Appendix E

Wastewater Collection Systems Report

PUTNAM ENGINEERING, PLLC.
Engineers and Architects

ENGINEERING REPORT
AND
SPECIFICATIONS
FOR
WASTEWATER COLLECTION SYSTEM

THE FAIRWAYS
FAIR STREET
TOWN OF CARMEL
PUTNAM COUNTY, NEW YORK

AUGUST 2003

(R0327)

ENGINEERING REPORT AND SPECIFICATIONS FOR WASTEWATER COLLECTION SYSTEM

THE FAIRWAYS
FAIR STREET
TOWN OF CARMEL
PUTNAM COUNTY, NEW YORK

INTRODUCTION

The Fairways is a proposed 150 unit multi-family residential development on a 94.9 acre parcel of land on Fair Street in the Town of Carmel. To accommodate the wastewater flow generated, it is proposed to construct a collection system consisting of manholes, 8" PVC sewer pipes, and 4" PVC house connections.

A pump station will be provided with adequate capacity for the proposed development. The pump station will transmit the gravity collected sewage from the development to the existing gravity lines in Kelly Road.

SEWER CONNECTION

Wastewater from the proposed Fairways will be collected and connected to Carmel Sewer District #2 via the pump station to an existing sewer manhole located in Kelly Road.

SEWER COLLECTION

It is proposed to collect the generated sewage flows via a conventional 8" PVC gravity collection system with sewer manholes at all horizontal and vertical change of directions and spaced no greater than 400' apart. Collected sewage will be pumped into existing sewer manholes in Kelly Road.

The sewer system design flows for the project are based on the Putnam County Health Department and New York State Department of Environmental Conservation projections for multi-family residential developments, which is calculated as follows:

Unit Type	Units	Estimated Water* Usage (GPD)
2 Bedroom	150	300 x 120* = 36,000
Club House / Pool	100	25 x 100 = 2,500

Total: 38,500 GPD

Total Estimated Metered Water Consumption per day = 38,500 GPD.
* Reflects using 20% credit for water saving fixtures.

SPECIFICATIONS
FOR
WASTEWATER COLLECTION SYSTEM

THE FAIRWAYS
FAIR STREET
TOWN OF CARMEL

SPECIFICATIONS

PVC PLASTIC PIPE SEWERS

Description

The Contractor under this Item will clear the site, remove all topsoil, trees, stumps, fences and the like; cut all pavements and pavement foundations; remove, handle, rehandle, fill and dispose of any and all materials (except rock excavation and existing masonry) encountered within the limits of the work and existing and including all pumping, bailing, draining, temporary sheeting and shoring, backfill, refill, rolling, tamping, puddling and protection therefore, and all incidental work required for the sewers and appurtenances; furnish all required materials and properly lay at the location shown on the drawings, or as directed by the Engineer, PVC plastic pipe, clean up the roads and rights of way, and restore them to the condition existing before undertaking the work, and perform all other work incidental to excavation, backfilling and laying the pipes, and appurtenances as required and described in these specifications.

The Contractor must assume all responsibility for any added expense or other liability which may arise because of quicksand, obstacles or conditions, foreseen or unforeseen, and encountered or manifest during the prosecution of any work which is specified or required under this contract.

Elevation of the existing ground is shown on the contract drawings. The elevations of the present ground are believed to be reasonably correct, but do not purport to be absolutely so, and, together with any schedule of quantities are presented only as an approximation. The Contractor will satisfy himself, however, by actual examination of the site of the work, as to the existing elevations and the amount of work required under these items. If the Contractor is not willing to accept the ground surface elevations indicated upon the drawings for payment, he shall so notify the Engineer prior to starting of any excavation work.

PVC Plastic Pipe

This specification designates general requirements for unplasticized polyvinyl chloride (PVC) Plastic Gravity Sewer Pipe with integral wall bell and spigot joints for the conveyance of domestic sewage.

Pipe and fittings shall meet extra-strength minimum of SDR = 35 of the requirements of ASTM Specification D3034-74. The pipe shall be colored green for in-ground identification as sewer pipe.

All pipe shall be suitable for use as a gravity sewer conduit. Provisions must be made for contraction and expansion at each joint with a rubber ring. The bell shall consist of an integral wall section with a solid cross-section rubber ring factory assembled, securely locked in place to prevent displacement. Sizes and dimensions shall be as shown in this specification. Standard lengths shall be 20 ft. and 12.5 ft. $\pm$1 inch. At manufacturer's option, random lengths of not more than 15% of total footage may be shipped in lieu of standard lengths.

All fittings and accessories shall be as manufactured and furnished by the pipe supplier or approved equal and have bell and/or spigot configurations compatible with that of the pipe .

Trench Excavation

The excavation shall be kept free from water, snow and ice during construction.

Special care shall be taken not to disturb the bottom of the excavation and not to remove the material at final grade until just before the pipe is placed.

The contractor shall be responsible at all times for the carrying out of all excavation operations in a safe and prudent manner so that the workmen and the public will be protected from unreasonable hazard. All applicable local, State and/or Federal requirements shall be observed and necessary permits acquired by the Contractor.

The Contractor shall install temporary fencing to protect the public from trenches left open overnight or on non-working days.

Temporary fencing shall be omitted where sheeting is extended to a minimum of three (3) feet above the working ground surface.

Sheeting shall be used in conformance with 107-05, NYSDOT specifications "Safety and Health Requirements", to protect employees and to satisfactorily complete the work without causing subsidence and to prevent damage to adjacent ground and structures. These requirements are minimum standards and may have to be increased depending on the hazards or as directed by the Engineer.

Disposal of Excavated Material

Material excavated under this section and not used for backfill, shall be used or disposed of as follows:

Only unsuitable materials, or that portion of suitable material excavation in excess of the quantity required to construct all embankments on the project, shall be considered as surplus.

When the Contractor has surplus materials that he wishes to dispose of within the right-of-way, the Engineer will, whenever possible, allow the material to be used to flatten embankment side slopes, or if this is not possible, allow deposition in other locations within the right-of-way as designated and approved by the Engineer. Where complete disposal of surplus materials cannot be accommodated within the right-of-way, the excess shall become the contractor's property for disposal. All disposal within the right-of-way shall be subject to the Engineer's approval of final condition and appearance.

Temporary Sheeting and Bracing

The requirements and minimum standards for sheeting are set forth in the Industrial Code - Rule No. 23 promulgated by the State of New York - Department of Labor.

Where excavations are made with sides which require supporting, the sheeting and bracing shall be of sufficient strength to sustain them against inward movement, loss of ground or damage to adjacent structures. Sheeting will normally be of wood but in certain cases steel sheeting may be required in which event it will be so indicated on the Plans.

