APPENDIX E

TECHNICAL SPECIFICATIONS

TECHNICAL SPECIFICATIONS

FOR

WATER DISTRIBUTION

AND

SANITARY SEWER SYSTEMS

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1.0 PURPOSE AND SCOPE

The purpose of this document is to set forth the rules, regulations and standards to guide Developers and Builders in the service area of the Willingboro Municipal Utilities Authority (hereinafter called the AUTHORITY), so as to promote the public health, safety, convenience, and general welfare of the municipality. These rules and specifications shall be administered by the AUTHORITY to insure the orderly growth, development, and construction of both the water distribution and sanitary sewer systems, in accordance with the requirements of the New Jersey Department of Environmental Protection and of the AUTHORITY.

These specifications are addenda to the regularly adopted rules and regulations of the AUTHORITY. They supersede and compliment all prior rules and regulations. Any alleged conflict between any of the articles or paragraphs or rules and regulations of the AUTHORITY will be interpreted by the AUTHORITY and the AUTHORITY'S interpretations and ruling shall be final. These regulations, administered by the AUTHORITY, are minimum requirements. They are intended to apply to the usual conditions encountered during design and construction. These specifications are subject to amendment for exceptional situations. The AUTHORITY reserves the right to specify greater or less stringent requirements in any case, in their judgment, to be in the best interest of the community.

Prior to commencement of any detailed design for any water main or sanitary sewer system, it is advisable to prepare preliminary reports and plans, and in turn schedule a meeting with the AUTHORITY and/or its ENGINEER for the purpose of review and discussion of the proposal. At this time, the AUTHORITY will make comments and/or provide pertinent data applicable to these plans. The AUTHORITY will provide the forms and information necessary to obtain approval for construction of the new facilities.

The AUTHORITY recognizes the fact that questions may arise during the planning, construction and/or testing phases of water and/or sanitary sewerage development that may or may not be covered by specifications, rules or regulations. In these cases, the AUTHORITY will take whatever action is necessary to either clarify the meaning of the specifications or provide direction or information necessary for the Developer, Builder or Contractor to understand and meet AUTHORITY requirements.

2.0 BONDING REQUIREMENTS

Prior to the onset of any construction of water systems, sewage systems or pumping stations, the developer shall submit Performance Bonds in the full amount, as calculated by the ENGINEER, for review and acceptance. At the Authority's discretion, letters of credits may be posted in lieu of Performance Bonds.

At no time shall any water, sewer or pump station construction take place without approved Performance Bonds or without expressed written approval from the AUTHORITY.

Upon completion of a substantial portion of the work, the developer may request a reduction of the performance bond.

Upon completion of all of the utility work, the developer may request a release of the performance bond. A performance bond shall not be released until all final paving is complete, manholes and valve boxes are brought to grade, and as-built drawings are approved. The AUTHORITY may release the performance bond after a two year maintenance bond is posted in its place. Typically, the two year maintenance bonds required will be for fifteen percent (15%) of the original performance bond amount. Before AUTHORITY release of the maintenance bond, a walk through will be performed and punch list generated.

All items on the punch list must be completed prior to AUTHORITY release of the maintenance bond.

3.0 WATER DISTRIBUTION SYSTEMS

Water mains are installed to provide a means for conveying water from the wells or storage tanks to some distant point where it may be used for human consumption, fire protection, watering of lawns and gardens or for many other purposes. Since this water is used for human consumption, among other things, the necessity for safe potable water is easily recognized.

In order to provide a water distribution system of high reliability, the construction of same must be inspected to insure that all rules and regulations are being met and that workmanship in general meets minimum specifications requirements. After construction has been completed, all lines must pass a chlorine residual test, a pressure test and a bacteriological test before the line is placed in service.

It shall be the responsibility of the Developer or Owner to maintain these lines after preliminary inspection has been completed and the water mains activated. The AUTHORITY, however, reserves the right to direct the responsible party to have the water mains retested when, in the opinion of the AUTHORITY, the water mains or appurtenances have been subjected to stresses or damage to such a degree that retesting is deemed necessary.

Once all construction has been completed but prior to the AUTHORITY accepting the lines, an inspector from the AUTHORITY will perform a final inspection of all water boxes and valves to see that they are physically sound and to proper grade. All hydrants and valves will be inspected and tested to see that they operate properly and that all valves are accessible. Should any problems be encountered during this inspection, it will be the Developer's or Builder's responsibility to make the necessary repairs and/or replacements.

Hydrant Flow Tests: All hydrant flow tests must be performed by qualified persons using a hydrant wrench. (Pipe wrenches are not acceptable.) The AUTHORITY must be notified a minimum of forty-eight (48) hours in advance of any requested flow tests. Call the Operations Manager (609/877-3875) to schedule flow tests. Tests shall be performed Monday to Friday from 8:00 a.m. to 4:00 p.m. The AUTHORITY reserves the right to refuse the authorization of any flow test at any time it deems necessary. The AUTHORITY's ENGINEER shall also be notified of all flow tests to be performed by a Developer or its representative.

Water Main Taps: All wet taps into AUTHORITY water mains require a minimum of forty-eight (48) hour notice to the AUTHORITY and ENGINEER. At its discretion, the AUTHORITY may authorize a main to be taken out of service and a dry tap to be utilized. In that case, it is the responsibility of the Developer or Builder to notify all affected AUTHORITY customers in writing a minimum of forty-eight (48) hours in advance of the temporary discontinuance of service. It shall be the responsibility of the Developer to rectify any and all disturbances or damages to the AUTHORITY customer's systems.

4.0 SANITARY SEWER SYSTEMS

Sanitary sewer collection systems and pumping stations are installed to provide a means of conveying wastewater from its source of origin to a wastewater treatment plant. Wastewater is essentially the water supply of the community after it has been fouled by a variety of uses. Wastewater contains organic materials and numerous pathogenic or disease-causing organisms which must be immediately and safely removed from its source of origin.

In order to provide a wastewater collection system which will function properly for many years, the design must be reviewed, evaluated and approved by the AUTHORITY prior to construction. During the period of construction, the AUTHORITY will perform inspections of all approved sewer systems.

Once all construction has been completed, but prior to the AUTHORITY accepting the lines, the lines will be air tested for infiltration and exfiltration. All lines shall be free and clear of construction debris and/or other matter. If necessary, the lines shall be mandrelled prior to placement in service. Should any problem be encountered during the tests or any other facet of the installation process, it will be the Developer's or Builder's responsibility to make the necessary repairs and/or replacements.

All taps into the AUTHORITY's existing sanitary sewer system require a minimum forty-eight (48) hour notice to the AUTHORITY and ENGINEER.

Pumping Stations: The design of sewage pumping stations will be handled on a case by case basis. Prior to the start of design the applicant/developer shall request a meeting with the AUTHORITY and the AUTHORITY's engineer to discuss the requirements for the specific pumping station.

All sewage pump stations shall be tested under the direction of the AUTHORITY and its ENGINEER. All equipment will be tested for operation during low, medium and high flow situations and for operation during a power outage. All pieces of equipment must operate in a satisfactory manner before the pump station can be placed into service. The AUTHORITY, at its discretion, may authorize operation of a pump station prior to completion of the punch list items.

A licensed operator is required for the operation of all pumping stations at all times. If the AUTHORITY authorizes operation of the pump station prior to the AUTHORITY's acceptance and ownership of same, it is the responsibility of the Developer to provide a State licensed pump station operator at all times.

The AUTHORITY will be responsible for and provide operation and maintenance of the pumping station upon release of the pumping station performance bond. At this time all utilities (electric, telephone, alarms) shall be placed in the AUTHORITY's name. In addition, it is at this time that the developer shall deed the pumping station to the AUTHORITY.

SECTION II
GENERAL SPECIFICATIONS

1.0 PURPOSE AND SCOPE

These specifications are intended as a guide for Developers and Builders within the Township. They are addenda to the regularly adopted rules and regulations of the AUTHORITY, and represent the minimum acceptable requirements. The AUTHORITY reserves the right to specify greater or less stringent requirements in any case, in their judgment, to be in the best interest of the AUTHORITY.

The AUTHORITY recognizes the fact that questions may arise during the planning, construction, and/or testing phases of a project that may or may not be covered by these specifications. In these cases, the AUTHORITY will take whatever action is necessary to either clarify the meaning of the specifications or provide the necessary information for the Builder, Contractor, or Developer to understand and meet the Authority's requirements.

Whenever and wherever the term "Standard Specifications" are used in these specifications, it shall mean the current edition of the New Jersey Department of Transportation Standard Specifications for Road and Bridge Construction.

Whenever and wherever the term "ENGINEER" is used in these specifications, it shall mean the ENGINEER duly appointed by the AUTHORITY.

1.1 GENERAL APPROVAL REQUIREMENTS

The following steps must be completed by the APPLICANT/ DEVELOPER in order to receive water and/or sanitary sewer service from the AUTHORITY:

- Establish an escrow account with the AUTHORITY to cover review, engineering, inspection and legal costs.
- Complete sewer construction or water service construction application forms for sanitary sewer and water service.
- Complete CID form - commercial/industrial user form, if applicable.
- Obtain NJDEP permits.
- Provide performance bonds.
- Pay connection fees.
- Provide easements and deeds.

1.2 PERMITS

It is the responsibility of the Developer or Builder to obtain all required permits before the onset of construction. The AUTHORITY will not permit construction of any sanitary sewer facilities without first obtaining a Treatment Works Approval Permit from the NJDEP.

2.0 PRODUCT DATA

2.1 GENERAL

A. Submit to the ENGINEER shop drawings, product data and samples required by the specification sections.

B. All shop drawings, product data and samples shall be reviewed and approved by the Design ENGINEER prior to submission.

C. Schedule submission for shop drawings, product data and samples at least twenty-one (21) days before dates reviewed submittals will be needed.

2.2 SHOP DRAWINGS

A. Original drawings, prepared by Contractor, subcontractor, supplier or distributor, which illustrate some portion of the work; showing fabrication, layout, setting or erection details.

B. Minimum sheet size: 8-1/2" x 11".

C. Present drawings in a clear and thorough manner: Details shall be identified by reference to sheet and detail, schedule or room numbers shown on development plans.

2.3 PRODUCT DATA

A. Preparation:

1. Clearly mark each copy to identify pertinent products or models.

2. Show performance characteristics and capacities.

3. Show dimensions and clearances required.

4. Show wiring or piping diagrams and controls.

B. Manufacturer's standard schematic drawings and diagrams:

1. Modify drawings and diagrams to delete information not applicable to the work.

2. Supplement standard information to provide information specifically applicable to the work.

C. Manufacturer's catalog sheets, brochures, diagrams, illustrations and other standard descriptive data:

1. Clearly mark each copy to identify pertinent materials, products or models.

2. Show dimensions and clearances required.

3. Show compliance with referenced standards.

2.4 SAMPLES

Office samples:

Of sufficient size and quantity to clearly illustrate:

1. Functional characteristics of product or material with integrally related parts and attachment devices.

2. Full rage of color, texture, and pattern.

3. After review, samples will be retained by ENGINEER. Upon completion of the work, Contractor may submit written request for return of samples.

2.5 CONTRACTOR'S RESPONSIBILITIES

A. Review shop drawings, product data and samples prior to submission.

B. Determine and verify:

1. Field measurements.

2. Field construction criteria.

3. Catalog numbers and similar data.

4. Conformance with specifications.

C. Coordinate each submittal with requirements of the work and of the AUTHORITY'S standard details.

D. Contractor's responsibility for errors and omissions in submittals is not relieved by the AUTHORITY or ENGINEER review of submittals.

E. Contractor's responsibility for deviations in submittals from requirements of AUTHORITY'S specifications is not relieved by the AUTHORITY or ENGINEER review of submittals, unless the AUTHORITY gives written acceptance of specific deviations.

F. Notify ENGINEER, in writing at time of submission, of proposed deviations in submittals from AUTHORITY requirements.

G. Begin no fabrication or work which requires submittals until return of submittals with ENGINEER'S stamp and initials or signature indicating review.

2.6 SUBMISSION REQUIREMENTS

A. Make submittals so as to cause no delay in the work or in the work of any other Contractor.

B. Number of submittals required:

Shop drawings: Submit the number of copies which the Contractor requires, plus four (4) copies, which will be retained by the ENGINEER and the AUTHORITY.

C. Accompany submittals with transmittal letter, in duplicate, containing:

1. Date of submission and dated of any previous submissions.

2. Project title and number.

3. Contractor's name and address.

4. The number of each shop drawing, product data and sample submitted.

5. Notification of deviations from AUTHORITY requirements.

6. Other pertinent data.

D. Submittals shall include:

1. Date and revision date.

2. Project title and number.

3. The names of:

   a. Design ENGINEER

   b. Contractor

   c. Subcontractor

   d. Supplier

   e. Manufacturer

   f. Separate details when pertinent.

4. Identification of product or materials.

5. Field dimensions, clearly identified as such.

6. Specification section number.

7. Relation to adjacent or critical features of the work or materials.

8. Applicable standards, such as ASTM or Federal Specification numbers.

9. Identification of deviations from AUTHORITY standards.

10. Identification of revisions on resubmittals.

11. An 8" by 3" blank space for Contractor and ENGINEER stamps.

12. Contractor's stamp, initialed or signed, certifying to review of submittal, verification of products, field measurements and field construction criteria, and coordination of the information within the submittal with requirements of the work and of the AUTHORITY'S standards.

13. Design Engineer's stamp, initialed or signed, certifying to review of submittal, verification of products, field measurements and field construction criteria, and coordination of the information within the submittal with requirements of the work and of the AUTHORITY'S standards.

