

APPENDIX C

STANDARD UTILITY CONSTRUCTION SPECIFICATIONS*

* **Editors Note:** Printed herein are the Standard Utility Construction Specifications, as adopted by ordinance number 92-18 on August 27, 1992. Amendments to the ordinance are indicated by parenthetical history notes following amended provisions. The absence of a history note indicates that the provision remains unchanged from the original ordinance. Obvious misspellings and punctuation errors have been corrected without notation. For stylistic purposes, headings and catchlines have been made uniform and the same system of capitalization, citation to state statutes, and expression of numbers in text as appears in the Code of Ordinances has been used. Additions made for clarity are indicated by brackets.

Cross References: Utilities generally, ch. 94.

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PREFACE

The specifications set forth herein provide minimum standards for the construction of water and sewage transmission and collection facilities which meet conditions which follow:

1. Facilities to be constructed within the City of Eustis rights-of-way.
2. Facilities to be turned over to the City of Eustis for operation.
3. Facilities to become a permanent part of City of Eustis utilities system.

These specifications describe the minimum acceptable standards of construction and to promote uniformity where practical. It is felt that adherence to the standards presented in this booklet will benefit both the citizens of Eustis and the operators of the facilities.

Water and sewer improvements shall be in general accordance with the city's adopted planning documents including (A) Master Water Plan, 1984 and Update of 1988, (B) Northerly and Southerly Sewage Collection System Studies of 1987 and 1988, and (C) the city's adopted planning documents and growth management comprehensive plan.

Should any design be submitted which varies appreciably from the standards set herein or uses materials other than those recommended, it should be accompanied by appropriate supporting documentation or engineering studies.

All plans submitted for review must be in conformance with all federal, state, county, and city regulations and codes. Minimum standards will not be less than those established by recognized private and governmental agencies, unless stated otherwise in these specifications.

Construction specifications for transportation and stormwater management are listed in appendix A and B, respectively.

SECTION 1.

BASIC INFORMATION

Sec. 1.1. Authority.

1.11. *Approval.* These design standards are accepted and approved by the city commission.

1.12. *Scope and intent.* The intent of these development procedures is to establish minimum engineering requirements for projects submitted to the city. The development procedures will apply to all development and construction projects, both public and private, within the jurisdiction of the City of Eustis.

1.13. *Variances.* Under extreme conditions with specific applications, the following procedures and policies may be altered to meet certain conditions which are beyond the control of the developer provided that such deviations or alterations are acceptable to the city. Final decisions concerning such alterations shall be made by the city manager or his designee.

1.14. *Changes to these standards.* Changes to these standards may be made by resolution adopted by the city commission.

Sec. 1.2. General.

The developer and his engineer shall bear all construction, testing, and inspection costs of the project.

1.21. *Predesign conference.* It is strongly recommended that a predesign conference between the owner, his engineer and the city be held.

1.22. *Plans.*

A) *Submission.*

- 1) All construction plans submitted to the city for review and approval shall bear the seal and signature of the Florida registered professional engineer responsible for the project. The address and telephone number of this person shall be shown along with the signature.
- 2) Ten sets of plans and specifications shall be submitted for approval to the city.

B) *Assembly.*

- 1) *Sheet size.* The standard size sheet for construction plans submitted to the city for approval shall be 24 inches by 36 inches. Worksheets and data sheets used in preliminary design work and reviews are not limited to any size, except that which is convenient to handle.
- 2) *Items of construction required.* The developer shall provide as appropriate water and sanitary sewers, and all other necessary improvements in accordance with city specifications, standards and policies.

C) *Utility coordination.* It shall be up to the developer to coordinate all utilities within his development.

D) *City standards and specifications.* Copies of city standards and specifications may be obtained from the city for the cost of reproduction.

1.23. *Permits.* The developer and his engineer are responsible for obtaining and submitting the required design and construction permits to the city and certifying the placement of the utilities into service from the Florida Department of Environmental Protection.

1.24. *Construction.*

A) *Start.*

- 1) *Notification.* The city shall be notified in writing of the proposed date of the beginning of construction of the water and sanitary sewer facilities. Any time that work is to stop for a period of time in excess of two working days, the city shall be notified of such interruption.
- 2) *Preconstruction conference.* A preconstruction conference shall be held at least two days before the commencement of construction. A 100 percent payment and performance bond shall also be provided. The developer shall be responsible for arranging this conference with the city.

B) *Completion.*

- 1) *As-built drawings.* Within two weeks following final inspection, the developer shall submit one mylar set and ten white-background prints of as-built drawings to the city. These drawings shall be signed by a registered engineer attesting that the accuracy of the facilities shown on the drawings are, in fact, correct.
- 2) *Certificates of compliance.* Certificates of compliance with the specifications furnished by the material supplier shall be submitted on all materials used in the completion of this work.

- C) *Off-site pollution protection.* It will be the developer's responsibility to provide downstream siltation protection during construction. In the event such protection is inadequate, it will be the developer's responsibility to remove any downstream siltation prior to the time of final inspection.

1.25. *Inspection.*

- A) *Periodic.* The city will periodically visit the project site to make a visual inspection of the progress of the work and methods of construction.

Upon observation of work not done in accordance with the plans and specifications, the city will notify the developer's contractor and request that necessary corrections be made or tests performed to assure compliance with the specifications, at no cost to the city.

- B) *Final.* The city shall be notified in writing when the project is complete. Upon receiving a written request for final inspection of the completed work, the representatives of the city, together with the representatives of other interested agencies, shall perform the final inspection within two weeks of the receipt of the request.

1.26. *Maintenance.* All items or systems must be designed in such a manner to minimize future maintenance. A two-year maintenance bond (20 percent) of approved construction cost shall be furnished to the

city at the time of final acceptance along with all warranties and manufacturers' manuals for all items to be maintained by the city. All disturbed earthen areas shall be grassed and mulched or sodded prior to acceptance. The city shall be provided five-year warranties on all pumps, motors, electrical panels, etc., by the contractor prior to final acceptance by the city.

1.27. *Transfer of private ownership.* When transfer of private facilities to public ownership takes place, all such private facilities shall be brought up to the current city standards at no cost to the city insofar as construction and maintenance are concerned, before the city will accept such facilities. The city is to be furnished copies of all approvals, permits, certificates of completion, etc., to or from completion, etc., to or from other agencies such as Lake County, Florida Department of Environmental Protection, St. Johns River Water Management District, Florida Department of Transportation, railroads, etc., before proceeding with construction. Proof of satisfactory completion of water and sewer facilities, positive water bacteriological tests, and submission of quick claim [quit claim] deeds, bills of sale, prior and current permits, warranties, manufacturers' manuals, and a 20 percent two-year maintenance bond shall be furnished to the city prior to acceptance.

