

WATER SPECIFICATIONS



**BUCK COUNTY WATER & SEWER AUTHORITY
1275 ALMSHOUSE ROAD
WARRINGTON, PA 18976**

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SECTION I SCOPE OF WORK AND SPECIAL REQUIREMENTS

1.01 SCOPE OF WORK

The Contractor shall furnish all labor, materials, equipment, machinery, apparatus and tools and perform all operations necessary to install, equip, adjust and to put into satisfactory operation the work of the project, and shall so connect the various items or sections of the work of the project so as to form a complete and operating whole. Any labor, materials, equipment or apparatus not specifically mentioned herein, or shown on the Detail Drawings, which may be found necessary to complete or perfect any portion of the work in a substantial manner and in compliance with the requirements stated or implied by these Specifications and Standard Details; shall be provided by the Contract.

1.02 SPECIAL REQUIREMENTS

In case of conflict with the Specifications or Standard Details, the following special requirements shall govern:

- A. Before any work is started, the Developer shall ascertain from the Authority whether or not the latter intends to employ a consultant as Engineer for the project. If the Authority indicates that no Engineer will be employed, the work "Authority" is substituted for the work "Engineer" throughout these Specifications, and the Developer and Contract shall be guided accordingly. The terms "Engineer" and "Authority Engineer" are used interchangeably in these Specifications.
- B. If the water lines cross telephone, telegraph, electric cables, gas, oil or water lines, no excavation or pipe laying shall be done at those crossings without the presence of an authorized representative from the office of the agency having jurisdiction. Attention is directed to the provisions of Act No. 287 and as superseded by Act 172 (1986) of the Commonwealth of Pennsylvania, and full compliance therewith is required.
- C. The contractor should plan his work so as to provide adequate protection during storms. Certain portions of the work may be affected during storms and floods. Provisions for preventing damage should be made available at all times.

Water lines and related work shall be protected at all times against damage from uplift due to high ground water levels.

- D. Where reference is made to Government Specifications, or to organizations such as ASTM, ANSI, etc., the latest editions shall be used, any or all referenced to earlier dated editions notwithstanding.

- E. Where water mains are to be constructed within State Highway right-of-ways, the Developer shall make necessary applications for permits to construct such water mains and shall pay all charges and fees required therefore. The permit applications shall be submitted to the Authority Engineer for review and to the Authority for execution.
- F. Local townships require that a "Road Opening Permit" be obtained to perform any construction within the rights-of-way of township streets. The Developer shall obtain all such road opening permits and shall pay all fees and charges required therefore.
- G. Where water mains are to be constructed within the limits of paved streets, all removal and replacement of street paving shall be in strict conformance with the requirements of the Township and of the Pennsylvania Department of Transportation, and will be paid by the Developer.
- H. Streets shall not be unnecessarily obstructed. The contractor shall take such measures as may be necessary to keep the street or road open and safe for traffic.
- I. All driveways shall be restored to a condition equal to their original undisturbed condition, using the same type and quality of materials as that of the particular driveway restored.
- J. All curbs, gutters and sidewalks damaged or disturbed shall be replaced with the same type of materials, as the original curb, gutter or sidewalk. The replaced curbs, gutters and sidewalks shall be of the same shape, thickness and surface finish as the original curb, gutter or sidewalk.
- K. At the shutdown of work at the end of the work day, all streets shall be left in such condition whereby they can be readily opened and safely traveled in cases of emergency such as a fire or for ambulance service.
- L. The Contractor shall delegate a competent and reliable person who is readily available and has full authority to act on behalf of the contractor, in case it is necessary to deal with any emergency situations which may arise in connection with the project during off working hours, evenings, weekends, and holidays.
- M. The use of a "Hydra-Hammer" for compaction of backfill will **not** permitted.
- N. All taps to existing Authority mains shall be done by Authority personnel or under the supervision of Authority personnel, as shall be determined by the Authority.
- O. Where reference is made herein in these specifications to "Standard Detail" or "Detail", it shall be understood to mean the 8 ½" x 11" drawings in these specifications.

P. Drawings of the water system which are to be submitted to the Engineer for approval in compliance with Articles 1.04 and 1.05 of these specifications shall be drawn on sheet sizes and to the scales shown below:

Key sheet (index map)	1" = 100'	or any convenient and legible scale which shows entire project on one 24" x 36" sheet
Master Utility Plan	1" = 100"	maximum sheet size shall be 24" x 36"
Plan & Profile Sheets		24" x 36" sheet size only
Horizontal Scale	1" = 50'	
Vertical Scale	1" = 5'	

The Authority or the Authority Engineer may require a change of scales, dependent on the size of the project.

Drawings shall be neat and legible, without extraneous notes. Match lines shall be shown between all separated plan views on the same sheet or successive sheets. Lettering shall be oriented consistently. The Authority Engineer may return any drawing for redrafting if he determines that legibility is inadequate or if Authority drafting standards are not being met.

Pipe sizes shall be shown on the key sheets(s), together with the names of all streets.

On the plan and profile sheets, the location of each existing or proposed building shall be shown with the elevation of the lowest finished floor. The water mains shall have ties to existing permanent or semi-permanent features. All pipe sizes, valves and fittings shall be identified in both plan and profile view. Existing and proposed profile of the roadway ground surface shall be shown. Where other utilities cross the proposed pipe lines, the size and invert elevation (top and bottom elevation, in the case of duct lines) shall be given.

The Master Utility Plan shall show all above and underground utilities, including, but not limited to storm, sanitary, electric, water and drainage structures.

Two monuments shall be assigned grid coordinates (PA State Grid Coordinate System 1983) and shall be shown on both the Master Utility Plan and Plan & Profile Sheet(s). The coordinates shall be determined with second order survey precision (minimum).

Property corners or other permanent appurtenances shall be acceptable as monuments. Monumentation shall be opposite ends of the development or at opposite ends of the improvements.

Details of bedding, encasement, service connections, water system appurtenances, etc., shall be as shown on the Detail Drawings which shall be included in the plan set.

Q. Before the work will be accepted for dedication by the Authority, the Developer shall submit to the Authority mylar type reproducibles of all working drawings, modified as necessary to show as-built conditions. The Developer shall submit a certificate with the as-built reproducibles attesting to the correctness of all information shown on the Drawings. (The Authority intends to use prints of the reproducibles to provide information to designers and contractors as required by the Commonwealth of Pennsylvania Act 287/172).

R. Easements shall be provided for all water lines which are outside the public right-of-way. Easement widths shall be as follows:

Distribution Mains - 30' wide easement (minimum)

Transmission Mains - 30" wide easement (minimum)

Transmission Mains (16" and larger) - 40" wide easement (minimum)

Greater easement widths may be required as directed by the Authority's Engineer. Water lines shall be installed no closer than 10 feet to the edge of easement that is 30 feet wide, and no closer than 15 feet to the edge of easements that are wider than 30 feet.

S. No permanent structures, fences, plantings or trees shall be placed within the permanent easement.

T. Stabilized access bed shall be provided through all easements for maintenance equipment (see detail W-29).

1.03 CONTRACTOR'S INSURANCE REQUIREMENTS

A. The Contractor is required to maintain Bodily Injury Liability Insurance including Personal Injury and Property Damage Liability in Comprehensive Form, in include Operations, Explosion, Collapse and Underground Hazard, Products and Completed Operations Hazard, Contractual and Independent Contractors. These policies shall contain an endorsement adding Bucks County Water and Sewer Authority as an additional named insured.

- B. Vehicle insurance shall be maintained on a Comprehensive form to include Owned, Hired and Non-Owned. These policies shall contain an endorsement adding Bucks County Water and Sewer Authority as an additional named insured.
- C. Contractor shall maintain Workmen's Compensation Insurance, including Employer's Liability for all operations as required by law.
- D. The Contractor shall maintain limits of liability for the above mentioned insurance in an amount not less than two million (\$2,000,000) dollars.
- E. At least seven (7) calendar days prior to starting work, the Contractor shall submit certificates of insurance for all coverage's detailed above.
- F. The Contractor shall require all subcontractors to maintain all required insurance coverage's as required of the contractor under the specifications.
- G. The contractor shall indemnify and hold harmless the Authority and the Authority Engineer of all claims made by employees of either the Contractor or Subcontractor arising from the execution of work required under this contract.

1.04 WATER SYSTEM DESIGN STANDARDS

- A. Water systems which are to be dedicated to the Bucks County Water and Sewer Authority shall be designed, constructed, inspected and tested at the Developer's expense. The water system design shall be submitted to the Authority Engineer for review and approval, and the Authority Engineer shall inspect the construction and testing. The design shall be in accordance with the standards herein and the review comments of the Authority Engineer. Undedicated water systems shall not be permitted to connect to the Authority's water system.
- B. Depth of Cover – 4 feet minimum.
- C. Controls – No main shall be installed without the presence of either curb or grade stakes.
- D. All distribution systems shall be looped. Mains shall be extended to the outer limits of the development parcel for connection to existing mains or possible future mains.
- E. Location of Mains – all mains must be located in public right-of-way or an easement dedicated to the Authority.
- F. Fire Hydrants – the entire development must fall within fire hydrant coverage. Hydrants shall be spaced no more than 600 feet apart. Hydrants shall be placed at the following additional locations:

1. near base of each water storage reservoir or tank.
 2. At all high points where air valve is not required
 3. At all low points with a blow off tee (tangent) on the main
 4. Within 400 feet of all structures except where permitted otherwise by township ordinance.
 5. As required by Township Fire Marshall.
- G. Pipe Deflection – deflection of the pipe at the joint may be permitted upon the approval of the Engineer. The deflection cannot exceed the pipe manufacturer’s maximum allowable deflection, but in no case shall be greater than two degrees.
- H. Design – all water mains shall be designed in accordance with the latest edition of the Department of Environmental Resources “Public Water Supply Manual” and the latest applicable AWWA Standards.
- I. Isolation Valves – all branch lines shall be provided with isolation gate valves, and continuous runs of pipe shall be provided with isolation gate valves at a maximum spacing of 800 feet.
- J. Residual Pressure – minimum residual water pressure during peak flow or fire flow shall be 20 psig.
- K. Fire Flow Rates – minimum rate shall be 1000 gallons per minutes for two hours or greater as required by local ordinances, and/or I.S.O. requirements.
- L. Minimum Pipe Sizes:
- | | | |
|-----|---|--|
| 8” | - | for street main |
| 6” | - | for cul-de-sac main less than 500’ long, without a fire hydrant (8” otherwise) |
| 6” | - | for fire hydrant branch connection |
| 12” | - | for transmission main or larger as directed by Authority Engineer |
- M. Each user shall have its own water service line and shall be connected to the water main with a corporation stop and a curb shut off valve with a valve box. See detail W-5.
- N. Each user shall have a meter with backflow preventer installed in the house with a remote reading registration meter on the outside wall. See detail W-25.
- O. All dead ends, fittings and fire hydrants shall be provided with both mechanical restraint and concrete thrust block, which shall be independently designed to restrain the pipe.
- P. Distribution mains (6” & 8”) shall be designed to pass over sanitary sewers and sanitary laterals with a minimum clearance of eighteen (18”) inches (O.T.O.).

1.05 PUBLIC WATER WELL DESIGN STANDARDS

A. Well sites and water supply facilities which are to be dedicated to the Bucks County Water and Sewer Authority shall be designed, constructed, inspected and tested at the Developer’s expense. The design shall be in accordance with the standards herein and the review comments of the Authority Engineer. The design shall be submitted to the Authority Engineer for review and approval and the Engineer shall inspect the construction and testing. Undedicated water systems shall not be permitted to connect to the Authority’s water system.

The Developer shall provide adequate land, access and facilities to be dedicated to the Authority, suitable for the development and operation of the well site for public water supply.

B. Each development shall provide production well source (s) capable of being permitted for a minimum total yield of whichever of the below listed criteria is greater:

- 1. 100,000 gallons per day
- 2. a daily flow volume equal to the Design Maximum Daily Demand

The Design Maximum Daily Demand shall be calculated using the generalized formula:

$$2.0 \times 70 \text{ gpd/cap} \times \text{number of people/EDU} \times \text{number of EDU's}$$

The number of equivalent dwelling units (EDUs) shall be the full build out for the parcel (s) as allowed under the Township Zoning Ordinance and Comprehensive Plans. It shall not be limited to the number of EDUs proposed by the plans or in the initial phases proposed by the Developer.

C. There shall be a maximum of two production wells, unless approved otherwise by the Authority. All wells shall be at least 500’ apart. If more than one production well is provided, the yield of each well shall be determined with all wells in full operation. The production well (s) shall have a minimum rated pumping capacity of 75 gallons per minute.

The well and facilities will have adequate ingress and egress for the construction and development of the well and facilities, as well as the future and maintenance thereof, including the necessary easement for ingress and egress on the public road to the well site and facilities for the construction, use and maintenance thereof, as well as for the laying of the necessary pipe and appurtenances to interconnect with the Authority water system.

- D. Clearance, between any well head and the nearest building or structure, shall be 50 feet minimum, 100 feet in recommended.
- E. Sanitary protective easement with a 100 feet radius shall be provided for each well, in accordance with the PA DEP Public Water Supply Manual. The protective easement shall be recorded on all deeds effected by the easement.
- F. Construction shall be in accordance with PA DEP Public Water Supply Manual, AWWA and these specifications.
- G. Well testing shall be at maximum practicable rate and the well shall be permitted for the maximum practical yield. Yield test shall have a minimum duration of 72 hours, and shall be conducted at a rate of not less than the maximum practical yield. Test pumping rate shall be continuous. Interruption will require extension of test period. The test pumping period may be extended if the dynamic well level continues to fall significantly at the test flow rate, as determined by the Authority's Hydrogeologic Consultant.
- H. Well station must be equipped with adequate chlorination system and emergency power source (a second independent electric service or standby generator).
- I. Water quality shall be in accordance with the Bucks County Board of Health and the PA DEP Public Water Supply requirements. Use of treatment systems or processes will be subject to the approval of the Authority.
- J. Monitoring during well testing shall be in accordance with PA DEP, local Township requirements and DRBC (if in its jurisdiction).

At least two monitoring wells per test well shall be constructed to monitor the impact of the test well. Monitoring wells at least 200 feet apart shall be a minimum distance 100 feet and a maximum distance of 200 feet from the test well.

Existing wells, within a radius as determined by the chart below, shall be shown on a plan:

Quantity of Cumulative Maximum Practical Yield	Radius from the Proposed Withdrawal to be Constructed
10,000 to 50,000 GDP	0.5 miles
50,000 to 100,000 GDP	0.75 miles
in excess of 100,000 GDP	1.00 miles

All property owners with an identified well shall be notified in writing that a well test will be conducted, the date of the test, the reason for the test and what it will consist of.

In order to determine the impact of the test well on existing wells a representative samples, evenly distributed throughout the area, of existing wells shall be monitored shall be approved by the Township.

- K. the production well shall be reamed to 8" diameter (minimum) to below the depths of all significant or potential water bearing strata. Bore hole must be clear to full depth, and straight to below the design pump suction level. Inner casing diameter must be 8" minimum. Outer casing diameter, if required by the Authority, must be 16 inches unless smaller diameters approved by Authority Engineer. Inner casing must penetrate 15 feet into bedrock and be at least 40 feet long. Annular space between the inner casing and bore hole must be grouted. If outer casing is required, the annular space between inner and outer casing must be grouted. Well must be constructed in accordance with the standards of the Bucks County Water and Sewer Authority and the Pennsylvania Department of Environmental Protection.

- L. All water storage shall be an elevated gravity system unless approved otherwise by the Authority. The developer shall provide sufficient water storage capacity for his development, either by connecting to an existing elevated storage tank that has excess undedicated storage volume or by constructing a new elevated storage tank. A new elevated storage tank must have a minimum volume of 400,000 gallons (in Solebury Township minimum volume is 500,000 gallons); but shall be sufficient to supply a minimum fire flow volume of 120,000 gallons plus two-day Design Maximum Daily Demand.

Fire flow volume may be increased depending on I.S.O. requirements or Township Ordinance requirements, whichever is greater. Tank gradient shall be as directed by the Authority Engineer.

- M. Hydrogeologist Report must be provided by the developer's consultant, and shall meet the requirements of the applicable Township Ordinances and be suitable for permit application to the Department of Environmental Protection and the Bucks County Board of health and Delaware River Basin Commission if within its jurisdiction.

- N. Construction drawings must be prepared for the well head, well house (if required), inside piping, pumping and disinfection systems, electrical and standby power systems, heating and ventilation, storage tank and foundation with altitude valve vault (if required), outside piping with detention tank, telemetry and control systems, and as directed by the Authority Engineer. Design must be in accordance with the requirements of the Bucks County Water and Sewer Authority, Authority Engineer review, the Department of Environmental Protection and the Township.

- O. Design of a transmission system may have to be provided by the developer.

- P. Permit submittal containing DEP application with water modules approved construction drawings, and Hydrogeologist Report must be provided by the developer to the Authority for execution as the permittee. A minimum of eight sets are required and developer's check payable to the Commonwealth must accompany the application.
- Q. Well head, well station and transmission system (if required), shall be constructed and paid for by the developer. The construction shall be inspected and tested by the Authority. In accordance with standard Authority agreements, cost of testing and inspection shall be borne by the developer.
- R. The developer must have the system operationally tested for at least two weeks in automatic mode. Operational testing shall include, but not be limited to, pumping system, disinfection system, automatic controls, stand-by power and telemetry. All defects revealed by testing shall be repaired to the Authority's satisfaction by the developer. After defects are repaired, the well station shall be operated in automatic mode for at least two weeks without any defects.
- S. The developer's engineer shall prepare acceptable deeds for land and facilities by developer and reproducible as-built drawings for review and approval by the Authority.

SECTION II MATERIALS

2.01 DUCTILE IRON PIPE AND FITTINGS

All buried water mains shall be Class 52 ductile iron pipe minimum. All piping to be gasketed push-on type and/or mechanical joints and, in special conditions approved by the Authority, flange pipe and fittings may be utilized.

