected in the joint in accordance with the manufacturer's recommendations.

3.02 Ductile Iron Pipe Laying

In general, the minimum cover over pipe shall be 3 feet.

All pipe shall be carefully examined for defects, and no pipe known to be defective shall be laid. If any pipe is found to be broken or defective after being laid, it shall be removed and replaced by sound pipe without any further payment than is included in the prices bid.

Joint surfaces shall be protected from damage, and shall be carefully examined before jointing. No damaged joints shall be used in the work.

Pipe shall be thoroughly cleaned and ample precautions shall be taken to prevent entrance of dirt and debris into the pipe after laying.

Exposed ends of all uncompleted lines shall be provided with plugs or covers at all times when pipe laying is not actually in progress.

All pipe shall be carefully laid to true alignment and grade with bell ends facing upgrade.

All trenches shall be dewatered prior to pipe laying.

The trench bottom shall be carefully graded to the proper elevation, and the maximum practical solid bearing area shall be provided throughout its entire length, prior to swinging the pipe into place. No blocking under the pipe will be permitted. The pipe shall be laid on a minimum of 6-inches of $\frac{3}{4}$ inch clean broken stone in accordance with the requirements of the Authority.

Care shall be taken not to excavate below grade. Materials excavated below adopted grade shall be replaced by material which will meet with the approval of the Engineer, without any further payment.

Immediately after the pipe is brought to final position, it shall be thoroughly secured and properly bedded, in accordance with ANSI/AWWA C150/A21.50, latest revision, and ample support shall be provided to prevent settlement or disturbance.

Pipe shall be protected during construction against possible flotation due to pouring of concrete or in case the trench becomes flooded prior to placing the backfill, either with water, or a wet mud mixture. The pipe shall be backfilled with a minimum of 18 inches of compacted quarry processed stone on top of pipe. Remainder of trench shall be backfilled in accordance with the HMUA's standard "PVC Sanitary Sewer Trench Detail".

Laying shall be in strict accordance with recommendations of pipe manufacturer.

3.03 Ductile Iron Pipe Jointing

Jointing shall be done in strict conformance with manufacturer's recommendations. Pipe shall be handled with care to avoid damage to the lining and coating.

Cutting of pipe where required shall be done in a neat and workmanlike manner using power driven pipe cutters or other means which will produce a smooth end normal to the pipe axis with the cement lining undamaged. Cut ends shall be beveled to avoid damage to the gasket. Pipe ends shall be thoroughly cleaned prior to jointing and only approved lubricants shall be used.

3.04 Ductile Iron Pipe Testing

If an inspection of the completed sewer or any part thereof shows any manholes, pipes, or joints which allow the infiltration of water in a noticeable stream or jet, the defective work or material shall be replaced or repaired as directed.

When a reach of pipe deemed adequate by the Engineer is ready for testing, the line shall be tested with low pressure air in accordance with specification section 2.05, testing of PVC gravity sewer.

Should any test disclose damaged or defective materials or leakage greater than that permitted, the Contractor shall, at his own expense, locate and repair and/or replace defective materials. The tests shall be repeated until the leakage is within the permitted allowance and is satisfactory to the Engineer.

In the event that the section under test fails to meet the allowable leakage, the Contractor shall make all necessary repairs and repeat the test. The test shall be repeated as many times as is necessary to meet the allowable leakage specified above.

3.05 Flushing and Internal Inspection of Gravity Sewers

All newly installed gravity sewers shall be internally inspected by closed circuit TV following the completion of acceptable air and deflection testing and, if in roadway, after

base course paving has been performed. The video report shall document the locations of all lateral connections and pipeline distances between manholes. The internal inspection shall be observed by the Authority or its Engineer and a video tape of the entire inspection and a written report of the same shall be provided to the Authority. The flushing and TV inspection procedures shall be as specified in Section 2.06.

3.06 Pipe Couplings and Repair Clamps

Where it is necessary to join pipes of different material with differing outside diameters, and where directed by the inspector, transition sleeve couplings shall be used to fit over the ends of plain end or spigot end pipe. The couplings shall be appropriately sized to join any two sewer pipe materials of compatible outside diameters. The couplings shall be Dresser Style 253 with stainless steel nuts and bolts and Buna N gaskets, or approved equal.

Where a pipeline repair includes the insertion of a section of new pipe, and where directed by the inspector, the butt joint at each end shall be accomplished using a sleeve type coupling. Sleeve couplings for all sanitary sewer pipe materials shall be Dresser Style 253 with stainless steel nuts and bolts and Buna N gaskets, or approved equal. For Ductile Iron Pipe, solid sleeve couplings may be TR-Flex sleeve, as manufactured by U.S. Pipe or Tyton Joint sleeve, as manufactured by Atlantic States Cast Iron Pipe Company, in accordance with Section 3.01 for Ductile Iron Pipe material.

Where it is necessary to repair a pipe line defect without cutting the pipe, and where directed by the inspector, a full circle band type repair clamp may be used. Repair clamps shall be Series 261, single band, full circumference, all stainless steel construction as manufactured by Smith Blair or approved equal. All parts including the band, lugs, keeper bars, bridge plate, stud bolts and nuts shall be Type 304 stainless steel. The gasket shall be Nitrile (Buna N). Repair clamps shall be sized for diameter and length as necessary to suit the repair.

3.07 Shop Drawings

Shop drawings and specifications covering all details of pipe and fittings furnished under this Item shall be furnished to the HMUA or its Engineer for approval before ordering any material.