2.7 RESUBMISSION REQUIREMENTS

A. Make any corrections or changes in the submittals required by the ENGINEER and resubmit until approved.

B. Shop drawings and product data:

1. Revise initial drawings or data, and resubmit as specified for the initial submittal.

2. Indicate any changes which have been made other than those requested by the ENGINEER.

C. Samples: Submit new samples as required for initial submittals.

2.8 DISTRIBUTION

A. Distribute reproductions of shop drawings and copies of product data which carry the ENGINEER stamp of review to:

1. Subcontractors.

2. Supplier.

3. Contractor's file.

B. Distribute samples which carry the ENGINEER stamp of review as directed by ENGINEER.

2.9 ENGINEER DUTIES

A. Review submittals with reasonable promptness.

B. Review for:

1. Design concept of project.

2. Information given in approved plans.

C. Review of separate item does not constitute review of an assembly in which item functions.

D. Affix stamp and initials or signature certifying to review of submittal.

E. Return submittals to Contractor for distribution or resubmission.

3.0 INSPECTIONS

Any work completed or proceeded without inspection and in an unacceptable manner will be considered done at the Developer's or Builder's expense since, by proceeding without inspection they have assumed the burden of proof for acceptability.

3.1 ENGINEER

The ENGINEER'S Field Services Department shall be notified at least forty-eight (48) hours in advance that field services are required. Notification may be made either in writing or verbally, but in either instance, notification must be received by the Field Services Department prior to the said forty-eight (48) hours.

A. Written notification shall be directed to:

Richard A. Alaimo Associates
Field Services Department
200 High Street
Mount Holly, New Jersey 08060

Attention: Chief Field Representative

B. Verbal notification shall be made to the above at:

(609) 267-8310

The request for field services is the direct responsibility of the Developer or Builder and should they neglect to request same (or request same less than forty-eight (48) hours prior to need, and field services cannot be scheduled), all work accomplished without field services will automatically be considered unacceptable. Extreme care should be taken to avoid this situation, since:

1. All construction not accessible for complete visual inspection must be reestablished in such a manner as to allow for same before it will be accepted.

2. All construction which is subject to curing and hardening and/or which must be compacted (e.g. Portland cement concrete, bituminous concrete, backfill, subgrade, etc.) must be tested in such a manner as to allow for complete evaluation before it will be accepted.

3. A complete schedule of the required tests, examinations, etc., required in specific instance will be provided by this office.

3.2 AUTHORITY

The AUTHORITY'S Operations Manager shall be notified at least forty-eight (48) hours in advance that inspection is required. Notification may be made either in writing or verbally, but in either instance, notification must be received prior to the said forty-eight (48) hours.

A. Written notification shall be directed to:

Willingboro Municipal Utilities Authority
433 John F. Kennedy Way
Willingboro, New Jersey 08046-2119

Attention: Operations Manager

B. Verbal notification shall be made to the above at:

(609) 877-3875

The request for inspection is the direct responsibility of the Developer or Builder and should they neglect to request same (or request same less than 48 hours prior to need, and inspection cannot be scheduled), all work accomplished without inspection will automatically be considered unacceptable. Extreme care should be taken to avoid this situation, since:

1. All construction not accessible for complete visual inspection must be reestablished in such a manner as to allow for same before it will be accepted.

2. All construction which is subject to curing and hardening and/or which must be compacted (e.g. portland cement concrete, bituminous concrete, backfill, subgrade, etc.) must be inspected in such a manner as to allow for complete evaluation before it will be accepted.

4.0 TRENCH EXCAVATING, BACKFILLING, AND COMPACTING

4.1 DESCRIPTIONS

A. Description of the work:

Trenching, backfilling, and compaction includes, but is not limited to:

1. Excavation for trenches and trench backfilling;

2. Rough and finish grading of the work; and

3. Furnishing and installing trench stabilization material and select backfill material.

B. Definitions:

1. Trench excavation: Removal and disposal of all material encountered when establishing required grade elevations, including pavements, concrete slabs and other obstructions.

2. Unauthorized excavation: Removal of materials beyond specified subgrade elevations without approval of the ENGINEER.

4.2 MATERIALS

A. Trench backfill material from on-site excavation.

B. All on-site backfill materials shall be subject to the approval of the ENGINEER, and to the following requirements:

1. Free from deleterious substances, stumps, brush, weeds, roots, sod, rubbish, garbage and matter that may decay.

2. Backfill to a height of two feet (2') above the top of pipes, culverts and other structures with material free from stones or rock fragments larger than two inches (2") in greatest dimension.

3. Free of large rocks or lumps that, in the opinion of the ENGINEER, may create voids or prevent proper compaction.

C. Select backfill material: Select backfill material shall be Type I-13. Soil aggregate select backfill materials, when designated, shall conform to Section 901.09 of the Standard Specifications.

D. Broken stone material:

1. Broken stone subbase material under slabs, foundations and structures shall conform to Section 901.04 of the Standard Specifications, and meeting the gradations specified in Table 901-1. Size shall be #5.

2. Trench stabilization material for bedding shall conform to the above requirements. Size shall be #6.

E. Other materials: All other materials, not specifically described but required for a complete and proper installation shall be as selected by the Contractor and approved by the ENGINEER.

4.3 METHODS OF CONSTRUCTION

A. Requirements of regulatory agencies:

1. All excavations shall be in compliance with Federal Occupational Safety and Health Act (OSHA) and Rules and Regulations of the State of New Jersey Department of Labor and Industry, Bureau of Engineering and Safety, N.J.A.C. 12:180. Failure to comply may result in a cease and desist order for that portion of work.

2. Excavation work shall be in compliance with applicable requirements of other governing authorities having jurisdiction.

B. Reference standards included in this specification section:

1. New Jersey State Highway Department Standard Specifications for Road and Bridge Construction, 1983 (Standard Specifications).

a. Section 901.03: Aggregate, Coarse

b. Section 901.04: Broken Stone

c. Section 901.09: Soil Aggregate

2. American Society for Testing and Materials (ASTM):

a. D-1556: Density of Soil in Place by the Sand-Cone Method.

b. D-1557: Moisture Density Relations of Soils and Soil Aggregate Mixtures Using 10-lb. Rammer and 18-inch Drop.

c. D-2049: Relative Density of Cohesionless Soils.

d. D-2922: Density of Soil and Soil Aggregate In-Place by Nuclear Methods (Shallow Depth).

C. Submittals: Pursuant to Section 2.0 of the General Specifications, Product Data.

D. Test reports:

When directed by the ENGINEER, submit test reports on all select backfill material in accordance with the following standards:

Particle Size Analysis of Soils: ASTM D-422.

E. Job Conditions:

1. Existing utilities: Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult the utility owner immediately for directions. Cooperate with owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility owner.

2. Do not interrupt existing utilities serving facilities occupied and used by Owner or others, except when permitted in writing by the ENGINEER and then only after acceptable temporary utility services have been provided.

F. Use of explosives: The use of explosives is not permitted unless approved by the ENGINEER.

G. Protection of persons and property:

1. Barricade open excavations occurring as part of this work and post with warning lights as required to protect persons on site. Operate warning lights as recommended by authorities having jurisdiction.

2. Protect trees, shrubs, lawns and other features remaining as part of final landscaping.

3. Protect structures, utilities, sidewalks, pavements and other facilities from damage caused by settlement, lateral movement, undermining, washout and other hazards created by earthwork operations.

4. In the event of damage, immediately make all repairs and replacements to the approval of the ENGINEER at no cost to the AUTHORITY.

H. Dust control: Use all means necessary to control dust on and near the work if such dust is caused by the Contractor's operations during performance of the work or if resulting from the conditions in which the Contractor leave the site.

I. Weather conditions: Do not place, spread, roll or fill materials during freezing, raining or otherwise unfavorable weather conditions. Do not resume work until conditions are favorable as determined by the ENGINEER.

J. Inspection by Contractor: Examine the areas and conditions under which trenching, backfilling, compacting and grading are to be performance and notify the ENGINEER in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in an acceptable manner.

K. Preparation:

1. Prior to commencement of work, forty-eight (48) hour notification shall be given to the AUTHORITY'S water and sewer department.

2. Prior to commencement of work, establish location and extent of all utilities in the work areas. Maintain, protect as required existing utilities which pass through the work area.

3. Prior to excavation in pavement areas, cut existing pavement vertically with sharp tool on a straight line to the limits of excavation shown on the Plans or as directed by the ENGINEER. Maintain cut straight and neat, or recut and dress as directed by the ENGINEER.

L. Lines and depth:

1. Trenches shall be excavated along the lines and at a depth necessary for laying the pipe to the grade given, as designated by the ENGINEER. Excavation shall not be carried below the required level except where unstable soil is encountered. Whenever excavation has been made below the required level, it shall be replaced with 3/4 inch crushed stone and shall be thoroughly tamped. The ENGINEER shall determine the depth of removal of unstable soil encountered.

2. Excavation for manholes and other structures shall have a twelve inch (12") minimum clearance and twenty-four inch (24") maximum clearance on all sides. The width of trenches for pipe shall equal pipe outside diameter plus two feet (2') unless otherwise provided by the ENGINEER. Excavations shall be confined within the narrowest possible limit and made as nearly as possible in a vertical line, and any sheathing, shoring, bracing and timbering which is necessary to obtain this result shall be done as hereinafter specified.

3. Preliminary excavation shall be made only to a depth of three inches (3") above the final depth of any trench or other excavations. The remaining depth shall be carefully excavated, shaped, and formed with hand tools immediately preceding laying of pipe or placing concrete. Trench bottoms shall be accurately formed to receive and support the bottom of the barrel of the pipe. Additional excavation shall be made in pipe trenches at the pipe joints and to prevent any possibility of a pipe resting on the bell rather than the barrel.

4. In rock, the bottom shall be excavated six inches (6") below the normal support grade and refilled with compacted granular material.

M. Materials excavated:

1. The materials excavated shall be stored compactly on the side of the trench and kept trimmed to be of as little inconvenience as possible to travel and adjoining properties. All streets shall be kept open for travel unless otherwise directed by the ENGINEER. All bituminous gravel, stone surface, gravel base course and topsoil shall be kept separate from other excavated materials and shall be used as the final layer in the backfill operation where appropriate.

2. Before excavating any existing surface, topsoil shall be stripped to a minimum depth of six inches (6") and stored for reuse as final grade where planting is proposed.

3. The Contractor shall not remove from the site any sand, gravel or other soil excavated from the trench which may be suitable for backfilling until backfilling is completed.

4. Surplus material remaining after the proper backfilling of trenches shall be used to fill in low areas or where shown on the profiles. Other surplus materials shall be transported and placed by the Contractor, at his expense, at a location within the Township as determined by the ENGINEER.

N. Removal of water:

1. The Contractor shall at all times provide and maintain ample means and devices to promptly remove and disperse all water or sewage entering excavations and structures dry until all work therein is completed.

2. The Contractor shall dispose of the water from the trenches and excavations in a manner satisfactory to the Owner, Developer and/or AUTHORITY inspector, without damage to adjacent property. In no case, shall water or sewage be allowed to enter new lines. Sewage shall not be discharged onto the ground, nor into the storm water system.

3. If groundwater and subsoil conditions along the line of the work are such that the Contractor cannot successfully remove water or provide a stable trench by ordinary trench pumping and bailing, or when necessary to protect the work, workmen, public, under or above ground utilities and structures, pavements and public and private property, the Contractor shall, where designed by the ENGINEER, furnish and provide the necessary equipment, power and labor to employ the well point method of trench dewatering. The well point system or portions thereof shall be removed by the Contractor upon the completion of backfill, and the holes remaining from the points shall be backfilled and thoroughly tamped.

O. Shoring and sheathing:

1. The Contractor shall be responsible for the installation of shoring and sheathing on all faces of the excavation where it is necessary: to insure a suitable, dry, and/or safe excavation, to eliminate settlement of, or damage to structures or items adjacent to the excavation, to preserve the bearing capacity of the soil, to keep the excavation within the narrowest possible limits, to protect work from damage, and to provide conditions acceptable to the ENGINEER and all interested agencies.

2. Bracing shall be installed so that there is no stress on or displacement of any part of the completed work until the construction thereof has proceeded far enough to provide the necessary strength, as determined by the ENGINEER.

3. Any damage to pipelines, road structures, etc., occurring through settlement, soil pressure, cave-ins, shift of sheathing, or any other causes associated with the Contractor's activities, shall be repaired or the damage items replaced by the Contractor without cost thereof to the AUTHORITY.

P. Backfill and compaction:

1. After each joint has been made, inspected, and approved, backfill shall proceed immediately. The space between the pipe and the bottom sides of the trench shall be backfilled by hand and thoroughly tamped with a light tamper. Fill shall be placed uniformly on both sides of the pipe in six-inch (6") layers using the material obtained from on-site excavating, except use select backfill material where indicated on the Plans or as directed by the AUTHORITY'S inspector.

2. Backfill to a height of two feet (2') above the top of the pipe with earth free from stones, rock fragments, dirt clods or frozen material greater than two inches (2") in largest diameter, and thoroughly tamped.

3. The remainder of the trench shall be backfilled in twelve-inch (12") layers, loose measure, each layer thoroughly tamped. Dampening of the material to be tamped may be required by the ENGINEER.

4. In light soils such as sand, loam, or light gravel, the trench may be backfilled carefully with a front end loader at a maximum rate of one cubic yard per load. Each load shall be placed immediately on the previous load.

5. Backfilling prior to approvals:

a. Any of the work enclosed or covered up before it has been approved will be considered unacceptable.

b. The Contractor shall, at his own expense, uncover all such work for inspection and approval prior to backfilling.

5.0 CONCRETE ENCASEMENT

5.1 DESCRIPTION

Provide concrete encasement at locations described herein, or as directed by the ENGINEER.

5.2 MATERIALS

A. Concrete:

1. Use concrete developing a minimum compressive strength of 4,000 psi at twenty-eight (28) days.

2. Use air-entrained concrete.

B. Cement, aggregates, water and air entrainment methods and materials: Section 914 of the Standard Specifications.

5.3 METHODS OF CONSTRUCTION

A. Reference standards included in this specification section:

New Jersey State Highway Department Standard Specifications for Road and Bridge Construction, 1989 (Standard Specifications):

1. Section 914: Portland Cement, Mortar and Grout Concrete

2. Section 501: Concrete Structures

B. Submittals: Pursuant to Section 2.0 of the General Specifications, Product Data.

C. Certificates: All deliveries of concrete shall be accompanied by delivery slips, copies of which shall be provided to ENGINEER by Contractor.