All pipe and fittings shall be bituminous coated cement mortar lined (double thickness per ANSI A 21.4/AWWA C-104).

Ductile iron pipe and fittings shall conform to the following standards:

ANSI A21.51/AWWA C151	-	Ductile Iron Pipe
ANSI A21.11/AWWA C111	-	Gasket Type Joints
ANSI A21.10/AWWA C110	-	Gray Iron and Ductile Iron Mechanical Joint Fittings
ANSI A21.53/AWWA C153	-	Ductile Iron Push-On Joint Fittings

Flanged ductile iron pipe shall be thickness Class 53, and shall fully conform to the requirements of ANSI.15/AWWA C115. Flanges shall be flat faced (raised face flanges shall not be permitted), ANSI B16.1, Class 125, and shall also conform to ANSI A21.15/AWWA C115.

Flanged joints shall be flat faced (raised face flanges shall not be permitted), gasketed and bolted, conforming to ANSI A21.10/AWWA C110 standards. Gaskets shall be full faced (ring gaskets shall not be used), rubber, 1/8 inch thick, conforming to ASTM 425 and ANSI A21.10 standards.

All nuts and bolts for flanged joints shall be low alloy steel conforming to the requirements of ANSI B16.1. All nuts and bolts in buried or corrosive applications shall receive a heavy coating of bituminous material.

Cast iron or ductile iron fittings, mechanical joint or flanged, shall be in accordance with ANSI 21.10/AWWA C-110. Flanges to be Class 125 drilling, full face. No push-on type fittings shall be permitted for water mains.

2.02 POLYETHYLENE ENCASEMENT FOR DUCTILE IRON WATER PIPE

In areas where buried pipe is installed in corrosive soil known to be harmful to pipe, fittings and appurtenances, they shall be installed with polyethylene encasement surrounding the exterior of the pipe and fittings. In the event the contract drawings do not indicate any encasement or the limits of the encasement, the decision of the Authority's Engineer shall determine the location where the encasement shall be used. All costs relating to soil sampling and analysis and inspection shall be borne by the developer. The polyethylene encasement shall be 8 mils thick and installed in accordance with Method A of ANSI A21.5/Awwa C-105.

2.03 POLYVINYL CHLORIDE (PVC) PRESSURE PIPE AND FITTINGS

Water distribution pipe with internal diameter 12" or less may be polyvinyl chloride (PVC) pressure pipe (ANNSI/AWWA C900), push-on or mechanical joint. PVC pressure pipe shall have a minimum wall thickness such that the maximum dimension ration (DR) is 18. Pipelike material shall conform to ASTM Standard D1784. All PVC pressure pipe shall have outside diameter equivalent to cast iron and ductile pipe. All joints shall have gasketed seals conforming to ASTM Standard D3139. Seal gaskets shall conform to ASTM Standard F477. DR-18 pipe shall be manufacturer to withstand 755 psi quick burst pressure tested in accordance with ASTM Standard D1599 and 500 psi for long term pressure, tested in accordance with ASTM Standard D1598. DR-14 pipe shall be manufactured to withstand 985 psi quick burst test pressure and 650 psi long term test pressure. Pipe shall be as manufactured or supplies by Clow Corporation, J-M Manufacturing Company, Harrington Company or approved equal.

PVC pressure pipe shall be bedded in accordance with manufacturer's requirements. The bedding material for PVC pipe shall conform to the grading and qualify as specified in PennDOT Form 408 to No. 1-B crushed stone coarse aggregate. The bedding is to be placed around the PVC pipe as specified in this Standard and as shown on the detail drawing. The bedding shall extend 4" minimum below the bottom of the pipe, surrounding the pipe on all sides and extend 12" minimum above the top of the pipe. See trench backfilling specifications for other requirement. A metallic tracer strip should be buried one-foot above PVC pipeline.

Fittings for PVC Pipe – all fittings for polyvinyl chlorine pressure pipe shall be in accordance with ANSI-AWWA C-900 and shall be manufactured from a single piece of injection molded PVC compound conforming to ASTM Standard D1784. All fittings shall be Class 150 minimum and shall be manufactured to withstand the pressure test in accordance with ASTM Standard D1598 and 1599, as described above. Gasket and joints shall be in accordance with ASTM Standards D3139 and F477. PVC fittings shall be as manufactured or supplied by Clow Corporation, J-m Manufacturing Company, Harrington Company or approved equal.

All PVC fittings shall be provided with mechanical joints. Cast iron and ductile iron fittings with mechanical joints conforming to AWWA C153 or C110 may be used with PVC pressure pipe when PVC fittings are not available. Mechanical joints shall be made in strict accordance with the recommendations of the joint manufacturer and suitable to the pipe for which it is being used.

For PVC to DIP unrestrained connections, use a Dresser Style 153 coupling or as approved by the Authority's Engineer.

2.04 DISTRIBUTION SYSTEM APPURTENANCES – WATER MAINS

A. CORPORATION STOPS

Corporation stops shall be Mueller Company No. H-15008 or as approved equal by the Authority, installed as shown on Standard Detail No. W-5.

B. CURB STOPS AND CURB BOXES

Curb stops shall be Mueller H-15209 three-quarter inch (3/4") stops or as approved equal by the Authority. Curb Boxes shall be installed with each corporation stop in accordance with the standard details.

Curb Boxes shall be of cast iron of sufficient length to reach the surface of the ground, but shall not extend above the surface. The boxes shall have the word "WATER" cast in the lid. Curb boxes shall be Mueller No. H-10334 with 89376 lids, or as approved equal by the Authority. Curb boxes shall receive bituminous coating (2 coats).

C. SERVICE PIPE

Between all corporation stops and curb stops, there shall be installed copper service pipe, Type K soft temper conforming to ASTM Specification 88-62, having the same diameter as the stop, suitable for underground service. A minimum cover of four (4) feet shall be maintained.

Service piping for single-family dwelling units shall be a minimum 3/4" size copper type or larger where directed by Authority Engineer. Only compression fittings shall be used for service piping and components. Soldered joints shall not be permitted.

Installation details of service piping of sizes greater than 1" shall be referred to the Authority for approval.

D. GATE VALVES

Gate valves for sizes 16" and larger shall be Metropolitan pattern and shall be manufactured in accordance with the American Water Works Association current Specification No. C-500 or latest revision thereof, and shall be suitable for use with 150 psi working pressure and 300 psi test pressure. Valves shall be installed in accordance with the standard details. Gate valves for sizes 4" through and including 12" diameter shall be resilient seated wedge gate valves, shall be designed, manufactured and tested in accordance with AWWA C-509, and shall be suitable for use with psi working pressure and 400 psi test pressure. All valves shall have a smooth and unobstructed waterway free from any sediment pockets. All valves shall be mechanical joint ends.

All metropolitan pattern valves shall be iron body, bronze mounted, double disc, parallel seat, non-rising stem, with wedge and bronze stem nut operating independently of the gates. Wedging surfaces shall be bronze to bronze. Pins and bolts in the wedging mechanism shall be made of bronze. The valves shall have a two-inch square operating nut. The valve stem shall have double "O" ring seals.

Resilient seated wedge gate valves shall have a cast iron solid wedge with a permanently bounded resilient material on the sealing surface. The resilient material shall be bonded directly to valve disc and shall be in accordance with ASTM-D429 specification for rubber to metal bond. Resilient seated gate valve shall be Metroseal as manufactured by U.S. Pipe, or as approved by the Authority's Engineer.

Valves in sizes 4" through 16" shall be mounted vertically. Valves larger than 16" shall be placed horizontally with 150 psi working water pressure. The gear box and valve stem of horizontally mounted valves shall be installed in manholes. All valves shall open by turning in a right clockwise direction (except in Solebury Township where valves shall open to the left), and shall have mechanical joint ends suitable for use with push-on joint pipes. Metropolitan pattern gate valves shall be manufactured by U.S. Pipe and Foundry Company or M&H Valve Company. Resilient seated gate valves shall be as manufactured by Mueller Company, Kennedy or as approved by the Authority's Engineer.

All body and cover bolts and nuts shall meet ASTM A-307 Grade B rustproof. Minimum diameter of valve stem at base of stem threaded shall be as follows for N.R.S. valves:

4"	0.8594"	16"	1.438"
6"	1.000"	20"	1.75"
8"	1.000"	24"	1.969"
10"	1.125"	30"	2.188"
12"	1.188"		

All gate valves 16" in diameter and larger shall be equipped with a bypass valve.

E. VALVE BOXES

All valve boxes shall be furnished with a Buffalo Type 3-piece valve box with oval bases or approved equal and as shown in standard detail W-22. Shaft shall be 5-1/4 inch. Valve boxes shall be installed over the bonnet and operating nut and of sufficient length to reach the surface of the ground, but not extend above the ground surface. The word "WATER" and a directional arrow shall be cast in the top of the valve box cover. Extensions shall be as approved by the Authority.

F. FIRE HYDRANTS

Six (6") inch mechanical joint restrained shut-off valves as aforementioned shall be furnished and installed on the branch to each hydrant with a roadway box mounted to grade over the shutoff valve for access to the operating nut. The roadway boxes shall be as aforementioned, and the word "WATER" and a directional arrow shall be cast in the covers of the roadway boxes.

Fire hydrants must be dry barrel type and must be designed manufactured and tested in accordance with current AWWA Standard C-502. Hydrants shall have a 6" mechanical joint inlet connection. The hydrant shall be three-way type for 150 psi service pressure and 300 psi test pressure.

The hydrants shall have 5-14" compression type valve opening with one 4-1/2" National Service Thread (NST) steamer nozzle and two 2-1/2" NST hose nozzles. The nozzles shall be attached to hydrant barrel by a mechanical means. Hydrant operating nut with weather shield and nozzle cap nuts shall be pentagonal shape with chains on caps. Hydrant shall open right (clockwise), except in Solebury Township where hydrants shall open left (counter clockwise). The valve seat and valve seat ring shall be made of bronze. The barrel shall be painted silver and the bonnet red. The hydrant bury length shall be sufficient to allow hydrant break flange to extend no more than 2" above ground line nor below ground line without the use of extensions when the connecting pipe has 4-foot of cover. The fire hydrant shall be Centurion Model A-423, manufactured by Mueller Corporation, Metropolitan style as manufactured by U.S. Pipe & Foundry Company, or approved by the Authority. Fire hydrants shall be provided to the developer by the Authority at its cost plus handling. See Standard Detail No. W-3 for typical installation of hydrants.

The hydrant standpipe below grade, together with all buried metal tie-rods and internal ferrous surfaces, shall be given two coats of black asphaltum varnish. The exposed surfaces above grade include nozzle caps and bonnet, shall be given two coats of a good quality oil base paint, the color to be selected by the Authority.

G. WATER SERVICE SADDLE (for C-900 PVC Water Main)

Water service saddles shall be of the single band (3 1/4" wide, minimum) style with the AWWA taper thread for insertion of the corporation stop. The saddle shall be sized and designed for use on PVC water main and be S70 style as manufactured by Ford Meter Box Company, or approved equal.

H. SERVICE LINE:

1. Curb Box: curb boxes for copper service line 3/4" and 1" in diameter shall be arch base extension type complete with stationary rod as manufactured by the Mueller Company, or as approved by the Authority. The arch base size shall be suitable to the size of the service pipe. (refer to Detail No. W-23).

2. Curb Stop: curb stops for 1 ½" and larger shall be ball valve compression fitting style, Model B44 as manufactured by Ford Meter Box Company, or as approved by the Authority. Curb stop for lines less than 1 ½" shall be inverted key type Mark II Oriseal as manufactured by Mueller Company, or as approved by the Authority. Curb stops shall be the same size as the service line. Curb boxes shall have telescoping extension and be cast iron as approved by the Authority.

Curb stops shall be Model H-15164 as manufactured by Mueller Company or approved equal (in Solebury Township only).

3. Service Connections: corporation stops shall be the same size as the service line, and shall be Model H-15008 as manufactured by Mueller Company, or as approved equal by the Authority. Service lines traversing under existing roadways

I. CUT-IN SLEEVES AND VALVES

Cut-in sleeves and valve assembly shall include a mechanical joint gate valve as manufactured by Mueller Company or approved equal.

The contractor shall schedule all work related to connections to the existing system, and provide increased work forces as necessary so as to minimize the shut-down time and inconvenience to present consumers. The Engineer will approve the proposed shut-down and tie-in schedule and procedures.

J. TAPPING SLEEVES AND VALVES

The tapping sleeve shall be mechanical joint type Mueller Company Type H-615 or as approved by the Authority. The type of pipe and actual outside diameter of the main should be confirmed by the Contractor before placement of order for the sleeve.

The tapping sleeve valve shall be Mueller Company Type H-667 or as approved by the Authority having Class 125 flange inlet for connecting to the sleeve and mechanical joint end on the outlet.

K. BLOWOFFS

The Contractor shall provide blowoffs at all dead ends in accordance with Standard Detail No. W-1.

L. AIR RELEASE VALVES

The requirement and location of air release valves for pipelines shall be determined by the Authority or the Authority's Engineer. Unless otherwise indicated, the air release valve shall be ValMatic Model 22 or as approved by the Authority's Engineer, and shall be installed in a manhole constructed in

accordance with Standard Detail No. W-2. For pipe larger than 8" or system pressure greater than 100 psi, see manufacturer's recommendations.

M. WATER METERS

All water meters shall be Magnetic Drive, generator register, positive displacement oscillating piston type, cold water meters. All meters shall be manufactured in accordance with AWWA Standard C-700, the latest revision thereof (see Standard Detail W-25). Water meters shall be as manufactured by Rockwell Meter Company or approved equal.

Cases: all meters shall have a non-corrosive water work bronze outer case with a separate measuring chamber which can be easily removed from the case. All meters shall have cast on them, in raised characters, the size and direction of flow through the meter. Cast iron frost bottoms shall be provided on 5/8", 3/4" and 1". 1 1/2" and 2" meters shall be the split case type with bronze lower and upper shell assemblies. All maincases shall be guaranteed against defects in materials and workmanship for twenty-five (25) years from date of shipment.

Registers: the registers must be the straight reading type and have a test dial. It shall read in gallons units of volume and capable of direct visual reading both at the meter and the remote counter location external to the meter. All reduction gearing and the generator shall be contained in a permanently hermetically sealed, tamperproof enclosure made from a corrosion resistant material and shall be secured to the upper maincase by means of a locking device located in the interior of the meter so the register cannot be removed externally. The meter register shall be provided with two terminal connections to allow transmission of the water meter reading to the remote totalizer. The register output pulse shall not be diminished or inhibited if it is submerged in water.

Measuring Chamber: the measuring chamber shall be either water works bronze or a suitable synthetic polymer and will not be cast as part of the maincase. All piston assemblies shall be interchangeable in all measuring chamber assemblies of the same size. The chamber's division plate shall be stainless steel with a bonded rubber coating. The chamber's bottom plate shall be held in place without the use of fasteners.

Magnetic Coupling: there shall be no stuffing box. The motion of the piston shall be transmitted to the sealed register through the use of a direct magnetic drive without any intermediate magnetic coupling.

Strainers: all meters must be provided with a corrosion resistant strainer which is easily removable from the meter without the meter itself being disconnected from the pipeline.

Pressure Capability: meters shall operate up to a working pressure of 150 pounds per square inch, without leakage or damage to any parts. The accuracy shall not be affected when operating at this pressure due to possible distortion.

Connector Cable: thirty-three (33) feet of connector cable shall be allotted per meter. The connector cable shall be provided for each meter purchased and on 1000 feet spools for cutting to required length at the time of meter installation. The cable shall be two conductor 18 gauge, solid copper conductor, vinyl covered over conductor and wire pair.

Remote Counter: the outside register shall be compact, sturdy and tamperproof. The sealing of the unit shall be accomplished by a plastic tab which will accommodate seal wire and a lead seal. The remote odometer shall be easily resettable to the desired reading. The word "WATER" shall appear on the face plate to denote the type of the remote counter.

Guarantees: all meters shall be guaranteed against defects in material and workmanship for a period of fifteen (15) years from date of shipment. The remote counters shall be guaranteed for a period of two (2) years from date of shipment.

Rejected Material: the contractor and or manufacturer shall, at his own expense replace or satisfactorily adjust or repair all units rejected for failure to comply with these specifications.

N. METER SETTERS

All meter setting equipment must be suitable for use with one-half (1/2) inch through one (1) inch copper pipe, and one-half (1/2) inch through one and one-half (1 1/2) inch iron pipe, by interchanging pack joint assemblies (see Standard Detail W-30).

All meter setting bodies shall consist of bent copper tubing with spun flanges and nuts connected to a cast bronze fitting in such a manner as to make the unit rigid and receive the water meter.

Meter setter shall be Ford Kornerhorn or approved equal.

O. BACKFLOW PREVENTERS

A backflow preventer shall be installed in all residences and buildings connecting to the Authority's main. The backflow preventer assembly shall be a reduced pressure type, Ford Model HHC dual check backflow preventer, or as approved by the Authority's Engineer. Backflow preventer shall meet ASSE Standard No. 1024 revised April 1988, or the latest revision thereof.

Backflow Preventer 3/4": backflow preventer shall be of a bronze body construction, with two compact independent acetyl resin plastic check valves, with buna "N" seals and stainless steel springs. The check valves shall be accessible for rebuilding or service without removing body from service line or meter setter. Access to check valves shall be capable being wire sealed to prevent unauthorized removal or tampering. It shall provide smooth flow characteristics and it shall not be adversely affected by normal line pressure

surges, nor will it cause water hammer and it shall operate without chatter or vibration. Backflow preventer shall be capable of being installed horizontally or vertically. It shall have a union connection on the inlet side compatible with the Kornerhorn and the outlet side with a ¾" male pipe thread to accept the ¾" female pack joint thread. The union and pack joint threads shall be designed to be used with a "Ford Kornerhorn No. 2 or 3" and shall include all gaskets and seals necessary to make a water tight connection. The backflow preventer shall be ANSI/ASSE approved and should be manufactured by Ford Meter Bo Company or other approved equal.