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ITEM 4 - FOR FURNISHING AND INSTALLING
PRECAST CONCRETE MANHOLES

4.00 Work Included

The Contractor shall furnish all labor, equipment and materials to install and construct precast concrete manholes with flexible manhole sleeves, exterior wall coating and manhole steps. The frames and covers of required types, masonry leveling courses for manhole frames, stubs for future sewers, drop piping, channeling, benching and joint plastering, and concrete encasement of external drop connection piping shall be included in the work for this item.

Prior to starting construction, shop drawings indicating all construction details shall be submitted for approval by the Engineer. In addition, the Contractor shall submit sketches indicating the centerline elevations of and horizontal angles between all pipe openings for each manhole.

4.01 Description - Precast Manholes

Precast concrete manholes shall consist of precast reinforced concrete sections, a conical or flat slab top section, and a base section conforming with the typical manhole details as shown on the Authority's standard details, and as specified herein.

Precast manhole sections shall be manufactured in accordance with ASTM Designation C478, latest revision. The minimum compressive strength of the concrete for all sections shall be 4,000 psi. The maximum allowable absorption of the concrete shall not exceed eight (8) percent of the dry weight. Precast manhole sections shall have no more than two lifting holes which shall be sealed with rubber plugs after installation and grouted flush with inside and outside walls. Tests, if required, shall be as those described in ASTM C76, latest revision. The circumferential steel reinforcement for riser pipe, cone sections and base walls shall be a minimum of 0.12 square inches per lineal foot. Reinforcing in both layers of steel of the flat slab top sections and in the layer of steel in the bottoms of bases shall be a minimum of 0.12 square inches per lineal foot in both directions. Flat slab top sections shall be designed to carry an H-20 wheel load. All manhole sections shall be manufactured by the "wet cast method."

Joints of the manhole sections shall be formed entirely of concrete employing a round rubber gasket conforming to ASTM C443, latest revision, and, when assembled, shall be self-centering and make a uniform watertight joint. Except for those surfaces within the gasket groove, all inside surfaces of the bell or outside surfaces of the spigot, or both, on which the rubber gasket may bear during the closure of the joint and at any degree of partial closure shall be parallel within one (1) degree and have an angle of not more than two (2) degrees with the longitudinal axis of the pipe. In joints formed entirely of concrete, the distance from either side of the gasket to the end of the bell or spigot shall

not be less than 3/4 inch. The gasket spaces between the bell and spigot shall be so shaped as to provide grooves that will prevent the gasket from disengaging from its compression surface or being blown out by hydrostatic pressures. Joints shall be mortared on exterior and interior surfaces. Manholes manufactured without a rubber gasket joint shall use bitumastic material installed in the joint at the time of assembly. Bitumastic material shall be furnished and installed on both the horizontal and vertical faces of the manhole joint.

Taper sections and cone sections shall be used wherever possible to reduce the manhole diameter to that required for the manhole castings. Only where required to meet field conditions, and if approved by the Inspector, the Contractor shall furnish manholes with flat top sections.

The frames and covers shall be set to final grade, utilizing brick and mortar for height adjustment, if necessary. Such adjustment shall be limited to two (2) courses of block or a maximum of 14 inches. The Contractor shall furnish to the job site sufficient one-foot manhole barrel riser rings for proper manhole height adjustment. Only one (1) one-foot riser may be used per manhole.

Flexible manhole sleeves or a circular rubber gasket shall be provided for all pipes entering manholes. These opening sleeves shall be integrally cast with the manhole base-sections. Each manhole sleeve shall be set to the correct alignment and elevation. Clamps shall be stainless steel.

Floors and inverts shall be best quality vitrified precast or brick concrete. Inverts shall have a cross section of the exact shape of the sewers which are connected, and changes in size shall be made gradually and evenly, unless otherwise specifically directed. Half pipe inverts may be used in straight-through manholes.

4.02 Materials

Concrete Foundation Mat: Where directed by the Engineer, concrete foundation mats for manholes shall be constructed in accordance with the Authority's standard details and concrete mat shall be 3000 pound concrete.

Whenever the term "concrete" is used herein, it is understood to mean a homogeneous mixture of cement, sand and coarse aggregate with the proper amount of water. The class of concrete shall be designated by strength. The strength shall refer to the unit compressive stress required to fracture the concrete in accordance with the Standard Methods of making Compression Tests of Concrete, as defined by the American Society for Testing Materials (Serial Designation C-39, latest revision).

Concrete shall have a compressive strength at the end of 28 days of not less than 3,000 pounds per square inch, as determined by tests described herein. Concrete shall have a cement content not less than 6 bags per cubic yard, a water content not exceeding 5.0

gallons per bag of cement, shall contain 2% entrained air and shall contain coarse aggregate such that the hardened concrete weight is 145 lbs./cu.ft., $\pm 3\%$. Unless otherwise approved by the Inspector, all concrete under this item shall be ready-mixed. Cement shall be Type II Domestic portland cement conforming to the requirements of "Specifications for Portland Cement", ASTM Designation C150, latest revision.

Frames and Covers: The Contractor shall furnish and set level to the proper grade, cast iron manhole frames and covers as follows: (See Contract Drawings for details).

1. Campbell Foundry No. 1202B standard, or equal, in Public Rights-of-Way.
2. Campbell Foundry No. 1486, or equal, Locking Type Frame, Installed in Private Rights-of-Way.
3. Campbell Foundry No. 6545, or equal, Watertight Frame, Installed Outside of Roadway Rights-of-Way in water prone areas.