D. Location:

1. Notify the ENGINEER when the following conditions are encountered. Subject to the ENGINEER'S approval, concrete encasement shall be provided at these locations. All materials, methods and equipment shall be subject to the approval of the ENGINEER.

a. At all locations where a proposed sanitary sewer main is located closer than ten feet (10') to a water main (measured horizontally).

b. At all crossings of sanitary sewer lines and water lines where the vertical separation is less than eighteen inches (18").

c. At all crossings of sanitary sewer mains and water mains where the sanitary sewer main is located above the water main.

d. All other locations where the vertical or horizontal separation between proposed and existing utility pipes is less than twelve inches (12").

2. Concrete encasement shall conform to the standard engineering drawings. When a situation is encountered for which there is no detail, concrete encasement shall conform to the following requirements or as otherwise approved by the ENGINEER.

a. Minimum thickness: Six inches (6")

b. Length: At utility crossings, extend concrete encasement a minimum of ten feet (10') on both sides of the center line of the crossing. At all other locations, extend concrete encasement until the allowable vertical or horizontal separation between utility pipes is achieved.

E. Performance:

The method of construction for concrete encasement shall conform to Section 501 of the Standard Specifications except as modified by the Supplemental Requirements below:

Earth cuts may be used as forms provided the horizontal and vertical earth surfaces can be shaped to the proper dimensions.

6.0 AS-BUILT DRAWINGS - MINIMUM REQUIREMENTS

6.1 GENERAL

A. This specification defines the minimum requirements for as-built drawings of water, sewer or force mains and pumping stations.

B. The AUTHORITY's engineer shall be responsible for the preparation of all as-built drawings in accordance with the following requirements. All costs for the preparation of as-built drawings will be paid for via the developer s escrow account.

6.2 SUBMITTAL REQUIREMENTS

A. Water Mains:

1. As-built pipe lengths between bends shall be provided.

2. As-built pipe diameter and pipe material shall be provided.

3. All bend angles shall be noted.

4. Approximate elevations of the pipe shall be provided.

5. All hydrants shall be located.

6. All valve sizes shall be shown and valves located using three (3) tie-down dimensions (i.e. measurement from a permanent object; catch basin, manhole, hydrant, road centerline, etc.).

7. All blowoffs shall be located similar to valves.

8. All valve and blowoff locations shall be determined by a licensed surveyor.

9. All curb stops for water services shall be located. Each shutoff shall be clearly identified by the townhouse, condominium, house, office, store, etc. that it services.

10. All concrete cradles and encasements shall be noted.

11. All the above information shall be shown on a plan and profile.

B. Sewer Mains:

1. As-built manhole rim elevations shall be provided.
2. As-built invert elevations of <u>all</u> pipes penetrating each manhole shall be provided.

3. Manhole rim and inverts shall be determined by a licensed surveyor.

4. As-built pipe lengths measured from manhole centerline to manhole centerline shall be provided.

5. As-built pipe slopes shall be calculated by the applicant.

6. As-built pipe diameter and pipe material shall be provided.

7. The as-built length from each lateral connection to the downstream manhole shall be provided. In addition, the as-built length from the last lateral to the upstream manhole shall be provided.

8. Any lateral deviating from the standard wye connection and 1/4" per foot slope shall be noted.

9. Any lateral left for a future connection shall have the pipe cover and three (3) tie dimensions taken at the end of the lateral (i.e. measurements from a permanent object; corner of house, catch basin, manhole, hydrant road, centerline, etc.).

10. All as-built concrete encasements and concrete cradles shall be noted.

11. All the above information shall be shown on a plan drawing.

C. Force Mains:

1. Approximate elevations at each bend and high point shall be provided.

2. Manufacturer's data on air relief valves, gauges and all valves shall be provided separately.

3. As-built drawings or any air relief and blowoff chambers shall be provided.

4. The as-built pipe length between bends shall be provided.

5. As-built pipe diameter and pipe material shall be provided.

6. All bend angles shall be noted.

7. All the above information shall be shown on a Plan and profile. The profile shall show all crossing utilities location and approximate elevation.

D. Pumping Stations

1. As-built drawings shall be submitted by the developer s contractor which indicate any changes from the original design, as approved.

2. Ten (10) copies of manufacturer's operation and maintenance information shall be submitted for all installed equipment.

SECTION III
WATER DISTRIBUTION SYSTEMS SPECIFICATIONS

1.0 GENERAL

1.1 MISCELLANEOUS CONSTRUCTION NOTES

A. Water mains shall be laid in straight lines except when otherwise specifically approved by drawings or directed by the AUTHORITY INSPECTOR. When deviation from a straight line is permitted, the deflection of each joint shall not exceed the manufacturer's recommended maximum for the type of joint and size of pipe being installed. Pipe shall be laid with at least four feet (4') of cover over the pipe to proposed finished grade or to the future finished grade when such is lower. Along extensions of roads which are unimproved, the pipe shall be laid with at least five feet (5') of cover over the top of the pipe to the existing grade. The depth of pipe may be increased locally to pass obstructions. Grade changes shall be accomplished by fittings and/or dividing the necessary deflection among several joints as approved by the inspector.

B. Special care shall be exercised to remove all dirt, stones and other materials from each pipe as it is laid, and to prevent any such materials from entering the pipeline. The Contractor shall see that the entire line is maintained absolutely clean on the inside and that all valves and hydrants are clean and in good working order when installed. Open ends shall be adequately protected at all times and shall be securely sealed with approved plugs whenever work is stopped for any reason whatsoever. After removing a plug, the interior of the pipeline shall be inspected and cleaned before resuming pipe laying operations.

C. Before placing each length of pipe, the Contractor shall carefully examine it for breaks, cracks or other defects and shall discard any section which appear in any work to be defective. All pipe and fittings shall be handled and installed with care to avoid damage.

D. Each section of pipe shall be solidly bedded in the trench bottom and shall be supported for its full length.

E. Before making a connection, the ends of the pipes and all joint members shall be thoroughly cleaned of loose excess coating and lumps. All mating shall be done in strict accordance with the manufacturer's recommendations and the requirements of the ENGINEER.

F. The Contractor shall do all necessary pipe cutting and shall locate valves, fittings and fire hydrants in the exact positions indicated on approved drawings. He shall provide and use cutting tools of an approved type and in good order, so as to insure clean, square cuts to exact measurements.

G. WATER METERS AND CURB BOXES

1. All meters shall be placed in meter pits at a convenient point approved by the AUTHORITY.

2. The meter pit will be readily accessible, and will provide proper protection for the meter.

3. The meter will be positioned to meter and control the entire supply.

4. The AUTHORITY will have the meter set.

5. A brick, concrete or other approved meter box or pit, fitted with a suitable and approved iron cover, will be built inside the property line by the customer. The size and dimensions of the pit or box shall be as approved by the AUTHORITY, shall provide adequate access to the meter and allow for ready installation or removal of the meter.

6. The minimum clearance from shutoff valves to end of pit shall be twelve inches (12").

7. The minimum sidewall clearance shall be twenty-four inches (24").

8. The meter pit shall be waterproof.

9. The meter pit shall be frost proof.

10. The meter pit shall be constructed with a sump and conduit for a sump pump if required by the AUTHORITY.

11. Constructed with piping in place for installation of the meter.

12. Piping shall be supplied with shutoff and check valves.

13. A minimum eight inch (8") of ¾" aggregate is provided for drainage.

14. The AUTHORITY must have one (1) business day's notice for setting the meter. When calling in a request for service, provide the following information:

a. Meter location (address)

b. Permit number

15. The plumber will have installed the required size adapters and spuds, leaving space for the meters as follows:

1/2 inch meter	7 ½"
5/8 x 3/4 inch meter	7 ½"
1 inch meter	10 ¾"
1 ½ inch meter	13"
2 inch meter	17"

16. The meters are to be uniformly set. Water services will include a curb stop and box at the curb line, a valve on either side of the meter for isolating purposes and a back-flow preventer.

17. The meter pit shall be constructed pursuant to the AUTHORITY's detail.

18. The AUTHORITY expects all lines to be protected from inclement weather. The water valve at the curb is to be shut off until AUTHORITY personnel determine the line can become active.

19. Curb box shall be placed in an area between customer's sidewalk and curb. Distance from curb shall be eighteen (18") inches. Box lid shall be above finished grade, chimney shall be in line with valve head. For those areas without curbing, curb boxes shall be placed eighteen (18") inches behind sidewalk. Valves will be buried at a minimum of three feet (3') and a maximum of five feet (5'). Curb stops for multiple dwelling units shall be as shown on the standard details.

20. Tapping inspections shall take place during normal business hours Monday through Friday. Forty-eight (48) hours notice shall be given.

21. No utility valves shall be installed under or in concrete or asphalt.

H. FIRE SERVICE METERS

1. Commercial: All commercial fire services for fire sprinklers or fire service connections require installation of a level 2 back-flow preventer. If the fire sprinkler system contains anti-freeze or some other chemical, then a reduced pressure zone (PRZ) device will be required.

2. Residential:

a. Condominium:

1) Provide a two inch (2") or required size, separate fire only service.

2) Install a buffalo-type curb box with a standard size cover marked FIRE SERVICE.

3) Plumber may utilize an anti-freeze system for the condo units as long as a level 3 back-flow preventer is installed (i.e. PRZ by Watts, Model 909, 009). The AUTHORITY is not certified as an inspector for back-flow preventers. The owner shall be responsible to have the back-flow preventer annually certified and inspected.

4) Maintenance of the fire service from the water main to the building shall be the responsibility of the owner (not the AUTHORITY).

5) Tests and maintenance of the entire fire service system shall be the responsibility of the OWNER.

b. Townhouse or Single Family Home:

1) Provide required size; separate fire only service for each individual unit.

2) Install a buffalo-type curb box, the cover shall be a standard size (5") water valve cover marked “FIRE”.

3) Plumber shall supply a Level 2 back-flow preventer (dual check valve) on the AUTHORITY’s side of the fire service meter. If an anti-freeze system is used, then a Level 3 back-flow preventer must be installed (i.e. PRZ by Watts, Model 909 or 009).

NOTE: The AUTHORITY is not certified as an inspector for back-flow preventers. The owner shall be responsible to have the back-flow preventer annually certified and inspected.

4) Maintenance of the fire service from the water main to the building shall be the responsibility of the homeowner (not the AUTHORITY).

5) Tests and maintenance of the fire service system shall be the responsibility of the homeowner.

K. Water and sewer mains shall be separated a distance of at least ten feet (10') horizontally. If such lateral separation is not possible, the pipes shall be in separate trenches with the sewer at least eighteen inches (18") below the bottom of the water main; or such other separation as approved by the AUTHORITY shall be made. In general, the vertical separation at a crossing of water and sewer line shall be at least eighteen inches (18"). Where this is not possible, the sewer shall be constructed of ductile iron pipe using mechanical or slip-on joints for a distance of at least ten feet (10') on either side of the crossing or other suitable protection shall be provided, such as concrete encasement of the sanitary sewer for ten feet (10') either side of the water pipe. This encasement is to be six inches (6") thick.

L. Tapping of the main shall not be permitted until the following charges, fees and/or levies are paid:

1. Connection fees.

2. Filing and escrow fees.

3. All performance bonds in place.

4. Additional charges for oversized water meters or fire service meters, if required.

M. An approved blowoff or fire hydrant shall be installed at the end(s) of all water line dead ends. Location shall be subject to approval prior to installation.

1.2 PRIOR TO CONSTRUCTION

Prior to starting construction of any water mains within the AUTHORITY service area, the Developer or Owner must have in his possession a set of AUTHORITY approved drawings. In addition, he must have paid all the necessary charges and fees as well as obtaining the necessary bonding. When easements are necessary, all paperwork must be in order; and if Road Opening Permits are required, these must also be obtained before work can start.

2.0 DUCTILE IRON PIPE AND FITTINGS

2.1 DESCRIPTION

A. Provide ductile iron pipe for water main.

B. Pipe sizes shall be six inch (6") or larger for residential areas and eight inch (8") or larger for any non residential area.

2.2 MATERIALS

A. Proprietary Products:

1. References to specified proprietary products are used to establish minimum standards of utility and quality.

B. Manufacturers:

1. U. S. Pipe and Foundry Company.
2. Griffin Pipe Products Company.
3. American Ductile Iron Pipe Company.
4. Tyler Pipe.
5. Atlantic States Cast Iron Pipe Company.
6. McWane Cast Iron Pipe Company.
7. Clow Water Systems Company.
8. or equal.

C. Pipe:

1. Ductile iron conforming to AWWA C151.
2. Manufactured in eighteen (18) or twenty (20) foot lengths.
3. Thickness/Pressure Class:

a. Push-on, Push-on Restrained, or Mechanical Joint:

4" through 12": Pressure Class 350
14" through 24": Pressure Class 250
30" through 64": Pressure Class 150

b. Flanged: Thickness Class 53.

4. Coatings and Linings:

a. All ductile iron pipe and fittings for water service shall be cement-lined in accordance with ANSI/AWWA C104/A21.4 and seal coated inside; 3" - 12" pipe minimum/ thick, 16" - 18" pipe minimum 3/16" thick.

b. All ductile iron pipe and fittings for sanitary and other services shall not be cement lined but shall be coated inside with bituminous material at least 1 mil. thick which conforms to the requirements for seal coat in accordance with ANSI/AWWA C104/A21.4 latest revision.

c. Coatings shall be free of runs, drips, sags and excessive material.

d. External coatings:

(1) Piping to be buried or installed in valve pits shall be coated on the outside with bituminous material at least 1 mil thick conforming to the requirements for seal coat in accordance with ANSI/AWWA C104/A21.4, latest revision, unless otherwise shown.

(2) Exposed piping and other piping so designated shall be provided without the external bituminous coating specified above and shall be coated in accordance with Section 09900, Painting, unless otherwise shown.

