

CHAPTER VII. STANDARD UTILITY CONSTRUCTION SPECIFICATIONS

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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's rights-of-way.
2. Facilities to be turned over to the city for operation.
3. Facilities to be connected to the city's utilities systems.

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

Water and sewer improvements shall be in general accordance with the city's adopted 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 and must be approved by the City of Crescent City and the city engineer.

Please note that 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.

7.1. Authority.

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

7.1.2. *Scope and intent.* It is intended for these development procedures 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 Crescent City.

7.1.3. *Policies.*

1. The city will provide water and sewer to its service areas. The annual budgeting process shall provide funding for new facilities and line extensions only in the following manner:

- a. For areas that are currently within the municipal boundaries of the City of Crescent City, the city will provide service lines via the capital improvements program. Should development occur prior to extension of service by the city, the developer will be responsible for construction of the service lines. The cost of connection to the service lines will be the responsibility of the developer. In the case of existing structures, the cost of connection will be the responsibility if the individual land owner or homeowners association.
- b. For those areas located in the City's Utility Service Area-A developer's agreement, which requires annexation, construction of the service lines shall be the responsibility of the developer based upon the developer's proportionate share, or may be shared with the city on a case by case basis. The cost of each connection will be provided by the developer.
- c. Allow the use of wells and septic tanks for development when aquifer and soil conditions are appropriate, and when central sewer service would not be cost-effective. Such use must be determined to be consistent with the Comprehensive Plan prior to approval. Development regulations will be used to ensure this determination.

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

7.2. **General.**

7.2.1. *Pre-design conference.* It is strongly recommended that a pre-design conference between the owner, his engineer and the city be held.

7.2.2. *Plans.*

1. Submission:

- a. 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.

7.2.3. *Inspection.*

1. Periodic.

7.2.4. *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 manufacturer prior to final acceptance by the city.

7.2.5. *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 Putnam 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 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.

7.2.6. *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.

7.3. Utility excavation, trenching and backfilling.

7.3.1. *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.

7.3.2. *Materials.*

1. Sheeting and bracing.
 - a. Wood sheeting to be left in place shall be pressure treated.
 - b. Steel sheeting to be left in place shall be as specified in ASTM Designation A328.

7.3.3. *Workmanship.*

1. *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. *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.

3. *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 subsection 7.3.3.11 "Backfill."

4. *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.

5. *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.

6. *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.

7. *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.

8. *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.

9. *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.

10. *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.

11. *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 12-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 95 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 98 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 7.3.3.11) 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 re-excavate and re-compact 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, labeled with the appropriate designation of pipe use.
- h. All watermains and sewer forcemains must have a continuous type TWH PVC insulated copper conductor #12 solid single strand wire strapped to the top of pipe every ten feet and pulled up into all valve boxes and all meter boxes. All wires shall be spliced with an approved watertight connection and taped back 12 inches from connection point to insure electrical continuity for the entire length of constructed pressure main.

12. *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. Jack and bores will be mandatory and no road-cuts allowed unless permitted by the public works director.
 - c. 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.
 - d. 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.
 - e. 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.
 - f. Density tests shall be provided for trenches in pavement across roadways as specified in subsection 7.3.11.
13. *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.
14. *Cleanup:* Work site cleanup and property restoration shall follow behind construction operations without delay. Some of this clean-up will be done on a daily basis, as needed, usually at the end of the work day.

7.4. Boring and jacking.

7.4.1. General.

Mandatory for all road crossings in the city limits unless approved in advance by the public works director.

1. 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.
2. It is mandatory that all underground pipelines crossing existing city roadways, state highways, and railroads shall be installed under these traffic-ways within bored and jacked steel casing pipe unless prior approval by the public works director is obtained. Specific crossing requirements shall be obtained in advance from authority having jurisdiction.
3. It shall be the responsibility of the contractor to submit the necessary permit documents and data to the appropriate authority and receive approval thereof.

7.4.2. *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-inch 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:

TABLE INSET:

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

20	32	0.375
24	36	0.375

7.4.3. *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 7.3.2 preceding.

7.4.4. *Workmanship.*

1. 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.
2. 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.
3. The casing pipe shall be adequately protected to prevent crushing or other damage under jacking pressure.
4. 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.
5. 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.

7.5. Pipe, fittings, valves and appurtenances.

7.5.1. *General.*

1. This section includes the material and installation standards for pipe, fittings, valves, and appurtenances, as applicable to sewerage and water installations.
2. 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.