All castings for manhole frames and covers shall be of tough grey iron, free from cracks, holes and cold shuts. The quality shall be such that a blow from a hammer will produce an indentation on a rectangular edge of the casting without flaking the metal.

All castings shall be made accurately to dimensions and shall be machined to provide even bearing surfaces. Covers must fit the frames in any position, and if found to rattle under traffic, shall be replaced. Filling to obtain tight covers will not be permitted. No plugging, burning in or filling will be allowed. The frame shall be thoroughly bedded in mortar. As an alternative to the installation of mortar, the Contractor may furnish and install rubber adjusting rings of an appropriate thickness. The rubber adjusting rings shall be as manufactured by American Highway Products (AHP), or approved equal. The rubber adjusting rings are to be secured to the top of the precast concrete manhole cone section and to the bottom of the manhole casting with approved adhesive.

Drop manholes shall be provided as shown on the Contract Drawings where the difference between inverts exceeds two (2) feet in elevation. Piping and fittings for the drop connection shall be of the same material as used for main piping and shall be placed on the outside of the manhole. Where approved by the HMUA, precast drop pipe sections may be utilized. The base manhole section shall include a monolithic precast concrete drop pipe encasement. Drop manhole piping shall be encased in concrete as shown on the Authority's standard details. **A 60" diameter manhole shall be used if the contractor wishes to have an internal drop installed.**

All castings shall be carefully coated inside and out, with asphaltic pitch varnish of approved quality. Manhole covers shall be embossed with the lettering and date as shown on the Authority's standard details. Where more than one size or type of frames and covers are included in the same contract, the Engineer shall specify, in the field, the locations of each type.

Steps: During the construction of each manhole, steps of bar aluminum seven-eighths of an inch (7/8") by thirteen-sixteenths of an inch (13/16") shall be set in place on the inside of the manhole beginning two (2) feet above the bottom, and spaced not more than twelve (12) inches to center, with the top step within 18 inches of the cover, as shown on the Authority's standard details. Steps shall be constructed to the dimensions shown on the Contract Drawings and shall be properly embedded in the wall. Steps shall be installed on the vertical side of the cone section and shall be aligned vertically. As an alternative, steps shall be polypropylene plastic with ½ inch Grade 60 steel reinforcement.

Aluminum alloys shall be Alcoa 6061-T6.

4.03 Installation

Precast base sections shall be installed on a crushed stone or concrete foundation mat as indicated on the Authority's standard details. The bell of the manhole base shall be wiped clean, be free of all dirt and grit, and liberally soaped in preparation for receiving the riser, cone or slab top section. Prior to snapping the gasket onto the spigot groove of the riser or cone section, the gasket should be wiped clean and well soaped. A screwdriver or hammer handle inserted beneath the gasket and run around the pipe will insure even seating. The riser or cone section with gasket in place should then be lowered into the bell of the manhole base, taking care that no dirt gets into the joint or on the gasket. Additional riser or cone sections should be joined in a similar manner. Where gaskets are not supplied with the manhole sections, bitumastic material shall be applied on both the horizontal face and vertical face of the manhole joint as each joint is assembled.

All pipes or castings to be embedded in masonry work shall be accurately set, brick headers shall be laid around the pipe so embedded. Spurs or stubs for branch sewers shall be built in the manholes where shown on the Drawings or otherwise required by the HMUA. They shall be closed with brick masonry or PVC plugs. Precast grade rings and manhole bricking shall not be used for grade adjustment of more than four (4) inches.

Flexible manhole sleeves and stubs for future use shall be furnished as indicated on the Contract Drawings. A two (2) foot length of pipe of the type and size indicated with end cap shall be installed in the sleeve.

Plaster shall be troweled to a smooth, hard finish, and no backfill shall be placed until mortar has thoroughly hardened.

Prior to backfilling all exterior joints shall be cleaned and mortared. After the mortar has obtained adequate set the entire exterior of the manhole shall be completely coated with an approved bitumastic sealing compound, applied in accordance with the manufacturer's recommendations. Manhole sections may be coated prior to installation, however those portions which will be mortared after installation shall not be coated until mortar is

applied. A bituminous or plastic type exterior joint filler may be used if recommended by the manhole manufacturer.

Upon completion, all debris shall be removed from manholes.

4.04 Watertight Work Required

The entire work of constructing manholes must be carried on in a manner to insure watertight work, and any leaks in manholes shall be caulked, repaired, or the entire work shall be removed and rebuilt.

Attention is particularly called to the necessity of keeping the water level below all parts of the brick or concrete foundation and walls until the cement has obtained adequate set.

4.05 Final Acceptance Testing

The Contractor shall perform a vacuum test in accordance with ASTM C 1244, latest revision. Vacuum test shall not be performed earlier than 7 days after installation of manhole. A "Vacuum Test" for leakage shall be performed on each manhole. This test shall be performed following the completion of the manhole installation, including but not limited to all inlet and outlet piping, benches, complete manhole with casting mortared in place and final surface restoration. The test shall be performed by the Contractor and witnessed by the Inspector. At the completion of testing, the Contractor shall submit to the HMUA a test report for each manhole including, date, time, manhole number, testing readings and whether the test passed or failed.

The Contractor shall provide a circular-shaped vacuum manhole tester as manufactured by Cherene Industries, Inc., or approved equal.

Prior to the start of testing, the Contractor shall repair to the satisfaction of the Inspector, all areas where there is visible infiltration into the manhole. The manhole shall then be thoroughly cleaned, drained and all openings sealed with plugs properly designed to provide a watertight seal for testing. All plugs and pipe shall be braced and the vacuum apparatus installed in accordance with the manufacturer(s)' instructions.