D. Pipe Fittings:

1. Ductile iron fittings shall conform to ANSI/AWWA-C110/A21.10 or ANSI/AWWA-C153/A21.53.

E. Joints for Ductile Iron Pipe and Fittings:

1. Below Grade:

a. Mechanical joints shall be used. Mechanical joints shall conform to the requirements of ANSI/AWWA-C111/A21.11.

b. All valve and valve connections shall be mechanical joint.

2. Above ground or in vaults or valve pit joints shall be flanged conforming to the requirements of ANSI/AWWA-C115/A21.15 or grooved and shouldered conforming to the requirements of ANSI/AWWA-C606.

F. Gaskets:

1. Gaskets shall conform to ANSI/AWWA-C111/A21.11 for mechanical joints and ANSI/AWWA-C110/A21.10 for flanged joints.

2. Gaskets for flanged joints shall be 1/16" thick, ring gaskets, of rubber with cloth insertion.

3. Gasket lubricants shall be water soluble and not have deteriorating effects on the pipe or rubber gaskets.

4. Gasket lubricants shall be supplied by pipe manufacturer.

G. Plugs:

1. Flat plugs for mechanical and flanged joints.

H. Sleeve Couplings:

1. Except as otherwise specified or shown on the plans, all sleeve couplings for connecting ductile iron pipe shall be Smith-Blair 441 standard sleeve straight cast couplings as manufactured by Smith-Blair, Incorporated, or equivalent. Bolts and nuts shall be stainless steel.

2. Couplings shall have ductile iron sleeves and flanges. Gaskets shall be of specially compounded natural rubber, and shall have a wedge type design and large cross sectional area. Bolts and nuts shall be stainless steel.

3. All necessary gaskets, followers, bolts and other appurtenances required for making up flexible joints shall be of the pattern and material recommended by the manufacturer for the conditions or service to be encountered.

I. Joint Harness: Studs for harnessed joints shall conform to the requirements of ASTM A193, Grade B-7, or equivalent. Plate lugs shall conform to ASTM A283, Grade B, or ASTM A285, Grade C, or equivalent.

J. Retainer Glands: Mechanical joint retainer gland shall be Model F-1058 ductile iron retainer gland as manufactured by Clow Corporation or equivalent, and shall be installed in accordance with manufacturer's printed instructions.

K. Thrust Blocks: Concrete for thrust blocks shall be 4,000 psi air entrained and conform to ASTM C-94.

L. Pipe repairs shall be accomplished utilizing stainless steel double banded repair clamps (Rockwell 226 "Super Reach" or equal), installed in accordance with the manufacturer's printed instructions. At the AUTHORITY's discretion, the length of pipe may have to be replaced.

2.3 METHODS OF CONSTRUCTION

A. Submittals:

1. All pipe and fittings shall be inspected and tested at place of manufacture as required by the AWWA standards referenced in this specification. Provide ENGINEER with two (2) copies of certifications from each manufacturer stating the product was inspected as required, and that the test results comply with the AWWA standards.

2. Submit manufacturer's product data for pipe, fittings, and gaskets as specified in section entitled, "Product Data".

3. All manufacturers shall validate other than by certification, the ductility of each length of pipe by an underwriters Laboratory approved method. All ductile iron pipe is to have Underwriters Laboratory approval.

B. Inspection and quality of pipe:

1. Before being lowered into the trench, each pipe shall be carefully inspected by the AUTHORITY and ENGINEER, and those not meeting the specifications shall be rejected and either destroyed or removed from the work within ten (10) hours. No pipe shall be laid except in the presence of the ENGINEER or his authorized inspector. The ENGINEER or AUTHORITY may order the removal and relaying of any pipe not so laid.

2. In addition to the inspection made by the ENGINEER, the Contractor shall carefully examine all pipe and special castings before placing the same in the trench. Any pieces which are broken or show evidence of cracks or fractures shall be rejected by him. Such inspection shall carry with it the responsibility on the part of the Contractor for the removal at his own expense of all pipe, special castings, and appurtenances, incorporated in the work, and which under test are found to be cracked or otherwise defective.

3. Contractor shall also inspect all pipe and fittings for loose, excess seal coating (and lumps) which may dislodge during service and clog fixtures. All such loose material shall be removed from the pipe or fitting prior to placement into service without damaging the integrity of the coating.

C. Installation of pipe and fittings:

1. Excavation and backfill for pipes shall conform to the specification entitled, "Trench Excavating, Backfilling and Compacting".

2. All piping shall be installed in a neat and workmanlike manner. All piping shall be installed to accurate lines and grades and shall be supported as shown, specified, or necessary. Where temporary supports are used, they shall be sufficiently rigid to prevent shifting or distortion of the pipe. Suitable provision shall be made for expansion where necessary.

3. No defective pipe or fitting shall be laid or placed in the piping, and any piece discovered to be defective after having been laid shall be removed and replaced by a sound and satisfactory piece by the Contractor at his own expense.

4. Every pipe and fitting shall be cleared of all dirt and other debris before being installed and shall be kept clean until accepted in the completed work.

5. No pipes shall be laid in fill or other unstable material, in wet trench, or in same trench with another pipe or other utility. A minimum eighteen inch (18") clearance shall be maintained between the outside surface of pipe and outside surface of other existing pipes and structures. When this clearance cannot be maintained, contact the ENGINEER for instructions prior to proceeding with the pipe installation.

6. No direct contact between pipes and structures at crossings will be permitted. Pipes in place shall not be worked over or walked on until covered by layers of earth well tamped in place to a depth of twelve inches (12") over the pipe.

7. Minimum cover over water mains shall be four feet (4').

8. The interior of all pipes shall be thoroughly cleaned of all foreign material before being lowered into trench. Pipes shall be kept clean during laying operations by means of plugs or other approved methods.

D. Piping supports: The Contractor shall furnish and install all supports necessary to hold the piping and appurtenances in firm, substantial manner at the lines and grades indicated. Where required, bends, tees, and other fittings buried in the ground shall be backed up with concrete placed against undisturbed earth where firm support can be obtained. If the soil does not provide firm support, then suitable bridle rods, clamps, and accessories to brace the fitting properly shall be provided. Such bridle rods, etc., shall be coated thoroughly with an approved bituminous paint after assembly, or, if necessary, before assembly. This work shall include bracing plugs to prevent leakage or blowout during testing.

E. Handling and cutting pipe: Every care shall be taken in the handling and laying of pipe and fittings to avoid damage to the pipe, scratching or marring machined surfaces, and abrasion of the coating or lining. Pipe cuts shall be made using an abrasive wheel, rotary wheel cutter, guillotine pipe saw, milling wheel saw, oxyacetylene torch or other method approved by the ENGINEER. Grind cut ends and rough edges smooth. For push-on connections, bevel all cut ends.

F. Assembling pipe:

1. Mechanical Joints:

a. Clean ring groove and bell socket prior to inserting rubber gasket seal. Properly seat gasket; make sure it faces proper direction.

b. Clean and lubricate spigot end of pipe. Lubricate spigot end of pipe and rubber gasket.

c. Hold pipe securely and in proper alignment when joining.

d. Join pipe so that reference mark on spigot end, if provided by manufacturer, is flush with end of bell.

e. Join pipe in strict accordance with manufacturer's printed installation procedures.

2. Flanged Joints:

a. Flange faces shall be clean and free of all debris and foreign material.

b. Flange faces shall bear uniformly on gasket, and bolts shall be tightened uniformly.

G. Protection of work:

1. Great care shall be exercised in the protection of finished work. Joints once made and disturbed shall be subjected to immediate rejection. It shall therefore be the duty of the Contractor to avoid the slightest movement in completed work, while in the act of laying the pipe, in backfilling, or in the passage of workmen up and down the trench. At all times during which pipe is not laid, the end of the pipe shall be sealed with a tight fitting plug. In no case will the drainage of trench water through a completed pipe be permitted.

2. All curves, bends, tees, hydrants or ends of pipe shall be securely blocked with socket clamps or yokes to prevent movement. At the end of line or turn, where provision has been made for future extension or connection, fittings shall be furnished with lugs and anchored by means of socket clamps or yokes.

H. Adapters: When it is necessary to join pipes of different types the Contractor shall furnish and install the necessary adapters. Adapters shall have ends conforming to the above specifications for the appropriate type of joint to receive the adjoining pipe. When adapters join two classes of pipe, the bodies may be of the lighter class.

3.0 GATE VALVES AND VALVE BOXES

3.1 DESCRIPTION

Provide gate valves for proposed water main. Valves shall be located so that no more than twenty (20) resident dwellings are affected by closing or opening of valves.

3.2 DELIVERY STORAGE AND HANDLING

A. Prepare valves and accessories for shipment according to AWWA C500, Section 31, and:

1. Seal valve ends to prevent entry of foreign matter into valve body.

2. Box, crate, completely enclose, and protect valves and accessories from accumulations of foreign matter.

B. Store valves and accessories in area protected from weather, moisture, or possible damage.

C. Do not store materials directly on ground.

D. Handle items to prevent damage to interior or exterior surfaces.

3.3 MATERIALS

A. Proprietary products:

1. References to specified proprietary products are used to establish minimum standards of utility and quality.

B. Valves:

1. Valves installed below the ground shall have mechanical joint end connections and shall be furnished and installed with a suitable valve box and ground level position indicator.

2. Valves installed above ground shall have flanged ends conforming to the 125-lb. American Standard unless otherwise indicated and have position indicators and actuators as shown or required.

3. Contact-surface-to-contact-surface dimensions shall conform to the ANSI Standard face-to-face dimensions of Ferrous Flanged and Welding End Valves, ANSI B16-10.

4. Valves shall have clear waterway equal to the full nominal diameter of the valve unless otherwise specified.

5. Each valve shall have maker's name, pressure rating and year in which manufactured cast on body.

6. Prior to shipment from the factory, each valve shall be tested by hydrostatic pressure equal to 400 psi in sizes twelve inch (12") and smaller, and 300 psi in sizes fourteen inch (14") and larger.

7. Coatings:

   a. All valves shall be coated on the interior and exterior in accordance with AWWA C550.

   b. Products containing coal tar shall not be used.

   c. Coatings used for potable water service shall be NSF approved.

8. All valves shall open to the left or counterclockwise. Any wrong hand valves shall be removed and replaced by the contractor at his own expense.

C. Manufacturers:

1. Clow Valve Corporation
   Oskaloosa, Iowa
   (515) 673-8611

2. M & H Valve Company
Anniston, Alabama
(205) 237-3521

3. American-Darling Valve
Birmingham, Alabama
(205) 325-7856

4. Milliken Valve Company, Incorporated
Bethlehem, Pennsylvania
(215) 861-8803

5. Mueller Company
Decatur, Illinois
(217) 423-4471

6. Kennedy Valve Company
Elmira, New York
(607) 734-2211

7. Waterous Company
South St. Paul, Minnesota
(612) 450-5000

8. U. S. Pipe & Foundry
Burlington, New Jersey
(609) 387-6147

9. DeZurik
Sartell, Michigan
(612) 259-2000

10. Red Valve Company, Incorporated
700 North Bell Avenue
Pittsburgh, Pennsylvania 15106
(412) 279-0044 (telephone)
(412) 279-7878 (fax)

3.4 GATE VALVE, THREE INCH (3") AND LARGER

A. Iron body, resilient seated, NRS conforming to AWWA C509.

B. "O"-ring stem seals field replaceable under full pressure.

C. Gate valves sixteen inch (16") or larger shall be supplied with a three inch (3") bypass and bypass valve.

D. No valve shall be set under roads, pavements, or walks except where so noted on the detail drawings.

E. Acceptable Manufacturers:

1. Clow Valve Corporation
Oskaloosa, Iowa
(515) 673-8611

2. M & H Valve Company
Anniston, Alabama
(205) 237-3521

3. American-Darling Valve
Birmingham, Alabama
(205) 325-7856

4. Mueller Company
Decatur, Illinois
(217) 423-4471

5. Kennedy Valve Company
Elmira, New York
(607) 734-2211

6. Waterous Company
South St. Paul, Minnesota
(612) 450-5000

7. U. S. Pipe & Foundry
Burlington, New Jersey
(609) 387-61474.

8. or equal.

3.5 VALVE BOXES

A. Buffalo type, cast iron, two (2) piece with 5 " shaft and cover marked "WATER". (NOTE: For fire services the cover shall be marked "FIRE SERVICE")

B. Two (2) "T" handle socket wrenches of 5/8" round stock and long enough to extend two feet (2') above ground surface from the deepest valve shall be provided for each size of buried valve furnished.

C. The valve box shall not transmit shock or stress to the valve.

D. Acceptable manufacturers:

1. Bingham & Taylor
2. Tyler
3. Clow
4. or equal.

3.6 CLEANOUTS

Large diameter gate valve shall be fitted with cleanouts on one side of the valve body. Cleanouts shall be of the hand hole type and, where required for valves with the stem in the horizontal position, shall be provided on the bottom of the valve body.

3.7 POSITION INDICATORS

A. All valves shall be equipped with position indicators.

B. Buried valves shall be equipped with ground level position indicators.

C. Acceptable manufacturers:

1. Henry Pratt (Diviner)
2. Val-Matic
3. Clow
4. M & H
5. or equal.

3.8 METHODS OF INSTALLATION

A. Submittals: Submit manufacturers' product data for valves and valve boxes as specified in General Specification Section 2.0 entitled, "Product Data".

B. Prior to installation, inspect valves for direction of opening, freedom of operation, tightness of pressure-containing bolting, cleanliness of valve ports and especially seating surfaces, handling damage and cracks. Do not install dirty or defective valves.

C. Valves shall be set and joined to the pipe in the manner specified in section entitled, "Ductile Iron Pipe and Fittings" for installing and joining ductile iron pipe.

4.0 FIRE HYDRANTS

4.1 DESCRIPTION

Provide fire hydrants for the purpose of fire protection. Hydrants must be placed within 500 feet of each other along road or street lines.