1.28. *Property ownership.* All facilities to be owned or maintained by the city shall be located on city property, within city right-of-way or on easements dedicated to the city for the uses intended.

1.29. *Time period of approved plans.* Plans shall be valid for construction for a period of one year from the date of city approval only. All items not under construction within one year of the approval date shall require a new approval prior to the commencement of construction.

SECTION 2.

UTILITY EXCAVATION, TRENCHING, AND BACKFILLING

Sec. 2.1. General.

The provisions set forth in this section shall be applicable to all underground sewer and water piping installations, regardless of location, unless prior approval is received from the city for special design consideration.

Sec. 2.2. Materials.

2.21. Sheet piling and bracing.

- A) Wood sheet piling to be left in place shall be pressure treated.
- B) Steel sheet piling to be left in place shall be as specified in ASTM Designation A328.

Sec. 2.3. Workmanship.

2.31. *Trench dimensions.* The minimum width of the trench shall be equal to the outside diameter of the pipe at the joint plus eight inches for unsheeted trench, or 12 inches for sheeted trench; and the maximum width of trench, measured at the top of the pipe, shall not exceed the outside pipe diameter plus two feet, unless

otherwise shown on the drawing details, or approved by the city.

2.32. *Utility bedding.*

- A) *Class B (minimum utility bedding).* The bottom of the trench shall be shaped to provide a firm bedding for the pipe. The pipe shall be firmly bedded in undisturbed soil, or hand shaped so that the pipe will be in continuous contact therewith for its full length.
- B) *Class A (special utility bedding).* Should special bedding be required due to depth of cover, impact loadings, or other conditions, class A bedding methods shall receive prior approval by the city.

2.33. *Unsuitable material below trench grade.* Soil unsuitable for a proper foundation encountered at or below trench grade, such as muck or other deleterious material, shall be removed for the full width of the trench and to the depth required to reach suitable foundation material, unless special design considerations received prior approval from the city. Backfilling below trench grade shall be in compliance with the applicable provisions of section 2.41, "Backfill."

2.34. *Extra utility-bedding material.* When rock or other noncushioning material is encountered at trench grade, excavation shall be extended to six inches below the outside of the bottom of the utility, and a cushion of sand or suitable crushed rock shall be provided.

2.35. *Sheeting and bracing.* In order to prevent damage to property, injury to persons, erosion, cave-ins, or excessive trench widths, adequate sheeting and bracing shall be provided in accordance with standard practice and in accordance with all safety, protection of property, and other applicable laws and regulations.

2.36. *Excavated material.* Excavated material to be used for backfill shall be neatly deposited at the sides of the trenches where space is available. Where stockpiling of excavated material is required, the contractor shall be responsible for obtaining the sites to be used.

2.37. *Material disposal.* Excess, unsuitable, or cleared or grubbed material resulting from the utility installation, shall be removed from the work site and disposed of at locations secured by the contractor. Excess excavated material shall be spread on the disposal site and graded in a manner to drain properly and not disturb existing drainage conditions.

2.38. *Borrow.* Should there be insufficient satisfactory material from the excavations to meet the requirements for fill material, borrow shall be obtained from pits secured by the contractor.

2.39. *Dewatering.* Utilities shall be laid "in the dry" unless otherwise approved. Dewatering systems shall be utilized in accordance with good standard practice and must be efficient enough to lower the water level in advance of the excavation and maintain it continuously to keep the trench bottom and sides firm and dry.

2.40. *Obstructions.* It shall be the contractor's responsibility to acquaint himself with all existing conditions and to locate all structures and utilities along the proposed utility alignment in order to avoid conflicts. Where actual conflicts are unavoidable, work shall be coordinated with the facility owner and performed so as to cause as little interference as possible with the service rendered by the facility disturbed.

2.41. *Backfill.*

- A) Backfill material shall be clean earth fill composed of sand, clay and sand, sand and rock, crushed rock or an approved combination thereof.
- B) When trenches are cut in pavements or areas to be paved, compaction as determined by AASHTO Specification T-180, shall be, for each six-inch backfill lift, equal to 98 percent of maximum density, with compaction in other areas, with prior city or coordinating agency approval, not less than 90 percent of maximum density. Density tests shall be provided for trenches within pavement or across roads.

Backfilling of pipe trench or under and around structures shall be, for each 12-inch backfill lift, compacted to 95 percent of maximum density as determined by AASHTO T-180.

One compaction test shall be carried out for each 300 linear feet of pipe and for every 100 square feet of backfill under and around structures and pavement as a minimum.

- C) If, in the opinion of the city, densities are questionable, density tests for determination of the above specified (section 2.41) compaction shall be made by a testing laboratory approved by the city at the expense of the contractor. Test locations will be determined by the city.
- D) If any test results are unsatisfactory, the contractor shall reexcavate and recompact the backfill at his expense until the desired compaction is obtained.
- E) Protective concrete slabs shall be installed over the top of trenches, where required, to protect the installed pipe against excessive loads across roadways and river/swamp areas.
- F) Existing sidewalks and driveways removed, disturbed, or destroyed by construction, shall be replaced or repaired by the contractor at his expense.
- G) All water and sewer lines must have a metallic tape trace placed above them, no deeper than eight inches from the finished grade.
- H) All water mains and sewer force mains must have a #16 copper wire strapped to the piping and pulled up into all valve boxes and all meter boxes.

2.42. *Roadway and pavement restoration.*

- A) Pavement or roadway surfaces cut or damaged shall be replaced by the contractor in equal or better condition than the original, including stabilization, base course, surface course, curb and gutter, or other appurtenances. The contractor shall obtain the necessary permits and all applicable authorizations from the proper agencies prior to any roadway work. Additionally, the contractor shall provide advance notice to the appropriate authority, as required, prior to construction operations.

- B) Restoration shall be in accordance with requirements set forth by the city. The materials of construction and method of installation, along with the proposed restoration design for items not referred to or specified herein, shall receive prior approval from the city.
- C) Where existing pavement is removed, the surfacing shall be mechanical saw cut prior to trench excavation, leaving a uniform and straight edge, with minimum disturbance to the remaining adjacent surfacing. The width of cut for this phase of existing pavement removal shall be minimal.
- D) Immediately following the specified backfilling and compaction, a temporary sand seal coat surface shall be applied to the cut areas. This temporary surfacing shall provide a smooth traffic surface with the existing roadway and shall be maintained until final restoration.
- E) Density tests shall be provided for trenches in pavement across roadways as specified in section 2.41.

2.43. *Protection and restoration of property.* During the course of construction, the contractor shall take special care and provide adequate protection in order to minimize damage to vegetation, surfaced areas, and structures within the construction right-of-way, easement or site, and take full responsibility for repair thereof.