The vacuum pump shall be used to draw a vacuum of ten inches (10") of Mercury. The valves shall be closed and the pressure shall be monitored with the time recorded for the pressure to drop from ten inches (10") of Mercury to nine inches (9") of Mercury. The minimum time allowed shall be sixty (60) seconds for manholes of all depths. If the one inch (1") pressure drop from 10" to 9" is less than sixty (60) seconds, the test will not be considered a "passing" result. The manhole shall be repaired and the test repeated until all manholes pass the test.

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ITEM 5 – FOR SEWER HOUSE CONNECTIONS – BRANCH FITTINGS AND PIPE

5.00 Work Included

Wherever directed by the Inspector, the Contractor shall install 4-inch and 6-inch gravity house connections from the main sewer to the easement line or property line as may be specifically ordered by the Inspector and at locations shown on the approved plans. The Contractor shall also install cleanouts as required.

When directed by the Inspector, the Contractor shall install 4-inch or 6-inch diameter gravity sewer branch connections.

For PVC sewer pipe, an approved tee-wye connection fitting shall be installed in the collection main in accordance with the instructions of the pipe manufacturer. The entire connection shall be cradled in concrete as detailed on the Contract Drawings, if specified by the Inspector.

Where directed by the Inspector, the Contractor shall install saddle connections.

5.01 Materials and Workmanship

All applicable provisions of other Items 2 and 3 of these Specifications shall pertain to this item. Gravity PVC pipe shall be Class SDR-35, in accordance with ASTM D3034-, latest revision, and ductile iron pipe shall be in accordance with AWWA C151, latest revision.

House connections in any given street shall be laid coincidentally with or shortly after, main sewer is installed so that street repairs and cleanup are rapidly completed.

Gravity house connections shall be plugged at the upstream end with a solid pipe plug secured in place to prevent infiltration. A 2" x 4" timber shall be left in the trench to indicate the location of the end of the line and shall extend from the invert of the pipe to a point 18-inches above the ground. The pipe shall be laid on a continuous upgrade of not less than 1/4" per foot (4-inch diameter pipe) or 1/8" per foot (6-inch diameter pipe) and located where ordered by the Inspector.

Where house connections exceed 75 feet in length or where ordered by the Inspector, the Contractor shall install cleanouts as shown on the Contract Drawings. Cleanouts shall be constructed of PVC pipe, fittings, caps and plugs of the same size used in the house connection. The tee-wye shall be encased in concrete, if directed by the Inspector. Where required by the Inspector, the entire cleanout shall be encased.

The branch connections shall be made as shown on the Drawings or herein specified. Branch connections for PVC gravity sewer pipe shall be such as to meet ASTM Standards as specified in ASTM D3034, latest revision, SDR 35. Branch connections for DIP gravity sewer pipe shall meet ANSI/AWWA C153/A21.53, latest revisions.

All PVC branch connections shall be supported to firm undisturbed ground with ¾" clean stone or concrete encasement as directed by the Inspector.

The connection fitting shall be installed as located in the field by the Inspector. The Contractor shall indicate the location of the stubs by a mark on the curb or pavement, as well as by placing a 4-foot length of 2 x 4 at the location of the branch connection. The tee-wye connection shall be plugged with an approved metal or plastic compression plug with a rubber ring seal until the house connection is installed.

All fittings shall be PVC gravity sewer pipe fittings with a rubber ring in each bell and ring groove so designed as to prevent ring displacement.

Where a new lateral connection is required to be installed on an existing sewerline where a branch fitting has not been provided a saddle tap connection shall be made using a 4" circular cutting device and a saddle connection. The saddle connection shall be a cast iron fitting with a rubber gasket with stainless steel straps. The saddle connection shall be Sealtite Model D as manufactured by Geneco, or approved equal.

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ITEM 6 - FOR FURNISHING AND INSTALLING
GRINDER PUMPING UNITS, COMPLETE

6.00 Work Included

The Contractor shall furnish all labor, equipment and materials to furnish and install individual household grinder pumping units, as specified herein, as detailed on the Contract Drawings, and in accordance with manufacturer's recommendations. The work shall include limited site and access clearing as required to facilitate the work; test pits; excavation; installation of the grinder pump unit, connection of an influent stub, effluent piping connections, installation of redundant check valve, installation of the alarm/disconnect panel; installation of the direct burial electric/control cable between the grinder pump unit and alarm/disconnect panel; backfill; site restoration and testing.

The Contractor shall furnish and install the grinder pumping units, alarm/disconnect panel, direct burial power and alarm cable, access extension sections, and redundant check valves for the 1-1/2 inch effluent pressure sewer. The grinder pumping unit shall be as manufactured by E-One, Interon, or approved equal.

The work shall also include close coordination with homeowners, the Inspector, the Owner and the Owner's grinder pump unit supplier.

Excavation, crushed stone, concrete, and backfill with select material shall be included in the work.

Certain site restoration work shall be under other applicable items of these specifications.

Prior to starting construction, the Contractor's personnel shall be trained in proper installation techniques by the grinder pump manufacturer. Shop drawings indicating all construction details shall be submitted by the Contractor for approval by the Engineer.

The Contractor shall be responsible for surface restoration of paved, improved, or unimproved areas disturbed during installation of the grinder pump unit, power and signal cables and conduit, and control/disconnect switch.