4.2 FIRE MARSHAL

The Willingboro or Westampton Township Fire Marshals shall approve all fire hydrant locations and equipment as well as the AUTHORITY. All plans shall be submitted directly to the Fire Marshal and to the AUTHORITY for approval.

4.3 MATERIALS

Hydrants shall be Kennedy Model K81, or approved equal, having the following characteristics:

1. Size of hydrant: 5" minimum.
2. Direction to open: Counterclockwise.
3. Size and shape of operating nut: 1 ½" from point to flat - pentagon.
4. Three-way hose nozzles:

   Two, 2 ½"ID (National Standard) with 7 ½" threads per inch.

   One, 5 ¾" OD, 4 ½"ID with 4 threads per inch.
5. Internal valve opening: 5 ¼"".
6. Color: Red, with white top.
7. Depth of bury: 4'-6".
8. Size and type of connection to main: 6" - mechanical joint.

4.4 METHOD OF INSTALLATION

A. Hydrants are to be located and installed in accordance with Fire Marshal and AUTHORITY approved drawings. The steamer connection will be turned to face the road or street to provide easy access.

B. The elevation of the hydrant will be such that the bottom of the steamer connection will not be less than eighteen inches (18") from the finished grade or top of curb.

C. A stone sump two feet (2') in length, width, and depth will be installed under each fire hydrant to permit hydrant to drain after each use. (Use 3/4" clean stone.)

D. A concrete thrust block will be poured behind the "tee" and the hydrant shall be rodded.

E. Hydrants shall not be located laterally within five (5) feet of any structure which would interfere with connection of hoses to the hydrant.

F. Water main shall not have more than one (1) fire hydrant on a main that is not looped.

G. For fire fighting purposes, note the following comparison of pipe capacity:

Size of Pipe Inches	**Relative Capacity**
6	1.0
8	2.1
10	3.8
12	6.2
14	9.3
16	13.2

H. Each hydrant shall have a valve and box installed between the hydrant and the water main to allow for isolation of the hydrant during servicing.

5.0 WATER SERVICES

5.1 DESCRIPTION

Provide water service lines, corporation stops, curb valves and boxes, back-flow prevention, meter isolation valves, and accessories.

5.2 MATERIALS

A. Proprietary Products:

1. References to specified proprietary products are used to establish minimum standards of utility and quality.

B. Acceptable Manufacturers:

1. Mueller Company
Decatur, Illinois

2. Materials shall be the product of a single manufacturer.

C. Curb Valve: Mueller "Mark II Oriseal"; Catalog No. H-15204.

D. Curb Box: Cast iron, improved extension type, arch pattern; Mueller Catalog No. H-10336.

1. Furnish each Mueller curb box with foot piece; Catalog No. H-10394 for 1 ½' size valve or stop, and Catalog No. H-10395 for two inch (2") size valve or stop.

2. Box Length: Order to meet project conditions.

E. Shutoff Rods: Steel; Mueller Catalog No. H-10321.

1. Furnish a total of two (2) rods.

2. Length: Order to meet project conditions. Minimum length shall be six feet (6').

F. Pentagon Keys: Steel; Mueller Catalog No. 10325.

G. Corporation Stop: Ground key type, Mueller H15000 with flared fittings, or approved equal.

H. Service Clamps (for PVC Pipe Only)

1. Service clamps shall be extra wide strap or double strap type with stainless steel straps.

2. Approved manufacturers:

a. Dresser Style 194.

b. McDonald Model 3801.

c. Rockwell #313, 342, 352.

d. JCM #403, 404, 406.

e. or equal.

3. Ductile iron pipe shall be directly tapped without the use of service clamps.

I. Piping:

1. Copper:

a. Seamless Copper Water Tube: ASTM-B88, Type K, annealed, straight or in coils.

b. Fittings: Cast bronze fittings for flared copper tubes: ANSI-B16.26.

2. IPS to PVC adapters: Use threaded male adapter as supplied by pipe manufacturer and approved by the ENGINEER.

5.3 METHODS OF CONSTRUCTION

A. Inspection:

1. Prior to all work of this section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.

2. Verify that the work of this section may be installed in accordance with all pertinent codes and regulations, the original design, and the referenced standards.

3. All work must be inspected by the AUTHORITY or the AUTHORITY's ENGINEER.

4. All taps must be inspected by the AUTHORITY or the AUTHORITY's ENGINEER.

B. Discrepancies:

1. In the event of discrepancy, immediately notify the AUTHORITY or AUTHORITY's ENGINEER.

2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

C. Workmanship:

1. Examine pipe, fittings, curb boxes and valves before installation to assure no defective materials are incorporated.

2. Keep inside of pipe fittings, boxes and valves free of dirt and debris.

D. Placement:

1. Lay piping on firm bed for entire length of trench except where supports are otherwise provided.

2. Employ partial backfilling and cradling to hold pipe in secure position during backfilling operations.

3. Backfill evenly on both sides of pipe to maintain alignment.

4. Anchor piping laid on grade prior to embedment in concrete.

E. Bending Pipe:

1. Bend pipe by any method and to any radius within manufacturer's recommendation.

2. Only bend surface free of cracks and buckles.

F. Flared Joints:

1. Ream or file pipe to remove burrs.

2. Slip fitting over tube end to be flared.

3. Expand end of tube using flaring tool.

4. Tighten joint fitting.

G. Curb Valves and Boxes:

1. Install curb valves and boxes in accordance with the manufacturer's printed instructions and in a manner to allow proper operation of the valve. Assure that valves are installed in the proper direction and that boxes are installed plumb.

6.0 TAPPING SLEEVES AND CROSSES

6.1 DESCRIPTION

Provide tapping sleeves or crosses (and valves) for connections to existing water mains.

6.2 MATERIALS

A. Acceptable manufacturers:

1. The products of Mueller Company, Decatur, Illinois, as specified in the following paragraphs are used to establish standards of quality. Other manufacturers' materials may be used provided they are approved as an equivalent product.

2. Materials shall be the product of a single manufacturer.

B. Tapping sleeve: H-615, 616 or 619 as indicated on the standard details.

C. Tapping cross: H-715, 716 or 719 as indicated on the standard details.

D. Other materials: All other materials, not specifically described but required for a complete and proper installation of the work of this section, shall be new, first quality of their respective kinds, and as selected by the Contractor subject to the approval of the ENGINEER.

6.3 METHODS OF CONSTRUCTION

A. INSPECTION

1. Examine areas to receive taps for:

a. Defects that adversely affect execution and quality of work.

b. Deviations beyond allowable tolerances for correct tap seat.

2. Start work only when conditions are satisfactory.

B. INSTALLATION

1. Workmanship:

   a. Examine pipe and sleeves or crosses before installation to assure no defective materials are incorporated.

   b. Keep inside of pipe and tapping materials free of dirt and debris.

   c. All sleeves must be properly disinfected prior to tap.

2. Placement:

   a. Lay sleeves or crosses on firm bed for entire length of fitting except where supports are otherwise provided.

   b. Employ partial backfilling and cradling to hold tap in secure position during backfilling operations.

   c. Backfill evenly on both sides of new tap to maintain alignment.

   d. Provide thrust blocks with plastic barrier as required.

C. TAPPING SLEEVES AND CROSSES:

1. Install tapping sleeves and crosses in accordance with the manufacturer's printed instructions and in a manner to allow proper installation of the new main.

2. Install tapping sleeves or crosses where new mains are to be connected to existing mains.

D. TESTING

1. Disconnect all equipment and devices which may be damaged by test pressures.

2. Plug or cap lines.

3. Test and disinfect each piping system.

4. Repair all leaks.

7.0 DISINFECTION OF WATER SUPPLY SYSTEMS

7.1 DESCRIPTION

A. Disinfect water supply system, and test for bacteriological quality and chlorine residual.

B. Definitions:

1. Water supply system: The water main, water service pipe, water distributing pipes and the necessary connecting pipes, fittings, control valves, pumps, and all appurtenances in or adjacent to the building or premises including wells.

2. Water service pipe: The pipe from the water main or other source of potable water supply to the water distributing system of the building served.

3. Water distributing pipe: A pipe within the building or on the premises which conveys water from the water service pipe to the point of usage.

C. The existing water supply system shall not be contaminated by allowing water with a high chlorine residual to enter the existing water supply system.

7.2 MATERIALS

Chlorine: High test calcium hypochlorite conforming to AWWA B300 and AWWA C601.

7.3 METHODS OF CONSTRUCTION

A. Quality assurance: Testing laboratories shall be certified by the State of New Jersey Department of Health.

B. Requirements of regulatory agencies: Taking and analysis of water samples, and water bacteriologic quality shall conform to the requirements of the New Jersey State Department of Environmental Protection and Energy.

C. Reference standards applying to this specification section:

1. New Jersey State Department of Environmental Protection: PW-D10 - Potable Water Standards, as amended.

2. American Water Works Association:

   a. AWWA B300: AWWA Standard for Hypochlorites.

   b. AWWA C601: AWWA Standard for Disinfecting Water Mains.

D. General: All disinfection procedures to include preventive measures during construction; methods of chlorine application; preliminary and final flushing; testing and procedures to following after cutting into existing water main shall conform to AWWA C601. The method of chlorine application shall be the Tablet Method, except that if trench water or foreign material has entered the main, or if the water temperature is below 41 F, the continuous Feed Method shall be used.

   1. The initial chlorine concentration in the water in the pipe shall be a minimum of 50 ppm (mg/l) available chlorine.

   2. The places where flushing shall be done, and the rates of preliminary flushing prior to disinfection when not using the Tablet Method, shall be approved by the AUTHORITY's ENGINEER

   3. The chlorine concentration in the water main after flushing shall be no higher than that generally found in the system, or not exceeding 0.2 ppm (mg/l).

E. The following tests shall be made after final flushing and before the water main is placed into service:

   1. Chlorine residual: Determine chlorine residual using the Drop Dilution Method as described in the Appendix of AWWA C601.

   2. Bacteriologic quality:

      a. Sampling: Take samples in accordance with AWWA C601 and Potable Water Standards PW-D10.

      b. Testing: Perform testing in accordance with the rules and regulations of the New Jersey State Department of Environmental Protection.

F. Bacteriological standards: Samples tested shall conform to the bacteriological standards specified in Potable Water Standards, PW-D10.

G. If the initial disinfection fails to produce satisfactory samples, disinfection and testing shall be repeated until satisfactory samples have been obtained. The Tablet Method shall not be used in these subsequent disinfections. The water main shall not be placed into service until satisfactory samples have been obtained.

7.4 SUBMITTALS

A. Copies of all bacteriologic tests shall be forwarded to the AUTHORITY and the AUTHORITY's ENGINEER prior to placing the water main in service.

B. The test data shall include a diagram of the areas tested and the date tested.

8.0 TESTING WATER SUPPLY SYSTEMS

8.1 DESCRIPTION

A. Test water supply system for exfiltration.

B. Definitions:

1. Water supply system: The water main, water service pipe, water distributing pipes and the necessary connecting pipes, fittings, control valves and all appurtenances in or adjacent to the building or premises.

2. Water service pipe: The pipe from the water main or other source of potable water supply to the water distribution system of the building served.

3. Water distribution pipe: A pipe within the building or on the premises which conveys water from the water service pipe to the point of usage.

8.2 MATERIALS

Furnish pumps, valves, taps, pressure gauges, water meters, and all other equipment required for testing of piping systems.

8.3 METHOD OF TESTING - EXFILTRATION TEST

A. General requirements:

1. Perform all tests in presence of the AUTHORITY’s ENGINEER.

2. Conduct exfiltration test prior to backfilling trench.

3. Establish test sections between valves, or as directed by the AUTHORITY’s ENGINEER.

4. All requirements of this specification shall be met prior to acceptance of water facilities by the AUTHORITY’s ENGINEER.

B. Procedure for exfiltration test - on-site piping:

1. Expel air from pipe through hydrants, blow-offs, or taps required for release of air from high points. Taps for release of air and blow-offs for filling pipe and releasing air shall be provided by the Contractor.

2. Fill each pipe section slowly with water, and subject pipe to hydrostatic pressure of 150 psi for one (1) hour.

3. When test pressure is reached, measure amount of make-up water required to maintain this pressure during the one (1) hour test period.

4. Leakage shall not exceed 12 gallons per inch of diameter per mile of pipe per day. Pipelines failing to meet this requirement shall be repaired and retested as above specified.

5. Compute leakage as follows:

a. Gallons of make-up water x 24 = gallons loss/day.

b. Gallons loss/day x $\frac{\text{feet of pipe testing}}{\text{gallons/loss/mile/day}} = \frac{5{,}280 \text{ feet/mile}}{}$

c. $\frac{\text{Gallons/loss/mile/day}}{\text{Gallons loss/inch diameter/mile/day.}} = \text{Pipe dia. in inches}$

d. Allowable exfiltration rate is 12 gallons/inch/diameter/mile/day.

C. Procedure for exfiltration test - water distributing pipe within building: Upon completion of a section or of the entire water distributing pipe, it shall be tested and proved tight under a water pressure not less than the working pressure under which it is to be used. The water used for tests shall be obtained from a potable source of supply.

8.4 SUBMITTALS

A. Copies of all pressure tests shall be forwarded to the AUTHORITY and the AUTHORITY's ENGINEER prior to placing the main in service.

B. The test data shall include a diagram of the areas tested and the date tested.

SECTION IV
SANITARY SEWER SPECIFICATIONS

1.0 GENERAL SPECIFICATIONS

1.1 SANITARY SEWER GRAVITY MAINS AND FORCE MAINS

A. No gravity sewer conveying raw sewage shall be less than eight inches (8") in diameter.

B. Sanitary sewer mains shall not be installed under either curbs or sidewalks. In addition, trays, cleanouts and force main valves shall not be installed under or in concrete cement.

C. No underdrains, conduits and/or cables of any nature will be installed in the same trench with sanitary sewer.

D. PVC or DIP gravity sewer and force mains shall be used for all sanitary sewer except the following conditions which include, but are not limited to:

1. The main is installed at a depth of less than thirty-six inches (36").

2. At all stream crossings.

3. The main is within 100' of a water supply well or below grade reservoir.

Under these conditions ductile iron pipe will be used, or as specified by the AUTHORITY's ENGINEER.