2.44. *Cleanup.* Work site cleanup and property restoration shall follow behind construction operations without delay.

SECTION 3.

BORING AND JACKING

Sec. 3.1. General.

A) The provisions of the section shall be the minimum standards for the installation of casing pipe by the boring and jacking method for placement of sewer and water pipelines.

B) In general, all underground pipelines crossing existing major city roadways, Florida state highways, and railroads shall be installed under these trafficways within bored and jacked steel casing pipe. Specific crossing requirements shall be obtained in advance from authority having jurisdiction.

C) It shall be the responsibility of the contractor to submit the necessary permit documents and data to the appropriate authority and receive approval thereof.

Sec. 3.2. Materials and installation.

3.21. *Dimensions and materials.* Casing pipes crossing under city roadways shall be located at suitable approved alignments in order to eliminate possible conflict with existing or future utilities and structures, with a minimum 36 inches depth of cover between the top of the casing pipe and surface of the roadway where practicable. Casings shall be new prime steel pipe conforming to the requirements of ASTM Designation A-139, grade B. The minimum casing pipe size and wall thickness shall be as shown in the following table for

the sewer and water carrier pipe size indicated.

Carrier Pipe (Nominal Size- Inches)	Casing Pipe (Outside Diameter- Inches)	Casing Pipe (Wall Thickness- Inches)
4	12	0.250
6	14	0.250
8	16	0.250
10	18	0.250
12	20	0.250
14	22	0.250
16	24	0.250
18	28	0.375
20	30	0.375
24	34	0.375

3.22. *Areas not under jurisdiction.* For casing pipe crossings under roadways, railroads, or other installations not within the jurisdiction of the city, the contractor shall comply with the regulations of said authority in regard to design, specifications and construction. However, in no case shall the minimum casing pipe diameter and wall thickness, for a specific carrier pipe size, be less than that specified under paragraph 3.21 preceding.

3.23. *Workmanship.*

- A) The boring and jacking operations shall be done simultaneously with continuous installation, until the casing pipe is in final position. Correct line and grade shall be carefully maintained. Add-on sections of casing pipe shall be full-ring butt welded to the preceding length, developing watertight total pipe strength joints. The casing installation shall produce no upheaval, settlement, cracking, movement or distortion of the existing roadbed or other facilities. Following placement of the carrier pipe within the steel casing, masonry or bituminous plugs are to be installed at each open end.
- B) Casing pipe holes shall be mechanically bored through the soil by a cutting head on a continuous auger mounted inside the pipe. The auger shall extend a minimum distance beyond the end of the pipe casing to preclude formation of voids outside of the pipe shell.
- C) The casing pipe shall be adequately protected to prevent crushing or other damage under jacking pressure.
- D) Required boring and jacking pits or shafts shall be excavated and maintained to the minimum dimension. Said excavations shall be adequately barricaded, sheeted, braced and dewatered as required.

The distance between the edges of the jacking pit and the pavement is six feet minimum.

- E) The carrier pipe shall be minimum class 50 ductile iron pipe with restrained joints. The carrier pipes shall be supported by wooden skids within the casing pipe.

SECTION 4.

PIPE, FITTINGS, VALVES AND APPURTENANCES

Sec. 4.1. General.

- A) This section includes the material and installation standards for pipe, fittings, valves, and appurtenances, as applicable to sewerage and water installations.
- B) Required specialty items not included under this section shall be high quality and consistent with approved standards of the industry for the applicable service installation.
- C) All material to be furnished by contractor or developer, with exception of meters and meter couplings.

Sec. 4.2. Pipe and fittings.

4.21. *General.* All pipe and fittings shall be clearly marked with the name or trademark of the manufacturer. All pipe and fittings shall be suitable for 200 psi working pressure. All pipe installations shall have indicator tape run with pipe to indicate the purpose of piping (water, sewer, force main).

4.22. *Ductile iron pipe.*

- A) Ductile iron pipe shall be in accordance with ANSI Standard A21.51. Pipe shall be laid in accordance with ANSI Standard A21.50. Thickness class shall be governed by design conditions; minimum thickness class shall be 50 mils.
- B) Cast and ductile iron pipe fittings shall conform to ANSI Standard A21.10.
- C) Joints:
 - 1) "Push-On" and mechanical type joints shall be in accordance with ANSI Standard A21.11.
 - 2) Restrained joint assemblies with mechanical joint pipe shall be mechanical joint retainer glands "locked-type" joints of Megalug or approved equal.
 - 3) Flanged connections shall be in accordance with ANSI Standard B16.1, 125-pound standard.
 - 4) No leaded joints or connection of any kind will be permitted.
 - 5) PVC fittings prohibited above three inches in diameter, unless otherwise specifically approved by the city.
- D) Coatings and linings:

- 1) Ductile iron pipe and fittings for force mains or when used as gravity sewer service shall receive an interior epoxy lining of 40 mils nominal, 35 mils minimum for both pipe and fittings.
- 2) Ductile iron pipe and fittings for water service shall receive an exterior bituminous coating as specified above under Paragraph 1 and shall be cement mortar lined in accordance with ANSI Standard A21.4.

4.23. *Polyvinyl Chloride (PVC).*

- A) Pipe shall be manufactured from clean virgin type I, grade I, rigid, unplasticized polyvinyl chloride resin conforming to ASTM Designation D1784 and AWWA Standard C900. Pipe material shall conform to ASTM Designation D1785. The pipe shall bear the National Sanitation Foundation (NSF) seal for potable water pipe. Pipe shall have a minimum standard dimension ratio (SDR) of 18, 150 psi for water and SDR 25, 100 psi for sewer force mains. A minimum SDR of 35 (ASTM 3034) for gravity sewer mains will be required.
- B) Connections for pipe two inches in diameter and larger shall be rubber compression ring type. Pipe shall be extruded with integral thickened wall bells without increase in SDR. Rubber ring gaskets shall consist of synthetic compounds meeting the requirements of ASTM Designation D1869, and suitable for the designated service. Other connections for pipe shall be solvent welded sleeve type joint. Fittings for two-inch and smaller pipe shall be PVC solvent welded joints. Fittings for use with PVC pipe (water lines or sewage force mains) will be cast iron or ductile iron with mechanical joint rubber compression ring type joints. For all pipe three inches and larger, no PVC fitting will be allowed except on pipe and fittings smaller than three inches.
- C) All nonmetallic piping (PVC, polyethylene tubing) shall have a #16 copper armored polyguard wire that strap and run with the pipe.

4.24. *Polyethylene plastic pipe.* Pipe or tubing shall comply with AWWA C800 and AWWA C901 and be approved for potable water service by the National Sanitation Foundation and bear the NSF seal. The product shall be rated for a minimum working pressure of 200 psi. Fittings shall be brass, equipped with compression type connections.