6.01 Coordination

A. Delivery of Grinder Pump Units

The Contractor shall coordinate with the grinder pump supplier and arrange all deliveries of grinder pumps and appurtenances to the installation site or to the Contractor's secure storage/staging area.

The Contractor shall also coordinate with the grinder pump supplier and arrange for technical assistance regarding installation concerns, testing, troubleshooting and repairs.

B. Installation Training

Prior to installation of any grinder pump units, the Contractor/Contractor's Representatives shall attend one (1) 8-hour seminar, conducted by the grinder pump supplier, in which the Contractor shall be trained in the proper installation, operation, and maintenance procedures associated with the furnished equipment (electrical, plumbing, and start up). Prior to installing any grinder pump units, the Contractor must demonstrate by letter or certificate, that they attended the seminar. The seminar shall be scheduled immediately prior to delivery of the first group of grinder pump units to the site.

6.02 Materials

Concrete for grinder pump ballast, foundation mat, fill, encasement or thrust blocks shall be 3,000 psi concrete.

Gravel or broken stone shall be as specified under Item 8.

Select fill material shall be as specified under Item 7.

PVC pipe for the gravity house connection stub (influent stub) shall be 4" nominal pipe size PVC (4.5" outside diameter) SDR-35 as specified under Item 5.

PVC Force Main Material

All pipe shall be best quality unplasticized polyvinyl chloride sewer pipe, adequate for the external loading conditions, with joints providing flexibility and watertightness under service conditions. Smooth internal surfaces, producing high carrying capacity obtainable with best standard practice and best workmanship, will be required. Pressure sewer pipe shall be in accordance with ASTM D2241 (latest revisions). Sewer pipe shall meet the requirements for extra strength sections of the above noted ASTM Specification (minimum SDR-21).

The pipe shall be accurate and of uniform dimensions. All pipe shall be straight and true to form without bulges, dents, cracks, tears, or other defects which will affect strength, and shall have no bulges or dents on interior surfaces which will result in a noticeable variation in diameter from that obtained on adjacent unaffected portions of the surface. Each pipe shall not vary in length more than 1.0 inch in a length of 20 feet measured as mid-ordinate. Materials properties shall meet the test requirements of ASTM D1784 (latest revisions).

Joints shall be of the bell and spigot type with rubber ring. Joints shall be manufactured in accordance with ASTM D3212, latest revision. The bell shall consist of an integral wall

section with a solid cross-section rubber ring factory assembled. The ring groove shall be so designed as to prevent ring displacement. Size shall be as shown on the Contract Drawings or as required by field conditions. Jointing shall be in accordance with recommendations of the manufacturer.

Installation and jointing shall be in accordance with Item 2.

6.03 Installation

Individual grinder pumps shall be installed at the locations and elevations shown on the Contract Drawings and as directed by the Inspector. Surrounding ground shall be graded to provide positive drainage away from the grinder pump unit. Grinder pump units shall not be situated in depressions subject to puddling.

The grinder pump unit shall be transported and installed in accordance with the manufacturer's recommended procedures.

Grinder pump units shall be installed on a bed of crushed stone or a concrete foundation mat and shall be provided with concrete ballast around the base of the unit as required by the manufacturer. Concrete ballast may be poured in place or precast. Quantity of concrete ballast required is dependent upon the buoyancy of the grinder pump unit installed and shall be as required by the grinder pump unit manufacturer.

Piping connections shall be made to the grinder pump unit after backfill has been placed and thoroughly compacted to the respective pipe elevation.

An influent gravity house connection pipe shall be installed. The Contractor shall furnish and install a five (5) foot section of four inch (4") PVC SDR-35 pipe with tee, vertical cleanout, and a one foot pipe stub with end cap from the cleanout, from the grinder pump unit towards the existing septic soil pipe. This stub shall be plugged at the upstream end with a Fernco type cap secured in place with stainless steel hose clamp to prevent infiltration. The one-foot pipe stub shall be marked with a 2" by 4" (2"x4") timber extending from the invert of the pipe to a point 18" above ground surface. The pipe shall be laid on a continuous upgrade of not less than 0.25-inch per foot and located where ordered by the Inspector. The cleanout assembly shall be as shown on the Authority's Standard Detail.

The alarm/disconnect panel shall be mounted on the exterior of the residential/commercial building as shown on the Contract Drawings and/or as directed by the Inspector. Direct burial electric/control cable shall be installed between the alarm/disconnect panel and the grinder pump unit.

Sewage grinder pump locations shown on the drawings are schematic only, to indicate properties to be served. Sewage grinder pumps shall be installed at locations adjusted as necessary to avoid ditches, sidewalks, existing utility lines, hedges, fences, and to insure proper hydraulics from house connection to grinder pump (i.e. slope, flow, etc.).

The local municipality, through its authorized representative, will make every attempt to arrange for access as required and to coordinate the grinder pump unit installation so as to provide minimum inconvenience to occupants of the structures being served and minimum inconvenience to the Contractor. However, no additional claims may be made by the Contractor for delays encountered due to delays attributable to property owners, electrical or plumbing inspections, or delays otherwise beyond the control of the Owner.

A 15-day maximum time limit shall be allowed on a single property to complete installation of the grinder pump, 1-1/2 " pressure service connections and surface restoration.

Test pits shall be excavated by hand by the Contractor, prior to construction of the pressure service connection and grinder pump, to determine locations and elevations of existing house sewer connections to septic tanks for the purpose of determining appropriate grinder pump locations and accessway lengths. From this information, the Engineer shall either confirm the locations shown on the drawings or he shall direct the Contractor where to install the grinder pump units, associated piping, service valves, and the length of accessway to be acquired and installed for each unit. If no grinder pump assembly is on hand with the required accessway height, the Contractor shall restore the test pit excavation to original grade until the required pump height is on hand.