Backflow Preventer 1": backflow preventer shall be the same as above except, it shall have the outlet side with a 1-1/4" male pipe thread to accept the 1-1/4" female pack joint thread. The union and pack joint threads shall be designed to be used with a "Ford Kornerhorn No. 4".

The Standard Detail W-17 shows a typical installation and the components for the water supply for private fire protection. The size of the pipeline, detector check valve and the backflow preventer shall be approved by the Authority and Fire Marshall. The developer shall submit copies of plans of the private fire protection system to the Authority for approval.

When the length of fire service main to a building is greater than 25 feet, the potable service line for that building shall be connected immediately before the backflow preventer to eliminate the "dead spot" of water in the service main. This connection shall be approved by the Authority.

In addition to backflow preventers for private fire protection systems, the Authority reserves the right to require the installation of reduced pressures backflow preventers for applications where a direct cross-connection exists between potable water and non-potable water, or a back siphon condition exists.

P. STEEL CASING

Steel casing pipe shall be used for protection of water pipe in tunnels and borings under railroad tracks, most state highways, limited access roads and other locations as required. The developer shall be responsible for securing all occupancy permits and paying such fees required for said occupancy. See Standard Detail W-27.

2.05 CONCRETE

A. PRE-MIXED

Three classes of concrete are specified: Class "A", Class "B", and Class "C". the compressive strength, as specified, is a 28-day minimum design branch.

1. Class "A" concrete is intended for reinforced concrete structures including underground chambers and manholes, miscellaneous structures, etc., and shall have a minimum compressive strength of 4000 psi.

2. Class "A" concrete is intended for structures not exposed to weather or freezing temperatures, and shall have a minimum compressive strength of 300 psi. Class "B" concrete shall be used for thrust blocks, underground pipe supports and reinforced encasements.
3. Class "C" concrete is intended for use in unreinforced sections, and shall have a minimum compressive strength of 2500 psi. Class "C" concrete shall be used for unreinforced pipe encasements.

B. SITE MIXED

1. Scope: furnish all plant, labor, supervision, materials, and equipment to do all plain and reinforced concrete work shown on drawings or herein specified. All work shall be done in accordance with ACI 318, Building Code Requirements for Reinforced Concrete. Unless otherwise specified, all references to standards and codes shall be the latest revision to date.
4. Storage: cement, aggregates, concrete admixtures and reinforcing steel shall be stored at the site in such a manner as to prevent deterioration and intrusion of deleterious materials. The manner of storage and location of storage areas shall require the approval of the engineer.
5. Materials:
 - a. Portland Cement: Portland cement shall conform to ASTM-C150, Standard Specification for Portland Cement or ASTM-C175, Standard Specification for Air-Entraining Portland Cement. The type of Portland cement shall be as noted on the drawings.
 - b. Fine and Coarse Aggregate: fine and coarse aggregates shall conform to ASTM-C-33, Standard Specifications for Concrete Aggregates. The nominal maximum size shall not exceed three-quarter (3/4) inch or to larger than one-fifth (1/5) of the narrowest dimensions between sides or forms, one-third (1/3) of the depth of slab, nor three-fourths (3/4) of the minimum clear spacing between individual reinforcing bars.
 - c. Sand: shall conform to ASTM C-144.
 - d. Mortar: shall be composed of cement and sand of a character herein specified. Proportions by volume shall be one part cement to two parts sand. One volume of sand shall be one (1) cubic foot; one volume of cement shall be ninety-four (94) pounds.
 - e. Water: water shall be potable and free from injurious amounts of oils, acids, alkalis, salts, organic materials of other substances that may be deleterious to concrete or steel.
 - f. Metal Reinforcement: metal reinforcement shall conform to ASTM-A615, Standard Specifications for Concrete Reinforcement, Grade 60. All bars shall be rolled from new billet steel.
 - g. Welded Wire Fabric: welded wire fabric shall conform to ASTM-A185, Welded Steel Wire Fabric for Concrete Reinforcement.

- h. Castings: shall be manufactured in accordance with the standard details. They shall be on uniform quality, free from blowholes, porosity, hard spots, shrinkage, distortion or other defects. They shall be smooth and well cleaned by shotblast or by some other approved method. They shall be coated with asphalt paint which shall result in a smooth coating, tough and tenacious when cold, not tacky and not brittle. Materials shall conform to ASTM-A48 Cl.30.
- i. Bedding and Backfill: shall be in accordance with Sections 3.12 and 4.01 of these Standards.

6. Strength of Concrete

The grade of concrete which shall be delivered, placed and cured, as shown on the drawings, shall be based upon the strength attained at 28 days of test cylinders taken and cured in accordance with ASTM-C192, Standard Method of Making and Curing Concrete Test Specimens in the laboratory. The cylinder strengths must be higher than the design strengths as noted on the drawings. Four cylinders shall be taken for each days pour and for each structure. Two cylinders shall be tested at seven days and two cylinders shall be tested at twenty-eight days.

Concrete exposed to the action of wet, freezing, atmosphere shall contain entrained air within the limits of Table 4.2.5 of ACI 318. For such concrete made with normal weight aggregate, the water-cement ratio shall not exceed 0.53 by weight.

7. See Section 4.05 for methods of concrete installation.

2.06 MANHOLES – AIR VALVE AND HORIZONTAL GATE VALVES

A. GENERAL

Precast concrete manholes shall be as manufactured by Atlantic Concrete Products, Inc., Tullytown, PA., or equal, manufactured in accordance with ASTM C-478, latest revision. Manholes shall have an internal diameter of 48 inches unless noted otherwise on the Construction Plans. The top section shall be an eccentric type top with a 24-inch clean opening.

The precast bases, risers and top sections shall be reinforced with steel as required in ASTM C-478, Section 6.

The entire exterior surface of precast concrete manholes shall be coated with 2 coats of cold tar epoxy, Koppers 300-M, Pennox Tar 32-B-4 or equal, applied as recommended by the manufacturer.

B. JOINTS

Joints of manhole sections shall be sealed with a double preformed plastic sealing compound similar or equal to "Butyl-Lok" as supplied by Atlantic Concrete Products, Inc.

C. MANHOLE STEPS

Manhole steps shall be installed at 12-inch intervals and shall be aluminum 6061-T6 alloy, drop front, safe tread as manufactured by Alcoa (No. 16829) or equal, as shown on Standard Detail No. W-18.

D. WATERSTOPS

All openings in the manhole wall shall have an approved waterstop Fernco CMA, Linkseal or approved equal. Waterstops shall be centered around the wall opening and shall make a watertight seal with the pipe.

E. SUMP AND GRATING

If groundwater is evident or as directed by the Authority Engineer, air valve and gate valve manholes shall be provided with a 12-inch diameter sump in the manhole base. See Detail W-16.

2.07 MANHOLE FRAMES AND COVERS

- A. Castings shall be of uniform quality, free from blow holes, porosity, hard spots, shrinkage, defects, cracks or other injurious defects. They shall be smooth and well cleaned by shot blasting and unless otherwise specified, shall be coated with coal tar pitch varnish of a type which will make a smooth coating, tough and tenacious when cold, not tacky and not brittle. Castings shall be designed for AASHTO Highway Loading Class HS-20.
- B. Material used in the manufacture of the castings shall conform to ASTM Specification A48, Class 35. A notarized certificate shall be submitted if required by the Engineer verifying the minimum tensile strength of the casting of 35,000 psi.
- C. All castings shall be manufactured true to pattern and with a close fit of component parts. Round frames and covers shall be of non—rocking design and with machined bearing surfaces so that fitting parts will not rock.
- D. All manhole frames shall be cast with four (4) three-quarter inch (3/4") diameter holes equally spaced in order that they may be bolted to the manhole.
- E. All covers shall have "BCWSA WATER KEEP OUT" cast thereon in two inch (2") letters.

- F. Standard manhole frames and covers shall have self-sealing lids with concealed pickholes. They shall be similar and equal to Neenah Foundry Company, Model R-1642 or Bob Woodard Pattern B256, Campbell Foundry Company 1502 (Type A) for all manholes located in roads, streets, driveways, parking lots and any other paved surface. Frames are to be bolted to the manhole riser with two (2) three-quarter (3/4") inch bolts.
- G. Watertight frames and covers shall have self-sealing lids with concealed pickholes. The lids are to be bolted to the frame with four (4) three-quarter (3/4") inch diameter stainless steel bolts. They shall be similar and equal to Campbell Foundry Company, 1502WT (Type A); Neenah Foundry Company, Model R-1916F Type L, or Quirin Model MHR427A.
- H. Manhole frames and covers shall be required as follows:
 - 1. Watertight bolt-down type shall be installed on all manholes in flood plains, flood prone areas, potential ponding areas, and as directed by the Authority's Engineer.
 - 2. Standard frames with vented covers for air valve manholes shall be used elsewhere.
- I. The elevation of manhole rims shall be at street surface except as follows:
 - 1. above 100-year flood elevation in flood plains and flood prone areas
 - 2. 6" to 12" above grade, in unmaintained easement areas not subject to flooding.
 - 3. At grade in maintained lawn areas (these covers shall be watertight)

2.08 CRUSHED STONE BACKFILL AND BEDDING

- A. Crushed stone backfill for manholes shall conform to the grading and quality as specified in Section 703 of the Commonwealth of Pennsylvania Department of Transportation Specifications Form 408 for No. 2A modified aggregate.
- B. Crushed stone backfill and bedding for water main shall be as specified in Sections 3.12 and 4.01, and as shown on Detail W-26.

SECTION III EXCAVATION AND BACKFILL

3.01 GENERAL

Trenches shall be excavated, protected and backfilled as necessary for the completion of the work to be done under the contract. All excavations shall be open trenches except where and to such extent as the Engineer may authorize or require that the same be done in tunnel. In general, trenches may be excavated and backfilled either

The Contractor shall perform all excavation of every description and of whatever substance encountered, to the depths indicated by the drawings, as specified herein, or as required by the Authority's Engineer. In performing the work as specified in this section, the Contractor shall conform to the current regulations of the Pennsylvania Department of Labor ASHA regulations. All excavated materials not required for backfill shall be removed and wasted or otherwise disposed of as required or specified.

If excavation is stopped on any trench for any reason and the excavation is left open for an extended lengths of time (as determined by the Engineer) in advance of construction, the Contractor shall backfill the trench and not excavate again until work proceeds

3.02 RESPONSIBILITY FOR CONDITION OF EXCAVATION

The Contractor shall solely be responsible for the condition of all excavations made by him. All slides and cave-ins shall be removed by the Contractor at whatever time and under whatever circumstances they may occur.

The failure or refusal of the Authority's Engineer to require the use of bracing or sheeting or a better quality, grade, or section, or larger sizes of steel or timber or to require sheeting, bracing struts or shoring to be left in place, shall not in any way or to any extend relieve the Contractor of any responsibility concerning the condition of excavation or any of this obligations under his contract nor impose any liability on the Engineer or the Authority, nor shall any delay, whether caused by any action or want of auction on the part of the Contractor, or by any act of the Engineer, Authority or their agents, or employees, resulting in the keeping of an excavation from caving or slipping, nor from any of his obligations under this contract relating to injury of persons or property.

3.03 ACCOMMODATION OF TRAFFIC

Streets shall not be unnecessarily obstructed, and unless the Contractor has been authorized in writing, he shall not completely close the street and shall take such measures as may be necessary to keep the street or road open and safe for traffic. If any streets are authorized to remain closed, the Contractor is required and responsible to provide proper and adequate detour routes and signs. The closing and detouring of

any street must be approved by the Engineer, State or Township, prior to said closing and detouring taking place.

Traffic control in state roadways shall be in accordance with PennDOT roadway opening permit and Publication 203, and traffic control in township roadways shall be in accordance with local regulations and local roadway opening permits.

It is the Contractor's responsibility to notify all agencies such as the police department, fire department, school district, ambulance companies, etc., of any road closings and detours.

The Contractor shall construct and maintain such adequate and proper bridges over excavations as may be necessary or as required for the safe accommodation of pedestrians or vehicles. The contractor shall furnish and erect without cost to the Authority substantial barricades at crossings or trenches, or along the trench, to protect the travelling public. The contractor shall not obstruct fire hydrants.

In narrow or congested areas, when so required, the contractor shall complete his work up to a point designated by the Engineer before opening the work ahead, in order to give access to driveways and other placed. The contractor shall in all cases so arrange his work as to cause the least inconvenience to the general public consistent with the proper prosecution of the work.

Storage of all materials, equipment, machinery, tools, etc., is the contractor's responsibility. The contractor is prohibited from storing any and all materials, equipment, machinery, tools, etc., on streets, shoulders, sidewalks, etc. all items must be stored and parked within the provided easement in unimproved areas.

All work pertaining to traffic control is to be performed by the contractor at no additional cost to the Authority.

3.04 REPARATION OF THE SITE

Prior to any excavation, the contractor shall properly prepare the right-of-way or site of the work.

The contractor shall first provide adequate protection for all lawns, trees, shrubs, landscape work, fences, utilities and sidewalks that are to remain in place, and for such other existing similar growth, structures and facilities. Such protection shall be maintained so long as necessary to prevent damage due to the operations of the contractor.

The structures and obstructions such as fences, shrubs, etc., which are to be removed prior to the start of construction must be removed, stored and protected by the Contractor. It is the contractor's responsibility to replace these features to an equal or better condition than when they were removed.

All clearing and grubbing must be performed by the contractor as a part of his contract. All trees, roots, trunks, organic material and unsuitable material must be removed from the site by the contractor. Burning of this refuse and other debris will NOT be permitted.

All personal property and utility damage caused by the Contractor during the clearing and grubbing operation shall be remedied at the contractor's expense.

All grass and sod shall be carefully removed from all lawns and stored, protected and re-laid following backfill and tamping of the excavated areas, provided it is in suitable growing condition. If the sod is not satisfactory for replanting, the contractor shall seed the excavated area. The contractor shall also remove all plant material, where required, store and replant the material following completion of the work, or replace with a suitable material. The plant material shall be examined by the Engineer from time to time after being planted and during the maintenance bond period. All material that has died or is dying shall be replaced by the contractor at his expense.

The Contractor shall neatly cut existing pavement prior to the start of excavation. All cut edges shall be straight both horizontally and vertically. All concrete paving must be cut with a concrete saw.

3.05 WIDTH AND DEPTH OF TRENCHES

The trench excavation shall be of the required depth and of sufficient width to provide adequate room from the construction and installation of the pipe. From the excavated trench subgrade to a point one foot above the top of the pipe, the width of the trench shall not be less than 12 inches or more than 16 inches wider than the outside diameter of the pipe. The pipe shall be installed so that clear space of not less than 6 inches in width is provided on each side of the pipe.

From a point 12 inches above the top of the pipe to the surface, the trench walls shall be kept as vertical as possible and in no case shall the trench width at the top exceed 40 inches plus the outside diameter of the pipe in all existing streets, roads, highways, paved surfaces, etc. The trenches which are to be excavated in rights-of-way or easements may exceed the maximum trench width if approved by the Engineer and provided sufficient work area is maintained and all work is performed and contained within the rights-of-way or easements at no additional cost to the Authority. The depth of the trench shall be made to a minimum of six (6) inches below the bottom of the pipe. Bedding of 2A modified aggregate or Ductile Iron Pipe and 1B stone for PVC pipe, shall be provided as shown on Standard Detail No. W-26.

When the material encountered at trench subgrade is determined by the Engineer to be unstable, it shall be removed to a minimum depth of 1 foot below the invert of the pipe. Maximum depth shall be determined by the Engineer. The trench excavation below subgrade of such unsuitable material shall be backfilled with a 2A modified aggregate to the bottom of all ductile iron pipe and to a point six (6) inches below the bottom of PVC pipe. All work, tools, equipment, labor, material, etc., required for the trench excavation below subgrade shall be the Contractor's responsibility. If earth trenches are excavated beyond the specified depths, the contractor shall backfill the excavation below subgrade with 2A modified aggregate.

The bell end of the pipe shall be carefully placed in the bedding so that no part of the trench load is supported by the bells. In all cases the bottom of the pipe shall be fully and uniformly supported; the full load of the pipe resting on the barrel of the pipe.

Trenches shall at all times during the progress of the work be excavated to the required width and depth for distance of at least 25 feet in advance of the end of the pipe in place. No trench shall be excavated more than 100 feet in advance of the completed line.

Test pits may be dug by the Contractor if approved by the Engineer to a depth and size as may be necessary. If the contractor excavates for test pits, or any other miscellaneous items for the purpose of satisfying himself as to the location of underground obstructions or conditions, no additional compensation will be paid.

3.06 SHEETING, BRACING AND SHORING

All work performed and materials used for sheeting, bracing and shoring shall be conformity with the requirements of the State Department of Labor and Industry, and other state and local laws and requirements.

All plank used for sheeting and sheet piling and all timber used for braces, shores and stringers or wailing-stripes shall be sound, straight grained yellow pine, Douglas fir or other material of equal strength. All plank and timber shall be free from cracks, shakes and large or loose knots. Plank shall be tongue and grooved or grooved and splined, if so required. Steel sheeting, if used, shall be standard and generally accepted product of a recognized manufacturer. All materials used in the work shall conform to the current regulations of the Pennsylvania Department of Labor and Industry for Excavations and Construction and shall be at least equal to the dimensions set forth therein.

Material for sheet piling, sheeting, bracing and shoring shall be furnished and driven or set in place by the contractor in accordance with current regulations of the Pennsylvania Department of Labor and Industry for Excavating and Construction, or wherever required by the Authority to protect the workers and the public or to maintain the maximum trench widths regardless of whether the same is or is not considered necessary by the contractor.

Whenever, the in opinion of the Authority, the materials being used or the methods being followed are not in conformance with generally accepted practices for that type of work, the Authority may stop that phase of the work.