Removal

Sheeting and bracing shall be removed before the completion of the work, unless the Engineer orders in writing that it remain in place or unless so ordered elsewhere in the Specifications. However, if the Contractor should elect to leave sheeting in place without the written order of the Engineer (but at all times with his approval), then in such case he will do so at his own expense. Sheeting left in place shall be cut off (wood) or burned off (steel) a minimum of two (2) feet below the finished or existing ground surface whichever is lower. When sheeting is being withdrawn, the backfilling shall be carried up by degrees to lessen the chance of displacement of any pipe or structure.

Materials

Wood sheeting shall be of such quality and size that it will not split in driving. Sheeting and bracing shall be Oak, a structural grade, of 1800 p.s.i. stress class, and furnished in accordance with the standard rules for grading, dressing and inspection. Douglas fir or other timber or equivalent grade may be substituted. Materials may be either new or used in good condition. Where close or tight sheeting is required, wood sheeting shall be tongued and grooved.

Laying PVC Plastic Pipe

All pipe shall be laid in trenches excavated as elsewhere specified herein. All joints shall be as above specified herein. All joints shall be installed in complete accordance with the requirements of the manufacturer who shall have a representative at the site of the work to instruct the Contractor in the proper methods of installing the pipe and making the joints. The manufacturer's representative shall remain at the site of the work for such time as may be necessary to insure that the pipe is being properly installed.

If any defective pipe or jointing assembly is discovered after being installed, it shall be removed, corrected and replaced. All expense resulting from defective or damaged pipe or jointing assemblies shall be borne by the Contractor.
All pipes and jointing assemblies shall be cleaned before they are laid, and shall be kept clean until they are inspected and accepted with the completed work. Open ends of pipe shall be kept properly plugged to prevent entrance of direct, debris and water.

Unless otherwise directed, pipe shall be laid uphill, without any break in the line from manhole. When not laying pipe, the end of the line shall be kept properly closed, so as to prevent entrance of all dirt and water.

First Class bedding will be required for all sewer lines with compacted granular bedding.

Concrete Pipe Cradles

Where, in the opinion of the engineer, the nature of foundations requires it, pipe shall be supported on concrete cradles.

In the trench excavated as specified, a cradle of such dimensions as are ordered by the Engineer shall be constructed of second class concrete, in accordance with the specifications for materials and for concrete construction.

The construction of cradles shall be made in two steps: first, the base slab shall be poured and allowed to set to such an extent as to bear the weight of the pipe to be placed thereon. This slab base shall be shovel finished and true to the gradient of the sewer.

After the pipe is in place, and the joints have been accepted, and the grade and alignment have been checked, the remaining portions of the cradle shall be poured and allowed to set for at least three days, free from water, before any backfill is placed around the pipe.

All specifications elsewhere given pertaining to methods of concrete construction, earth excavation and metal reinforcement shall apply to any concrete pipe supports ordered by the engineer.

In case it is decided to support the sewer structure on concrete piers above the existing surface, details of such construction will be furnished by the Engineer prior to the commencement of the work.

Payment for concrete pipe cradles and/or concrete piers, if required, will be made under other appropriate items of the contract.

Measurement and Compensation

PVC plastic pipe sewers will be measured from center to center of manholes along the interline of the pipe. Depth of cut will be measured from the surface of the ground, before excavation starts, to the invert of the sewer.

The unit price stipulated for PVC plastic pipe under this Item includes the clearing of the site, cutting of pavements, including foundations, placing and removal of all temporary sheeting and shoring, the pumping and removal of water, sewage and other liquids, the storage, rehandling and disposal of excavated materials, the filling and backfilling with such material as directed by the Engineer, the leveling off of spoil areas, the rolling, tamping, and restoration of the site particularized by these specifications, the furnishing and laying of the pipe complete with joining materials, and the furnishing of all labor, materials, tools and appliances necessary to complete the work as specified or shown. It shall also include the final testing for leakage; cleaning the sewers and line of trench; and any other incidental work. Payment for granular bedding and concrete pipe cradles and/or supports will be over and above the price bid per linear foot.

Payment will be made under test items for the number of feet of pipe and fittings installed, as measured along the centerline of the sewer. Wye branches in the line will be paid for under a separate item.

The unit price bid per linear foot for 4 inch house laterals shall include all costs, as mentioned above, for PVC plastic pipe sewers, and shall further include the cost of furnishing a 30 degree bend along the radius between the wye branch and the run of 4 inch pipe. All bends shall conform to the specifications for PVC plastic pipe sewers.

Payment will be made under these items for laterals for the number of feet of pipe and fittings installed, as measured in a straight line from the centerline of the main sewer along the axis of the lateral pipe to the end of the plug, or cap, in the 4 inch house lateral.

Precast Concrete Manholes

The contract items covered in the following specification are as follows:

Item 2A - Furnish and Install Precast Concrete Manholes, including frame and cover.

Item 2B - Furnish and Install Precast Concrete Drop Manholes, including frame and cover.

Item 2C- Furnish and Install Precast Concrete Flush Manholes, including frame and cover.

General

Sanitary sewer manholes shall be constructed as shown on the Plans and as specified herein.

Materials

Sanitary sewer manholes shall be for Class A Concrete construction, either poured-in-place or precast or a combination of the two, as indicated on the Plans. Concrete blocks will not be approved for the construction of sanitary sewer manholes.

Steel reinforcement shall be furnished for poured-in-place construction where shown. In some instances, as the Plans will indicate reinforcement will not be required. However, all precast concrete manhole components shall be reinforced.

Components

Sanitary sewer manholes shall consist of the following component parts:

(1) Manhole Base
(2) Manhole Barrel
(3) Manhole Top Slab
(4) Invert Channels & Filleting
(5) Manhole Steps
(6) Brick Collar (below frame and cover)
(7) Frame and Cover

In addition to the components, it is very important that pipe connections at manholes and pipe stubs provided for future lateral connections, be constructed as specified herein and as detailed on the Plans.

Manhole Base

Shall generally be of poured-in-place construction, founded on a bed or crushed stone or gravel. However, should the Contractor propose the use of precast bases for certain manholes, these bases will be allowed by the Engineer depending on full compliance with the following:

(a) that the precast bases are demonstrated to be equal or greater in structural strength to the poured-in-place

(b) that the precast bases be properly founded on a concrete mat below

(c) that the holes formed for the connecting pipes to enter the base be made at least 2 inches larger in diameter than the respective outside diameters of the connecting pipes

(d) that the necessary grouting of the joints where these pipes enter the base be performed in such a manner that the dewatering pumps remain "on" during the grouting and for a minimum of four hours after the grout has taken its initial set, to prevent contact between groundwater and the grout

(e) while not an absolute requirement, precast bases should be equipped with lifting rings to aid in their handling and installation

It must be kept in mind that all manholes, whether poured-in-place or precast shall be made watertight and are subject to leakage tests along the pipe.