4.25. *Copper pipe and tubing.* Pipe or tubing shall meet AWWA C800. Fittings shall be brass, with approved compression connections.

4.26. *Special items.*

- A) Tapping saddles shall be of two types:
 - 1) Stainless steel full circle sleeve as manufactured by Ro-Mac type SST, assuring a full circumferential seal, or approved equal.
 - 2) Mechanical joint type with outlet, flange ANSI B16.1, 125 lb. standard, Mueller #615 or #715, assuring a full circumferential seal, or approved equal.

- B) Service saddles shall be as manufactured by Smith & Blair, Inc., or approved equal. Units for ductile iron, PVC, or cement pipe shall be double strap. Sealing gasket shall be BUNA-N rubber and straps shall be corrosion resistant stainless steel or equivalent alloy steel.

Sec. 4.3. Valves.

4.31. *General.* The valve type, size, rating, flow direction arrow, if applicable, and manufacturer shall be clearly marked on each unit. Valves shall open left (counterclockwise) with an arrow cast in the metal of operation handwheels and nuts indicating the direction of opening.

- A) *Valves for underground service.* Valves from two inches thru 12 inches for underground service shall be iron body gate valves, nonrising stem type and shall be equipped with a two-inch square cast iron operating nut with corrosion protection coating inside and out, resilient seated valve which meets all C509 requirements of AWWA (water and sewer), Mueller A2370-20, American-Flow Control CRS-80, or approved equal. Valves 12 inches and larger for underground service, shall be iron body gate valves, bronze mounted, conforming to AWWA C500, solid wedge double disc (water or sewer) non-rising stem type, and shall be equipped with two-inch square cast iron operating nut, Mueller #2380-20, American-Flow Control Model #55, or approved equal. All dead-end lines will have valves at end the size of main line pipe with blow off attached. End line valves shall be adequately restrained to the pipeline such that they may be excavated and the line extended without shutting off line pressure.
- B) *Valves for aboveground service for fire systems only.* Valves shall be iron body, bronze mounted gate valves, conforming to AWWA C500, solid wedge (sewage) or double disc (water) with the exception that valves shall be outside screw and yoke (OS & Y) rising stem type. Valves shall have cast iron hand wheels or chain operators with galvanized steel chains, as required. Valves for fire suppression system shall be approved by city fire officials and a detector valve may be required.
- C) *Valves smaller than two inches.* Valves smaller than two inches shall be bronze body gate valve conforming to federal specifications 150 psi minimum working pressure with threaded joints equal to American 3 FG or Red and White 280. The use of this type of valve would have to be approved by the city.

4.32. *Backflow devices.*

- A) Double check valve assembly shall be designed to specification of the USC Cross Connection Control Laboratory, AWWA C506 and A.S.S.E. #1015.

Double check valves shall be Hersey Model FDC for three-fourths-inch through two-inch and Model #2 for 2 1/2-inch thru ten-inch, Watts #709 series three-fourths-inch thru ten-inch, or approved equal. Double check valve assembly from 2 1/2 inch and up shall be furnished with OS & Y gate valve shutoffs.

- B) Reduced pressure zone valve shall be designed to specification of the USC Cross Connection

Control Laboratory, AWWA C506 and A.S.S.E. #1013. Reduced pressure zone valve shall be Hersey Model FRP-II for sizes three-fourths-inch through two-inch and Model #6CM for sizes 2 1/2-inch through ten-inch, Watts Series 909 for sizes three-fourths-inch through ten-inch, or approved equal. Reduced pressure zone valve assembly from 2 1/2 inches and up shall be furnished with OS & Y gate valve shutoffs.

- C) Pressure vacuum breaker shall be designed to specification of USC Cross Connection Control Laboratory, A.S.S.E. #1020. Spring loaded single float and disc with independent water inlet and air inlet valves, furnished with shutoff valves and ball type test cocks. Pressure vacuum breaker shall be Watts #800, Febco #765, or approved equal.
- D) Shutoff valves on backflow assembly for sizes three-fourths inch through two inches shall be provided with ball valves, assemblies above two inches shall be provided with resilient seat full flow gate valves.

4.33. *Check valves.* Valves for wastewater application shall be iron body, bronze mounted stainless steel hinge pin, outside lever and spring operated, swing type, and equipped with removable inspection covers. Units shall be rated for 150 psi minimum working pressure and shall permit full flow area equal to that of the connecting pipe; Mueller #2600-6-02, or approved equal.

4.34. *Plug valves (PV).* Valves for wastewater application shall be semisteel body, nonlubricated, eccentric type, with resilient faced plugs, and capable of driptight shutoff at the rated pressure if applied at either port. Operation of all valves eight inches or larger, and smaller sizes in exposed locations which require handwheels or chainwheels, shall be by approved gear actuators, equipped with position indicator and stop, and shall be furnished by the valve manufacturer. Gear actuators for buried or submerged installations shall be furnished with sealed enclosures. Valves shall be equipped with actuating nuts, cast iron handwheels or chain operators, with galvanized steel chains, as appropriate for the installation and type of operator. Valves and appurtenances shall be Series 100, as manufactured by DeZurik Corp., or approved equal.

4.35. *Butterfly valves.* Valves shall be cast iron body, self-lubricated, rubber seated, one-piece stainless steel shaft, and capable of drip-tight shut-off at the rated pressure and meet AWWA C504. Valve operators shall conform to AWWA C504. Valve operator for buried or submerged installations shall be furnished with sealed enclosures. Valves shall be equipped with actuating nuts, cast iron handwheels or chain operator as appropriate for the installation and type of operator. Valves shall be installed in a vertical position. Valves and appurtenances shall be DeZurik, Series 130, American-Darling 150, or approved equal.

4.36. *Valve boxes.* Units shall be adjustable, cast iron, minimum interior diameter of five inches, with covers cast with the applicable inscription in legible lettering on the top; "SEWER" or "WATER". Boxes shall be suitable for the applicable surface loading and valve size. Valve boxes not in the pavement shall have the top concrete pads flush with the finish grade, with minimum dimensions of 24 inches by 24 inches by six inches.

4.37. *Meter boxes.* Boxes shall be of concrete construction as manufactured by Brooks, Model 37, or approved equal.

4.38. *Fire hydrants.* Fire hydrants shall be of Mueller Super Centurian 200 oil reservoir, American-Flow Control six-inch B-84-B, Kennedy Guardian #K-81A or approved equal. See section 8.32 for details.