Existing underground utilities on privately owned lots are not shown on the drawings. The Contractor shall proceed with caution in any excavation and shall take every means to determine the exact location of underground structures, pipelines, sewers, septic tanks, leach fields, dry wells, conduits, etc., prior to excavation in the immediate vicinity thereof. The Contractor shall be held strictly responsible for the repair and/or replacement of any structures, pipe lines, sewers, conduits, etc., above or below ground, which may be broken or otherwise damaged by his operations. Any damage to existing utilities shall be repaired by the Contractor as directed by the Inspector.

The Contractor shall excavate for the installation of the sewage grinder pump unit in accordance with the Contract Drawings, Standard Details and as specified. The Contractor shall avoid excavating in the area of existing septic tanks to insure that the tanks are not damaged during this work. The Contractor shall minimize the amount of disturbed area when excavating and stockpiling earth. Damage to trees, shrubs, and property shall be avoided.

A minimum of six inches of gravel bedding shall be placed at the bottom of the excavation and leveled. The 4-inch socket inlet on the grinder pump unit shall be suitably plugged to prevent the entrance of soil and water during placement of the pump unit. The grinder pump unit shall be carefully lifted utilizing the lifting eyes provided by the manufacturer and placed on the gravel bedding. Spreader bars shall be used when lifting grinder pump units so that the weight of the pump unit will be equally distributed among the lifting eyes.

After placement within the excavation, the grinder pump unit shall be properly oriented to receive the inlet piping connection and set plumb.

A concrete anti-flotation collar shall be constructed in place in accordance with the details shown on the drawings. The Contractor shall brace the grinder pump unit during placement of the concrete using timbers or other anchoring means to prevent shifting or flotation of the unit. The concrete shall be vibrated to eliminate voids and cured for 24 hours before backfilling. The top of the concrete collar shall be at least three inches (3") below the bottom of the inlet socket. At the Contractor's option, he may have anti-flotation collars precast after having details/drawings submitted to and approved by the Engineer.

Connection of the 1-1/2" pressure house connection to the 1-1/4" threaded 304 stainless steel female fitting on the grinder pump unit shall be made using 1 - 1/4" SDR 21 PVC to 304 stainless steel adaptor and a bushing.

Following installation of the tank including accessway, piping, concrete collar, etc., the grinder pump unit shall be inspected by the HMUA or HMUA's Representative. Following inspection, the grinder pump unit shall be backfilled and compacted.

Backfill shall consist of sub-rounded to rounded pea gravel or processed stone having a gradation within the following limits.

<u>Sieve Size</u>	<u>Percent Passing by Weights</u>
1/2"	100
No. 4	70 – 85
No. 40	10 – 30
No. 200	0 – 5

The excavation for the pump unit shall be backfilled to within six inches of existing grade, a filter fabric underlayer installed, followed by six inches of topsoil.

At the time of installation, or within one (1) working day thereof, the Contractor shall supply to the HMUA the pump unit serial number, the date of installation, and the location of installation.

6.05 Testing

Hydrostatic Test

The PVC SDR-21 pressure pipe shall be tested as described below.

Each section of pressure sewer between cleanouts shall be cleaned and pressure tested to locate defects in materials or workmanship.

The section to be tested shall be filled with water ensuring that all air has been removed from the section under test. Once the pressure sewer line is filled, water shall be pumped into the pressure sewer to increase the pressure to a maximum of 150 psi as measured at the lowest point of the section being tested.

When the test pressure of 150 psi has been reached, the pump shall be valved off for a period of 15 minutes. At the end of the test period, the pressure shall be increased, measuring the amount of water required to reach the test pressure of 150 psi. No leakage shall be allowed

Should this test show the line to be defective, the Contractor shall remedy such defects and retest the line as specified. This procedure shall be repeated until the test requirements are met.

Deflection Test

The Contractor shall perform vertical ring deflection testing on all portions of PVC sewer piping, in the presence of the Inspector, after backfilling has been in place for at least 30 days.

Deflection testing shall be conducted on each section of pipe.

The rigid ball or mandrel used for the deflection test shall have a diameter not less than 95 percent of the base inside diameter or average inside diameter of the pipe, depending on which is specified in the ASTM Specification, including the appendix, to which the pipe is manufactured. The pipe shall be measured in compliance with ASTM D2122 Standard Test Method of Determining Dimensions of Thermoplastic Pipe and Fittings. The test shall be performed without mechanical pulling devices.

The deflection testing shall be performed with a deflectometer, calibrated television, or a properly sized 'Go, No-Go' mandrel. The mandrel(s) shall be constructed at the Contractor's expense and subject to the approval of the Inspector.

Piping which exceeds the allowable deflection shall be located, excavated, replaced, and retested at the expense of the Contractor.

Grinder Pump Testing

Each sewer grinder pump unit installation shall be tested as specified herein with a qualified pump manufacturer factory trained technician assisting the Contractor. The pump manufacturer shall supply the Contractor a test assembly which permits the testing of each grinder pump unit separate from the house service main and permits testing of the service force main from the pump unit.

- a. Testing of the sewer grinder pump units shall not be performed until ALL DOWNSTREAM pressure sewer house connections throughout the service valve

assemblies, and gravity sewer piping has been installed for all downstream contracts in this project. Before testing, all equipment shall first be properly lubricated, serviced and adjusted in accordance with the manufacturer's specifications to insure that the equipment is properly installed without developing vibration, overheating, or excessive noise.