Manhole Barrels

Shall generally be of precast construction meeting the requirements of ASTM Des. C478-61T (latest amendment). Precast barrel (riser) sections shall be designed and constructed as such, and shall not be sections of 48 inch diameter pipe whose inner walls have been drilled out for the insertion of manhole steps and then patched with grout. When precast barrel sections are used with poured-in-place bases, the base section shall be poured up to a minimum height above the top of the connecting pipes as shown and a construction joint shall be provided, formed with a steel ring (supplied by the manufacturer) to the shape of a standard concrete pipe bell, to properly receive the spigot end of the first precast section above. Joints in the precast barrels may be made with either non-shrink cement-grout joints (containing no lime) or sewage resistant rubber ring gaskets (joints pointed with cement grout) with the purpose of obtaining the best possible watertight joint.

Manhole Top Slab

Shall be generally of precast construction meeting the requirements of A.S.T.M. Des. C478-61T (latest amendment) and sufficiently reinforced to resist an A.A.S.H.T.O. "H-20" loading with impact included. The underside of the present slab for use with precast barrels shall be equipped with a construction joint formed to the shape of a standard concrete pipe spigot, so as to seat properly into the bell end of the precast barrel section immediately below the slab. The circular opening in the slab shall be eccentrically positioned so as to be tangent to the inner face of the manhole barrel and in line with the manhole steps below.

Invert Channels and Filleting

Invert channels shall be Class A concrete and under no circumstances will the use of bricks and mortar to form the invert channel be permitted. Channels shall be constructed using forms and shall not be handshaped. Channels in manholes at angle points in the sewer alignment shall be formed in a "gentle" curve between inlet and outlet pipes and not in a straight line (along the chord) between them. Further details of invert channels will be found on the Plans.

Filleting shall be performed with the cement mortar grout as detailed on the Plans.

Manhole Steps

Extruded aluminum steps of the type, size and spacing shown on the plans are shop installed on the precast barrel and top sections. The top step is not over 15 inches below the cast iron manhole frame, and the remainder of the steps are continued downward along the interior side of the manhole to a level of 2 feet above the bottom of the sewer as required.

Brick Collar

Unless otherwise specifically indicated, a collar of concrete brick, New York State Specification M-44B, shall be placed around the opening atop each manhole slab below the manhole frame. The minimum average compressive strength of the concrete brick shall be 2,500 psi and the compressive strength of any individual unit shall not be less than 2,000 psi. All concrete brick will be tested in accordance with ASTM C-140. The collar shall be paved inside and out with

1/2 inch mortar. The height of the brick collar will vary but in general it will amount to about two ordinary brick courses.

The Contractor when ordering the precast manhole components shall figure that the top of the slab will be an elevation twelve (12) inches below finished grade. Such will provide for future minor changes in surface elevations (i.e., those which are not great enough to necessitate changes in the concrete manhole barrel itself).

Cast Iron Frames and Covers

These are made of best quality gray cast iron conforming to Class No. 30, "Standard Specifications for Gray, Iron Castings," A.S.T.M. Designation: A 48-56. The seat of the frame and the outer edge of the cover are machined. All frames and covers are cold-dipped in black asphaltum at the foundry.

Unless otherwise noted, each manhole shall be installed with a circular bell type manhole frame and cover; Manufacture is equal to the Campbell Foundry Co., Neenah Foundry Co., or equal, pattern number as shown on the plans. Manhole covers shall be the solid lid type.

Pipe Connections at Manholes

All manhole connections for all pipes shall be made with cast in place resilient seal or rubber boot manhole connector.

In case of reinforced concrete pipe, wall fittings must be used as shown on the Plans or as recommended by the pipe manufacturer. In general, these fittings shall consist of a galvanized wall sleeve, rubber ring gasket and hot poured bituminous caulking as shown on Standard Details.

In case of drop connections, which shall be used wherever the difference of elevation between incoming and outgoing pipes exceeds two (2) feet, the class of the drop pipe shall be the same as that of the main line. The drop connection shall be encased in concrete as shown.

Stub Connections at Manholes

At manholes, where pipe stubs are to be located to provide for future sewer connections, stubs shall consist of a standard cast iron bell and spigot wall pipe with integrally cast waterstop. A standard bell plug shall be installed and laid in place in the bell opening.

It is important that both the grouting-in of the wall pipe and the leading of the plug be made watertight. The elevation, location and size of these wall pipes shall be as indicated on the Plans.

Grout

Grout for use in manholes and other structures for sealing around pipes, castings and other inserts, or for patching, shall be a non-shrink grout. It shall consist of 1:1 mixture of Portland cement and mason's sand and a non-shrink admixture.

Measurement and Compensation

The unit price bid shall include all costs, materials, and labor necessary to include but not limited to excavation, backfill, pumping, bailing, draining, temporary sheeting, shoring, testing, and all other incidental work complete with frame and cover.

Testing Sewers

A. The entire sewer system, including piping and manholes shall be tested for leakage. System may be tested by the use of either water or low-pressure air.

B. General test requirements.

1. Piping shall be adequately restrained against movement before testing. Pressure sewer line shall have thrust blocks installed (under another section of the Specification) and the concrete shall have attained full design strength before test pressure is applied to the line.

2. Piping system shall be flushed clean, and sediment, scale, dirt, and debris removed before piping is tested.

3. Adequate provisions shall be made for carrying off flushing water without causing erosion or other damage.

4. Manholes and piping shall be tested before joints are concealed or made inaccessible.

5. Tests shall be made in the presence of an inspector of the authority having jurisdiction.

C. Notice of tests shall be made in writing to the Engineer, the Health Department and the Town, and received by them not less than five days before the date of test.

D. Gravity flow system test.

1. When the groundwater is more than 1 ft. above the crown of the pipe at the upper end of the section to be tested, an infiltration test shall be made. The upper end of the section to be tested shall be plugged and V-notch weir of appropriate size shall be fitted into the lower end. There shall be no leakage around the weir place. Commercially manufactured weirs, made and calibrated for the purpose, may be employed.

2. When groundwater is less than 1 ft. above the crown of the pipe at the upper end of the section to be tested, an infiltration test shall be made. The sewer shall be plugged at the inlet pipes of both the upper and lower manholes. The line shall

then be filled with water to a level 2 ft. above the crown of the pipe in the upper manhole. Before any measurements are made, a period of about 2 hours shall be permitted to allow for absorption and escape of trapped air. Following this, a test period of at least 4 hours shall begin. At the end of the test period, loss of water shall be measured and leakage computed therefrom.