4.39. *Service line.* Service lines shall be one inch for single and 1 1/2 inches with one inch branch off for double service. All fittings shall be Mueller or Ford brass. Curb stops to be Mueller #15317 or Ford #FB41-344W. Corporation stops to be Mueller #H-15008 or Ford #F 1000.

Sec. 4.4. Installation.

4.41. General requirements.

- A) Piping, fittings, valves and appurtenances shall be installed in accordance with these standards.
- B) Piping shall be installed along straight line and grade between fittings, manholes, or other defined points, unless definite lines of alignment, deflection or grade change have been established. Modification to approved alignment or grade during construction shall receive prior approval from the city and all resulting design considerations shall be resolved by the contractor.
- C) Materials shall be cleaned and maintained clean, with all coatings protected from damage. The interior of the pipe shall be free of dirt and debris, and when work is not in progress, all open ends shall be plugged.
- D) Pipe, valves, fittings, or other items shall be inspected prior to installation, and any items showing a fracture or other defect shall be rejected. However, a cast or ductile iron pipe showing an end crack, with no fracture indicated beyond that visible, may be salvaged by cutting off the damaged section 12 inches past, providing the remaining pipe is sound.
- E) Underground piping shall not be driven to grade by striking it with an unyielding object. When the pipe has been properly bedded, enough compacted backfill shall be placed to hold the pipe in correct alignment. If necessary, precaution should be taken to prevent flotation.
- F) Jointing shall be by an approved method and shall not require undue force to accomplish full satisfactory seating and assembly. Connections at structures shall be cut accurately and worked into place without forcing and shall align with the connecting point.
- G) Underground pressure piping systems shall be thoroughly braced with concrete thrust blocks at fittings, valves and plugs. Fittings shall not be encased in concrete or thrust blocks covered prior to inspection. If the soil does not provide firm support, then suitable tie rods and clamps, or restrained joint assemblies to support the fitting properly shall be provided. When tie-rods and/or clamps are used, they shall receive two heavy coats of bituminous paint to minimize corrosion.
- H) Subaqueous pipe laying may be permitted where conditions make it impractical to lay pipe in the "dry", provided the contractor submits his plans for laying pipe under water to the city and obtains advance approval thereof.
- I) Ductile iron pipe is required at all street crossings, ditch, stream or swamp crossings, culvert crossings or with bore and jack crossings.

- J) Disinfecting of all potable water pipes shall be accomplished by the contractor following approved pressure testing. Unless alternate procedures are set forth under the applicable service Standard, said disinfecting procedures shall be in accordance with AWWA Standard C601.
- K) Cast and ductile iron pipe (CI & DI) installation shall be performed in accordance with the applicable provisions of AWWA Standard C600.
- L) Polyvinyl chloride (PVC) pipe-lubrication and/or solvent for pipe and fitting joints shall be nontoxic (NSF approved for potable water). Following making, solvent type joints shall not be disturbed for five minutes and shall not have internal pressure applied for 24 hours, or as recommended by the pipe manufacturer.

SECTION 5.

SANITARY GRAVITY SEWERS

Sec. 5.1. General.

This section includes general technical criteria for the construction and installation of sanitary gravity sewer systems.

Sec. 5.2. Design standards.

The developer shall comply with the applicable requirements specified within WPCF Manual of Practice No. 9, and chapter 20 of the Ten-State Standards-Recommended Standards for Sewage Works and as established by the Florida Department of Environmental Protection, and subsection 5.3 of this section.

Sec. 5.3. Standard requirements.

5.31. *General.* The materials of construction and general installation procedures shall comply with the specific applicable standards set forth under section 2, "Utility Excavation, Trenching and Backfilling"; section 3, "Boring and Jacking"; and section 4, "Pipe Fittings, Valves and Appurtenances."

5.32. Manholes.

- A) Manholes shall be precast concrete. The minimum inside diameter of manholes shall be 48 inches for sewer sized to 21 inches in diameter or less, with submittal of special designs for larger pipes. Manholes are to be placed at the ends of jack and borings section for gravity sewer lines.
- B) Precast reinforced manholes shall be in accordance with ASTM Designation C478, with preformed flexible plastic joint sealer conforming to Federal Specification SS-S-0210 (GSA-FSS), "Ram-Nek", as manufactured by the K.T. Snyder Co., Inc., Houston, Texas, or approved equal.
- C) Manholes are generally to be located in dedicated right-of-way or utility easement.

- D) Manhole frames and covers shall be gray cast iron conforming to ASSTM Designation A48, class 30, and shall have a minimum 24-inch opening. Covers shall have no perforations and shall be marked with the word "Sewer." Frames and covers shall be fully bedded in mortar to the correct finish grade elevation, with adjustment brick courses placed below, as detailed for precast manholes. There will be no steps allowed in manholes.
- E) Manhole flow channels shall have smooth and carefully shaped bottoms, built up sides and benching constructed from concrete. Channels shall conform to the dimensions of the adjacent pipe and provide changes in size, grade and alignment evenly.
- F) The interior surfaces of all manholes shall be protected by the application of two coats of Koppers Bitumastic No. 300M, or approved equal. Exterior surfaces shall receive two coats of Koppers Bitumastic Black Solution, or approved equal.
- G) Sewer cleanouts not in the pavement shall have around their tops concrete pads, which will be flush with the top of the curb, with minimum dimensions of 18 to 18 by three inches.
- H) Manholes shall not be located in drainage swales or any other low area likely to collect or pond water during rains.

5.33. *Pipe depth and protection.* The minimum allowable cover for gravity sewers shall be three feet from the top of the pipe to finish grade.

5.34. *Pipe bedding.* Special care shall be exercised in the design and installation to provide adequate bedding for the type of pipe used, taking into consideration trench width and depth, superimposed loadings above grade and the material below trench grade. Pipe loadings capabilities shall be computed in accordance with established design criteria and special supporting bedding or facilities shall be provided as required.

5.35. *Connections at structures.* Where sanitary sewers connect to structures, pipe joint bell shall not be installed at the wall face. Core bore into the existing manholes and use Kor-N-Seal flexible connectors or approved equal with stainless steel straps on all pipe to manhole connectors.

5.36. *Transition connections.* Where pipes of alternate materials are to be connected between manholes, suitable approved transition couplings shall be installed.

5.37. *Pipe cutting.* The cutting of pipe shall be performed by the proper tools and methods.

- A) *Service connections.* Installation shall be performed by the proper methods, including the wye branches installed in the sewer main at the point of connection, and the service pipe and required fittings extended to the property line, perpendicular to said line, terminating with stoppered ends or fittings. The minimum service pipe size shall be six inches in diameter and may provide for single or double connections. On curbed streets, the exact location for each installed service shall be marked by etching or cutting as "S" in the concrete curb and painted red. Where no curb exists or is planned, locations shall be adequately marked by a method approved by the city.