- b. All testing shall be performed in the presence of the Inspector. The Contractor shall notify the Engineer in advance of all testing. All equipment, materials and labor required for the testing shall be furnished by the Contractor, including, at a minimum, a portable generator (if temporary power is required) and water for testing each basin.
- c. The Contractor shall apply power to the sewage grinder pump unit using a portable electric generator with appropriate electrical power (i.e., frequency, phase, voltage, etc.) and of sufficient capacity to operate the sewage grinder pump unit.
- d. The authorized factory technician(s) shall perform the following test on each station:
 1. Make certain the discharge shut-off valve is fully open. This valve must not be closed when the pump is operating. In some installations, there may be a valve(s) at the street main that must also be open.
 2. Turn ON the alarm power circuit.
 3. Fill the wet well with water to a depth sufficient to verify the high level alarm is operating. Shut off water.
 4. Turn ON pump power circuit. Initiate pump operation to verify automatic "on/off" controls are operative. Pump should immediately turn ON. Within one (1) minute alarm light shall turn OFF. Within three (3) minutes the pump shall turn OFF.
- e. Should any sewage grinder pump unit fail any part of the specified testing procedure, the Contractor shall ascertain the cause of the failure and make the necessary repairs or adjustments as required. Contractor shall then retest as specified. The Contractor shall repair or replace any damaged component with factory supplied new parts or components, at no cost to the Owner.

Any defective work which shows up while conducting tests or before conditional acceptance, shall be replaced or repaired by the Contractor at his own cost and expense. Any leaks occurring after conditional acceptance, but before final acceptance, due to either blown joints or cracked pipe or fittings, shall be repaired by the Contractor at his own expense. When pipe or fittings are damaged in any respect because of the Contractor's neglect or method of installation, they shall be replaced with new materials at the expense of the Contractor. Should the work be done by the Owner in the case of an emergency, the actual cost of replacing such materials and making such installations will be deducted from any amount of money retained by the Owner under the Contract.

The pump manufacturer shall provide one (1) 8-hour seminar, in which they shall train the Contractors and representatives of the Owner in the proper installation, operation, and maintenance procedure associated with the furnished equipment (electrical, plumbing, and start up). Each attendee will be furnished with a letter or certificate certifying that they attended the seminar. This training seminar shall be scheduled immediately prior to delivery of the first group of grinder pump units to the site.

6.06 Watertight Work Required

The entire work of installing grinder pumping units must be carried on in a manner to insure watertight work, and any leaks in the pumping units, influent or effluent pipe stubs shall repaired, or the entire work shall be removed and rebuilt.

Attention is particularly called to the necessity of keeping the water level below all parts of the concrete foundation and fill until the concrete has obtained adequate set.

6.07 Electrical

The Contractor shall mount a grinder pump alarm/disconnect panel to an exterior wall of each house served by a grinder pump, at a location determined by the Inspector, and shall furnish and install, in compliance with appropriate national local codes, all wiring and conduit between the remote-mounted alarm/disconnect panel and the grinder pump station as shown on the Drawings and as specified hereinafter.

- a. The grinder pump station shall be provided with a cable (supply cable) for connection between the station and the control panel. The supply cable shall be shipped inside the station with a small portion fed through the cable connector mounted on the wall of the fiberglass shroud. The supply cable, a six conductor, No. 12 AWG minimum tray cable shall meet NEC requirements for direct burial with a minimum of 24" burial depth maintained. Those portions of the cable, which have less than 24" of cover, must be contained in a 1-1/4" PVC conduit. This includes the vertical portion dropping to a 24" depth at the station and the length rising out of the ground at the control panel. The conduit shall be sealed at the alarm box side. Wiring shall be installed in compliance with local codes. All connections to the alarm/disconnect panel shall be weatherproof, and connections through accessways shall be watertight.
- b. Metallic Detection tape shall be furnished and installed by the Contractor in trench over buried cables, 12 inches below finished grade.
- c. Each installation shall be complete in every respect and shall include all work necessary and required to provide a neat and workmanlike installation, and shall include but not be limited to: all that material required for all installations, furnished, supplied and installed; all interconnections and reconnections; control panel to grinder pump connection to specified limits; and all other work, whether specified or not, to insure compliance with the NEC and local municipal Electrical Code Official's

requirements. It shall be the responsibility of the Contractor to secure any required municipal building permits for the work involved, and to arrange for any necessary inspections by those agencies requiring inspections. An electrical subcontractor must be engaged by the Contractor to wire the units and to make permit applications. Each installation shall be grounded in accordance with NEC and local municipality Electrical requirements.

- d. This item shall include mounting of the control and disconnect panel upon the structure being served or stand-alone pole mounted as directed by the Engineer, and shall be in accordance with the customer's existing service. Control panels mounted on the structure shall be firmly affixed to the structural members of the building and shall not merely be fastened to the exterior surface of said building. Stand-alone pole mounted control panels shall conform in all respect to height and applicable NEC requirements.

The Contractor shall install a complete package underground pump station on the Homeowner's premises. Included in this work is the installation by a licensed Electrical Contractor of power and signal cables from underground station to a side wall of Homeowner's house and panels which must be within the line of site of the underground pump station. The Contractor's electrical subcontractor shall install on the side wall of the house, a rainproof NEMA 4X disconnect/alarm panel as manufactured by Environment One, or equal. The electrical subcontractor shall install all interconnecting wiring between the control panel and terminate all pump station wiring in panel. The Contractor shall apply to the local Construction Code Official for an electrical permit, shall pay all fees for his work and shall have all his work inspected and approved.