3. Air testing shall be performed in accordance with the procedures described in ASTM C 828, except as otherwise noted. For low-pressure air tests, use equipment specifically designed and manufactured to test sewer pipelines with low-pressure air. The equipment shall be provided with an air regulator valve or air safety valve so set that the internal air pressure in the pipeline cannot exceed 8 psig.

   a. The leakage test using low-pressure air shall be made on each manhole-to-manhole section of pipeline after placement of the backfill.

   b. Pneumatic plugs shall have a sealing length equal to or greater than the diameter of the pipe to be tested. Pneumatic plugs shall resist internal test pressures without requiring external bracing or blocking.

   c. All air used for testing shall pass through a single control panel.

   d. Low-pressure air shall be introduced into the sealed line until the internal air pressure reaches a value 4 psig greater than the maximum pressure exerted by groundwater that may be above the invert of the pipe at the time of test. However, the internal air pressure in the sealed line shall not be allowed to exceed 8 psig. When the maximum pressure exerted by the groundwater is greater than 4 psig, conduct infiltration test.

   e. At least two minutes shall be allowed for the air pressure to stabilize in the section under test. After the stabilization period, the low-pressure air supply hose shall be quickly disconnected from the control panel. The time required in minutes for the pressure in the section under test to decrease from 3.5 to 2.5 psig (greater than the maximum pressure exerted by groundwater that may be above the invert of the pipe) shall not be less than that shown in the following table:

Pipe Diameter in Inches	Minutes
4	2.0
6	3.0
8	4.0

f. When the sewer section to be tested contains more than one size of pipe, the minimum allowable time shall be based on the largest diameter pipe in the section, and shall be the time shown in the table reduced by 0.5 minutes.

4. Rate of infiltration and infiltration shall not exceed 100 gal./in. of pipe diameter per mile of pipe per 24 hours. Each section of pipe tested shall meet the above criterion.

E. Manhole testing.

1. Leakage testing of sewer manholes shall be included in the testing of the gravity sewer system. Leakage for each manhole shall not exceed 1 gal./vertical ft. of manhole per 24 hours.

2. After assembly and before backfilling, perform vacuum test of manholes. Plug lift holes and pipes. Place test head at inside of top of cone section and inflate seal as recommended by manufacturer. Draw vacuum of 10 inch. of mercury and shut off vacuum pump. With valves closed, measure time elapsed before vacuum drops to 9 in. Time shall exceed 60 seconds for 48 in. diameter. Retest as directed by Engineer.

F. Force main system test.

1. Pressure pipe shall be given combined pressure and leakage tests in sections of acceptable length.

2. Furnish and install suitable temporary testing plugs or caps; all necessary pressure pumps, pipe connections, meters, gages, and other necessary equipment; and all labor required.

3. Unless it has already been done, the section of pipe to be tested shall be filled with water of approved quality, and all air shall be expelled from the pipe. If blowoffs are not available at high points for releasing air, make the necessary excavations and do the necessary backfilling and shall make the necessary taps at such points, and shall plug said holes after completion of the test.

4. If water for test purposes is obtained from water mains, extreme care shall be taken to prevent excess pressure from occurring in the force main. A pressure-reducing valve shall be used in connection with a tested pressure gage on each side of the pressure-reducing valve. These gages shall be carefully watched at all times, and the pressures on them shall be read and recorded every 2 minutes when the municipality's water pressure is in the connection between the water main and the force main.

5. The section under test shall be maintained full of water for a period of 24 hours prior to the combined pressure and leakage test being applied.

6. The meter and gage shall be installed and kept in use during the test in such a manner that all water entering the force main under test will be measured and the pressure in the force main indicated.

7. The pressure test shall consist of first raising the water pressure (based on the elevation of the lowest point of the section under test and corrected to the gage location) to a pressure of 125 lb. per sq. in. If the Contractor cannot achieve the specified pressure and maintain it for a period of one hour with no additional pumping, the section shall be considered as having failed to pass the test.

8. Following a successful pressure test, or concurrently therewith, make leakage test by metering the flow of water into the pipe while maintaining in the force main a pressure equal to the specified test pressure. If the average leakage during the 4 hour period exceeds a rate of 20 gallons per 24 hours per inch of inside diameter per mile of pipeline, the section shall be considered as having failed the leakage test.

9. If the section shall fail to pass the pressure test, the leakage test, or both, locate, uncover, and repair or replace defective pipes, fittings or joints, all at his own expense, and without extension of the time for completion of the work. Additional tests and repairs shall be made until the section passes the specified tests.

10. All joints within chambers shall have no visible leakage. Joints from which water continues to run or squirt in an active manner will not be accepted.

11. Upon successful completion of the tests, plugs or caps installed for the testing shall be removed.

12. If, in the judgment of the Engineer, it is impracticable to follow the foregoing procedure exactly for any reason, modifications in the procedure shall be made as required and accepted, but in any event the Contractor shall be responsible for the ultimate tightness of the line within the above leakage and pressure requirements.

G. Before submitting system for final approval of the authorities having jurisdiction, submit a written statement to Engineer that work has been completed in accordance with the Contract Documents.

H. Promptly following satisfactory completion of leakage testing, a report fully describing test procedures and listing test results shall be submitted to the Engineer and to governmental agencies that have jurisdiction. The report shall be signed by the Contractor's superintendent.

I. Pipe deflection testing for PVC piping.

1. Thirty days following completion of the backfill over the PVC pipe installation, the pipeline shall be tested for deflection using a "go/no-go" deflection mandrel. The "go/no-go" gage shall be passed through all sections of the pipeline.

2. Pipe deflections shall be measured and converted to percent deflection. Deflections shall be recorded, with a copy of results submitted to Engineer. Test results shall be mailed or delivered to Engineer not later than the day following the day on which test was made.

3. Section of pipe with deflection greater than 7.5% shall be replaced.

The Contractor shall furnish all labor, equipment, water, plugs, pumps and other equipment necessary for the proper performance of these tests.

There shall be no direct payment for any costs involved in performing these tests and in fully meeting the requirements of this specification.

PUTNAM ENGINEERING, PLLC.
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ENGINEERING REPORT
AND
SPECIFICATIONS
FOR
WASTEWATER COLLECTION SYSTEM

GATEWAY SUMMIT
ROUTE 6
TOWN OF CARMEL
PUTNAM COUNTY, NEW YORK

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ENGINEERING REPORT AND SPECIFICATIONS
FOR
WASTEWATER COLLECTION SYSTEM

GATEWAY SUMMIT
ROUTE 6
TOWN OF CARMEL
PUTNAM COUNTY, NEW YORK

INTRODUCTION

Gateway Summit is a proposed 9 Lot Commercial Subdivision on a 88.29 acre parcel of land on Route 6 in the Town of Carmel. The subdivision will provide sites for a hotel, with a banquet and conference center, assisted living/senior housing projects, professional offices/retail use, a YMCA, a restaurant and a retail building. Each of the above will be situated on its own lot. To accommodate the wastewater flows generated, it is proposed to construct a collection system consisting of manholes, 8" PVC sewer pipes, and 4" and 6" PVC service connections.