E. Sewer and water mains generally should be separated a distance of at least ten feet (10') horizontally. If such lateral separations are not possible, the pipes shall be in separate trenches with the sewer at least eighteen inches (18") below the water main; or such other separation as approved by the AUTHORITY.

F. Concrete encasement will be required for the following conditions:

1. At all locations where a proposed sanitary sewer main is located closer than ten feet (10') to a water main (measured horizontally).

2. At all crossings of sanitary sewer lines and water lines where the vertical separation is less than eighteen inches (18").

3. At all crossings of sanitary sewer lines and water lines where the sanitary sewer is vertically above the water line.

4. All other locations where the vertical or horizontal separation between proposed and existing utility pipes is less than eighteen inches (18").

G. When a new sanitary line is constructed and tied into an active manhole, the new line will be plugged and remained plugged until all testing has been completed and approved by the AUTHORITY.

H. All sanitary sewer laterals that are scheduled for connection to a specific sewer main must be connected and extended to the curb line prior to the acceptance testing on that line.

I. Neither repair clamps nor saddles are permitted to be used on new sanitary sewers within the jurisdiction of the AUTHORITY. These are only to be used in cases of emergency, and then only with the prior written approval of the AUTHORITY. If and when saddles are approved, they will be of the strap on type with stainless steel hardware; no bolt on saddles will be permitted.

J. Force mains will not be tied directly into a gravity manhole. A collector manhole will be constructed adjacent to the gravity manhole and the force main will terminate in this collector manhole. The effluent will flow by gravity into the manhole, which is part of the gravity system.

K. Private ejector lines shall be connected directly to the sewer main.

L. Air relief valves will be required at the high points of any force main.

M. Interceptors shall be provided for commercial and industrial discharges when in the opinion of the AUTHORITY and/or ENGINEER they are necessary for the proper handling of liquid waste containing grease, oil, sand or lint to the building drainage system, the public sewer or sewage treatment plant or processes. All commercial and industrial dischargers must complete a usage questionnaire which requires submittal of plumbing plans for each facility.

1.2 MINIMUM GRADES AND VELOCITY OF FLOW

A. All sewer shall be designed and constructed to give mean velocities, when flowing full, of not less than 2.0 feet per second, based on Kutter's Formula using an "N" value of 0.01. The following are the minimum slopes which should be provided for PVC pipe only; however, slopes greater than these are desirable:

Sewer Size	**Minimum Slope in Feet Per 100 Feet**
8 Inch	0.30
10 Inch	0.20
12 Inch	0.15
14 Inch	0.12

15 Inch	0.10
16 Inch	0.09
18 Inch	0.075
20 Inch	0.065
21 Inch	0.06
24 Inch or Above	0.05

Slopes for ductile iron pipe shall be based on an N factor of 0.013.

Minimum slope of mains emanating from terminal manholes shall be increased where flow conditions exist. Cul-de-sac lots shall provide minimum 1% slope to terminal manhole.

B. Slopes slightly less than those required for the 2.0 feet per second velocity, when flowing full, may be permitted. Such decreased slopes will only be considered where the depth of flow will be 0.3 of the diameter or greater for design average flow. Whenever such decreased slopes are selected, the design engineer must furnish with his report his computations of the anticipated flow velocities of average and daily or weekly peak flow rates. The pipe diameter and slope shall be selected to obtain the greatest practical velocities to minimize settling problems.

C. Sewers shall be laid with uniform slope between manholes.

D. Where velocities greater than fifteen feet (15') per second are attained, special provision shall be made to protect against displacement by erosion and shock.

E. The use of sewers with a slope in excess of twenty percent (20%) is prohibited. Instead, drop manholes should be considered. In any event, the AUTHORITY and its ENGINEER will review all proposed sewers with a slope in excess of twenty percent (20%) or a case by case basis.

1.3 ALIGNMENT

A. All sewers twenty-four inches (24") or less shall be laid with straight alignment between manholes. The alignment shall be checked by either using a laser beam or lamping.

1.4 CHANGES IN PIPE SIZE

A. When a smaller sewer joins a larger one, the invert of the larger sewer should be lowered sufficiently to maintain the same energy gradient. An approximate method for securing these results is to place the 0.8 depth point of both sewers at the same elevation.

1.5 MANHOLES

A. Manholes shall be installed at the end of each line; at all changes in grades, alignment or size, and at distances not greater than four hundred feet (400').

B. A drop pipe should be provided for a sewer entering a manhole at an elevation of twenty-four inches (24") or more above the manhole. Drop manholes shall be constructed with an outside drop connection. The entire outside of the drop connection shall be encased in concrete.

C. The minimum diameter of manholes shall be forty-eight inches (48"). A minimum access diameter of thirty inches (30") shall be provided.

D. The flow channel through manholes should be made to conform in shape and slope to that of the sewers.

E. "WMUA" shall be cast in lids of all sanitary manholes.

F. All pipe penetrations into a manhole shall be no less than ninety degrees (90) to the centerline of the downstream main.

G. Manhole rims shall be set at base paving elevation and adjusted at a later date prior to installing the surface course. Manholes located in grassed areas shall be raised three inches (3") above grade with fill built-up around the cover.

H. All street manholes should have infiltration inserts with handles and vents. The manufacture name should be provided for future replacements.

1.6 INVERTED SIPHONS (IF APPROVED BY THE ENGINEER)

A. Inverted siphons should not have less than two (2) barrels, with a minimum pipe size of six inches (6") and shall be provided with the necessary appurtenances for convenient flushing and maintenance.

B. Sufficient head shall be provided and pipe sizes selected to secure velocities of at least 3.0 feet per second for average flows.

C. The inlet and outlet details shall be so arranged that the normal flow is diverted to one barrel, and that either barrel may be cut out of service for cleaning.

1.7 LATERALS

A. All laterals are to be connected to the main by means of a wye connection only. The standard lateral connection shall be four inches (4") for one (1) unit connecting and six inches (6") for more than one (1) unit. All service laterals will be laid with the same care prescribed in Section 2.0 of these specifications, which includes proper trench construction and backfill, and stoning of the trench bottom when necessary to obtain a stable base under the pipe.

B. The standard sewer service lateral will be constructed of PVC, cast iron, ductile iron or a combination thereof. If the OWNER or Builder desires to use pipe of a material other than that listed above, he must obtain the prior written approval of the AUTHORITY.

C. Adapters to connect the service lateral to house service lateral must be approved by the AUTHORITY.

D. The standard gravity sewer lateral will be constructed of four inch (4") or six inch (6") diameter PVC SDR #35 pipe from the sewer main to the cleanout just behind the curb line, and four inch (4") or six inch (6") pipe from the curb line to the house.

E. All sanitary sewer laterals should be installed at a grade equal to one-quarter inch (1/4”) per foot, but in no case will they be installed at a grade less than one eighth inch (1/8") per foot.

F. All laterals will be installed at a constant grade and in a straight line. There will be a cleanout constructed and a plug provided just behind the curb line and at any point where it is necessary to change the direction of the lateral. Cleanouts are required every fifty feet (50') on long laterals.

G. When the sanitary sewer mains are over nine feet (9') in depth, the construction of a vertical riser is required up to a point eight feet (8') below finish grade.

H. Minimum depth for a sanitary sewer lateral is thirty-six inches (36") at the curb line.

I. In no case shall laterals be installed under driveways. A lateral location plan shall be submitted to the AUTHORITY.

1.8 LATERAL CONNECTION TO EXISTING LINES

A. Gravity: Connections of the saddle type installed in the main sewer line shall be made in a smooth, round hole, machine-drilled into the top quarter of the main sewer pipe. The fitting should be such to insure that no protrusion of the fitting into the main sewer pipe shall result. The fitting shall conform to the contour of the sanitary sewer and is one that is specifically designed to fit the particular size main sewer pipe into which the connection is made. The machine-drilled hole shall be of such size to provide one-eighth (1/8) space between the shoulder of the fitting and the face of the main sewer pipe when installing. All voids shall be completely filled with joint material. The joint material shall be completely waterproof and capable of withstanding the stresses normally encountered in construction or maintenance. All saddles shall be a double strapped stainless steel connection. Wrap saddle in 6 mil clean polyethylene and encase in minimum six inches (6") of concrete.

B. Sewage Ejectors:

1. Sewage ejectors discharging to an existing gravity sewer shall be provided with a check valve and shutoff valve at the location of the ejector pump. The connection to the main shall be the same as in A., "Gravity Lateral Connection to Existing Lines".

2. Sewage ejectors discharging to a force main shall be connected via a direct tap. Each connection shall be equipped with a check valve and shutoff valve in an at grade box at the property line and a second check valve and shut off valve at the location of the ejector pump.

3. All sewage ejector services shall be marked with plastic marking tape as described in Item 2.2.C. of the section entitled "PVC Gravity Sewer and Pressure Pipe".

1.9 FORCE MAIN CONNECTION TO EXISTING FORCE MAIN

A. Sewage ejectors discharging to existing force mains shall be designed to overcome the total static and dynamic head conditions in the force main when flowing full. Connections shall be done with a tapping sleeve in accordance with manufacturer's directions.

1.10 GREASE RECOVERY UNITS AND INTERCEPTORS

A. Grease recovery units (G.R.U.) shall be installed in the waste line(s) leading from sinks, drains, or other fixtures in all food service, food processing, or other commercial establishments which produce grease/oil and which are connected into the public sewer system. Greases and oils are defined as any substance(s)

with physical characteristics which enable them to be quantitatively analyzed based upon their solubility in Freon, including hydrocarbons, fatty acids, soaps, fats, waxes, oils and any other substances or materials not volatilized during solubility testing. Grease and oil interceptors shall be constructed of impervious materials capable of withstanding abrupt and extreme changes in temperature. They shall be watertight, substantially constructed and equipped with readily removable access covers. Where deemed necessary, cold water sprays shall be installed. The design and pertinent data shall be submitted to the Authority for review and approval, prior to construction or installation. Separators must be constructed entirely on the property of the owner.

For new construction, all grease interceptors shall be an exterior concrete unit.

B. Oil, sand and lint interceptors shall be installed in the waste line(s) of all commercial establishments which produce such waste and are connected into the AUTHORITY's sewer system.

C. All grease recovery units or interceptors shall be so installed as to provide ready accessibility to the cover and contents thereof, for servicing and maintaining the grease recovery units or interceptors in working operating condition. All grease recovery units or interceptors shall be maintained in an efficient operating condition by regular, periodic removal of accumulated contents.

D. The AUTHORITY, through its authorized officers, employees and agents, shall have authority to inspect, at reasonable times, those food service, food processing or other commercial establishments which produce oil, grease, sand, lint or other harmful ingredients and which are connected into the AUTHORITY's sewer system to ensure that said establishments have installed and are properly maintaining their grease recovery unit and/or interceptor on all waste line(s).

E. Failure to comply shall constitute a misdemeanor and be subject to the discontinuance of water service and/or the fine and penalties as set out in the Rules and Regulations.

F. Plumbing and floor plans shall be submitted for AUTHORITY review and approval. Finalized plans shall be forwarded by the establishment to the AUTHORITY for their records.

G. Full service restaurants, pizzerias and fast food type restaurants or other commercial establishments which produce excessive quantities of grease/oily waste shall furnish both an interior G.R.U. and an exterior grease trap.

H. Grease conveying laterals shall be separated from laterals conveying raw sewage until after interceptor connection.

1.11 PRIOR TO CONSTRUCTION

Prior to starting construction of a sewer system within the AUTHORITY's service area, the Developer or Owner must have in his possession a set of AUTHORITY approved drawings. In addition, he must have paid all the necessary charges and fees as well as obtaining the necessary bonding. When easements are necessary, all paperwork must be in order; and if road opening permits are required, these must also be obtained before work can begin.

2.0 PVC GRAVITY SEWER AND PRESSURE PIPE AND FITTINGS

2.1 DESCRIPTION

PVC gravity sewer and pressure pipe for proposed sanitary sewer system.

2.2 MATERIALS

A. PVC Gravity Sewer Pipe and Fittings:

1. ASTM D-3034; SDR 35; Sizes 4" through 15".

2. ASTM F-679; Sizes 18" through 27".
3. ASTM F-794; Sizes 18" through 48" ribbed.

a. Joint design: ASTM D-3212, Pus-On Type Joint using an elastomeric ring gasket.
Infiltration shall not exceed 50 gallons/inch diameter/mile/day.
b. Joint material: Elastomeric ring rubber gasket, ASTM D-3212.

c. Joint material Primer/Adhesive: As provided or specified by pipe manufacturer.

B. PVC Pressure Sewer Pipe and Fittings:

1. AWWA C900; Sizes four inch (4") through twelve inch (12").

a. Coupling shall be an integral part of pipe.

b. Pipe shall have slip-on joints with a rubber ring seal.

c. Pipe shall be PVC "Blue Brute" Pipe with "Ring-Tite" joints as manufactured by Johns-Manville, or approved equivalent.

d. Pipe shall be of the following pressure classes having the SDR numbers indicated.

(1) DR-14, Pressure Class 200
(2) DR-18, Pressure Class 150
(3) DR-25, Pressure Class 100

e. Fittings and Rubber Rings shall be as supplied by the Pipe manufacturer.

C. Plastic marking tape: Provide and install plastic marking tape over force main piping. Plastic marking tape shall be of plastic material with integral wires, foil backing or other means to enable detection by a metal detector when the tape is buried up to 18" deep. The tape shall have the words "CAUTION SEWER LINE BELOW" in contrasting letters repeated continuously. The tape shall be of a type specifically manufactured for marking and locating underground utilities. The metallic core of the tape shall be encased in a protective jacket or provided with other means to protect it from corrosion. Tape to be minimum 6" wide and be a safety green color.