All sheeting, sheet piling, braces and shores shall be driven or put in place by men specially skilled in such work and shall be so arranged that they may be withdrawn as the trenches are backfilled, without injury to or settlement of adjacent structures and pavements.

Where the maximum width of trench may be exceeded under these specifications and where permitted under the Regulations of the Pennsylvania Department of Labor and Industry, the sides of the trench may be sloped in lieu of providing sheeting and bracing.

If the sloping of the trench banks is permitted, the slope shall begin at a point 12 inches above the top of the pipe. Sheeting shall be installed as required by the Department of Labor and Industry Regulations to support the vertical part of the excavation.

Sheeting, sheet piling, bracing and shoring shall be withdrawn and removed as the trenches are being backfilled, except where and to such extent as the Engineer shall require in writing that the same be left in place, or where he shall permit the contractor to leave the same in place at the contractor's own request and in each case at no additional cost to the Authority.

In withdrawing sheeting and sheet piling, special care shall be taken to insure that all voids or holes left by the planks as they are withdrawn are filled with satisfactory material and thoroughly rammed with thin rammers provided especially for that purpose.

The Contractor shall cut off any sheeting or sheet piling left whenever and at such points as the Engineer shall require, and shall remove from the site the portion cut off.

The failure or refusal of the Engineer to require the use of sheeting or sheet piling or a better quality or larger sizes of timber, or to require sheeting, sheet piling, bracing or shores shall not in any way or to any extent relieve the contractor of any or all of his obligations under the contract, nor impose any liability of the Engineer.

3.07 DEWATERING

The Contractor shall remove by pumping, bailing or other means, any water which may accumulate or be found in the trenches or other excavation and shall form all dams, flumes, or other works necessary to keep them entirely clear of water while the water main and other structures are being constructed. The contractor shall have sufficient pumping machinery available at all times on the site, ready for immediately use. At no time is water to run through the pipes or its bedding material.

The water from the trenches and excavations shall be disposed of in such a manner as will not cause a public health nuisance or injure public or private property, work competed or in progress, street surfaces, or cause interference with use of the area by the public. Where points of drainage discharge are in question, approval shall be obtained from the municipal Authority. In addition, all such work shall be conducted in accordance with the recommendations and regulations of the Pennsylvania Department of Environmental Resources with respect to soil erosion and sediment control.

3.08 UTILITIES

It is the contractor's responsibility and obligation (Act 287-Act 172) to contact all utility companies for utility location verification regardless of the utility location on the contract plan prior to the start of any and all excavation. Any utility damages by the contractor must be repaired in a manner acceptable to the utility's representative. The contractor shall carefully support and protect from any damage all existing gas pipes, water pipes,

steam pipes, electric conduits, sewers, drains, hydrants, valve boxes and other structures which may be encountered during the performance of the work.

Where dead ends shall exist following removal of pipes, conduits or sewers, they shall be carefully plugged or bulkheaded with brick and mortar.

3.09 BARRICADES, GUARDS AND SAFETY PROVISIONS

To protect persons from injury and to avoid property damage, adequate barricades, construction signs, torches, red lanterns and guards, as required, shall be placed and maintained during the progress of the construction work and until it is safe for traffic and pedestrian use. All materials, stockpiles, equipment and pipe which may serve as obstructions and safety hazards to the public shall be enclosed by fences and barricades, and shall be protected by proper lights when visibility is poor.

If required during any street opening, watchmen shall be provided by the contractor to prevent accidents. All rules and regulations of local, state and county authorities regarding safety provisions shall be observed.

3.10 DRAINS, CULVERTS, SEWERS AND OTHER OBSTRUCTIONS

Adequate provision shall be made for the flow of sewers, drains, culverts and watercourses encountered during the construction. The structures which may have been disturbed during construction shall be satisfactorily restored upon completion of the work. Where concrete gutter drains along state highways or municipal roadways are disturbed, the entire gutter shall be replaced unless construction joints permit replacement of these sections disturbed. All pipes or crushed stone or gravel, located under these gutters that are removed or disturbed shall be completely replaced. All this work shall be in complete accordance with the requirements of the Pennsylvania Department of Transportation and/or local governing officials.

3.11 EXPLOSIVES AND BLASTING

The use of explosives shall be governed by the "Regulations for the Storage, Handling, and Use of Explosives" of the Pennsylvania Department of Labor and Industry.

All blasting shall be field monitored using seismographic type equipment and shall be performed under the supervision of a blaster, licensed to practice in the Commonwealth of Pennsylvania.

The Contractor is responsible to keep and submit to the Authority an accurate record of each blast. The record shall show the general location of the blast, depth and number of drill holes, the kind and quantity of explosives used, ground velocity and displacements, and other data required for a complete record.

All blasting will be permitted only after securing all appropriate permits. No blasting shall be done adjacent to existing lines or structures which may be damaged through

blasting operations, and under no circumstances shall blasting be done on the site during or for a period of at least 48 hours after the placement of concrete.

Rock excavation within 20 feet of water or gas mains shall be done by hand or with mechanical rock splitters, and the utmost care shall be exercised to avoid disturbance of the main. All exposed sewers and special structures shall be carefully protected from the effects of blast, and any damage to them by blasting shall be promptly repaired by the contractor at his expense, and in no case shall the blasting be done within 40 feet of newly laid water main.

All shots shall be covered with cable or rope mats placed in accordance with governing regulations, and special care shall be exercised in areas where high tension power lines are located.

Prior to blasting, sufficient warning shall be given all persons in the vicinity and traffic shall be stopped at the proper distance from the site and controlled by watchmen.

The contractor shall use the utmost care in the use of explosives necessary for the completion of the work and not to endanger life or property. All blasting operations shall be done by experienced men who have proper certificates or licenses. The handling and use of explosives shall be done strictly in accordance with the specifications issued by the United States Bureau of Mines and with any Federal or State regulations now in effect or that might become effective in the future; and in compliance with the local and state laws. Failure to observe necessary precautions will be sufficient grounds for temporary suspension of the work. All explosives shall be transported and stored in a secure manner in accordance with the local and state laws. All vehicles and such storage places shall be marked clearing "Dangerous – Explosives", and shall be in care of a competent watchmen at all times. In no case shall caps or other detonators be stored or transported with dynamite or other explosives. The location of magazines or the storage of explosives and the separate storage of detonators shall be subject to the approval of the Engineer and applicable state agencies.

All blasts shall be properly matted and securely covered. The contractor shall be solely responsible for injury to persons on property located within or beyond the area of scope of the project that may result from his use of explosives.

A permit must be secured from the Pennsylvania Fish Commission if the use of explosives is required. The following P.F.C. Waterways Patrolman must be notified when the project is started, when explosives are to be used, and when the project is completed for final inspection:

Wayne Imler (or current Waterway Patrolman)
New Hope, PA 19426
Telephone: 215-862-5301

3.12 BEDDING AND BACKFILLING

Immediately after a section of the piping is laid on the bedding, sufficient backfill material shall be placed along each side of the pipe to hold pipe to line and grade. Backfill around and over ductile iron pipe and backfill around, under and cover PVC pipe shall be as indicated in the detail drawings. Compaction of all backfill material above pipe bedding envelop will be accomplished in eight (8) to twelve (12) inch lifts loose thickness, by means of vibratory tampers or other methods so designated by the Engineer, depending on soil conditions within the specific areas.

All trench excavation and backfill on State Highways will be subject to inspection by representatives of the Commonwealth of Pennsylvania, Department of Transportation, and the work must be performed in accordance with the requirements of that department without additional payment, even though such requirements may entail more labor or services than the methods herein described.

Within State Highway right-of-way, all trenches from a point one foot above the top of pipe shall be backfilled in eight (8) inch compacted layers for the entire length of the trench and each layer shall be compacted by vibratory tampers of a type and size satisfactory to the Engineer and the Commonwealth of Pennsylvania Department of Transportation. All trenches within the roadway and shoulder paving of all State Highways shall be backfilled from a point one (1) foot above the top of pipe to the bottom elevation of the required replacement paving with No. 2A modified aggregate or 2 RC as approved conforming to the grading requirements specified in Section 703 of the Commonwealth of Pennsylvania Department of Transportation Specification Form 408.

All trenches within paved township streets, driveways, parking lots (all paved surfaces) and within three feet of the edge of pavement shall be backfilled and compacted in eight (8) to twelve (12) inch lifts loose thickness to a point two (2) inches below the existing pavement. The backfill material shall be the same as the material used for backfilling State Highway roadways, 2A modified aggregate or 2RC aggregate, as approved.

All trenches in unimproved areas shall be backfilled and compacted in eight (8) to twelve (12) inch lifts (loose thickness) from a point one (1) foot above the top of pipe with clean earth backfill material, or as designated by the local Township. Compacted density shall be not less than ninety (90%) percent of the maximum dry density determined at optimum moisture content (ASTM D 1557). The backfill material above the bedding envelope may contain stones not more than six (6) inches in largest diameter, but not in a proportion exceeding twenty (20%) percent of the total volume of the backfill material. The use of organic materials, wet materials, or frozen materials as backfill material is not permitted.

Backfilling and tamping shall be started immediately after preliminary alignment inspection is made and shall continue without interruption to completion, unless otherwise directed by the Engineer.

Compacting of any backfill by puddling and jetting will not be permitted.

The use of a HYDRA-HAMMER for compacting backfill in trenches is prohibited.

The density of the backfill material after compaction in trenches under paved surfaces shall be no less than ninety (90) percent of the maximum density determined at optimum moisture content as determined by ASTM Standard D-1557, or as required by the roadway occupancy permit, or township specifications, whichever is most stringent.

The contractor shall immediately upon completion of the backfilling, place and roll a 2-inch layer of temporary paving (ID 2 – binder) in all roads, streets, State Highway roadways, driveways, parking lots (all paved areas), etc. The contractor shall not proceed to excavate additional trench, until this work is completed and approved, unless specifically directed otherwise by the Engineer.

In all unpaved areas where such areas are not used as a traffic way, the Contractor shall crown to such a height as determined by the Engineer, the top of all backfilled excavation. This crown is to be constructed after the trench backfill material has been tamped. As the trenches are filled in, and the work complete, the contractor shall carry away, remove and make use of all surplus material, without additional compensation, to such a point as the Engineer may approve.

When the trenches do not furnish sufficient material of suitable quality for refilling, the contractor shall procure and supply the additional required material, without additional compensation.

All trenches must be backfilled at the end of the day. If the contractor does not backfill the trenches at the end of the day with approval of the Engineer, all open trenches must be enclosed with snow fences, securely staked. Blinking barricades must also be placed around the area to the satisfaction of the engineer.

Any settlement of backfill is the complete responsibility of the contractor and all finished grades shall be rendered permanently to the proper grades for good surface drainage, surfacing, resurfacing, repaving or laying of concrete walkways. Puddling will NOT be permitted.

After the backfill material has been sufficiently compacted, the contractor shall substantially and neatly grade the entire disturbed area. All excess backfill material shall be removed by the contractor at not additional cost to the Owner.

3.13 TUNNELLING

Tunneling will be allowed when permission is granted by the Authority and appropriate state or local agencies. Tunnels for laying pipe lines shall be of sufficient size to allow joining of pipe and grouting around them. Tunnels shall be timbered where necessary in accordance with approved methods. All methods of tunneling used shall be subject to the approval of the Authority and state or local agencies having jurisdiction. Minimum tunnel size shall be 48" ID.

SECTION IV WATER MAIN AND APPURTENANCES CONSTRUCTION

4.01 WATER MAIN INSTALLATION

- A. Materials used in the construction of the water mains shall be in accordance with Section II of these Specifications. Before any work is started, certificates of Conformance shall be submitted to the Authority Engineer, in triplicate, proving conformance with the specifications.
- B. The bedding material shall conform to the grading requirements as specified in Section 703.2 of the Commonwealth of Pennsylvania Department of Transportation Specifications For 408 for 2A modified aggregate for ductile iron pipe, and for 1B aggregate for plastic pipe. After the trench has been excavated to the proper subgrade, the bedding material shall be placed in the trench at a minimum thickness of size (6) inches and as shown on the standard details. The pipe shall then be placed so that the entire length of the pipe is resting on the bedding, with the bells up-grade. Each length of pipe shall be carefully handled and accurately laid by skilled workmen to line with minimum 4'0" cover in dry trenches without the use of any form of blocking. Each length shall be cleaned; the joint prepared in accordance with the manufacturer's recommendations and be pushed home against the previously installed length.

Suitable tools and equipment shall be used for proper handling, storing and placing of the pipe and fittings in the trench. In order to avoid damage to the interior of pipe, lifting hooks or bars shall not be inserted therein. Each pipe and fitting shall be checked for defects and injuries as laying proceeds. Imperfect pipe materials shall be rejected, marked and immediately removed from the work site.

If pipe must be cut to fit as closing pieces, such cuts shall be evenly and squarely made in a workmanlike manner with approved equipment. Injury to linings or coatings shall be satisfactorily repaired.

Where pipe is laid on a radius or curvature, each section of pipe shall be deflected at its joint equally with each adjacent pipe. Maximum deflection shall be the smaller of either two degrees per joint or manufacturer's recommendation.

Mechanical joints are to be made in strict accordance with the "Notes on Installation of Mechanical Joints" following Section 11-7 of Specification ANSI/21.11, AWWA C-111.

The pipe shall then be covered with 2A modified aggregate for ductile iron pipe, or 1B aggregate for PVC pipe, as shown on the standard details, to a point one (1) foot above the top of the pipe. Any section of pipe disturbed after it is set must be reset by the contractor as directed by the Engineer...

Trench backfill above the bedding envelope shall be in accordance with Section 3.12 of these specifications.

- C. The Contractor must plug the end of the pipe at the end of each working day. The plug should be capable to keeping water from entering the pipe.
- D. Pipes which are to be encased for stream and utility crossings shall be encased in Class C concrete, having a minimum compression strength of 2,500 psi
- E. All water mains must receive and pass the required tests as per Section 6.01 of these specifications. Pipes that fail the test must be repaired and retested. Mains will not be accepted until they pass the required test.
- F. PVC water pipe shall be installed in accordance with ASTM Specification D-2321.
- G. The contractor shall submit to the Authority Engineer for approval, completely dimensioned shop and/or setting drawings, and material certifications for the following:
 - 1. pipe and appurtenances
 - 2. hydrants
 - 3. air valves and/or blow off assemblies
 - 4. precast reinforced concrete manholes, ladder steps, joint sealant, frame and covers (watertight, vented, standard). and gasket waterstops
 - 5. stone bedding and backfill
 - 6. sump frame and grating

4.02 FIRE HYDRANT INSTALLATION

A. INSTALLATION

Hydrants shall be installed in strict accordance with the applicable requirements hereinafter set forth, unless otherwise directed by the Engineer.

B. SETTING HYDRANTS, VALVES AND VALVE HOOKS

All gate valves shall be set with stems vertically above the centerline of the pipe. Special care shall be taken to avoid closing valves with sand, stones, or other substances lodged in the valve seat. Hydrants, valves and valve boxes shall be set plumb with valve boxes placed directly over the valves. After being correctly positioned at street grade, stone fill shall be carefully tamped around the valve box for a distance of four (4) inches on all sides of pipe and distributing mains shall have the same depth of cover.

Each hydrant shall be placed upon a solid cement block, not less than four (4) inches thick and fifteen (15) inches square or as directed. The backside of the hydrant, opposite the pipe connection, shall be firmly wedged against the vertical face of the trench with a thrust block to prevent the hydrant from blowing off the line. Bridle rods and rod collars shall also be installed. Bridge rods and rod collars shall be not less than three-quarter (3/4") inch stock, and shall be

thoroughly protected by painting with two (2) coats of bitumastic paint or epoxy coating.

As an alternative to rodding, the contractor may elect to use flanged hydrant connector pieces of the appropriate length, suitable to the installation and as approved by the Engineer.

Around the base of each hydrant shall be placed not less than two (2) cubic feet of 2B stone to insure the complete drainage of the hydrant when closed. All backfill around hydrants shall be in four (4) inch layers or less and shall be thoroughly compacted to the surface of the ground. Before installing any hydrant or valve, care shall be taken to see that all foreign matter and material is removed from the interior of the barrel. Stuffing boxes shall be tightened and the hydrant or valve opened and closed to see that all parts are in working order and condition. Ground line bead to be two (2) inches above ground; maximum distance from curb to be two (2) feet or as directed by the Engineer where there is no curb. (refer to Standard Detail W-3).

4.03 WATER SERVICE INSTALLATION

A. GENERAL

Installation of service lines shall not be permitted until after the water main has satisfactorily passed tests for the lack of fecal coliforms and for leakage and hydrostatic pressure. Prior to these tests, corporation stops shall be inserted. Service lines traversing under existing roadways may be tunneled using approved methods describing elsewhere. Where the tunneled or bored hole exceeds the nominal outside diameter of the service pipe, a carrier pipe sized to fit the existing bored hole shall be provided and the service connection shall be installed and supported within the carrier pipe.

All water service connections shall be a minimum $\frac{3}{4}$ " diameter Type K copper with corporation stop and curb stop as shown in Standard Detail W-5 or as directed by the Authority's Engineer. Materials and products are specified under Section II. The service connection beyond the curb stop shall be installed and maintained by the consumer. Four (4) feet of cover shall be maintained for the service piping.

The service line extension must be laid on the straight line as near as possible to secure proper alignment and avoid obstacles.

As a general rule, all service lines shall be located at the mid-point between side lot lines. Curb boxes shall not be placed in sidewalks or driveways.

All service connection piping 100 feet in length or less shall be installed in continuous runs from the corporation stop to the curb stop and from the curb stop to the meter setting. Connections in service piping longer than 100 feet shall be made using an additional curb stop and box assembly as specified in Section II.