SEWER CONNECTION

Wastewater from the proposed Gateway Summit project will be collected and connected to Carmel Sewer District #2 at an existing sewer manhole located near the intersection of Route 6 and Old Route 6.

SEWER COLLECTION

It is proposed to collect the generated sewage flows via a conventional 8" PVC gravity collection system with sewer manholes at all horizontal and vertical change of directions and spaced no greater than 400 feet apart. Collected sewage will flow by gravity to an existing sewer manhole near the Route 6/Old Route 6 intersection.

The sewer system design flows for the project are based on the Putnam County Health Department and New York State Department of Environmental Conservation projections for the proposed uses. The following presents the estimated design flows:

GATEWAY SUMMIT SUBDIVISION			
PRIMARY SUBMISSION PLAN			
LOT #	PROPOSED USE	DESIGN FLOW RATE	DESIGN FLOW WITH 20% CREDIT
1	Hotel (150 Rooms x 120 GPD) Banquet and Conference Center (400 people x 20 GPD)	18,000 GPD 8,000 GPD	14,400 GPD 6,400 GPD
2	Restaurant 7,000 SF (230 Seats x 35 GPD)	8,050 GPD	6,440 GPD
3	Retail 45,000 SF (45,000 SF x 0.1 GPD)	4,500 GPD	3,600 GPD
4	Office 10,000 SF (10,000 SF x 0.1 GPD)	1,000 GPD	800 GPD
5	Senior Housing 143 Units (143, 2BR x 300* GPD)	42,900 GPD	34,320 GPD
6	Assisted Living or Senior Housing 48 Units (48, 2BR x 300* GPD)	14,400 GPD	11,520 GPD
7	Corporate/Professional Offices and Convenience Retail 8,000 SF (8,000 SF x 0.1 GPD)	800 GPD	640 GPD
8	YMCA 68,000 SF (500 people x 25 GPD)	12,500 GPD	10,000 GPD
9	Conservation Area	0 GPD	0 GPD
	TOTAL:	**110,150 GPD**	**88,520 GPD**

*Reflects using 20% credit for water saving fixtures.

The above chart reflects a design flow rate with and without water saving devices in accordance with the NYSDEC guidelines. The flow rate based on the guidelines is 110,150 GPD. However, current standards dictate that water saving fixtures be used in all new construction. Therefore, we believe the design flow rate should be 88,520 GPD as tabulated in the fourth column.

SPECIFICATIONS
FOR
WASTEWATER COLLECTION SYSTEM

GATEWAY SUMMIT
ROUTE 6
TOWN OF CARMEL

SPECIFICATIONS

PVC PLASTIC PIPE SEWERS

Description

The Contractor under this Item will clear the site, remove all topsoil, trees, stumps, fences and the like; cut all pavements and pavement foundations; remove, handle, rehandle, fill and dispose of any and all materials (except rock excavation and existing masonry) encountered within the limits of the work and existing and including all pumping, bailing, draining, temporary sheeting and shoring, backfill, refill, rolling, tamping, puddling and protection therefore, and all incidental work required for the sewers and appurtenances; furnish all required materials and properly lay at the location shown on the drawings, or as directed by the Engineer, PVC plastic pipe, clean up the roads and rights of way, and restore them to the condition existing before undertaking the work, and perform all other work incidental to excavation, backfilling and laying the pipes, and appurtenances as required and described in these specifications.

The Contractor must assume all responsibility for any added expense or other liability which may arise because of quicksand, obstacles or conditions, foreseen or unforeseen, and encountered or manifest during the prosecution of any work which is specified or required under this contract.

Elevation of the existing ground is shown on the contract drawings. The elevations of the present ground are believed to be reasonably correct, but do not purport to be absolutely so, and, together with any schedule of quantities are presented only as an approximation. The Contractor will satisfy himself, however, by actual examination of the site of the work, as to the existing elevations and the amount of work required under these items. If the Contractor is not willing to accept the ground surface elevations indicated upon the drawings for payment, he shall so notify the Engineer prior to starting of any excavation work.

PVC Plastic Pipe

This specification designates general requirements for unplasticized polyvinyl chloride (PVC) Plastic Gravity Sewer Pipe with integral wall bell and spigot joints for the conveyance of domestic sewage.

Pipe and fittings shall meet extra-strength minimum of SDR = 35 of the requirements of ASTM Specification D3034-74. The pipe shall be colored green for in-ground identification as sewer pipe.

All pipe shall be suitable for use as a gravity sewer conduit. Provisions must be made for contraction and expansion at each joint with a rubber ring. The bell shall consist of an integral wall section with a solid cross-section rubber ring factory assembled, securely locked in place to prevent displacement. Sizes and dimensions shall be as shown in this specification. Standard lengths shall be 20 ft. and 12.5 ft. ±1 inch. At manufacturer's option, random lengths of not more than 15% of total footage may be shipped in lieu of standard lengths.

All fittings and accessories shall be as manufactured and furnished by the pipe supplier or approved equal and have bell and/or spigot configurations compatible with that of the pipe .

Trench Excavation

The excavation shall be kept free from water, snow and ice during construction.

Special care shall be taken not to disturb the bottom of the excavation and not to remove the material at final grade until just before the pipe is placed.

The contractor shall be responsible at all times for the carrying out of all excavation operations in a safe and prudent manner so that the workmen and the public will be protected from unreasonable hazard. All applicable local, State and/or Federal requirements shall be observed and necessary permits acquired by the Contractor.

The Contractor shall install temporary fencing to protect the public from trenches left open overnight or on non-working days.

Temporary fencing shall be omitted where sheeting is extended to a minimum of three (3) feet above the working ground surface.

Sheeting shall be used in conformance with 107-05, NYSDOT specifications "Safety and Health Requirements", to protect employees and to satisfactorily complete the work without causing subsidence and to prevent damage to adjacent ground and structures. These requirements are minimum standards and may have to be increased depending on the hazards or as directed by the Engineer.

Disposal of Excavated Material

Material excavated under this section and not used for backfill, shall be used or disposed of as follows:

Only unsuitable materials, or that portion of suitable material excavation in excess of the quantity required to construct all embankments on the project, shall be considered as surplus.