2.3 METHODS OF CONSTRUCTION

A. Reference standard used in this specification section:

1. American Society for Testing and Materials (ASTM):

a. ASTM D-3034: Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings.

b. ASTM F-679: PVC Large Diameter Plastic Gravity Sewer Pipe and Fittings.

c. ASTM F-794: PVC Large diameter Ribbed Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.

d. ASTM D-3212: Joint for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.

e. ASTM D-2241: PVC Plastic Pipe.

2. American Association of State Highway and Transportation Officials:

M-45: Aggregate for Masonry Mortar.

3. New Jersey Department of Transportation, Standard Specifications for Road and Bridge Construction 1980 Supplement.

B. Submittals:

1. Manufacturer's literature and recommendations:

a. Submit manufacturer's descriptive literature for all materials to be used.

b. Submit pipe manufacturer's recommended method of gasket installation.

c. Submit all test results including a diagram of sections tested.

d. Submit all of the above for AUTHORITY ENGINEER'S approval.

2. Certificates:

a. Submit manufacturer's certified letter stating that pipe or joint material ordered meets requirements of this specification. Letter shall indicate compliance with appropriate ASTM designations listed.

b. Submit two (2) copies prior to installing materials.

C. Product delivery, storage and handling:

1. Storage of materials:

a. Store materials to prevent physical damage.

b. Store pipe and fittings off ground to prevent dirt and debris from entering.

c. Store flexible gasket materials and joint primer or adhesive compounds, in cool dry place. Keep rubber gaskets clean, away from oil, grease, excessive heat, and out of direct rays of sun.

2. Handling of materials:

a. Protect materials during transportation and installation to avoid physical damage.

b. Use extra care in cold weather when flexibility and impact resistance of PVC pipe is reduced.

c. Do not install out-of-round pipe.

d. Unload pipe to prevent abrasion.

e. Do not drag or push pipe when handling or distributing on project site.

D. Inspection by Contractor:

1. Check pipe for following information which shall be clearly marked on each pipe section:

a. Pipe type and SDR number.

b. Nominal pipe size.

c. The PVC cell classification, for example 12454-B.

d. Name or trademark of manufacturer.

e. The ASTM Specification designation.

2. Check fittings for the following markings:

a. The ASTM Specification designation.

b. Manufacturer's name or trademark.

c. Nominal size.

d. The material designation PVC, PSM.

3. Inspect pipe for defects prior to placement in trench. The pipe and fittings shall be free from visible cracks, holes, foreign inclusions or other injurious defects.

4. Assure that all materials are to the type specified and are not defective. Unmarked pipe; or pipe and materials not meeting specifications requirements shall be removed from the site as directed by the ENGINEER.

E. Excavation for trenches:

1. Dig trenches to the uniform width required for the particular item to be installed, sufficiently wide to provide ample working room.

   a. Maximum trench width to a point one foot above the outside top of pipe shall be the pipe outer diameter plus sixteen inches.

   b. Maximum trench width at ground surface shall be as required for depth of pipe.

2. Excavate trenches to the depth indicated or required. Carry the depth of trenches for piping to establish the indicated flow lines and invert elevations.

3. Trenches for pipes shall not be opened more than the number of linear feet of pipe that can be placed and backfilled in one day.

4. Grub roots and stumps within six inches of outside surface of pipe bottom and sides to minimum depth of six inches below bottom of trench.

5. Install pipe bedding of material approved for initial backfill in accordance with the standard details and as specified herein.

F. Installation:

1. Lay pipe only in presence of ENGINEER. ENGINEER may order removal and relaying of pipe not so laid.

2. Fine grade trench bottom so that pipe is supported for its full length.

3. Lay pipe to lines and grades required. Face socket end of pipe in direction of pipe laying.

4. Do not lay pipe on unsuitable material, in wet trench, or in same trench with another pipe or utility.

5. Lower pipe into trench with ropes, machinery, or other means approved by ENGINEER.

6. General procedure for joining pipe:

   a. <u>DO NOT USE EXCAVATING EQUIPMENT TO SHOVE PIPE SECTIONS TOGETHER</u>.

b. Hold pipe securely and in proper alignment when joining.

c. Do not disturb previously made joints. Check completed piping to assure joints are intact. Insure placement of backfill over pipe is accomplished without disturbing pipe position.

d. Do not allow earth, stones, or other debris to enter pipe or fittings.

e. Method of installing joint materials and joining piping shall be in strict accordance with manufacturer's printed instructions as approved by the ENGINEER.

G. Backfill and compaction:

1. Initial backfill:

a. Initial backfill material shall be soil aggregate designation I-8 conforming to the requirements of Article 8.8.1. Table 36 of the Standard Specifications, 1980 Supplement, or stone crushing to conform with AASHTO designation M-43 (ASTM designation D448), Size No. 8, 1/8" to 3/8" (2.36 mm to 9.25 mm) clean, free flowing and shall meet all ASTM C-33 requirements for quality and soundness.

b. Install initial backfill material as shown on the standard details for the type of pipe being used.

c. When required material shall be placed under the pipe haunch to provide adequate side support. Material shall be installed entire trench width and shall be tamped and rodded to insure full contact with pipe at haunch up to the spring line.

d. Little or no tamping of the initial backfill directly over the pipe shall be done.

2. Final backfill: See General Specification Section 4.0 entitled "Trench Excavating, Backfilling and Compacting".

H. Testing:

1. Deflection testing:

a. For pipe conforming to the requirements of ASTM D3034 Maximum allowable pipe deflection (reduction in vertical inside diameter) shall be 7-1/2%.

b. For pipe conforming to the requirements of ASTM D2241 Maximum allowable pipe deflection (reduction in vertical inside diameter) shall be 5%.

c. Deflection tests shall be successfully performed on the complete installation by means of one of the following methods prior to the acceptance of construction.

(1) "Go-No-Go" mandrel properly sized.

(2) Calibrated television.

2. Lamping:

a. ENGINEER will lamp all installed pipe between manholes. Sewer lines shall meet the following standards to pass the lamping inspection.

(1) Barrel of pipe shall have no vertical deflection (not to be confused with the deflection test), and at least seventy-five percent of barrel shall be visible in the horizontal direction.

(2) Pipe not meeting this specification shall be relaid and relamped until compliance is achieved at no cost to the AUTHORITY.

3. Air testing:

a. Air testing shall conform to the requirements of Section 7.0 "Testing of Sanitary Sewer Systems" except as herein modified.

b. The minimum time duration for a low pressure exfiltration pressure drop between two consecutive manholes shall not be less than shown in Table 1.

c. The prescribed drop shall not exceed .5 psi from 3.5 to 3.0 psi in excess of the groundwater pressure above the top of the sewer.

TABLE 1
MINIMUM DURATION FOR AIR TEST PRESSURE DROP

PIPE SIZE		
INCHES	**MM**	**TIME (MINUTES)**
4	100	2 ½
6	150	4
8	200	5
10	225	6 ½
12	305	7 ½
15	380	9 ½

I. Appurtenance installation:

1. Manholes:

a. Precast manholes with connection ports shall have elastomeric seals precast into manhole walls.

b. Precast manholes with connection ports shall have flexible boot or sleeve precast into manhole walls.

2. Laterals:

a. All laterals shall be installed with the same construction procedure as the sewer main.

b. Sewer laterals in streets and rights-of-way shall be four inches (4").

3.0 DUCTILE IRON PIPE AND FITTINGS

3.1 DESCRIPTION

Provide ductile iron pipe for sanitary sewer force main or for gravity sanitary sewer main.

3.2 MATERIALS

A. Sanitary sewer force main:

1. Ductile iron pipe:

    a. Shall conform to AWWA C151.

    b. Manufactured in eighteen or twenty foot nominal lengths.

    c. Pressure Class 150 (minimum).

2. Joints for ductile iron pipe:

    Push-on-joint, conforming to AWWA C151 and AWWA C111.

3. Pipe fittings:

    a. Shall be ductile iron fittings conforming to AWWA C110, with a minimum pressure rating of 250 psi.

    b. Fitting shall have push-on type joints.

4. Plugs and clamps: Plugs shall be solid plugs conforming to the pipe sizes indicated on the plans, and shall be Plug No. F-1147 as manufactured by Clow Corporation or approved equal. Clamps for retaining plugs shall be Socket Clamp No. F-740, as manufactured by Clow Corporation or approved equal.

5. Gasket lubricant:

    a. Water soluble and not having deteriorating effects on the pipe or rubber gaskets.

    b. Shall be as supplied by pipe manufacturer or as approved by the ENGINEER.

B. Sanitary sewer gravity main:

1. Ductile iron pipe:

    a. Shall conform to AWWA C151.

    b. Manufactured in eighteen or twenty foot nominal lengths.

    c. Pressure Class 150 (minimum).

2. Joints for ductile iron pipe: Push-on-joint, conforming to AWWA C151 and AWWA C111.

3. Pipe fittings:

   a. Shall be ductile iron fittings conforming to AWWA C110, with a minimum pressure rating of 250 psi.

   b. Fittings shall have push-on type joints.

4. Plugs and clamps: Plugs shall be solid plugs conforming to the pipe sizes indicated on the Plans, and shall be Plug No. F-1147 as manufactured by Clow Corporation or approved equal. Clamps for retaining plugs shall be Socket Clamp No. F-740, as manufactured by Clow Corporation or approved equal.

5. Gasket lubricant:

   a. Water soluble and not having deteriorating effects on the pipe or rubber gaskets.

   b. Shall be as supplied by pipe manufacturer or as approved by the ENGINEER.

3.3 METHODS OF CONSTRUCTION

A. Submittals:

1. All pipe and fittings shall be inspected and tested at place of manufacture as required by the AWWA standards referenced in this specification. Provide ENGINEER with two copies of certifications from each manufacturer stating the product was inspected as required, and that the test results comply with the AWWA standards.

2. Submit manufacturers' product data for pipe, fittings, and gaskets as specified in General Specification Section 2.0 entitled, "Product Data".

3. All manufacturers shall validate other than by certification, the ductility of each length of pipe by an Underwriters Laboratory approved method. All ductile iron pipe is to have Underwriters Laboratory approval.

4. Submit all test results, including a diagram of sections tested.

B. Inspection and quality of pipe:

1. Before being lowered into the trench, each pipe shall be carefully inspected, and those not meeting the specifications shall be rejected and either destroyed or removed from the work within ten (10) hours. No pipe shall be laid except in the presence of the ENGINEER or his authorized inspector. The ENGINEER may order the removal and relaying of any pipe not so laid.

2. In addition to the inspection made by the ENGINEER, the Contractor shall carefully examine all pipe and special castings before placing the same in the trench. Any pieces which are broken or show evidence of cracks or fractures shall be rejected by him. Such inspection shall carry with it the responsibility on the part of the Contractor for the removal at his own expense of all pipe, special castings, and appurtenances, incorporated in the work, and which under test are found to be cracked or otherwise defective.

C. Installation of pipe and fittings:

1. Excavation and backfill for pipes shall conform to the specification entitled, "Trench Excavating, Backfilling and Compacting".

2. All piping shall be installed in a neat and workmanlike manner. All piping shall be installed to accurate lines and grades and shall be supported as shown in the standard details, specified, or necessary. Where temporary supports are used, they shall be sufficiently rigid to prevent shifting or distortion of the pipe. Suitable provision shall be made for expansion where necessary.

3. No defective pipe or fitting shall be laid or placed in the piping, and any piece discovered to be defective after having been laid shall be removed and replaced by a sound and satisfactory piece by the Contractor.

4. Every pipe and fitting shall be cleared of all dirt and other debris before being installed and shall be kept clean until accepted in the completed work.

5. No pipes shall be laid in fill or other unstable material, in wet trench, or in same trench with another pipe or other utility. A minimum eighteen inch (18") clearance shall be maintained between the outside surface of pipe and outside surface of other existing pipes and structures. When this clearance cannot be maintained, contact the ENGINEER for instructions prior to proceeding with the pipe installation.

6. No direct contact between pipes and structures at crossings will be permitted. Pipes in place shall not be worked over or walked on until covered by layers of earth well tamped in place to a depth of twelve inches over the pipe.

7. Minimum cover over sewer mains shall be four feet.

8. The interior of all pipes shall be thoroughly cleaned of all foreign material before being lowered into trench. Pipes shall be kept clean during laying operations by means of plugs or other approved methods.

9. Brace all plugs as required to prevent leakage or blowout during testing.

D. Piping supports for ductile iron force mains: The Contractor shall furnish and install all supports necessary to hold the piping and appurtenances in firm, substantial manner at the lines and grades required. Where required, bends, tees, and other fittings buried in the ground shall be backed up with concrete placed against undisturbed earth where firm support can be obtained. If the soil does not provide firm support, then suitable bridle rods, clamps, and accessories to brace the fitting properly shall be provided. Such bridle rods, etc., shall be coated thoroughly with an approved bituminous paint after assembly, or, if necessary, before assembly. This work shall include bracing plugs to prevent leakage or blowout during testing.

E. Handling and cutting pipe: Every care shall be taken in the handling and laying of pipe and fittings to avoid damage to the pipe, scratching or marring machined surfaces, and abrasion of the coating or lining. Pipe cuts shall be made using an abrasive wheel, rotary wheel cutter, guillotine pipe saw, milling wheel saw, oxyacetylene torch or other method approved by the ENGINEER. Ground cut ends and rough edges smooth. For push-on connections, bevel all cut ends.

F. Assembling piping:

1. Clean ring groove and bell socket prior to inserting rubber gasket seal. Properly seat gasket; make sure it faces proper direction.

2. Clean and lubricate spigot end of pipe. Lubricate spigot end of pipe and rubber gasket.

3. Hold pipe securely and in proper alignment when joining.

4. Join pipe so that reference mark on spigot end, if provided by manufacturer, is flush with end of bell.

5. Join pipe in strict accordance with manufacturer's printed installation procedures.

G. Protection of work:

1. Great care shall be exercised in the protection of finished work. Joints once made and disturbed shall be subjected to immediate rejection. It shall therefore be the duty of the Contractor to avoid the slightest movement in completed work, while in the act of laying the pipe, in backfilling, or in the passage of workmen up and down the trench. At all times during which pipe is not laid, the end of the pipe shall be sealed with a tight fitting plug. In no case will the drainage of trench water through a complete pipe be permitted.