B. CONNECTION AT MAIN

Service connections at the main shall be made in accordance with the table and where service clamps are required they shall be Adams, Rockwell or Mueller service clamps (double strap), or as approved by the Authority. Service clamps shall be bronze. Straps, nuts and washers for service clamps shall be Type 304 stainless steel. Service clamps shall be required for taps in Class 52 ductile iron pipe. An engagement of three full threads is required on connections where no service clamps are used.

Size of Tap

Pipe	¾"	**1"	1-1/4"	1-1/2"	2"	2-1/2"	3"	3-1/2"	4"
6"	None	S.S.	S.S.	S.S.	S.S.	D.S.	NTP	NPT	NPT
8"	None	S.S.	S.S.	S.S.	S.S.	D.S.	NTP	NPT	NPT
10"	None	None	S.S.	S.S.	S.S.	D.S.	D.S.	NPT	NPT
12"	None	None	None	None	S.S.	D.S.	D.S.	D.S.	D.S.

S.S. - Single strap
D.S. - Double strap
NPT - No taps permitted
None - No service clamp required

** - a ¾ inch by 1 inch corporation stop may be used in lieu of a single strap.

C. SERVICE ENTRANCE AT DWELLING UNIT

A ball valve shall be installed on the "street side" of the meter immediately inside the building. A pressure reducing valve set a maximum of 65 psi installed on the "house side" of the meter is required where the incoming system pressure is greater. The meter shall be of a manufacturer and type approved by the Authority, and shall be set by the Authority. A 1-inch conduit shall be installed in the entrance wall of a dwelling to protect the ¾-inch water service line. This conduit shall be copper or iron as approved by the Township. The annular space between the conduit and waterline shall be made watertight by sealing with bitumastic sealer. A backflow preventer shall be installed on all new building connections as described in Section 2.04 (0).

4.04 RAILROAD CROSSINGS

Contractor shall complete all work within railroad right-of-way in accordance with the permits and all requirements of the railroad. When required by the railroad and before proceeding with construction, the contract shall provide the railroad with plans and computations, prepared by a Registered Professional Engineer registered in the Commonwealth of Pennsylvania, showing any sheeting and shoring needed during construction, proposed methods of construction, and

sequence of operations. A steel pipe tunnel shall be drilled or jacked under the tracks to enclose and protect the main, and to provide working space therein for backfilling. The casing pipe may be placed in a single length or in shorter lengths welded together before placement. All welding shall be done by experienced certified welders acceptable to the Authority, and all welds shall be of sufficient strength to resist drilling or jacking forces exerted. The carrier pipe shall be accurately placed and blocked within the casing and casing backfilled, throughout its entire length, with concrete or sand as specified by the railroad. Extreme care shall be exercised during backfilling so as not to disturb the carrier pipe, and any pipe so displaced shall be re-laid at the contractor's expense. Casing pipe ends shall be effectively sealed by Williamson-U-Seals or other methods approved by the railroad.

4.05 CONCRETE CONSTRUCTION FOR THRUST BLOCKS AND ENCASEMENTS

- A. Materials used concrete construction shall conform to Section 2.05 of these specifications. All pours shall be monolithic.
- B. Forms used by the contractor must be adequately constructed and supported to bulging of and/or deforming the concrete. Forms are to be coated with cup grease or an approved equal in order facilitate removal. All forms must be removed by the contractor after the concrete has sufficiently hardened.
- C. Water must be removed from all areas where concrete is to be poured.
- D. The placing of concrete must be set up in order that the concrete will not drop more than four (4) feet. Concrete must be tuckered and worked in a manner that will cause the concrete to fill all voids under and around pipes.
- E. Backfilling over the concrete shall not be permitted until the concrete has sufficiently hardened.
- F. All thrust blocks, encasements and/or concrete anchors shall be constructed to the dimensions specified in the Standard Details section of these specifications. These items shall be required at these locations specified on the drawings. The Engineer may add additional thrust blocks or anchors in the field if they are required.
- G. Thrust blocks poured at mechanical joints should be constructed so as not to cover the bolts of the joints or rendering them inoperable.

4.06 CONCRETE INSTALLATION

A. SELECTION OF CONCRETE PROPORTIONS

There shall be adequate workability and proper consistency to permit the concrete to be worked readily into the forms and around reinforcement under the conditions of placement to be employed, without excessive segregation or

bleeding. In addition, the proportions shall be established on the other bases of Sections 4.2.2. through 4.2.8 of ACI 318.

If ready-mix concrete is used, it shall conform to ASTM-C94, Standard Specification for Ready-Mixed Concrete.

The contractor shall submit a design mix prepared by a certified testing laboratory approved by the Engineer. The mix design shall be in accordance with the applicable ACI Standards. Twenty-eight (28) day test cylinder results will be required of the design mix before the Authority will approve same. No concrete may be placed until a design mix has been approved.

The Authority will take samples and perform strength tests of each class of concrete in accordance with Section 4.3 of ACI 318. The contractor shall bear the cost of this work, and shall supply all of the concrete at the point of delivery of concrete at no cost to the Authority. The contractor shall also repair the concrete to the satisfaction of the Authority at no cost to the Authority wherever the Authority has had to drill cores or sawed beams.

B. MIXING AND PLACING CONCRETE

1. Preparation of Equipment and Place of Deposit: before concrete is placed, all equipment for mixing and transporting the concrete shall be clean, all debris and ice shall be removed from the spaces to be occupied by the concrete, forms shall be properly coated, masonry filler units that will be in contact with concrete shall be well drenched, and the reinforcement shall be thoroughly clean of ice or other deleterious coatings.

Water shall be removed from the place of deposit before concrete is placed unless a tremie is to be used or unless otherwise permitted by the Engineer.

2. Mixing of Concrete: all concrete shall be mixed until there is uniform distribution of the materials and shall be discharged completely before the mixer is recharged.

For job-mixed concrete, mixing shall be done in a batch mixer of approved type. The mixer shall be rotated at a speed recommended by the manufacturer and mixing shall be continued for at least 1-1/2 minutes after all materials are in the drum, unless a shorter time is shown to be satisfactory by the criteria of "Specification for Ready-Mixed Concrete" (ASTM C-94) for central mixers

Ready-mixed concrete shall be mixed and delivered in accordance with the requirements set forth in "Specification for Ready-mix Concrete" (ASTM C-94).

Concrete shall not be mixed when the water and/or the atmospheric temperature is plus 40°F or below, measured by accurate thermometer kept on the premises. Concrete shall not be poured if the U.S. Weather Bureau forecasts an air temperature of less than 40°F during the next 24 hours. Contractor shall be prepared to maintain a temperature of plus 50°F or more in all concrete for a minimum of 5 days after placing of normal strength concrete.

3. Conveying: concrete shall be conveyed from the mixer to the place of final deposit by methods which will prevent the separation of loss of materials.

Conveying equipment shall be capable of providing a supply of concrete at the site of placement without separation of ingredients and without interruptions sufficient to permit loss of plasticity between successive increments.

A delivery ticket indicating the mix (including maximum size of aggregate and amount of mix water), design strength of the concrete, design slump, and time of leaving in the truck mixer shall be submitted with each batch at the time of delivery. Failure to render such ticket to the General Contractor's Job Superintendent shall automatically be cause for rejection of the concrete. The General Contractor's Job Superintendent shall write on the back of the delivery ticket: a) the time of arrival of the truck mixer on the site; b) the time of deposit of the concrete from the truck; and c) the place of deposit of the concrete. The completed delivery ticket shall be delivered to the Engineer. Failure to deliver such completed ticket to the Engineer will be cause for the Authority's Engineer to reject the deposited concrete at any time and cause it to be removed and replaced at the Contractor's expense. No concrete shall be deposited on the job when it has contained its mix water longer than 60 minutes.

4. Depositing: concrete shall be deposited as nearly as practicable in its final position to avoid segregation due to rehandling or flowing. The concreting shall be carried on at such a rate that the concrete is at all times plastic and flows readily into the spaces between the bars. No concrete that has partially hardened or been contaminated by foreign materials shall be deposited in the structure, nor shall retempered concrete or concrete which has been remixed after initial set be used unless approved by the Authority.

After concrete is started, it shall be carried on as a continuous operation until the placing of the panel or sections is completed except as permitted or prohibited by Section 6.4 of ACI 318. The top surface of vertically formed lifts shall be generally level. When construction joints are necessary, they shall be made in accordance with Section 6.4 of ACI 318. Concrete shall be deposited in approximately horizontal layers of 12 to 18 inches. No concrete that has partially hardened or been contaminated by

foreign material shall be deposited in the work, nor shall retempered concrete be used. The maximum height of free fall shall be four (4) feet.

All concrete shall be thoroughly consolidated by suitable means during placement, and shall be thoroughly worked around the reinforcement and embedded fixtures and into the corners of the forms. Vibration shall be transmitted directly to the concrete and in no case shall be transmitted through the forms. The duration of the vibration at any location in the forms shall be held to a minimum necessary to produce thorough compaction. Vibration shall be supplemented by forking or spading by hand, and shall be adjacent to the forms on exposed faces in order to secure smooth, dense and even surfaces.

Where conditions make consolidation difficult, or where reinforcement is congested, batches of mortar containing the same proportions of cement, sand and water as used in the concrete, shall first be deposited in the forms to a depth of at least one (1) inch.

Concrete shall be deposited at slumps in accordance with those determined in the portion of this Specification under "Selection of Concrete Proportions".

5. Curing: unless cured in accordance with the following paragraphs, concrete shall be maintained above 50°F and in a moist condition for at least the first seven (7) days after placing, except that high-early-strength concrete shall be so maintained for at least the first three (3) days. Supplementary strength tests in accordance with Section 4.4.3 of ACI 318 may be required to assure that curing is satisfactory.

Curing by high pressure steam, steam at atmosphere pressure, heat and moisture, or other accepted processes, may be employed to accelerate strength and reduce the time of curing. Accelerated curing shall provide the compressive strength of the concrete at the load stage considered at least equal to the design strength required at that load stage. The curing process shall produce concrete with durability at least equivalent to the curing method of the preceding paragraph.

6. Cold Weather Requirements: adequate equipment shall be provided for heating the concrete materials and protecting the concrete during freezing or near-freezing weather. All concrete materials and all reinforcement, forms, fillers and ground with which the concrete is to come in contact shall be free from frost. No frozen materials or materials containing ice shall be used.

Heating units and protective covering shall be provided for the first five (5) days after placing. The temperature of the air near the concrete shall be measured with approved thermometers by the contractor. The temperature shall be maintained above 65°F for the five (5) days, and

then gradually reduced to 50°F over the next two (2) days. Thereafter, the temperature may be gradually reduced to the outside ambient.

Concreting in cold weather shall be done in accordance with ACI 306, Recommended Practice for Cold Weather Concreting.

7. Hot Weather Requirements: during hot weather, proper attention shall be given to ingredients, production methods, handling, placing, protection and curing to prevent excessive concrete temperatures or water evaporation which will impair the required strength or serviceability of the member or structure.

Concreting in hot weather shall be done in accordance with ACI 305, Recommended Practice for Hot Weather Concreting.

C. FORMS

1. Design of Formwork: forms shall result in a final structure which conforms to the shape, lines and dimensions of the members as required by the plans and specifications, and shall be substantial and sufficiently tight to prevent leakage of mortar. They shall be properly braced or tied together so as to maintain position and shape. Forms and their supports shall be designed so that previously placed structure will not be damaged.

Design of formwork shall include consideration of the following factors:

- a. rate and method of placing concrete
- b. construction loads, including vertical, horizontal and impact loads.

Forms shall be designed so that joints will be straight and continuous and adjoining surfaces flush. Tolerances shall be according to Section 2.3.1 of ACI 347, Recommended Practice for Concrete Formwork unless otherwise shown on the drawings.

Form ties for exposed surfaces shall be of a type or provide a control break of the form tie a minimum of $\frac{3}{4}$ " back of the face of the concrete, using a cone or cleave at the face of the concrete surface to provide a uniform hole around the form tie back to the point of break of the tie.

For surfaces permanently exposed to view, the form facing shall be constructed of all new, unoiled, unscarred plywood or metal pans. Plywood panels may be reused provided they are flat, sound, straight-edged and free from open knots and splits. They shall also be scraped and brushed to remove all traces of concrete, have all nails removed, holes plugged and be recoated with a form release coating if required.

For exposed concrete surfaces, the form facing may be as specified in the preceding paragraph or seasoned wood boards may be used which are free from excessive warpage or other defects that would prevent tight joints or affect the true lines and surfaces of the concrete.

Form release coating for use on unoiled wood forms shall be W.R. Grace & Company Formfilm; or approved equal, applied in strict accordance with manufacturer's printed instructions.

Form release coating for use on metal forms shall be Adhesive Engineering Co. Concreative 7007, J.P. Banning Plastiglass or approved equal, applied in strict accordance with manufacturer's printed instructions.

2. Removal: no construction loads exceeding the dead load plus live load shall be supported on any unshored portion of the structure under construction. No construction loads shall be supported on, nor any shoring removed from, any part of the structure under construction except when that portion of the structure in combination with the remaining forming and shoring systems has sufficient strength to support safely its weight and the loads placed thereon. This strength may be demonstrated by job-cured test specimens and by a structural analysis considering the proposed loads in relation to these test strengths and the strength of the forming and shoring system such analysis and test data shall be furnished by the contractor to the Engineer when so required.

Forms shall be removed in such manner as to insure the complete safety of the structure. Where the structure as a whole is adequately supported on shores, the removable floor forms, beam and girder sides, column forms, and similar vertical forms may be removed after twenty-four (24) hours provided the concrete is sufficiently strong not to be injured thereby.

Forms shall be thoroughly cleaned after each use and surfaces in contact with concrete shall be recoated with the specified form release coating if required.

The Authority's Engineer approval shall be obtained before removing any forms.

Immediately after removal of forms, form ties extending into concrete shall be cut off at least $\frac{3}{4}$ " back from surface exposed to view and holes pointed up with 1:2 cement and sand mortar approximately the same color and finish as the adjacent concrete surface, mixed and placed as dry as possible to avoid excessive shrinkage.

Honeycombing shall be cut out and repaired as directed. Voids shall be cleaned and loose material removed by mechanical means. The area shall be saturated with a concrete epoxy coating, then a one part cement,

two part sand grout shall be applied uniformly to completely fill all bubbles and cavities and honeycomb areas.

D. CONDUITS AND PIPES EMBEDDED IN CONCRETE

All conduits and embedded pipes shall be designed and placed in the forms in accordance with Section 6.3 of ACI 318, except that no aluminum sleeves, pipes, conduits or inserts shall be permitted in the concrete.

E. CONSTRUCTION JOINTS

Joints not indicated on the plans shall be so made and located as not to impair significantly the strength of the structure. Where a joint is to be made, the surface of the concrete shall be thoroughly cleaned and all laitance and standing water removed. Vertical joints also shall be thoroughly wetted and coated with neat cement grout immediately before placing of new concrete.

A delay at least until the concrete in columns and walls is no longer plastic must occur before casting or erecting beams, girders, or slabs supported thereon. Beams, girders, brackets, column capitals, and haunches shall be considered as part of the floor system and shall be placed monolithically therewith.

Construction joints in floors shall be located near the middle of the spans of slabs, beams, or girders, unless a beam intersects a girder to this point, in which case the joints in the girders shall be offset a distance equal to twice the width of the beam. Provision shall be made for transfer of shear and other forces through the construction joints.

Location and design of construction joints not indicated on the plans shall require the approval of the Authority's Engineer in order to determine that the joint will transmit properly the shear and moment at the joint.

F. DETAILS OF REINFORCEMENT

1. Hooks and Bends

Hooks and bends shall conform to appropriate sections of ACI 318.

2. Surface Conditions of Reinforcement

Metal reinforcement at the time concrete is placed shall be free from mud, oil, or other nonmetallic coatings that adversely affect bonding capacity.

Metal reinforcement, except prestressing steel, with rust, mill scale, or a combination of both shall be considered as satisfactory, provided the minimum dimensions, including height of deformations, and weight of a hand wire brushed test specimen are not less than the applicable ASTM specification requirements.

3. **Placing Reinforcement**

Supports and tolerances for bars and fabric shall be in accordance with Section 7.3 of ACI 318.

4. **Spacing of Reinforcement**

Spacing of reinforcement shall be in accordance with Section 7.4 of ACI 318.

5. **Splices**

Splices of reinforcement of bars and fabric shall be in accordance with information on the drawings and the appropriate Sections of ACI 318.

6. **Concrete Protection for Reinforcement**

The following minimum concrete cover shall be provided for reinforcing bars.

Cast-in-place concrete (non-prestressed):

	<u>Minimum Cover, In.</u>
Cast against and permanently exposed to earth	3
Exposed to earth or weather	
#6 through #18 bars	2
#5 bars, 5/8 in. wire, and smaller	1 – 1/2
Not exposed to weather or in contact with the ground	
Slabs, walls, joists:	
#14 and #18 bars	1 – 1/2
#11 and smaller	3/4
Beams, girders, columns:	
Principal reinforcement, ties	1 – 1/2
Stirrups or spirals	
Precast concrete (manufactured under plant control conditions)	

Exposed to earth or weather:

Wall panels:

#14 and #18 bars	1 – 1/2
#11 and smaller	3/4

Other members:

#14 and #18 bars	2
#6 through #11	1 – 1/2
#5 bars, 5/8 in. wire, and smaller	1 – 1/4

Not exposed to weather or in contact with the ground:

Slab, walls, joists:

#14 and #18 bars	1 – 1/4
#11 and smaller	5/8

Beams, girders, columns:

Bar Diameter, but not less than 5/8 and need not exceed 1 – 1/2

Ties, stirrups or spirals

3/8

In corrosive atmosphere or severe exposure conditions, the amount of concrete protection shall be suitably increased, and the denseness and nonporosity of the protecting concrete shall be considered, or other protection shall be provided.

Exposed reinforcing bars, inserts and plates intended for bonding with future extension shall be protected from corrosion.

When the general code, of which this ACI 318 forms a part, requires a fire-protective covering greater than the concrete protection specified in this section, such greater thicknesses shall be used.