When the Contractor has surplus materials that he wishes to dispose of within the right-of-way, the Engineer will, whenever possible, allow the material to be used to flatten embankment side slopes, or if this is not possible, allow deposition in other locations within the right-of-way as designated and approved by the Engineer. Where complete disposal of surplus materials cannot be accommodated within the right-of-way, the excess shall become the contractor's property for disposal. All disposal within the right-of-way shall be subject to the Engineer's approval of final condition and appearance.

Temporary Sheeting and Bracing

The requirements and minimum standards for sheeting are set forth in the Industrial Code - Rule No. 23 promulgated by the State of New York - Department of Labor.

Where excavations are made with sides which require supporting, the sheeting and bracing shall be of sufficient strength to sustain them against inward movement, loss of ground or damage to adjacent structures. Sheeting will normally be of wood but in certain cases steel sheeting may be required in which event it will be so indicated on the Plans.

Removal

Sheeting and bracing shall be removed before the completion of the work, unless the Engineer orders in writing that it remain in place or unless so ordered elsewhere in the Specifications. However, if the Contractor should elect to leave sheeting in place without the written order of the Engineer (but at all times with his approval), then in such case he will do so at his own expense. Sheeting left in place shall be cut off (wood) or burned off (steel) a minimum of two (2) feet below the finished or existing ground surface whichever is lower. When sheeting is being withdrawn, the backfilling shall be carried up by degrees to lessen the chance of displacement of any pipe or structure.

Materials

Wood sheeting shall be of such quality and size that it will not split in driving. Sheeting and bracing shall be Oak, a structural grade, of 1800 p.s.i. stress class, and furnished in accordance with the standard rules for grading, dressing and inspection. Douglas fir or other timber or equivalent grade may be substituted. Materials may be either new or used in good condition. Where close or tight sheeting is required, wood sheeting shall be tongued and grooved.

Laying PVC Plastic Pipe

All pipe shall be laid in trenches excavated as elsewhere specified herein. All joints shall be as above specified herein. All joints shall be installed in complete accordance with the requirements of the manufacturer who shall have a representative at the site of the work to instruct the Contractor in the proper methods of installing the pipe and making the joints. The manufacturer's representative shall remain at the site of the work for such time as may be necessary to insure that the pipe is being properly installed.

If any defective pipe or jointing assembly is discovered after being installed, it shall be removed, corrected and replaced. All expense resulting from defective or damaged pipe or jointing assemblies shall be borne by the Contractor.
All pipes and jointing assemblies shall be cleaned before they are laid, and shall be kept clean until they are inspected and accepted with the completed work. Open ends of pipe shall be kept properly plugged to prevent entrance of direct, debris and water.

Unless otherwise directed, pipe shall be laid uphill, without any break in the line from manhole. When not laying pipe, the end of the line shall be kept properly closed, so as to prevent entrance of all dirt and water.

First Class bedding will be required for all sewer lines with compacted granular bedding.

Concrete Pipe Cradles

Where, in the opinion of the engineer, the nature of foundations requires it, pipe shall be supported on concrete cradles.

In the trench excavated as specified, a cradle of such dimensions as are ordered by the Engineer shall be constructed of second class concrete, in accordance with the specifications for materials and for concrete construction.

The construction of cradles shall be made in two steps: first, the base slab shall be poured and allowed to set to such an extent as to bear the weight of the pipe to be placed thereon. This slab base shall be shovel finished and true to the gradient of the sewer.

After the pipe is in place, and the joints have been accepted, and the grade and alignment have been checked, the remaining portions of the cradle shall be poured and allowed to set for at least three days, free from water, before any backfill is placed around the pipe.

All specifications elsewhere given pertaining to methods of concrete construction, earth excavation and metal reinforcement shall apply to any concrete pipe supports ordered by the engineer.

In case it is decided to support the sewer structure on concrete piers above the existing surface, details of such construction will be furnished by the Engineer prior to the commencement of the work.

Payment for concrete pipe cradles and/or concrete piers, if required, will be made under other appropriate items of the contract.

Measurement and Compensation

PVC plastic pipe sewers will be measured from center to center of manholes along the interline of the pipe. Depth of cut will be measured from the surface of the ground, before excavation starts, to the invert of the sewer.

The unit price stipulated for PVC plastic pipe under this Item includes the clearing of the site, cutting of pavements, including foundations, placing and removal of all temporary sheeting and shoring, the pumping and removal of water, sewage and other liquids, the storage, rehandling and disposal of excavated materials, the filling and backfilling with such material as directed by the Engineer, the leveling off of spoil areas, the rolling, tamping, and restoration of the site particularized by these specifications, the furnishing and laying of the pipe complete with joining materials, and the furnishing of all labor, materials, tools and appliances necessary to complete the work as specified or shown. It shall also include the final testing for leakage; cleaning the sewers and line of trench; and any other incidental work. Payment for granular bedding and concrete pipe cradles and/or supports will be over and above the price bid per linear foot.

Payment will be made under test items for the number of feet of pipe and fittings installed, as measured along the centerline of the sewer. Wye branches in the line will be paid for under a separate item.

The unit price bid per linear foot for 4 inch house laterals shall include all costs, as mentioned above, for PVC plastic pipe sewers, and shall further include the cost of furnishing a 30 degree bend along the radius between the wye branch and the run of 4 inch pipe. All bends shall conform to the specifications for PVC plastic pipe sewers.

Payment will be made under these items for laterals for the number of feet of pipe and fittings installed, as measured in a straight line from the centerline of the main sewer along the axis of the lateral pipe to the end of the plug, or cap, in the 4 inch house lateral.

Precast Concrete Manholes

The contract items covered in the following specification are as follows:

Item 2A - Furnish and Install Precast Concrete Manholes, including frame and cover.

Item 2B - Furnish and Install Precast Concrete Drop Manholes, including frame and cover.

Item 2C- Furnish and Install Precast Concrete Flush Manholes, including frame and cover.

General

Sanitary sewer manholes shall be constructed as shown on the Plans and as specified herein.

Materials

Sanitary sewer manholes shall be for Class A Concrete construction, either poured-in-place or precast or a combination of the two, as indicated on the Plans. Concrete blocks will not be approved for the construction of sanitary sewer manholes.

Steel reinforcement shall be furnished for poured-in-place construction where shown. In some instances, as the Plans will indicate reinforcement will not be required. However, all precast concrete manhole components shall be reinforced.

Components

Sanitary sewer manholes shall consist of the following component parts:

(1) Manhole Base
(2) Manhole Barrel
(3) Manhole Top Slab
(4) Invert Channels & Filleting
(5) Manhole Steps
(6) Brick Collar (below frame and cover)
(7) Frame and Cover

In addition to the components, it is very important that pipe connections at manholes and pipe stubs provided for future lateral connections, be constructed as specified herein and as detailed on the Plans.