2. All curves, bends, tees, hydrants or ends of pipe shall be securely blocked with socket clamps or yokes to prevent movement. At the end of line or turn, where provision has been made for future extension or connection, fittings shall be furnished with lugs and anchored by means of socket clamps or yokes.

H. Adapters: When it is necessary to join pipes of different types the Contractor shall furnish and install the necessary adapters. Adapters shall have ends conforming to the above specifications for the appropriate type of joint to receive the adjoining pipe. When adapters join two classes of pipe, the bodies may be of the lighter class.

I. Pipe repairs shall be accomplished utilizing stainless steel double banded repair manufacturer's printed instructions.

4.0 MANHOLES

4.1 DESCRIPTION

A. Provide precast concrete manholes for gravity sanitary sewer system.

B. Reconstruct existing manholes.

C. Provide connection to existing manholes.

4.2 MATERIALS

A. Precast concrete manholes shall conform to ASTM C 478.

B. Rubber gasket for precast manhole sections shall conform to ASTM C 361. Concrete and rubber gasket joint shall be watertight at head pressure of up to fifty feet (50').

C. Rubber gasket pipe to manhole seal for precast manholes: ASTM C 443.

1. Gasket shall be cast integrally in manhole wall.

2. Use "A-Lok" gasket as manufactured by Atlantic Concrete Products Company, Omega Concrete Products, Inc., Duncan Thecker Precast, or approved equal.

D. Ladder rungs: Shall be aluminum alloy conforming to ASTM C478.

1. Steps shall be twelve inches wide with a non-slip surface, with the ends turned up a minimum of two inches. Rungs shall be set into the wall a minimum of three inches, and extend six inches from the manhole wall.

E. Castings for Manholes: Campbell Foundry Pattern No. 1012D with lifting handles and "WMUA" cast-in-lid, or approved equal.

4.3 METHODS OF CONSTRUCTION

A. Submittals: Submit manufacturers' product data for ladder rungs and precast manholes as specified in General Specification Section 2.0 entitled "Product Data".

B. Reference standards used in this specification:

1. New Jersey State Highway Department Standard Specifications:

Section 603: Inlets and Manholes

2. American Society for Testing and Materials (ASTM):

a. ASTM C361: Reinforced Concrete Low-Head Pressure Pipe.

b. ASTM C443: Joints for Circular Concrete Sewer and Culvert Pipe Using Rubber Gaskets.

c. ASTM C478: Precast Reinforced Concrete Manhole Sections.

C. The general method of construction and manhole reconstruction shall conform to Section 603 of the Standard Specifications. The manhole shall be constructed as shown on the standard details.

D. Manhole walls shall be constructed of precast concrete rings and all joints between. The outside surface shall be painted with seal coats of coal tar or asphalt. Manhole walls may be constructed of poured concrete, subject to approval by the AUTHORITY ENGINEER. Installation of rubber gaskets for precast manholes shall be in accordance with the manufacturers' recommendations.

E. Frames shall be well bedded in mortar, making a watertight joint. Cover and frame shall have a shop coat of asphalt pitch and shall have a field coat of similar paint after the frame is set in final position. Steps shall be provided in the manhole as shown on the standard details.

F. Each manhole shall be constructed absolutely watertight. Manholes that are not watertight will not be accepted. Plastering on top of defective joints to correct leaky conditions will not be permitted.

G. The invert channels shall be smooth and semi-circular in shape conforming to the inside of the adjacent sewer section. Changes in direction of flow shall be made with a smooth curve of as large a radius as the size of the manhole will permit. Changes in size and grade of the channels shall be made gradually and evenly. The invert channels shall be formed in the concrete fill above the manhole base, or shall be half tile laid in concrete, or shall be constructed by laying full section sewer pipe through the manhole and cutting out the top half after the surrounding concrete has hardened. The floor of the manhole outside the channels shall be smooth and shall slope toward the channels not less than one inch per foot nor more than two inches per foot.

H. Construct manholes to the lines and grades required in the system being installed.

I. A maximum of four (4) courses of brick, up to twelve inches (12") in height, shall be used on any precast manhole. When a greater number of courses is required to attain the proper grade, another precast section shall be used.

J. Provide all manhole top sections with minimum thirty-two inch (32") diameter clear opening.

5.0 TESTING SANITARY SEWER SYSTEMS

5.1 DESCRIPTION

A. Test gravity sanitary sewer for exfiltration and infiltration.

B. Lamp all gravity sanitary sewer lines.

C. Remote television inspection.

5.2 MATERIALS

Furnish pumps, valves, plugs, taps, pressure gauges, air compressor, and all other equipment required for testing of piping system.

5.3 METHOD OF TESTING - EXFILTRATION TEST FOR GRAVITY SANITARY SEWER LINES

A. General requirements:

1. Perform all tests in presence of the ENGINEER.

2. Conduct exfiltration test when all utilities (including gas, water, telephone, sewers), manholes, laterals have been installed.

3. Establish test sections between consecutive manholes as directed by the ENGINEER.

4. All requirements of this specification shall be met prior to acceptance of sewer facilities by the ENGINEER.

B. Procedure for exfiltration test (low pressure air test, 3.5 lbs.):

1. Plug test section of sewer line at each end. Tap one (1) plug and provide air inlet connection for filling pipe from air compressor.
2. Cap or plug all service laterals, stubs and fittings connecting to sewer test section, brace same against internal pressure to prevent air leakage by slippage and blowouts.

3. Connect air hose to tapped plug selected for air inlet. Connect other end of air hose to portable air control equipment used for controlling air entry rate to sewer test section and monitoring air pressure in pipeline.

4. Air control equipment shall include shut-off valve, pressure regulating valve, pressure reduction valve and monitoring pressure gauge having pressure range from 0 to 5 psi and an accuracy of +0.04 psi.

5. Connect another air hose between air compressor (or other source of compressed air) and air control equipment. This completes test equipment set up.

6. Supply air to test section slowly, filling pipeline until constant pressure of 3.5 psi is maintained. Air pressure must be regulated to prevent pressure inside the pipe from exceeding 5.0 psi.

7. When constant pressure of 3.5 psi is reached, throttle air supply to maintain internal pressure above 3.0 psi for at least five (5) minutes, permitting temperature of entering air to equalize with temperature of pipe wall. During this stabilization period, check all capped and plugged fittings with a soap solution to detect leakage at connections.

8. If leakage is detected, release pressure in line and tighten all leaky caps and plugs. Start test operation again by supplying air. When necessary to bleed off air to tighten or repair faulty connection, a new five-minute interval shall be allowed after pipeline has been refilled.

9. After stabilization period, adjust air pressure to 3.5 psi and shut off or disconnect air supply. Observe gauge until air pressure reaches 3.0 psi. At 3.0 psi commence timing with a stop watch which is allowed to run until the line pressure drops to 2.5 psi. The time required, as shown on the stop watch, for a pressure loss of 0.5 psi is used to compute air loss.

10. If the time, in minutes and seconds, for the air pressure to drop from 3.0 to 2.5 psi is GREATER than that shown in Table 1 for designated pipe size, the section undergoing test shall have passed.

11. If the time, in minutes and seconds, for 0.5 psi drop is LESS than shown in Table 1 for designated pipe size, the section of pipe shall have failed the test. Necessary repairs shall be made by the Contractor and the line retested.

***TABLE 1**
TIME REQUIREMENTS FOR AIR TESTING
FOR SEWER LINE OF UNIFORM PIPE SIZE

	TIME	
PIPE SIZE	**MINUTES**	**SECONDS**
** 4	2	32
** 6	3	50
** 8	5	6
10	6	22
12	7	39
14	8	56
15	9	35
16	10	12
18	11	34
20	12	45
21	13	30

* Multi Pipe Sizes: When sewer line undergoing test is 8 inch or larger diameter pipe and includes different sized laterals, the figure in Table 1 for uniform sewer main sizes WILL NOT give reliable or accurate criteria for the test. Where multi-pipe sizes are to undergo air testing, the ENGINEER will compute "average" size in inches which is multiplied by 38.2 seconds. The results give minimum time in seconds acceptable for pressure drop of 0.5 psi for "average" diameter pipe.

** For 8 inch and smaller pipe only, if during the five (5) minute stabilization period, pressure drops less than 0.5 psi after initial pressurization and air is NOT added, pipe section undergoing test shall have passed.

C. Procedure for air pressure correction due to groundwater:

1. Air pressure correction is required when prevailing groundwater is above sewer line being tested. Under this condition, air test pressure shall be increased 0.433 psi for each foot groundwater level is above invert of pipe.

2. Establish height of groundwater (in feet) above pipe invert:

   a. DURING SEWER AND MANHOLE CONSTRUCTION, install one-half inch diameter pipe nipple (threaded one or both ends, approximately ten (10") inches long) through manhole wall directly on top of one of sewer pipes entering manhole, with threaded end of nipple extending inside the manhole.

   b. Seal pipe nipple with a threaded one-half inch cap.

   c. Immediately before air testing, determine groundwater level by removing the threaded cap from nipple, blowing air through the pipe nipple to remove any obstructions, and connecting clear plastic tube to pipe nipple.

   d. Hold plastic tube vertically permitting water to rise to groundwater level.

   e. After water level has stabilized in plastic tube, measure vertical height of water, in feet, above invert of sewer pipe.

3. Determine air pressure correction, which is added to 3.0 psi normal starting pressure of test, by dividing the vertical height in feet by 2.31. The result gives air pressure correction in pounds per square inch to be added:

Example: If the vertical height of water from the sewer invert to the top of the water column measures 11.55 feet, the additional air pressure required would be

$$\frac{(11.55)}{2.31} = 5 \text{ psi}$$

Starting pressure of the test would be 3.0 plus 5 or 8.0 psi, and the one-half pound drop becomes 7.5 psi. There is not change in the allowable drop (0.5 psi) or in the time requirements established for the basic air test.

5.4 METHODS OF TESTING - INFILTRATION TEST

A. General:

1. All work relating to infiltration testing shall be performed in the presence of the ENGINEER. The weir will be provided by the ENGINEER.

2. All requirements of this specification shall be met prior to acceptance of sewer facilities by the ENGINEER.

B. Procedure for infiltration test:

1. Examine the sanitary sewer system for infiltration at the downstream end of the system after construction has been completed.

2. In the event that there is infiltration and water is flowing at the downstream end of the system, then the source and volume of flow shall be determined by an infiltration test.

3. The test shall consist of isolating the source of infiltration by plugging the first upstream manhole and observing to see if the flow stops. This procedure is repeated one manhole at a time until each source has been isolated.

4. When the infiltration has been isolated to a section or area, the volume of flow shall be determined using a 90 degree V-notch weir inserted into the pipe.

5. The actual infiltration rate will be determined by the ENGINEER based on the weir measurements. This rate will be compared with the allowable infiltration rate of 50 gallons/inch diameter/mile of pipe/per day (24 hours).

6. If the allowable infiltration rate is greater than the actual infiltration rate, the infiltration test passes. If the actual infiltration is greater than the allowable infiltration, the infiltration test fails.

7. In the event the infiltration test fails, the section of the pipe involved shall be repaired as necessary and the test repeated.

5.5 METHOD OF TESTING - LAMPING

A. General:

1. Lamping shall be performed on all gravity sanitary sewer lines.

2. Lamping will be performed by the ENGINEER. The Contractor shall provide all necessary labor to assist the ENGINEER during the lamping inspection.

B. Procedure for lamping:

1. Lamping consists of visually examining the inside of the pipe between two consecutive manhole using a light and mirror.
2. The light is shown from one manhole towards the other manhole.

3. A mirror is held at the invert of pipe and adjusted so that light and barrel of pipe can be seen.

4. The barrel of the pipe shall have no vertical deflection and at least seventy-five (75%) percent of the barrel shall be visible in the horizontal direction.

5. In the event that lamping shows the pipe not laid to line and grade within the acceptance limits specified above, then it shall be repaired and relamped as necessary until the lamping complies with the acceptance limits.

5.6 Remote Television Inspection

A. General:

1. The Contractor/Developer shall have performed a remote television inspection of the sanitary sewer system prior to the release of the performance bond. Construction or material deficiencies revealed during the inspection will be promptly repaired by the Contractor.

6.0 TESTING SANITARY SEWER GRAVITY AND FORCE MAINS

6.1 DESCRIPTION

Test sanitary sewer gravity and force mains for exfiltration.

6.2 MATERIALS

Furnish pumps, valves, taps, pressure gauges, meter, and all other equipment required for testing of piping systems.

6.3 METHOD OF TESTING - EXFILTRATION TEST

A. General requirements:

1. Perform all tests in presence of the ENGINEER.

2. Conduct exfiltration test prior to backfilling trench.

3. Establish test sections between valves, or as directed by the ENGINEER.

4. All requirements of this specification shall be met prior to acceptance of force main by the ENGINEER.

B. Procedure for exfiltration test:

1. Expel air from pipe through blow-offs, or taps required for release of air from high points. Taps for release of air and blow-offs for filling pipe and releasing air shall be provided by the Contractor.

2. Fill each pipe section slowly with water, and subject pipe to hydrostatic pressure of 150 psi for one (1) hour.

3. When test pressure is reached, measure amount of make-up water required to maintain this pressure during the one (1) hour test period.

4. Leakage shall not exceed 12 gallons per inch of diameter per mile of pipe per day. Pipelines failing to meet this requirement shall be repaired and retested as above specified.

5. Compute leakage as follows:

a. Gallons of make-up water x 24 = gallons loss/day.

b. Gallons loss/day x

$$\frac{\text{feet of pipe testing}}{\text{gallons/loss/mile/day.}} = 5{,}280 \text{ feet/mile}$$

c. $$\frac{\text{Gallons/loss/mile/day}}{\text{Pipe dia. in inches}} =$$

Gallons loss/inch diameter/mile/day.

d. Allowable exfiltration rate is 12 gallons/inch/diameter/mile/day.