G. WATERTIGHT JOINTS

Watertight joints shall be provided and installed as shown on the drawings, using the appropriate keys, seals, curing compounds, caulking, waterstops, admixtures or membranes in strict accordance with the manufacturer's instructions.

When new concrete surfaces abut old concrete surfaces, the contractor shall provide a watertight joint by means of Igas joint sealant as manufactured by Sika Chemical Corporation or approved equal. Additional details of this joint will be as shown on the drawings, if required.

H. SUBGRADES

1. Remove unsuitable material and replace with acceptable fill. Subgrade shall provide uniform bearing under all slabs.
2. All pipes, conduits, etc shall be in place and approved before closing slab is poured.
3. Six (6") inch deep porous fill shall be furnished, placed and compacted by this concrete section, under all slabs on grade. Do any final compaction, leveling or sloping which may be necessary.
4. Porous fill shall consist of crushed stone or clean gravel ranging from 1-1/2" maximum size to 1/2" minimum size. If gravel is used, it must be washed and free from all clay. Cinders will not be acceptable for porous fill under floor slabs.
5. Moisture barrier shall be a clear 8-mil thick polyethylene, polyethylene coated barrier paper, or a 1/8" thick asphalt core membrane sheet, as shown on the drawings.

I. CASTINGS AND OPENINGS IN CONCRETE

1. The contractor shall coordinate the work of the other trades in regard to openings in slabs and shall assume the responsibility of indicating all required holes not shown on structural drawings on the reinforced shop drawings prior to submission to the Engineer for approval.
2. It shall be the duty of the contractor or coordinate the work under this section with the work of mechanical trades to insure that mechanical work will not be placed so as to injure or cause weaknesses in the concrete work.
3. Individual sleeves or groups of conduits shall not be placed horizontally or vertically in beams, nor shall they be placed in slabs and walls so as to interfere with the specified location of reinforcing.
4. conduits shall be placed no closer than 3 diameters on center and if closer than 1" to the concrete surface, expanded metal or wire mesh shall be laid between them and the concrete surface, and shall extend 8" beyond the conduit.
5. Sleeves shall be placed by the Contractor requiring the sleeve.

J. EXPANSION JOINTS AND CONTROL JOINTS

1. Where shown on the drawings, Contractor shall install expansion joints using preformed bituminous-fiber type expansion joint filler 1/2" thick by full slab depth unless detailed otherwise by the Engineer. Joint fillers are to be in accordance with ASTM D 544, Type V.

2. Joint sealer in all expansion joints shall be in accordance with ASTM Specification D 1190. Joint sealer shall be applied to the top one inch of all joints indicated as premolded joints on the drawings.
3. Except for the expansion joints shown by the drawings, Contractor shall locate expansion joints only where approved by the Engineer.
4. Provide control joints as indicated or required. Place isolation and control joints in slabs-on-ground to stabilize differential settlement and random cracking.

K. EQUIPMENT PADS

All equipment and appurtenances that are installed on the floor slab shall be placed on concrete pads having a height of four inches above the finished slab elevation. The pad shall be separated from the concrete slab by one-half inch expansion joint, and the pad shall extend two inches beyond the foundations of the items they are supporting. The edges of the pad shall be finished with a one-half inch chamfer. This requirement shall apply to the diesel generator and chlorine booster pumps.

L. PAINTING AND WATERPROOFING

Surfaces shall be clean, dry and free from any contaminant that might interfere with proper adhesion or performance of the coating system. Form oil shall be removed by abrasive blasting. Areas to be exposed to immersion, whether constant or intermittent, or highly corrosive environments shall be sandblasted with silica sand to obtain a profile of 3 to 4 miles. Exterior concrete and masonry walls for basements, below grade, shall receive a two-coat coal tar epoxy system, 24 mil total minimum dry film thickness. Interior concrete and masonry walls, above grade, shall receive a chlorinated natural rubber coating system, 3 mil total minimum dry film thickness.

M. FINISHES

All floor slabs shall be finished as follows: screed, float and trowel monolithic slab to proper elevations and/or grades; then steel troweled to a hard, dense, polished finish. All slopes must be true and must allow for proper drainage at all times.

Unexposed surfaces require no special finishing other than filling of voids, providing that the surfaces are sufficiently true so as not to interfere with other work and, further, provided that they are structurally sound.

Exposed surfaces shall receive a rubbed smooth finish subject to approval of the Engineer.

Exterior concrete slabs and platforms shall receive a wood floated finish worked in such a manner as to result in a coarse-textured surface that will result slipping. Unless specified in the approved drawings or specifications, all concrete finishes shall be as defined in ACI 301 Specifications for Structural Concrete for Building.

SECTION V EROSION AND SEDIMENTATION CONTROL

5.01 GENERAL

The Contractor shall be responsible for controlling all erosion and sedimentation for all areas disturbed during the construction of this project. The contractor shall adhere to rules and regulations of the Department of Environmental Protection for the control of erosion and sedimentation (see Section 5.05).

All erosion control measures and facilities must be maintained by the contractor for the duration of the project.

The following Pennsylvania Fish Commission Waterways Patrolman must be notified by the contractor as to when the project will start, when explosives are to be used, and when the project is completed for final inspection:

Wayne Imler (or currently Waterways Patrolman)
New Hope, PA 18938
Telephone: 215-862-5301

5.02 CONTROL MEASURES

- A, All construction activities pertaining to earthmoving shall be performed in manner that will minimize erosion.
- B. Hay bales and silt fences are to be placed by the contractor as directed by the Engineer to control sediment from entering waterways. The hay bales must be located within the construction easement and staked as per the Standard Details.
- C. All disturbed areas must be stabilized immediately.
- D. Stone filtration dams are to be placed downstream of all stream crossings by the contractor as directed by the Engineer. These dams are to be constructed as per the Detail Drawings and are to be maintained by the contractor for the duration of the duration.
- E. Temporary stream crossings must be constructed by the contractor prior to the start of construction on any stream crossing. These are to be constructed as per the Detail Drawings at the location indicated on the construction plans.

5.03 STREAM CROSSINGS

A. Stream bed shall not be used as a roadway by the contractor for moving equipment and vehicles from one site to another. Temporary stream crossing must be constructed for such crossings as per Section 5.02 of these Specifications.

- B. Siltation control shall be provided at all stream crossings.
- C. All excess material and debris removed from the stream bed during construction must be removed, disposed of and not remain in the flood plain area as designated by the Engineer.
- D. All temporary stream crossing materials must be removed upon completion of construction. This includes all filtration dams, pipes, fill materials, etc. the stream bed is to be returned to its original condition and the banks are to be stabilized by sowing grass seed when construction is completed.

5.04 REMOVAL OF EROSION AND SEDIMENTATION CONTROLS

- A. The supplying, installing, maintaining and removing of all erosion and sedimentation controls are the responsibility of the contractor.
- B. All disturbed areas due to the removal of these controls must be stabilized by the contractor to reduce erosion. These areas are to be maintained by the contractor until adequate vegetation is established.

5.05 STANDARD CONDITIONS RELATING TO EROSION CONTROL

- A. By approval of the plans, the Authority does not assume any responsibility for the feasibility of the plans or the operation of the measures and facilities to be constructed thereunder.
- B. If at any time the erosion and sedimentation activities undertaken pursuant to this permit or the discharge of the effluent there from is causing or contributing to pollution of the waters of the Commonwealth, the contractor shall forthwith adopt such remedial measures as are acceptable to the Department of Environmental Resources.
- C. Additional permits must be secured from local municipalities where earthmoving or well drilling activities are covered by local ordinances.
- D. At least seven days before earthmoving will begin, the Contractor, by telephone or certified mail shall notify the Department Environmental Protection of the date of beginning of construction and invite the County Conservation District Representative to attend a pre-construction conference. The contractor shall have his erosion control plan available at the site of the activity at all times.
- E. All earthmoving or well drilling activities shall be undertaken in the manner set forth in the erosion and sedimentation control plan. Revisions to the plan must be approved by the Department of Environmental Protection of County Conservation District.

- F. The erosion control measures and facilities shall be constructed under the supervision and competent inspection of an individual trained and experienced in erosion control, and in accordance with plans, designs and other data as herein approved or amended, and with the conditions of the permit. Control facilities shall be frequently inspected to insure effective control.
- G. When the approved erosion control measures and facilities are completed, the contractor shall notify the Department of Environmental Protection so that an inspection of the measures and facilities may be made by a representative of the County Conservation District.
- H. No storm water, sewage or industrial wastes not specifically approved by the permit, shall be admitted to the erosion and sedimentation measures and facilities for which the permit is issued, unless with the approval of the Department of Environmental Protection.
- I. Sediment shall at no time be permitted to accumulate in sedimentation basins to a depth sufficient to limit storage capacity or interfere with the settling efficiency thereof. The sediment removed shall be handled and disposed of in a manner that will not create pollution problems and so that every reasonable and practical precaution is taken to prevent the said material from reaching the waters of the Commonwealth.
- J. All slopes, channels, ditches or any disturbed area shall be stabilized as soon as possible after the final grade or final earthmoving has been completed. Where it is not possible to permanently stabilize a disturbed area immediately after the final earthmoving has been completed or where the activity ceases for more than 20 days, interim stabilization measures shall be implemented promptly.
- K. Upon completion of the project, all areas which were disturbed by the project shall be stabilized so that accelerated erosion will be prevented. Any erosion and sedimentation control facility required or necessary to protect areas from erosion during the stabilization period shall be maintained until stabilization is completed. Upon completion of stabilization all unnecessary or unusable control measures and facilities shall be removed, the areas shall be graded and the soils shall be stabilized.

SECTION VI TESTING AND DISINFECTION

6.01 WATER MAIN TESTING

A. PRESSURE TEST

After the pipe has been laid, corporation stops installed and the trench backfilled, the line shall be filled with water. thereafter, each section between valves and, where practical, a section not over 1,000 feet shall receive the following hydrostatic test. The contractor shall not install any service lines until after successful test. Then the system shall be retested with services installed.

The pipe shall be completely filled with potable quality water and tested to a minimum of 100 psi or two times the normal operating pressure to a maximum of 150 psi (for distribution mains, only) based on the elevation of the lowest point of the line or section under test (whichever is greater). The pressure shall be applied by means of a pump connected to the pipe in a manner satisfactory to the Engineer. The pump, pipe connections, taps into the pipe and all necessary apparatus except gauges shall be furnished by the contractor.

Before applying the specified test pressure, all air shall be expelled from the pipe. The contractor shall furnish and install corporation cocks as may be required at all high points and leave these exposed so that air can be expelled as the line is filled with water.

Where any section of a main is provided with concrete thrust blocking, the pressure test shall not be made until at least five (5) days have elapsed after the concrete thrust blocking was installed.

The test pressure shall be maintained for a period of not less than one (1) hour. Should any pressure test disclose an inability to hold the test pressure, the contractor shall locate and correct defects and retest to the satisfaction of the Authority.

B. LEAKAGE TEST

A leakage test shall be conducted after the pressure test has been satisfactorily completed. The test shall be in accordance with AWWA C600 Standards. The Engineer will furnish the pressure gauge and measuring device for the leakage test. The contractor shall furnish the pump, pipe, connections and all other necessary shall be four (4) hours and during the test, the pipe shall be subjected to a pressure test at maximum operating pressure for the locality, based on the elevation of the lowest point in the line or section under test. However, the leakage test pressure shall be at least 100 psi. leakage is defined as the quantity of water to be supplied to the newly laid pipe, or any valved section thereof necessary to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled.

No pipe installation will be accepted until the leakage is less than 10 gallons/inch diameter/mile for the four (4) hour test duration.

Should any test of pipe laid disclose leakage greater than that specified above, the Contractor shall, at his own expense, locate and repair the line and retest until the leakage is within the specified allowance.

The contractor will be responsible for correction, in the same manner as specified above, for leaks developing in lines that have been backfilled prior to the test.

C. TESTING EXPOSED PIPE

Pressure and leakage testing shall be performed on all exposed piping located within a structure. If the pipe is a continuation of buried pipe discussed above, the testing shall occur together.

Pipe that has not been tested with the buried piping will be tested in the same manner as above, except that it must be totally in place; properly supported; with any concrete supports and thrust blocks in place and sufficiently cured; and in general a completed installation.

D. TESTING MANHOLES

Air valve manholes and other chambers shall be test in accordance with Section 5.03 or 5.04, Standard Sewer Specifications.

Authority personnel shall be present during all water main testing. Authority personnel must operate all water main valves of existing system.

6.02 WATER MAIN DISINFECTION

The contractor shall take precautions during the installation of the pipeline to protect the pipe interiors, fittings and valves against contamination. Pipe delivered for construction shall be strung so as to minimize the entrance of foreign material. When pipe laying is not in progress as, for example, at the close of a day's work, all openings in the lines shall be closed by watertight plugs. Joints of all pipe in trench shall be completed before work is stopped. If water accumulates in the trench, the plugs shall remain in place until the trench is dry.

All newly installed water lines shall be disinfected by the contractor, as herein defined, before water is used for domestic consumption. One of the following two methods shall be employed:

1. by fastening the required number of calcium hypochlorite tablets to the inside of every length of pipe laid, or

2. by continually introducing a strong hypochlorite solution by means of a chemical solution or feed pump into metered fresh water introduced into the line.

a. The Tablet Method: it is only applicable if the pipeline has been laid in a sanitary manner in the judgment of the Engineer. Otherwise, the line shall be flushed and the alternate method, amplified in the section below, shall be used.

The disinfection tablets of calcium hypochlorite having an available chlorine content of 70% by weight and sized to weight 6 to 8 tablets per ounce. The tablets shall be fastened to the inside top of every length of pipe laid, starting with the first and progressing as each additional length is added. The top of the pipe shall be marked by chalk to prevent rotation so that the tablets will be found at the top of the main when the pipe is in place. The number of tablets to be used per 20-foot section of pipe is tabulated below and appropriate adjustments are to be made if lengths other than 20-foot are used.

Pipe size, inches:	6	8	10	12	20	24
Tablets per 20-foot section:	3	4	5	8	22	32

When the installation has been completed, the main shall be filled with water at a velocity of less than 1-foot per second.

b. Feed Method: the hypochlorite solution feed method of disinfection may be employed as an alternate to the tablet method, and must be employed if the sanitary condition of the line is suspect by the Engineer. If the line is known to contain or has been in contact with dirty water, mud and debris, it shall first be flushed at a flushing velocity of not less than 2.5 feet per second and for a time to pass on less than 3 volumes of line water.

the preferred point disinfection application is at the beginning of the valved section of the line where water is being introduced. Application may be made through a corporation stop, provided a boss has been provided in the pipe prior to installation of the corporation stop. The water entering the new construction shall be metered and the proportional amount of disinfectant applied at a uniform rate while the process continues. Calcium hypochlorite may be used for disinfection and its application rate shall be 0.6 lbs. Or 70% strength material per 1,000 gallons of water. if the application is being made to a line that has been flushed and which contains water, the application of the disinfecting solution shall be maintained until no less than 40 mg/l chlorine residual is found at the farthest end of the line.

C: Duration of the Tests: the chlorinated water shall remain in contact with the mains for a period of 24 hours or longer, and at the end of that time water samples from the extremities of the line should indicate a chlorine residual of 50 mg/l or more. If a residual less than that valve is indicated, the disinfection procedure shall be repeated. If, on the other hand, a residual of 50 mg/l or more is indicated, the system shall be drained and flushed to waste until a residual under 1 mg/l is measured. Any time thereafter, a sample for bacteriological analysis shall be taken and submitted to a certified laboratory for total coliform analysis. The absence of these organisms shall confirm that the line is sanitary and it may be put into use subsequent to a satisfactory test. Should coliform organisms be found present in the water, the disinfection process shall be repeated until a satisfactory test is received.

D. Upon satisfactory completion of the disinfection of the new water mains, the lines shall be flushed clean of all chlorinated water prior to placing the lines in service.

6.03 TESTING OF MANHOLES – EXFILTRATION TEST

Before the “Manhole Exfiltration Test” is performed, the manhole shall be thoroughly cleaned and all openings sealed to the complete satisfaction of the Engineer. All pipe openings in the base and the walls shall be sealed with plugs designed to provide a watertight seal.

After the manhole has been properly cleaned and sealed, the manhole shall be completely filled with water. In order to make allowance for the amount of water which may be absorbed, the manhole to be tested shall be completely filled with water to the bottom of the cover seat a period of one (1) hour prior to commencement of the “Manhole Exfiltration Test”.

The manhole being tested shall be considered “acceptable” when the total rate of exfiltration does not exceed a rate of 0.069 gallons per foot of diameter per vertical foot per hour.

If the manhole does not satisfy these testing requirements, the source of exfiltration causing the test failure must be located, repaired and retested until the testing requirements are satisfied.

6.04 TESTING OF MANHOLES – VACUUM TEST

After the tank erection is completed and before it is painted, it shall be filled with water furnished from the well head by the General/Mechanical Contractor, to the maximum working water level. Any leaks that are disclosed shall be repaired by chipping or melting out any defective welds and then rewelding. No repair work shall be done on any joints unless the water in the tank is at least two (2) feet below the point being repaired. Water will be disposed of by the contractor in an environmentally safe and approved manner.

The sterilization procedure shall conform to spray sterilization procedure as described in AWWA Standard D105 Section 5, chlorination Method No.2. the procedure should be performed not less than ten (10) days after the interior paint has been applied. The tank spheroid shall not be chlorinated until all evidence of solvent odor is gone.

The tank shall be rinsed and then it shall be disinfected in accordance with AWWA Standard D105. The interior surfaces of the tank which will ultimately be in contact with stored water include piping shall be thoroughly sprayed to run off with water containing 200 parts per million of chlorine. This solution can be obtained by adding one (1) ounce of calcium hypochlorite (HTH) to each twenty-six (26) gallons of water. (Other methods of tank disinfection as outlined in Section 4, Specification AWWA D-105 may also be used).