Manhole Base

Shall generally be of poured-in-place construction, founded on a bed or crushed stone or gravel. However, should the Contractor propose the use of precast bases for certain manholes, these bases will be allowed by the Engineer depending on full compliance with the following:

(a) that the precast bases are demonstrated to be equal or greater in structural strength to the poured-in-place

(b) that the precast bases be properly founded on a concrete mat below

(c) that the holes formed for the connecting pipes to enter the base be made at least 2 inches larger in diameter than the respective outside diameters of the connecting pipes

(d) that the necessary grouting of the joints where these pipes enter the base be performed in such a manner that the dewatering pumps remain "on" during the grouting and for a minimum of four hours after the grout has taken its initial set, to prevent contact between groundwater and the grout

(e) while not an absolute requirement, precast bases should be equipped with lifting rings to aid in their handling and installation

It must be kept in mind that all manholes, whether poured-in-place or precast shall be made watertight and are subject to leakage tests along the pipe.

Manhole Barrels

Shall generally be of precast construction meeting the requirements of ASTM Des. C478-61T (latest amendment). Precast barrel (riser) sections shall be designed and constructed as such, and shall not be sections of 48 inch diameter pipe whose inner walls have been drilled out for the insertion of manhole steps and then patched with grout. When precast barrel sections are used with poured-in-place bases, the base section shall be poured up to a minimum height above the top of the connecting pipes as shown and a construction joint shall be provided, formed with a steel ring (supplied by the manufacturer) to the shape of a standard concrete pipe bell, to properly receive the spigot end of the first precast section above. Joints in the precast barrels may be made with either non-shrink cement-grout joints (containing no lime) or sewage resistant rubber ring gaskets (joints pointed with cement grout) with the purpose of obtaining the best possible watertight joint.

Manhole Top Slab

Shall be generally of precast construction meeting the requirements of A.S.T.M. Des. C478-61T (latest amendment) and sufficiently reinforced to resist an A.A.S.H.T.O. "H-20" loading with impact included. The underside of the present slab for use with precast barrels shall be equipped with a construction joint formed to the shape of a standard concrete pipe spigot, so as to seat properly into the bell end of the precast barrel section immediately below the slab. The circular opening in the slab shall be eccentrically positioned so as to be tangent to the inner face of the manhole barrel and in line with the manhole steps below.

Invert Channels and Filleting

Invert channels shall be Class A concrete and under no circumstances will the use of bricks and mortar to form the invert channel be permitted. Channels shall be constructed using forms and shall not be handshaped. Channels in manholes at angle points in the sewer alignment shall be formed in a "gentle" curve between inlet and outlet pipes and not in a straight line (along the chord) between them. Further details of invert channels will be found on the Plans.

Filleting shall be performed with the cement mortar grout as detailed on the Plans.

Manhole Steps

Extruded aluminum steps of the type, size and spacing shown on the plans are shop installed on the precast barrel and top sections. The top step is not over 15 inches below the cast iron manhole frame, and the remainder of the steps are continued downward along the interior side of the manhole to a level of 2 feet above the bottom of the sewer as required.

Brick Collar

Unless otherwise specifically indicated, a collar of concrete brick, New York State Specification M-44B, shall be placed around the opening atop each manhole slab below the manhole frame. The minimum average compressive strength of the concrete brick shall be 2,500 psi and the compressive strength of any individual unit shall not be less than 2,000 psi. All concrete brick will be tested in accordance with ASTM C-140. The collar shall be paved inside and out with 1/2 inch mortar. The height of the brick collar will vary but in general it will amount to about two ordinary brick courses.

The Contractor when ordering the precast manhole components shall figure that the top of the slab will be an elevation twelve (12) inches below finished grade. Such will provide for future minor changes in surface elevations (i.e., those which are not great enough to necessitate changes in the concrete manhole barrel itself).

Cast Iron Frames and Covers

These are made of best quality gray cast iron conforming to Class No. 30, "Standard Specifications for Gray, Iron Castings," A.S.T.M. Designation: A 48-56. The seat of the frame and the outer edge of the cover are machined. All frames and covers are cold-dipped in black asphaltum at the foundry.

Unless otherwise noted, each manhole shall be installed with a circular bell type manhole frame and cover; Manufacture is equal to the Campbell Foundry Co., Neenah Foundry Co., or equal, pattern number as shown on the plans. Manhole covers shall be the solid lid type.

Pipe Connections at Manholes

All manhole connections for all pipes shall be made with cast in place resilient seal or rubber boot manhole connector.

In case of reinforced concrete pipe, wall fittings must be used as shown on the Plans or as recommended by the pipe manufacturer. In general, these fittings shall consist of a galvanized wall sleeve, rubber ring gasket and hot poured bituminous caulking as shown on Standard Details.

In case of drop connections, which shall be used wherever the difference of elevation between incoming and outgoing pipes exceeds two (2) feet, the class of the drop pipe shall be the same as that of the main line. The drop connection shall be encased in concrete as shown.

Stub Connections at Manholes

At manholes, where pipe stubs are to be located to provide for future sewer connections, stubs shall consist of a standard cast iron bell and spigot wall pipe with integrally cast waterstop. A standard bell plug shall be installed and laid in place in the bell opening.

It is important that both the grouting-in of the wall pipe and the leading of the plug be made watertight. The elevation, location and size of these wall pipes shall be as indicated on the Plans.

Grout

Grout for use in manholes and other structures for sealing around pipes, castings and other inserts, or for patching, shall be a non-shrink grout. It shall consist of 1:1 mixture of Portland cement and mason's sand and a non-shrink admixture.

Measurement and Compensation

The unit price bid shall include all costs, materials, and labor necessary to include but not limited to excavation, backfill, pumping, bailing, draining, temporary sheeting, shoring, testing, and all other incidental work complete with frame and cover.

Testing Sewers

A. The entire sewer system, including piping and manholes shall be tested for leakage. System may be tested by the use of either water or low-pressure air.

B. General test requirements.

1. Piping shall be adequately restrained against movement before testing. Pressure sewer line shall have thrust blocks installed (under another section of the Specification) and the concrete shall have attained full design strength before test pressure is applied to the line.

2. Piping system shall be flushed clean, and sediment, scale, dirt, and debris removed before piping is tested.

3. Adequate provisions shall be made for carrying off flushing water without causing erosion or other damage.

4. Manholes and piping shall be tested before joints are concealed or made inaccessible.

5. Tests shall be made in the presence of an inspector of the authority having jurisdiction.

C. Notice of tests shall be made in writing to the Engineer, the Health Department and the Town, and received by them not less than five days before the date of test.

D. Gravity flow system test.

1. When the groundwater is more than 1 ft. above the crown of the pipe at the upper end of the section to be tested, an infiltration test shall be made. The upper end of the section to be tested shall be plugged and V-notch weir of appropriate size shall be fitted into the lower end. There shall be no leakage around the weir place. Commercially manufactured weirs, made and calibrated for the purpose, may be employed.