- B) *Protection of water systems.* The horizontal separation between sanitary sewers and existing or proposed water mains shall not be less than ten feet. Special considerations will be given where this is not possible. Unless sewer pipes cross below water mains with a vertical separation of 18 inches between the bottom of the water pipe and the top of the sewer, special protection shall be provided.

Sec. 5.4. Testing.

- A) The contractor shall perform testing of all sanitary gravity sewers, as set forth in the following and shall conduct said tests in the presence of representatives from the city and/or other authorized agencies with 48 hours' advance notice provided.
- B) Sanitary sewers to be tested shall be within sections. Testing shall not proceed until all facilities are in place and concrete cured. All piping shall be thoroughly cleaned prior to testing to clear the lines of all foreign matter.
- C) Infiltration shall not exceed 300 gallons per day per inch of diameter per mile as measured between manholes. Testing shall proceed for a continuous period of two hours, with infiltration amounts measured by methods approved by the water and wastewater departments.
- D) Should any test fail necessary repairs shall be accomplished by the contractor, and the test repeated until the established limits. Any repairs shall be performed under the supervision of the city forces and by methods receiving prior approval by the city.
- E) If during final inspection the city has reason to doubt the integrity of the sewer lines due to infiltration or poor line alignment, the city may require internal inspection (televising) of the sewer lines at the expense of the developer.
- F) As built plans to be furnished to the city upon completion of project, with actual linear measurements from permanent points to all sewer systems components, including location of each house lateral.

SECTION 6.

SANITARY SEWAGE FORCE MAIN

Sec. 6.1. General.

- A) This section includes the general requirements for construction and installation of force main systems serving sanitary sewage pumping stations.
- B) The relevant provisions of other sections of this specification shall be applicable to this section unless otherwise indicated herein or approved by the city.

Sec. 6.2. Design standards.

The developer shall comply with the applicable criteria set forth in WPCF Manual of Practice No. 9, and

the department of environmental protection requirements. Additionally, ASCE publication Pipeline Design for Water and Wastewater may be used as a design guide, and subsection 5300 of this manual.

Sec. 6.3. Standard requirements.

6.31. *General.* The materials of construction and general installation procedures shall comply with the specific applicable standards set forth under section 2, "Utility Excavation, Trenching and Backfilling"; section 3, "Boring and Jacking"; and section 4, "Pipe, Fittings, Valves and Appurtenances."

6.32. *Joint restraining.* Pressure piping fittings and other items requiring restraint shall be braced with thrust blocks or restraining assemblies as required by design. Restraining devices shall be designed for the maximum pressure condition (testing) and the safe bearing loads for the horizontal thrust, if thrust blocking is used.

6.33. *Pipe depth and protection.* The standard minimum cover for sewage force main systems shall be 36 inches from the top of the pipe to finish grade. Where this condition cannot be met, special consideration will be given. Additional depth may be required where future surface improvements are planned or anticipated.

6.34. *Air and vacuum venting.* Where the force main profile is such that air pockets or entrapment could occur resulting in flow blockage, provisions for air release and/or venting shall be provided. Where free flow will occur during operation or after pumping stops, combined air release and vacuum valve assemblies shall be provided.

6.35. *Valve locations.* Valves shall be installed on all subsidiary force mains at the point of connection to the major main and where force mains are to be extended. At future connection branches or ends, the valves shall be restrained by methods other than thrust blocking in order to facilitate said connection without system shut down.

6.36. *Branch connections.* Tee fitting connections are acceptable provided the connection is adequately blocked or otherwise restrained.

6.37. *Cleanout connections.* Should force mains appear to be susceptible to sedimentation clogging, as created by depressed crossings or extended low flow (velocity) periods, suitable clean out connections shall be provided.

6.38. *Terminal discharge.* Force mains shall enter the terminal facility (gravity sewer manhole, pumping station wet well, or other) at a point equal to the operational water level of said receiving unit. Should an elevation drop be required to obtain the outlet connection, the prior downslope of the force main shall not exceed 45 degrees, and adequate air venting shall be provided at the profile breakpoint.

6.39. *Identification.* In order to preclude possible domestic water tapping, all installed underground sanitary sewage force mains shall be marked with a continuous yellow stripe located within the top 90 degrees of the pipe.

Sec. 6.4. Testing.

6.41. The contractor shall perform hydrostatic testing of all sanitary sewage force mains, as set forth in the following, and shall conduct said tests in the presence of representatives from the city and/or other authorized agencies with 48 hours advance notice provided.

6.42. Piping and appurtenances to be tested shall be within sections between valves or adequate plugs, not exceeding 2,000 feet with prior approval from the city. Testing shall not proceed until concrete thrust blocks are in place and cured, or other restraining devices installed. All piping shall be thoroughly cleaned and flushed prior to testing to clear the lines of all foreign matter. While the piping is being filled with water, care shall be exercised to permit the escape of air from extremities of the test section, with additional release cocks provided if required.

6.43. Hydrostatic testing shall be performed at 100 psi for all sizes of force mains. The testing procedure shall continue for an uninterrupted period of not less than two hours. Testing shall be in accordance with the applicable provisions as set forth in section 13 of AWWA Standard C600. The allowable rate of leakage shall be less than the number of gallons per hour determined by the following formula:

DIP:			PVC:		
L(DIP)	=	$S D (P)^{1/2}$ _____ 133,200	L(PVC)	=	$N D (P)^{1/2}$ _____ 7,400

L	=	allowable leakage in gallons per hour
N	=	number of joints
S	=	length of pipe tested in feet
D	=	nominal diameter of the pipe in inches
P	=	average test pressure maintained during the leakage test in pounds per square inch gauge.
(Note: Leakage for PVC on L(DIP), use 0.9 L(DIP))		

- A) The testing procedure shall include the continued application of the specified pressure to the test system, for the two-hour period by way of a pump taking supply from a container suitable for measuring water loss. The amount of loss shall be determined by measuring the volume displaced from said container.
- B) Should the test fail, necessary repairs shall be accomplished by the contractor and the test repeated until within the established limits. The contractor shall furnish the necessary labor, water, pumps, gauges, and all other items required to conduct the required sanitary sewage force main testing and shall perform the necessary system repairs required to comply with the specified hydrostatic test.

SECTION 7.

SEWAGE PUMPING STATIONS

Sec. 7.1. General.

7.11. This section includes the general requirements for the design criteria and installation of sewage pumping stations.

7.12. The relevant provisions included in these specifications shall be applicable to this section, unless otherwise indicated herein or approved by the city.

Sec. 7.2. Design standards.