After two (2) hours, the surfaces shall be thoroughly rinsed with clean potable water supplied from an approved and safe source. The rinse water or waste water shall be dechlorinated by addition of sodium sulfite in an approved manner to a maximum concentration of 5 ppm chlorine.

Personnel working inside the tank during sterilization shall be equipped with suitable air masks, protective clothing, and safety lines leading through a manhole to personnel outside the tank, precautions shall be observed. After rinsing the storage tank shall be filled to overflow level. Then bacteriological testing will be performed for presence of contamination. Should biologic contamination be detected, the tank shall be re-chlorinated and retested until no bacterial contamination is detected.

SECTION VII RESTORATION

7.01 SCOPE

This section of the specifications covers the requirements for the following:

- a. restoration of unimproved areas/landscaping procedures
- b. removal and protection of street roadway and shoulder pavement
- c. temporary replacement of street roadway and shoulder pavement
- d. permanent replacement of street roadway and shoulder pavement
- e. restoration of unpaved streets
- f. restoration of paved driveways
- g. restoration of crushed stone driveways
- h. replacement of sidewalks, curbs, gutters and stormwater inlets
- i. dust control
- j. overlay paving of streets

7.02 GENERAL

Restoration shall include all paved and unimproved areas.

When the main has been completed in an easement over private property, the contractor shall restore the areas covered by both the temporary and permanent easement to as near the original condition as is practical. The restoration shall include bringing the area up to the original grade, placing topsoil and seeding, replanting or replacing shrubbery, repairing or replacing sidewalks, driveways, fences, etc., damaged or removed in the course of the construction of the main, but does not include the replacement of trees authorized to be removed by the Engineer.

The contractor shall take all necessary precautions to protect trees, shrubs, grassed areas and all landscaping from damage. Any damages caused by the contractor to these features shall be repaired or replaced at the contractor's expense. Where grassed areas have been affected by the construction, the contractor shall furnish and place topsoil and shall fertilize and seed such areas. Any areas that fail to show a uniform stand of grass shall be reseeded and refertilized until an acceptable stand of grass exists. The contractor shall properly water, mow, rake, weed and otherwise maintain the grass until dedication.

Unless otherwise specifically qualified herein, the term "street" as used in this section of the specifications shall be understood to mean a street, highway, avenue, boulevard, road, alley, lane, driveway, parking lot or any other area used as a way for vehicles.

Where the term “specified maximum trench width” is used herein, it shall be understood to mean the applicable maximum trench width specified hereinbefore in Section III of these specifications.

Where the term “paved shoulder” is used herein, it is understood to mean the shoulders on State Highways.

The “PennDOT Form 408 Section” noted herein refer to sections contained in the current issue of the Commonwealth of Pennsylvania Department of Transportation Specifications Form 408. The references pertain only to materials, constructions equipment, methods and labor.

All removal, protection and replacement of street roadway, shoulder pavement and overlay paving on State Highways will be subject to inspection by representatives of the Commonwealth of Pennsylvania Department of Transportation, and the work must be performed in accordance with the requirements of that Department.

Any inspection, insurance or other charges demanded by the Commonwealth of Pennsylvania Department of Transportation, or other authority having jurisdiction will be paid for by the Contractor.

The contractor will be required to maintain, without additional compensation, all permanent and replacement of street roadway and shoulder pavement; all restoration of unpaved streets; all restoration of crushed stone and paved driveways; all replacement of sidewalks, curbs, and gutters; and all overlay paving of streets done by him under this contract for a period of twenty-four (24) months after the date of the Authority’s approval of the completion certificate issued by the Engineer, including the repair or removal and replacement of such work which has failed or has been damaged or wherever surface depressions have developed. Materials and methods used to repair or replace such work shall conform to the applicable requirements of these specifications.

The contractor shall be responsible for any injury or damage resulting from lack of required maintenance during the prescribed maintenance period and the Bucks County Water and Sewer Authority and the Engineer shall be indemnified and saved harmless from any and all loss by reason of any suit or action at law based upon any occurrence or omission occurring during this period.

7.03 MATERIALS

All materials used in the work covered by this section of the Specifications shall conform to the current edition of the Commonwealth of Pennsylvania Department of Transportation Specifications Form 408 and bulletins supplementary thereto. Before use, when required by the Engineer, samples of materials shall be submitted for test, and no materials shall be used until approved.

a. PA 2A Modified Coarse Aggregate: shall conform to the grading requirements specified in PennDOT Form 408 Section 703.3 for 2A coarse

aggregate. The PA 2A crushed stone shall be made from stone meeting the quality requirements for Type C stone aggregate as specified in PennDOT Form 408 Section 703.2. Samples of this crushed stone shall be submitted to the Engineer for approval, and none shall be used until such approval is obtained.

b. E-1A Emulsified Asphalt: shall be bituminous material conforming to Pennsylvania Department of Transportation Bulletin No. 25 Specifications for Bituminous Materials.

c. AC-20 Asphalt Cement: shall conform to Pennsylvania Department of Transportation Bulletin No. 25 Specifications for Bituminous Materials.

d. Temporary Paving: shall consist of a two inch layer of ID2 binder conforming to the requirements specified in Section 421 of the current issue of the Commonwealth of Pennsylvania Department of Transportation specifications.

e. Calcium Chloride: shall conform to PennDOT Form 408 Section 721 for Calcium Chloride.

f. Bituminous Concrete Binder Course ID-2: the materials, composition of mixture and methods used to construct the bituminous concrete binder course shall conform to the applicable requirements specified in PennDOT Form 408 Section 421 for the Bituminous Binder Course ID-2. The bituminous materials shall be Asphalt Cement Class Ac-20.

g. Bituminous Concrete Wearing Course ID-2: the materials composition of mixture and methods used to construct the bituminous concrete surface course shall conform to the applicable requirements specified in PennDOT Form 408 Section 420 for Bituminous Wearing Course ID-2. The bituminous materials shall be Asphalt Cement Class AC-20.

h. Bituminous Concrete Wearing Course ID-2: the materials composition of mixture and methods used to construct the bituminous concrete surface course shall conform to the applicable requirements specified in PennDOT Form 408 Section 420 for Bituminous Wearing Course ID-2.

i. Reinforced Cement Concrete Pavement: shall consist of reinforced high early strength (HES) cement concrete pavement. The materials and methods used to construct the reinforced cement concrete pavement shall conform to the applicable requirements specified in PennDOT Form 408 Section 501 for Reinforced or Plan Cement Concrete Pavements and reinforcing steel and expansion tie bolts shall be placed in accordance with the Commonwealth of Pennsylvania Department of Transportation Roadway Construction Standard RD-26.

j. Cement Concrete Driveways, Sidewalks, Curbs and Gutters:

1. the cement concrete shall be Class "A" conforming to the requirements of PennDOT Form 408 Section 704.
2. the crushed stone for the sidewalk bed and driveway base course shall conform to the requirements of PDT Section 350.

k. Bituminous Print Coat: shall be bituminous material conforming to PennDOT Form 408, Section 461.2(a).

l. Bituminous Tack Coat: shall be bituminous materials conforming to PennDOT Form 408, Section 460.2,

m. Aggregate Base: shall conform to the requirements specified in PennDOT Form 408, Section 350.2.

n. Bituminous Seal Coat: shall conform to the requirements specified in PennDOT Form Section 470.2.

7.04 CONSTRUCTION METHODS

A. RESTORATION OF UNIMPROVED AREAS AND LANDSCAPING PROCEDURES:

1. General: the contractor shall, in the preparation of the site, provide adequate protection for all lawns, trees, shrubs and landscape work that area to remain in place, or shall remove and preserve all topsoil within areas in which the lawns cannot be protected. Such protection or preservation shall be maintained so long as necessary to prevent damage or deterioration due to the operations of the contractor.

All landscape work and topsoil that is removed shall be stored and protected and replanted or re-laid following backfill and tamping of the excavated areas, provided it is suitable for reuse. If the material is unsuitable, it must be replaced by the contractor at his expense.

All areas other than traveled streets and landscaped area that are disturbed by the contractor shall be neatly graded and restored to as near the original condition as practical. a ground cover of rye grass shall be planted so that erosion of said areas is kept to a minimum until natural vegetation flourishes and predominates.

Hydroseeding may be used for seed application at the option of the contractor. The rate of application, methods and equipment for hydroseeding shall be approved by the Engineer.

2. Lawn Restoration: all lawn areas damaged during the course of construction shall be restored as follows:

a. the sowing of seed shall be done only within the seasons extending from September 1st to October 15th, and from April 15th to June 1st, except at such times therein as the Engineer may deem inadvisable because of weather or other conditions, and except as otherwise specified. In the event that seasonal and other conditions permit, and upon approval of the Engineer, seeding may start earlier and/or be continued later than the specified date. The sowing of seed shall be started on all areas during the first planting season after the areas have been released to the contractor for lawn operations.

The preparation of lawn areas shall not start until immediately preceding the season for seeding, except that topsoil may be spread at the option of the contractor, provided that it is thoroughly loosened for its full depth before the seed is placed.

b. all topsoil that was removed and preserved prior to excavation shall be used for lawns and plantings, provided it is suitable for such use. Any additional topsoil to be furnished shall be fertile, friable, natural topsoil, typical of topsoil of the locality. It shall be free from stones, without admixture of subsoil, plants, or roots, sticks or other extraneous matter, and shall not be used for planting operations while in a muddy or frozen condition.

The topsoil shall be spread and brought to the finished grade, then leveled through the use of straight edges and finally rolled, but not compacted; the topsoil is to have a depth of not less than 6 inches after final rolling. The surface shall be rolled with a 200 pound roller. The surfaces, when finished and settled, shall conform to the finished grade and shall be free to hollows or other inequalities and from stones, sticks and other debris. The topsoil requirements shall apply to seeding and sod work.

c. the contractor shall apply limestone to the surface if necessary and in sufficient quantities to raise PH to between 6.5 and 7.0 and spread super-phosphate and commercial fertilizer at the rate of 25 pounds per 1,000 square feet and dried blood nitrogen at a rate sufficient to provide a minimum of 2 pounds of actual nitrogen per 1,000 square feet.

The commercial fertilizer shall bear the manufacturer's guaranteed statement of analysis and contain at least 16% available phosphoric acid and contain at least 4% total ash. The super-phosphate shall have a minimum guaranteed analysis of 20% available phosphoric acid. Commercial fertilizer bearing the trade name "Scotts Turf Builder", or approved equal, shall also be approved under these specifications.

The fertilizer shall be thoroughly incorporated into the top 3 to 5 inches of topsoil at least 2 days prior to seeding.

d. Lawn seed of a type which will produce a lawn similar to the existing one shall be sown evenly at the rate of 7 pounds to 1,000 square feet of lawn area, one-half sown in one direction and the remainder at right angles to the first sowing, and shall be lightly raked into the surface. The area shall then be lightly rolled once and thoroughly watered with a fine spray. Care shall be taken that the seed is not washed out.

No seeding shall be permitted after rain unless the surface of the ground is loosened, nor when the velocity of the wind exceeds a gentle breeze of about 5 miles per hour. Extreme care shall be exercised during the seeding and raking, so that no change in grade is made and so that the seed is not raked from one spot to another. All seeded areas shall be mulched with a light covering of weed-free straw or hay in the amount of 60 pounds per 1,000 square feet, but all sloped areas shall be covered with cheesecloth or muslin laid in a continuous surface, properly supported in place.

e. Adjacent Areas: all areas adjacent to the disturbed areas of work shall be cleaned of all rubbish, debris and other materials, following the completion of the lawn and planting work.

f. Cleanup: the contractor shall clean up the project site and remove all surplus pipe materials, blocking and banding, excavated materials, cut trees and brush, broken pieces of pavement and concrete, rubbish and debris, etc., and all debris shall be properly disposed of by the contractor. All temporary structures shall be removed by the contractor and any areas of access shall be regarded as necessary and restored to their condition prior to construction.

All cleanup work shall be completed to the satisfaction of the Authority.

B. REMOVAL AND PROTECTION OF PAVEMENT

1. General: unless otherwise specified or required by the Engineer, street roadway and shoulder pavement shall be cut to neat lines equidistant from the centerline of the trench using equipment suitable for such work, and the edges of the pavement shall be protected and maintained by the contractor until the repaving is completed. If the pavement edges area not maintained to the satisfaction of the Engineer, the pavement shall be recut when the repaving is done, and the extra width of pavement removed and repaving thereby made necessary shall be done by the contractor at his own expense. All street roadway and shoulder pavement shall be cut by a mechanical saw.

The contractor shall also protect the paved surfaces outside of the pavement of the pavement removal and overlay limits and shall repair at his own expense all damage done thereto as a result of his operations.

In case the contractor removes or disturbs the paving for a greater width than those stated herein, or in case he removes or disturbs any paving on account of settlement, slides, blasting or cave-ins or in making excavation outside the lines of work without the written authorization of the Engineer, the Authority will require the contractor to replace all such pavement removed or disturbed without compensation.

2. State Highways:

a. General: except as otherwise specified hereinafter in paragraph (b), the street roadway and shoulder pavement (both base and surface courses) shall be removed for a width equal to the "specified maximum trench width" plus 2 feet and not less than 1 foot on each side of the trench width as excavated, except where the street roadway or shoulder paving consists of a concrete base course and a bituminous surface course, in which case the bituminous surface course shall be removed for a width equal to the "specified maximum trench width" plus 3 feet and not less than 1 foot 6 inches on each side of the trench width as excavated.

b. Removal of State Roadway Pavement Beyond the Specified Pavement Removal Widths: on State Highways where the street roadway pavement consists of a concrete base course and a bituminous surface course, it is a requirement of the Pennsylvania Department of Transportation that for longitudinal trenches both the base and surface courses of the pavement shall be removed to the closest longitudinal joint in the pavement; and for transverse trenches where the edge of the trench is within 4 feet of a transverse joint in the pavement, both the base and surface courses of the pavement shall be removed to the transverse joint.

3. **Streets Other Than State Highways & Paved Driveways:** the street roadway pavement (both base and surface courses) on streets other than State Highways and on paved driveways shall be removed for a width equal to the "specified maximum trench width" plus two (2) feet and not less than one (1) foot on each side of the trench width as excavated.

C. REPLACEMENT OF PAVEMENT

1. **General:** the work of this section shall be performed after the trenches (both the main line trenches and the service connection trenches) for any run of water mains have been acceptably backfilled.

Construction methods used for repaving of roadways and shoulders of all streets which may be under the control or jurisdiction of the Pennsylvania Department of Transportation shall, in addition to the requirements specified herein, conform to the current specifications and special requirements of that Department. On all other streets where either repaving or restorations are required, the construction methods used shall be as specified herein or as required by the Engineer.

The placing of bituminous material for base and surface courses of permanent pavement replacement shall terminate between October 15th and October 31st, and shall not be resumed prior to April 1st to April 15th, or as determined by the Engineer, depending upon weather conditions. Bituminous material for base and surface courses of permanent pavement replacement shall not be placed when the air temperature is 40 degrees F or lower; nor when the temperature of the pavement, base or binder on which it is to be placed is 40 degrees F or lower, as determined by the Engineer.

On State Highways where one-half of the roadway is to receive overlay paving, it shall be the contractor's responsibility and his expense to restore surfaces damaged by his operations, except lateral crossings, on that portion of the roadway not to be overlaid. Restoration shall be as specified by the Pennsylvania Department of Transportation.

At joints between existing pavements and repaving work, the edges of existing pavements shall be cut back parallel with the trench and at right angles, neatly trimmed and as approved by the Engineer. An application of Class AC-20 asphalt cement shall be provided at locations where new bituminous pavement joins existing bituminous pavement.

Backfilling of trenches and the preparation of subgrades shall conform to the requirement of Section II of these Specifications.

The minimum requirements for temporary and permanent replacement pavement shall be as specified hereinafter.

2. **Temporary Pavement:** the temporary paving shall be placed within two (2) days after the trenches area properly backfilled. The contractor shall continuously maintain temporary pavement without additional compensation until it is replaced with permanent pavement (see Detail W-6).
 - a. **State Highways:** on paved roadways of State Highways, provide temporary pavement over all areas where the pavement has been removed. The bituminous material of the temporary pavement shall be properly cured, after which it shall be placed and compacted. The temporary pavement shall have a minimum thickness after compaction of two (2) inches and the top surface thereof shall be flush with the surface of the adjacent pavement.
 - b. **Streets Other Than State Highways and Paved Driveways:** unless otherwise specified, on all paved roadways or streets other than State Highways and paved driveways, after the trenches have been acceptably backfilled, the contractor shall provide over all areas where the existing pavement has been removed, a temporary pavement conforming to the requirements specified herein. The temporary pavement shall have

a minimum thickness after compaction of two (2) inches and the top surface thereof shall be flush with the surface of the adjacent paving.

3. Permanent Pavement:

- a. **State Highways:** the permanent replacement of street roadway and shoulder pavement on State Highways will not be permitted until at least 90 days after the required temporary pavement has been placed, except if required by the conditions of the PennDOT occupancy permit. However, permanent replacement pavement must be placed before 180 days after the required temporary pavement has been placed. The specified thicknesses of replacement pavement are the compacted thicknesses. The minimum requirements for permanent replacement pavement to be provided where the existing pavement has been removed shall be as specified hereinafter, and as dictated by the conditions of the roadway occupancy permit. Permanent pavement replacement after the 90-day waiting period shall as a minimum be a bituminous concrete base course which is not less than 5 inches thick, a 2-inch thick bituminous concrete binder course, and a 1- 1/2-inch thick bituminous concrete wearing course with its top surface flush with adjacent existing pavements. Should an overlay be required, the top surface of the binder course shall be flush with the surface of the existing pavement.