2. When groundwater is less than 1 ft. above the crown of the pipe at the upper end of the section to be tested, an infiltration test shall be made. The sewer shall be plugged at the inlet pipes of both the upper and lower manholes. The line shall then be filled with water to a level 2 ft. above the crown of the pipe in the upper manhole. Before any measurements are made, a period of about 2 hours shall be permitted to allow for absorption and escape of trapped air. Following this, a test period of at least 4 hours shall begin. At the end of the test period, loss of water shall be measured and leakage computed therefrom.

3. Air testing shall be performed in accordance with the procedures described in ASTM C 828, except as otherwise noted. For low-pressure air tests, use equipment specifically designed and manufactured to test sewer pipelines with low-pressure air. The equipment shall be provided with an air regulator valve or air safety valve so set that the internal air pressure in the pipeline cannot exceed 8 psig.

   a. The leakage test using low-pressure air shall be made on each manhole-to-manhole section of pipeline after placement of the backfill.

   b. Pneumatic plugs shall have a sealing length equal to or greater than the diameter of the pipe to be tested. Pneumatic plugs shall resist internal test pressures without requiring external bracing or blocking.

   c. All air used for testing shall pass through a single control panel.

   d. Low-pressure air shall be introduced into the sealed line until the internal air pressure reaches a value 4 psig greater than the maximum pressure exerted by groundwater that may be above the invert of the pipe at the time of test. However, the internal air pressure in the sealed line shall not be allowed to exceed 8 psig. When the maximum pressure exerted by the groundwater is greater than 4 psig, conduct infiltration test.

e. At least two minutes shall be allowed for the air pressure to stabilize in the section under test. After the stabilization period, the low-pressure air supply hose shall be quickly disconnected from the control panel. The time required in minutes for the pressure in the section under test to decrease from 3.5 to 2.5 psig (greater than the maximum pressure exerted by groundwater that may be above the invert of the pipe) shall not be less than that shown in the following table:

Pipe Diameter in Inches	Minutes
4	2.0
6	3.0
8	4.0

f. When the sewer section to be tested contains more than one size of pipe, the minimum allowable time shall be based on the largest diameter pipe in the section, and shall be the time shown in the table reduced by 0.5 minutes.

4. Rate of infiltration and infiltration shall not exceed 100 gal./in. of pipe diameter per mile of pipe per 24 hours. Each section of pipe tested shall meet the above criterion.

E. Manhole testing.

1. Leakage testing of sewer manholes shall be included in the testing of the gravity sewer system. Leakage for each manhole shall not exceed 1 gal./vertical ft. of manhole per 24 hours.

2. After assembly and before backfilling, perform vacuum test of manholes. Plug lift holes and pipes. Place test head at inside of top of cone section and inflate seal as recommended by manufacturer. Draw vacuum of 10 inch. of mercury and shut off vacuum pump. With valves closed, measure time elapsed before vacuum drops to 9 in. Time shall exceed 60 seconds for 48 in. diameter. Retest as directed by Engineer.

F. Force main system test.

1. Pressure pipe shall be given combined pressure and leakage tests in sections of acceptable length.

2. Furnish and install suitable temporary testing plugs or caps; all necessary pressure pumps, pipe connections, meters, gages, and other necessary equipment; and all labor required.

3. Unless it has already been done, the section of pipe to be tested shall be filled with water of approved quality, and all air shall be expelled from the pipe. If blowoffs are not available at high points for releasing air, make the necessary excavations and do the necessary backfilling and shall make the necessary taps at such points, and shall plug said holes after completion of the test.

4. If water for test purposes is obtained from water mains, extreme care shall be taken to prevent excess pressure from occurring in the force main. A pressure-reducing valve shall be used in connection with a tested pressure gage on each side of the pressure-reducing valve. These gages shall be carefully watched at all times, and the pressures on them shall be read and recorded every 2 minutes when the municipality's water pressure is in the connection between the water main and the force main.

5. The section under test shall be maintained full of water for a period of 24 hours prior to the combined pressure and leakage test being applied.

6. The meter and gage shall be installed and kept in use during the test in such a manner that all water entering the force main under test will be measured and the pressure in the force main indicated.

7. The pressure test shall consist of first raising the water pressure (based on the elevation of the lowest point of the section under test and corrected to the gage location) to a pressure of 125 lb. per sq. in. If the Contractor cannot achieve the specified pressure and maintain it for a period of one hour with no additional pumping, the section shall be considered as having failed to pass the test.

8. Following a successful pressure test, or concurrently therewith, make leakage test by metering the flow of water into the pipe while maintaining in the force main a pressure equal to the specified test pressure. If the average leakage during the 4 hour period exceeds a rate of 20 gallons per 24 hours per inch of inside diameter per mile of pipeline, the section shall be considered as having failed the leakage test.

9. If the section shall fail to pass the pressure test, the leakage test, or both, locate, uncover, and repair or replace defective pipes, fittings or joints, all at his own expense, and without extension of the time for completion of the work. Additional tests and repairs shall be made until the section passes the specified tests.

10. All joints within chambers shall have no visible leakage. Joints from which water continues to run or squirt in an active manner will not be accepted.

11. Upon successful completion of the tests, plugs or caps installed for the testing shall be removed.

12. If, in the judgment of the Engineer, it is impracticable to follow the foregoing procedure exactly for any reason, modifications in the procedure shall be made as required and accepted, but in any event the Contractor shall be responsible for the ultimate tightness of the line within the above leakage and pressure requirements.

G. Before submitting system for final approval of the authorities having jurisdiction, submit a written statement to Engineer that work has been completed in accordance with the Contract Documents.

H. Promptly following satisfactory completion of leakage testing, a report fully describing test procedures and listing test results shall be submitted to the Engineer and to governmental agencies that have jurisdiction. The report shall be signed by the Contractor's superintendent.

I. Pipe deflection testing for PVC piping.

1. Thirty days following completion of the backfill over the PVC pipe installation, the pipeline shall be tested for deflection using a "go/no-go" deflection mandrel. The "go/no-go" gage shall be passed through all sections of the pipeline.

2. Pipe deflections shall be measured and converted to percent deflection. Deflections shall be recorded, with a copy of results submitted to Engineer. Test results shall be mailed or delivered to Engineer not later than the day following the day on which test was made.

3. Section of pipe with deflection greater than 7.5% shall be replaced.

The Contractor shall furnish all labor, equipment, water, plugs, pumps and other equipment necessary for the proper performance of these tests.

There shall be no direct payment for any costs involved in performing these tests and in fully meeting the requirements of this specification.