The developer shall comply with the applicable regulations established by the Florida Department of Environmental Protection. Additionally, the criteria provided in chapter 30, "Sewage Pumping Stations," of the "Ten-State Standards-Recommended Standards for Sewage Works," and WPCF Manual of Practice No. 9, may generally be utilized as design guidelines, and section 5.3 of this section, if not in conflict with state, county, or other regulatory agency requirements. See typical submersible lift station design drawing, attached [at the end of this appendix] [which is on file with the city engineer].

Sec. 7.3. Standard requirements.

7.31. *Station water system (nonpotable).* All sewage pumping stations shall be provided with a station water system, with adequate capacity and pressure, for washdown or other requirements. Said supply shall be completely separated from the potable supply by use of reduced pressure type backflow preventors or other city-approved protective systems.

7.32. *Emergency pump connections.* Sewage pumping stations shall be equipped with stationary standby power generator connections to provide for emergency auxiliary pumping. Standard generator plugs 20 hp and over 200 amp, Russell Stoll #JRSB 2044FR and under 20 hp for 100 amp, Pyle Int. #JRE-4100 shall be used, unless otherwise approved by the city.

7.33. *Sewage pumps, motors, and standby generators.*

- A) [*Sewage pumping units.*] Sewage pumping units shall be capable of handling raw, unscreened sewage and shall be capable of passing a sphere of at least three inches in diameter. Pumps shall be electric motor driven and of a proven design that has been in sewage service under similar conditions for at least five years. Pumps shall provide the required peak design performance requirements and be suitable for operation within the total hydraulic range of operation. See attached drawing [at the end of this appendix] [which is on file with the city engineer].
- B) *Pump motors.* Pump motors should be nonoverloading, excluding service factor, throughout the entire operating range of the pumps. Two or more normally closed heat-sensing miniature switches connected in series and embedded within the motor windings shall be provided to shut off power and initiate alarm light for motor overtemperature condition. See attached drawing [at the end of this appendix] [which is on file with the city engineer].
- C) *Pump controls.* Each pumping station control system shall include a liquid level controller which shall sense the sewage level in the wet well and provide appropriate signals to the logic circuits

to produce the required mode of operation for the pumping facilities. Capability shall be provided for manual start-stop control for all pumping units, as well as the normal automatic control from the liquid level sensing and logic circuits. An automatic alternator shall change the starting sequence on each pump cycle. High and low water level alarm system shall be provided. Each sewage pump shall be provided with an elapsed time meter to indicate pump running time. The submersible station controls shall be housed within an exterior panel, pole mounted or free standing enclosure. The panel will be stainless steel of NEMA 3 R weathertight construction, with hoop and padlock, lightning arrestors and surge protection, exterior alarm light, audible horn and exterior silence button.

- D) *Submersible pump facilities.* Sewage pumping stations of the submersible type are suitable where the peak design flow rate does not exceed 1,000 gallons per minute or the pump motor size is 30 horsepower or less. Said installation shall include the removable pump units, aluminum access frame and cover, stainless steel pipe pump guide bars, pump discharge connection and other necessary appurtenances. The submersible pumping system and accessories shall be as manufactured by Flygt Corporation, Norwalk, Conn., or approved equal. See standard drawing [at the end of this appendix] for submersible lift station.
- E) *Factory-built facilities.* Factory-built facilities shall have prior city approval before inclusion in proposed plans.
- F) *Emergency on-site standby generator.* An on-site standby emergency generator shall be provided and installed at lift stations with capacity at or over 700 gpm flow and/or as required by DEP, and/or under special circumstances due to remoteness of site for lift stations smaller than the above cited standards.

7.34. *Hoist for submersible lift stations.* All submersible lift stations with 25 hp or larger, shall be equipped with a hoist capable of removing pumps. The hoist shall be as manufactured by Ace Boat Hoist Co. or equal. The hoist shall be attached to the wet well. The controls and panel shall be NEMA 4 rated, with a forward and reverse motion and holding a load with no modifications or adjustments of pulleys or belts. The reach shall be from the centerline of the base and shall be capable of reaching the farthest and nearest pump with the adjustments of the lifting cable along the boom and be able to rotate 360 [degrees].

- A) [*Components.*] All structure components shall be fabricated from steel tubing with hot dipped galvanized treatment. Each component must be cleaned and free of rust, grease or flux.

All rotating parts shall be mounted on bushings or bearings which can be routinely lubricated.

Lifting cables shall be operated by an electrical powered hoist mechanism capable of lifting 2,000 pounds and be equipped with an emergency heavy-duty brake. All electrical components shall be covered and protected from weather.

Cable shall be stainless steel, rated for 4,000 pounds and shall be a minimum of 60 feet in length.

Snatch blocks and hooks shall be compatible with cables and capable of supporting loads up to 4,000 pounds.

All anchor bolts shall be of stainless steel and of a sufficient cross sectional area to resist any force created by the hoist in any position at the maximum load as specified.

- B) *Submittals - drawings.* Drawings shall include construction, installation, maintenance schedule and any other equipment required for proper installation and operation. All drawings are to be submitted to the City of Eustis Wastewater Department.

7.35. *Valves.*

- A) *Valve vaults.* Valve vaults must be a minimum of six feet by six feet, with no less than 12 inches from the side wall to the valve clearance. Vault must be coated, with Bituminous 300M inside and outside with a finish coat of 40 mils. All metal on the inside of the valve vault shall be coated with Bituminous 300M and will also have a finish coat of 40 mils.
- B) *Valves.* All valves used in station valve boxes shall be DeZurik Series with 100 percent full flow plug valves. Any valve six inches or over must be gear operated.

7.36. *Fence requirements.*

Sewage pumping stations require fencing in accordance with standards established in section 5.10 of appendix B.

SECTION 8.

WATER DISTRIBUTION SYSTEMS

Sec. 8.1. General.

This section sets forth the general requirements for construction and installation of water distribution systems for potable water service.

Sec. 8.2. Design standards.

The design standards of the water system are listed in section 5.3.

Sec. 8.3. Standard requirements.

8.31. *General.* The materials of construction and general installation procedures, with the exception of fire hydrants, shall comply with the specific applicable standards set forth under section 2, "Utility Excavation, Trenching and Backfilling"; section 3, "Boring and Jacking"; and section 4, "Pipe, Fittings, Valves and Appurtenances," as well as "Standard Details-Water Distribution Systems."

8.32. *Fire hydrants.* Hydrants shall comply with AWWA Standard C502, "Fire Hydrants for Ordinary Water Works Service," and shall be equipped with a minimum of one pumper outlet nozzle 4 1/2 inches in diameter and two hose nozzles 2 1/2 inches in diameter. Threads, nozzle caps, operating nuts and color shall

conform to city standards. Units shall be traffic type with breakable safety clips or flange, and stem with safety coupling located below barrel break line to preclude valve opening. Hydrants shall be dry top type. Outlet nozzles shall be on the same plane, with minimum distance of 18 inches from center of nozzles to ground line. Valve shall be compression type with 5 1/4 inches minimum opening unless otherwise requested and show inlet connection to be six inches minimum.