Should the contractor be required by the PennDOT permit to begin permanent pavement replacement prior to the 90-day waiting period, the permanent pavement replacement shall consist of an 8-inch thick reinforced high early strength (HES) cement concrete pavement and a 2-inch thick bituminous concrete binder course ID-2, and a 1- 1/2 inch thick ID-2 wearing course with its top surface flush with the adjacent existing pavement. (see Detail W-10)

- b. **Streets Other Than State Highways:** the permanent replacement pavement to be provided on streets other than State Highways, placed after the 90-day waiting period, shall consist of a bituminous concrete base course and a bituminous concrete binder course. A bituminous concrete overlay pavement shall be placed if required by the conditions of work and/or Township roadway occupancy permit. The bituminous concrete base course shall not be less than 5 inches thick and the 1-1.2 inch thick bituminous concrete binder course shall be flush with the surface of the existing adjacent pavement if an overlay is required. If an overlay is not required, than a 1-inch thick bituminous wearing course shall be place directly over the bituminous concrete base course. All as required by the conditions of the Township Road occupancy permit.

Should the contractor opt to or be required to place permanent pavement before the 90-day waiting period has elapsed, an eight

(8) inch thick reinforced concrete base course shall be installed in lieu of the five (5) inch thick BCBC. (see Detail W-7)

4. **Restoration of Unpaved Streets:** after the trenches have been backfilled as specified in Section III, the contractor shall furnish and place a PA 2A modified coarse aggregate course for the full width of the existing road. This crushed stone surface course shall be graded, shaped and rolled to a compacted thickness of six (6) inches.
5. **Restoration of Paved Driveways:** the permanent replacement paving to be provided on paved driveways of commercial establishments shall be as specified hereinbefore for streets other than State Highways.

For bituminous paved residential driveways, the replacement paving shall consist of a crushed stone base course and a bituminous concrete surface course.

The PA 2A modified aggregate base course shall not be less than four (4) inches thick after compaction, and the top surface thereof shall not be less than two (2) inches below the surface of the adjacent existing paving. The bituminous concrete surface course shall consist of a two (2) inch thick wearing course of Id-2 bituminous concrete. The top surface of this surface course shall be flush with the surface of the adjacent existing paving.

The cement concrete residential driveways shall be replaced by the contractor using Class "A" concrete conforming to the requirements specified in PennDOT for 408, Section 704. The replaced driveway shall be of the same thickness, workmanship and surface finish as the original driveway unless otherwise required by the Engineer.

6. **Restoration of Crushed Stone Driveways:** all crushed stone driveways where broken into or damaged by the contractor shall be restored to a condition equal to its original undisturbed condition using the same type and quality of materials as that of the particular driveway restored.
7. **Replacement of Concrete Sidewalks:** unless otherwise required by the Engineer, all sidewalks removed or disturbed shall be replaced by the contractor with a four (4) inch thick crushed stone bed and four (4) inch concrete surface. The materials for and methods used to construct the bed and surface shall conform to the applicable requirements of PennDOT Form 408, Section 676.
8. **Replacement of Curbs:** all curbs removed or disturbed shall be replaced by the contractor. The replaced curbs shall be of the same shape, thickness, workmanship and surface as the original curb unless otherwise required by the Engineer.

9. **Replacement of Concrete Gutters:** all concrete gutters removed or disturbed shall be replaced by the contractor using Class "A" concrete conforming to the requirements specified by PennDOT Form 408, Section 704. The replaced gutter shall be of the same shape, thickness, workmanship and surface finish as the original gutter unless otherwise required by the Engineer.
10. **Repair/Replacement of Inlets:** the contractor will be required to repair any stormwater inlets damaged during construction. Replacement of damaged inlets may be required based upon the Engineer's inspection and subsequent determination. The contractor will be required to replace all damaged and broken stormwater piping.

The frame and grate assemblies of those inlets to be replaced shall be carefully removed by the contractor and the Engineer will be determine if they are suitable to be used to construct the new inlets.

If the Engineer directs the contractor to use these frames and grates to construct the new inlets, prior to their installation, they shall be thoroughly cleaned by wire brushing and painting with one coat of an approved asphalt base paint.

If the existing frame and grate assemblies are determined by the Engineer as being unsuitable for use in the construction of the new inlets, they shall remain the property of the utility Owner.

The materials and methods used to replace the inlets shall conform to the applicable requirements of the Commonwealth of Pennsylvania Department of Transportation Specifications Form 408.

11. **Dust Control:** the contractor shall employ such measures necessary to provide effective dust control by sprinkling water, by the use of calcium chloride or by any other method approved by the Engineer. Dust control measures shall be employed when, where, and in a manner required by the Engineer.

SECTION VIII SPECIAL CONDITIONS

8.01 GENERAL

“Materials”, Excavation and Backfill” and any other section of these specifications required to complete the work addressed in this section shall be applicable. Those items which may require different materials and/or construction methods shall be specified in this Section.

8.02 STREAM CROSSINGS

- A. Any stream crossing included in this project shall be identified on the Contract Drawings and shall meet the conditions set forth in these Specifications.
- B. Prior to the start of any construction, all erosion and sedimentation controls must be placed as per the rules, regulations and requirements of the Pennsylvania Department of Environmental Protection (DEP). The contractor is advised that the DEP rules, regulations and requirements also apply to all other work on this project outside of the stream crossing locations.

The stream bed must not be used as an access road for moving machinery and equipment from one site to another. The contractor must construct temporary stream crossings which must be used by all equipment and machinery. Temporary stream crossings are to be constructed as per Standard Detail No. 28 and Section 5.02 of these specifications.

- C. After the contractor has constructed the required controls for erosion, sedimentation and transportation around the stream, the trench excavation and backfill operation shall commence as per Section III of these specifications. The trench subgrade shall be prepared a minimum of six (6) inches below the bottom of the pipe. Unsuitable subgrade material shall be removed and backfilled with 2A modified aggregate.

After the trench subgrade has been prepared, the pipe shall be encased in Class C, 2500 psi concrete; a minimum of six (6) inches thick around the outside diameter of the pipe as per the Detail Drawings. The pipe may be supported in the trench by the use of solid concrete block. The concrete encasement shall be poured and constructed as per Section 4.05 of the specifications.

The contractor may start the backfilling operation once the concrete has sufficiently set as determined by the Engineer.

The backfilling shall be performed so as to avoid the formation of a permanent ridge in the stream bed. After backfilling is completed, the contractor shall remove all excess material and debris from the stream bed.

Construction of the stream crossings shall be completed in one operation. The contractor may not start another operation until the stream crossing is completed, the stream bed restored and the temporary crossing removed, unless otherwise approved by the Engineer.

8.03 BORING UNDER STATE HIGHWAYS

A. GENERAL

1. The contractor shall furnish all labor, materials and equipment required to install a steel casing for the proposed State Highway crossing with a water main as shown on the plans. The work shall include casing installation by specified method, excavation and backfill, furnishing an installation of the DIP, carrier pipe, grout backfill, end seals and restoration of all disturbed areas following the satisfactory completion of work and required testing.

The contractor shall give written notice to the PennDOT Engineer with copies to the Authority and Engineer no less than fourteen (14) days in advance of when he or his subcontractor will start work within the highway right-of-way in order that work can be properly coordinated. Contractor should note that proposed work involved the construction operations on and over the property owned and controlled by Pennsylvania Department of Transportation and all work shall be performed in a manner satisfactory to the PennDOT Engineer or his authorized representative. The traffic on the highway shall be maintained at all times with safety and continuity, and contractor shall conduct all of his operations on or over highway right-of-way fully within the rules, regulations and requirements of PennDOT. The contractor shall be responsible for acquainting himself with such requirements as PennDOT may demand. The contractor shall be responsible for traffic safety. He shall also be responsible for any damage to persons and property.

2. The developer will prepare the necessary applications for permits for the construction of the crossing of the highway. The application will be made based on the design conditions shown on the drawings and/or outlined in the specifications. All changes by the contractor in the methods and/or materials for the construction of the crossings must be approved by the Engineer prior to the start of construction of the crossing. The contractor is responsible for obtaining all required permits from the State at no expense to the Authority to resubmit shall not be the responsibility of the Authority to resubmit the permit application for approval if the contractor constructs the crossing in a method other than that shown on the drawings and/or outlined in the specifications. The State must also approve all proposed changes by the contractor prior to the start of construction of the crossings.

The contractor is responsible for any and all delays in the construction progress due to this type of change.

3. The contractor or subcontractor proposing to do the work shall demonstrate to the Authority and the Engineer the successful completion of at least four (4) similar casing installations within the past five (5) years.
4. The location of the borings shall be identified on the contract drawings.

B. MATERIALS

1. **Casing Pipe:** the casing pipe shall be of steel having minimum yield strength of 35,000 psi, smooth wall and manufactured to the requirements of ASTM A-53. The steel casing pipe shall have the following minimum wall thickness: (CE-8 Table Railroad Specifications)

Nominal Diameter	Thickness
36"	.5625
42"	.5625
48"	.750
54"	.750

The casing shall be coated inside and outside with a bituminous coating of either coal tar or asphalt base at least two (2) mils in thickness.

2. **Carrier Pipe**

- a. Class 56 Ductile Iron for water, push-on joint pipe with cement lining (railroad specifications). Ductile iron pipe is to conform to Section 2.01 of these specifications.

3. **Sign Posts:** a 4-inch diameter post, seven (7) feet in length of galvanized steel shall be installed over the centerline of the water main on both sides of the highway. The post shall be installed in a hole three (3) feet deep and twelve (12) inches in diameter and the hole shall be completely filled to the ground surface with Class C concrete. Attached to each post shall be a durable, weatherproof painted metal sign that shall contain the following information:

- a. Name and address of Owner
- b. Type of pipe and content
- c. Depth below grade at sign
- d. Emergency telephone number
- e. PennDOT file number
- f. Sign post shall be removable at base joint (see detail).

C. CONSTRUCTION

1. The steel casing shall be installed by means of the Boring or Drilling Method. All equipment and methods shall be approved by the Engineer and the Pennsylvania Department of Transportation. All supervisory and

operating personnel engaged in the operation of boring or drilling equipment shall be fully qualified for such work, and shall have had at least twelve (12) months experience in the operation of the equipment being used.

The casing pipe shall be installed true to line and grade as shown on the plans. Bored installations shall have a bored hole not exceeding the outside diameter of the casing by more than one-half (1/2) inch. If voids should develop or if the bored hole diameter exceeds the allowable amount, grouting or other approved methods shall be employed to fill such voids at the contractor's expense.

When augers or similar devices are used for casing pipe emplacement, the front of the pipe shall be provided with mechanical arrangements or devices that will positively prevent the auger and cutting head from leading the pipe by more than 1-1/2", and thereby assuring that there will be no unsupported excavation ahead of the pipe. The auger and cutting head arrangement shall be removable from within the pipe in the event an obstruction is encountered. The face of the cutting head shall be arranged to provide reasonable obstruction to the free flow of soft or poor material. Plans and descriptions of the auger stop arrangement to be used shall be submitted to the Engineer for approval, and no work shall proceed until such approval is obtained and the arrangement is inspected in the field by the Engineer. Work started prior to this inspection will be halted and the installed casing abandoned in place.

2. Shored pits shall be constructed for boring or jacking the casing. The contractor shall submit the proposed method for supporting the pit walls to the Engineer for review and approval. If a jacking machine is used with an auger as a vehicle removing the material, the machine must be able to jack independent of the auger. The use of water or other liquids to facilitate casing emplacement and spoil removal is prohibited. Installation of the steel pipe casing shall start at the low end.
3. The boring operation shall be continued without interruption, except to install new lengths of the casing pipe. The lengths of the casing pipe shall be joined by bevel cut full penetration welds. The joints shall be welded completely around the circumference of the pipe so as to prevent water leakage from the casing throughout its length. After the joints are formed, the welds shall be coated with a bituminous coating at least two (2) miles in thickness.
4. If groundwater is encountered during the installation of the casing and the carrier pipe, the contractor shall take all steps necessary to maintain dry conditions in the boring pit. Extreme care must be taken by the contractor so that soil and/or soil fines are not removed by erosion during the dewatering operation. The discharge water shall be clear. If, during the dewatering operation, unstable soil conditions occur, the contractor shall take all necessary steps to rectify the problem by stabilizing the soil.

5. After the casing has been installed, the carrier pipe shall be installed. The contractor and/or his subcontractor must support, brace, tie, etc., the carrier pipe to the grades indicated on the plans. The method of support must be approved by the Engineer prior to the start of the tunnel construction. The ends of the casing are to be bulkheaded and the annular space in the casing shall be filled with cement grout as shown on Standard Detail No. W-27.
6. An obstruction is defined as being any physical object such as water, electric, gas, sewer, telephone lines, manholes, etc. objects such a rock, boulders, sandstone, shale, etc., encountered during construction of a crossing which halts the forward motion of the casing pipe are not considered as obstructions.

If an obstruction is encountered during the installation of the casing pipe and the obstruction is such that it prevents the forward action of the pipe, the contractor shall cease operations and notify the Engineer immediately. In the event the installation cannot be continued, the casing pipe shall be abandoned in place and filled completely with grout.

If the contractor is required to shift the location of the crossing because of encountering an obstruction, all work related to adding fittings, pipe, etc., other than that shown on the drawings necessary for connecting the water mains prior to passing through the casing conduit will be paid for as extra work.

If during construction of a crossing the contractor encounters an object other than an obstruction such as rock, boulders, etc., which halts the forward motion of the casing conduit, and if the conduit must be abandoned in place and the method of construction and diameter of the conduit must be changed, the contractor will submit a new location for the boring to the Engineer for review and approval. Should the contractor elect to shift the location of the crossing, the original conduit shall be left in place and completely filled with grout. Once the contractor has determined a new location, he shall make all arrangements with the jurisdictional body controlling the crossing and shall determine from the jurisdictional body if any other items must be handled such as private right-of-way, construction easement, etc. the contractor will be responsible for completing all arrangements for the change including necessary rights-of-way, construction easement, approval of change in the application of the controlling agencies, material changes and revisions to interconnecting piping.

8.04 PNEUMATIC PIERCING TOOLS

Tunneling with the use of pneumatic piercing tools shall be permitted. Use of pneumatic piercing tools will be considered for installation of water services only.

SECTION IX PUBLIC WATER WELLS

9.01 GENERAL

The purpose of this section of the specifications is to promote the development of safe and satisfactory sources for public water supply. The work to be done hereunder includes the furnishing of all labor, equipment, materials, transportation, tools, supplies, plant and appurtenances, unless hereinafter specifically excepted, necessary for the complete and satisfactory construction of production wells for public water supply.

The specifications cover drilling and test pumping of test wells; and drilling, construction and test-pumping of production wells; and disinfection and water quality testing. Depending upon the results of test drilling, the production well will be constructed either by drilling a larger diameter well in the vicinity of the test well or by reconstructing the test well. Test pumping of test wells prior to converting them to production wells will depend upon field conditions.

Two monitoring wells shall be used during pump testing of each production well. The monitoring wells shall be from 100 feet (minimum) to 200 feet (maximum) from the production well. The monitoring wells will be drilled, six inch diameter, about 500 feet deep.

The diameter of test wells shall be six (6) or eight (8) inches, and the diameter of the production wells shall be eight (8) to ten (10) inches in diameter depending upon potential capacity. The depths of the test wells are anticipated to be 350 to 500 feet. The depth of production wells shall be 500 feet or as directed by the Authority.

9.02 WORK AREA, PROTECTION OF

A. The Contractor shall not occupy with men, tools, equipment or materials any ground outside the property owned by the developer without written consent of the owner of such property. The contractor shall conduct his work so as not to impede or hinder any work being done by others on or adjacent to the site.

B. PROTECTION OF THE SITE

Excepting as otherwise provided herein, the contractor shall protect all structures, walks, pipelines, trees, shrubbery, etc., during the progress of his work. The contractor shall remove from the site all cuttings, drilling equipment, debris and unused materials. Upon completion of the work, the contractor shall restore the site as nearly as possible to its original condition, including the replacement, at the contractor's sole expense, of any facility or landscaping which has been damaged beyond restoration or destroyed. The water blown during the drilling and pumped during the

pumping test shall be conducted to the nearby drainage in such a way that the soil erosion and sediment dispersion are eliminated. Erosion and sedimentation control structures such as berms, basins and filters shall be used to accomplish this goal. The contractor shall take necessary steps to prevent pollution of the water without damage to property or the creation of a nuisance.

C. SOIL EROSION AND SEDIMENT CONTROL

The contractor shall comply with any and all the local or state regulations concerning the erosion of soil and discharge of sediments and sediment-laden water into wetlands, flood plains and streams. The contractor shall take all necessary steps to comply with such rules and regulations during all phases of drilling, development and pumping of the test and production wells.

D. CLEAN-UP

During the following the course of the work, the contractor shall keep a reasonable degree of order by disposing of accumulated rubbish and waste material. On the completion of the work, the site shall be cleared of all debris, dirt and left-over materials, tools and equipment which may have accumulated during the performance of the work.

E. PERMITS, CERTIFICATES, LAW AND ORDINANCES

The contractor shall at his own expense procure all permits, certificates and licenses required of him by law for the performance of his work. He shall comply with all federal, state or local laws, ordinances or rules and regulations relating to the performance of the work. The work shall also be performed in accordance with the following:

1. **AWWA Specifications:** each permanent well shall be in accordance with the pertinent parts of AWWA Standard for Deep Wells (A100) and specifications contained herein. Where differences between such specifications occur, the specifications contained herein will apply.
2. Construction shall also be in accordance with all pertinent requirements of the Pennsylvania Department of Environmental Protection and Bucks County Health Department.

9.03 WORKMANSHIP AND MATERIAL

- A. The contractor shall employ only competent workmen for the performance of his work and all the work shall be performed by an experienced well driller, and shall be under the technical supervision of the Developers Hydrogeologist.

- B. The contractor shall warrant that all workmanship, material and equipment furnished and installed by him shall be free of defects for a period of two (2) years after acceptance of the work and should such defects appear, the contractor shall repair such defects at no cost to the Authority. The work shall be guaranteed with a maintenance bond supplied by the developer.