The electrical/control cabinet shall be rated NEMA 4X and shall be supplied by the pump manufacturer or approval equal source. The Contractor install the cabinet (cabinet furnished under separate contract) which shall contain all breakers and control features required by the grinder pump system to be installed at the site, and which shall conform to all applicable requirements of NEC and local municipal Electrical Bureau Code Enforcement Official.

The grinder pump station shall be designed for 1 phase, 240 volt, 60 hertz, 3 wire power supply and shall be furnished with sufficient lengths of manufacturer-provided cable. The power supply cable shall be six conductor No. 12 AWG minimum tray cable provided by the pump station manufacturer, or as otherwise required to meet local code requirements. Size of the cable conductors shall be determined based on the actual distance between alarm and disconnect panel and grinder pump station by the manufacturer.

The Contractor shall install cable furnished by the pump manufacturer. Direct burial cable shall be installed at 24" below finished grade. Those portions of the cable which have less than 24" of cover must be contained in 1-1/4" PVC conduit. This includes the vertical portion dropping to a 24" depth at the station and the length rising out of the ground at the control panel.

The grinder pumps shall be free from electrical and fire hazards as required in a residential environment. As evidence of compliance with this requirement, the completely assembled and wired grinder pump in its tank shall be listed by Underwriters' Laboratories, Inc.

It shall be the responsibility of the Contractor to furnish and install equipment and material in compliance with appropriate National Electric Code and local municipal Codes. The homeowner shall be responsible for providing and installing adequate electrical power, overcurrent protection and all wiring from his circuit breaker or fuse panelboard to the control/disconnect panel installed by the Contractor.

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ITEM 7 - FOR FURNISHING AND PLACING QUARRY-PROCESSED STONE

7.00 Work Included

The Contractor shall furnish, place, grade and compact quarry-processed stone for pipe bedding and backfill as noted on the Drawings or as directed by the Engineer.

7.01 Materials and Placing

Quarry-processed stone, Type 5A, N.J.D.O.T., shall be equivalent to Dense Graded Aggregate (DGA) material as outlined in the New Jersey State Department of Transportation Standard Specifications, Section 901.08 dated 1996, or latest revision thereof. Dense Graded Aggregate material shall be broken stone or crushed gravel conforming to the gradation and moisture requirements set forth by the NJDOT. A 30 pound sample shall be submitted to the Engineer for approval before any material is trucked onto the site. The Engineer reserves the right to have a certified testing laboratory perform sieve analyses on the material. The material shall be leveled to the required grades and compacted by approved methods in 6-inch layers. Recycled Concrete Aggregate (RCA) shall not be allowed as select backfill in trenches.

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ITEM 8 - FOR FURNISHING AND PLACING BROKEN STONE
OR GRAVEL MATERIAL

8.00 Work Included

The Contractor shall furnish, place, grade, and compact all broken stone or screened gravel for foundations or drainage, where required by the Drawings and Specifications and when ordered by the Engineer. Excavation for stone or gravel base and disposal of excess material will be included under this Item.

Broken stone or gravel foundation shall be required under all sewer/water mains as shown on the standard trench detail included in the Contract Documents.

8.01 Materials and Placing

Broken stone or screened gravel shall be clean, hard, durable, strong, washed gravel or crushed stone conforming to the requirements of N.J.D.O.T. Standard Specifications for Coarse Aggregate, Size No. 57 (¾" Gravel or Broken Stone). Gravel or stone shall be used where shown on the Contract Documents, or where required by field conditions or as ordered by the Engineer. The gradation of the gravel or stone shall be approved by the Engineer. The material shall be accurately leveled to required grades, and where required shall be compacted by tamping or other approved means

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ITEM 9- FOR TRENCH BACKFILL COMPACTION

9.00 Work Included

The Contractor shall furnish all necessary labor, materials and equipment required to compact all trench backfill material within roadways, driveways and sidewalks. It is the purpose of this item to insure that all trench backfill material used will be compacted in such a manner so as to attain maximum compaction in accordance with Sections 203 and 207 of the NJDOT Standard Specifications for Road and Bridge Construction, latest revision. The work includes backfill compaction of all sanitary sewers, manholes and house connection run-outs complete, as well as the compaction of backfill in test pits within roadway areas.

Following pipe laying, backfill under the pipe haunches, around the pipe and up to cover of at least 18-inches over the top of the pipe shall be placed by hand in 6-inch layers, each layer to be thoroughly compacted by mechanical or vibro-tampers of an approved type. Compaction and tamping shall be as directed such that the pipe shall be securely bedded and protected at the end of each day's operation.

All trenches or excavations shall then be backfilled in mechanically compacted 12-inch lifts to the original surface of the ground or up to such grades as shall be directed, to obtain 90% of relative density. No heavy stones or boulders shall be allowed to drop into the trench. The trenches and excavations shall be wet down as required to obtain optimum density while the backfilling is being carried out.

The Contractor shall employ mechanical tampers, or high speed vibro-tampers to consolidate the backfill during trench backfilling. Note: Hydro-hammers are not to be used 3 feet or less from the top of the pipe.

If in the Contractor's opinion he can obtain a density of backfill equal to or greater than that which is obtained by backfilling and compacting in 12 inch layers, he may submit his scheme to the Engineer for consideration. Adequate proof of such a method will be required before any decision is made. Jetting of trenches will not be permitted under any circumstances.

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