- A) Hydrants shall be installed plumb and in true alignment with the connection pipes to the water main. They shall be securely braced against the end of the trench (undisturbed soil) with concrete thrust blocks. The gravel or crushed stone for the drain sump, followed by backfilling, shall be carefully placed and compacted. Installed hydrants shall be painted red for the final coat.
- B) Hydrant placement is to be a minimum of six feet and a maximum of nine feet from the curb or paved road surface unless otherwise approved.

The center of the steamer port shall be 18 inches minimum and 24 inches maximum above final grade.

Steamer port shall be correctly positioned for the proper connection.

8.33. *Joint restraining.* Pressure piping fittings and other items requiring restraint, shall be braced with thrust blocks or other items restraining assemblies. Said restraining devices shall be designed for the maximum pressure condition (testing) and the safe bearing loads for horizontal thrust, if thrust blocking is used.

8.34. *Pipe depth and protection.* The standard minimum cover for water distribution systems shall be three feet from the top of the finish grade. However, should this design not be feasible, protective concrete slabs shall be provided over the pipe within the limits of the lesser cover. Where waterways, canals, ditches or other cuts are crossed, protective concrete slabs shall also be installed across and to ten feet each side of the bottom. Additionally, approved utility crossing signs shall be placed on the pipe alignment at each side of the canal, etc. All water lines and sewer lines must have a metallic tape trace placed above them no deeper than eight inches.

8.35. *Connections at structure.* Where pipes are to extend into or through structures, flexible joints are to be provided at the wall face.

8.36. *Special exterior protection for corrosion.* Extra protection shall be provided for underground cast or ductile iron pipe and fittings within areas of severe corrosive conditions. This shall be accomplished by the installation of polyethylene encasement, through the area of concern. The soil test evaluation to determine the necessity for extra protection in suspect areas shall be set forth in ANSI Standard A21.5. Additionally, where other existing utilities are known to be cathodically protected, cast or ductile iron pipe crossing said utility shall be installed parallel to and within ten feet of, protection shall also be provided. Steel pipe shall not be installed in severe corrosion areas.

8.37. *Air venting and blowoffs.* Where the water main profile is such that an air pocket or entrapment could occur, resulting in flow blockage, methods for air release shall be provided. Air venting capabilities shall be provided for distribution mains by appropriately placing fire hydrants, blowoffs, or other manual devices. At critical points on major mains, automatic air release assemblies shall be installed. Special care shall be taken to preclude any cross connection possibility in the design of automatic air release valve application. All dead-end

water mains, temporary or permanent, shall be equipped with a manually operated blowoff at the terminal.

8.38. *Service connections.* Connections to water mains four inches and larger shall be made by drilling the appropriate size hole and installation of service saddles, with services to smaller sizes accomplished by in-line fittings. A fitting with the service line extended to the property line, perpendicular to said line, and terminating with a plugged curb stop, pending meter installation. On curbed streets the exact location for each installed service shall be marked by etching or cutting a "W" in the concrete curb and painted blue. Where no curb exists or is planned, locations shall be adequately marked by a method approved by the city.

Sec. 8.4. Testing.

A) The contractor shall perform hydrostatic testing of all water distribution systems, as set forth in the following and shall conduct said tests in the presence of representatives from the city and/or other authorized agencies, with 48 hours' advance notice provided.

B) Piping and appurtenances to be tested shall be within sections between valves, unless alternate methods have received prior approval from the city. Testing shall not proceed until concrete thrust blocks are in place and cured, or other restraining devices installed. All piping shall be thoroughly cleaned and flushed prior to testing to clear the lines of all foreign matter. While the piping is being filled with water, care shall be exercised to permit the escape of air from extremities of the test section, with additional release cocks provided, if required.

C) Hydrostatic testing shall be performed at 150 pounds per square inch pressure, unless otherwise approved by the city, for a period of not less than two hours. Testing shall be in accordance with the applicable provisions as set forth in Section 13, AWWA Standard C600. The allowable rate of leakage shall be less than the number of gallons per hour determined by the following formula:

DIP:			PVC:		
L(DIP)	=	$S D (P)^{1/2} \text{ --- } 133,200$	L(PVC)	=	$N D (P)^{1/2} \text{ --- } 7,400$

L	=	allowable leakage in gallons per hour
N	=	number of joints
S	=	length of pipe tested in feet
D	=	nominal diameter of the pipe in inches
P	=	average test pressure maintained during the leakage test in pounds per square inch gauge.
(Note: Leakage for PVC on L(DIP), use 0.9 L(DIP))		

D) The testing procedure shall include the continued application of the specified pressure to the test system, for the two-hour period, by way of a pipe taking supply from a container suitable for measuring water loss. The amount of loss shall be determined by measuring the volume displaced from said container.

E) Should the test fail, necessary repairs shall be accomplished by the contractor and the test repeated until within the established limits. The contractor shall furnish the necessary labor, water, pumps, gauges and all other items required to conduct the required water distribution system testing and perform necessary repairs.

Sec. 8.5. Disinfecting.

8.51. Following the pressure testing, the contractor shall disinfect all sections of the water distribution system, and receive approval thereof from the appropriate agencies, prior to placing in service. Advance notice shall be provided to the city before disinfecting procedures start. The disinfection shall be accomplished with the applicable provisions of AWWA Standard C651, "Standard Procedures for Disinfecting Water Mains" and all appropriate agency approvals.

A) Care shall be taken to provide disinfection to the total system and extremities shall be carefully flushed prior to chlorination.

After disinfection and final flushing have been accomplished, samples of water for bacteriological analysis shall be collected and submitted to and as directed by the Florida Department of Environmental Protection or other appropriate approval agency. Should these samples or subsequent samples prove to be unsatisfactory, then the piping shall be disinfected until a sufficient number of satisfactory samples are obtained.

B) The contractor shall furnish all equipment and materials and perform the work necessary for the disinfecting procedures, including additional disinfection as required.

Sec. 8.6. As-built drawings.

8.61. The developer must provide a mylar and white copy set of as-built drawings of the project, showing accurate measurements of water and sewer lines and structures from fixed known locations within the development. The as-builts shall be signed and sealed by the project design engineer attesting to the accuracy of the locations of the facilities. The as-built drawings are to be provided before the city can accept the improvements. The developer is to provide four copies of the plans for approval by the city.

Sec. 8.7. Illustrations and drawings.

The illustrative drawings that may be required are on file with the city engineer.