3. All material to be furnished by contractor or developer, with exception of meters and meter couplings.

7.5.2. *Pipe and fittings.*

1. *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 p.s.i. working pressure and shall meet all applicable AWWA specifications. All pipe installations shall have indicator tape run with pipe to indicate the purpose of piping (water, sewer, force main) and copper tracing wire for location purposes.

2. *Cast and ductile iron:*

a. Ductile iron pipe shall be in accordance with ANSI/AWWA C151/A21.51. Pipe shall be laid in accordance with ANSI/AWWA C150/A21.50. Thickness class shall be governed by design conditions, minimum thickness class shall be 50.

b. Cast and ductile iron pipe fittings shall conform to ANSI/AWWA C110/A21.10 and ANSI/AWWA C153/A21.53. All underground fittings shall be mechanical joint, unless otherwise specified.

c. *Joints:*

1. "Push-on" and mechanical type joints shall be in accordance with ANSI/AWWA C111/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/AWWA C115/A21.15, 125-pound standard.

4. No leaded joints or connection of any kind will be permitted.

5. PVC fittings for pressure mains are prohibited above two inches in diameter, unless otherwise specifically approved by the city.

d. *Coatings and linings:*

1. Cast and ductile iron pipe and fittings for force mains or when used as gravity sewer service shall receive an interior epoxy lining for both pipe and fittings in accordance with AWWAC210.

2. Cast and ductile iron pipe and fittings for water service shall be cement mortar lined in accordance with ANSI/AWWAC104/A21.4.

3. Cast and ductile iron pipe and fittings for water and sewer shall receive an exterior asphaltic coating approximately one mil thick. The coating shall be

applied to the exterior of all pipe and fittings unless otherwise specified. Coatings shall be applied in accordance with AWWA C110-fittings, AWWAC115-flanged pipe, and AWWA C151-ductile iron pipe.

3. *Polyvinyl chloride (PVC):*

a. Pipe shall be manufactured from clean virgin type I, grade I rigid, unplasticized polyvinyl chloride resin (Class 12454-A or Class 12454 conforming to ASTM D1784). The PVC compound shall have an established hydrostatic design basis (HDB) of 4,000 psi as described in ASTM D2837. The pipe shall bear the National Sanitation Foundation (NSF) seal for potable water pipe. Pipe with diameters less than four inches shall be Class 200 with a minimum Standard Dimension Ratio (SDR) of 21 and shall be in accordance with ASTM D-2241.

Pipe with diameters of four inches to 12 inches for water mains shall have a minimum dimension ratio (DR) of 18, Class 150, and shall be manufactured in accordance with AWWA Specifications C-900 latest revision. Pipe with diameters of 14 inches to 18 inches for water mains shall have a minimum dimension ratio (DR) of 18, Class 150, and shall be manufactured in accordance with AWWA Specification C-905 latest revision or Class 50 ductile iron pipe (per subsection 7.5.2.2) may be used. Pipe with diameters of four inches to 12 inches for sewer force mains shall have a minimum dimension ratio (DR) of 25, Class 100, and shall be manufactured in accordance with AWWA Specification C-900 latest revision. Pipe with diameters of 14 inches to 18 inches for sewer force mains shall have a minimum dimension ratio (DR) 25, Class 100, and shall be manufactured in accordance with AWWA Specification C-905 latest revision or Class 50 ductile iron pipe (per section 4.2) may be used. Sanitary gravity sewer pipe shall have a minimum standard dimensional ratio (SDR) of 35 and shall be manufactured in accordance with ASTM D3034.

PVC PIPE COLORS

WATER - Blue or white

SEWER - Green or white with yellow stripe (forcemain) green or white (gravity sewer)

RE-USE - Purple

b. Connections and fittings for pipe 1 1/2 inches and smaller shall be solvent welded sleeve type joint. Connections and fittings for pipe two inches and 2 1/2 inches in diameter shall be rubber compression ring type. Pipe shall be extruded with integral thickened wall bells without increase in DR. Rubber ring gaskets shall consist of synthetic compounds meeting the requirements of ASTM Designation D1869, and suitable for the designated service. Fittings for pressure mains three inches and larger (water lines or sewage force mains) shall be cast iron or ductile iron with mechanical joint rubber compression ring type joints.

c. All piping (PVC, polyethylene tubing) shall have a type TWH insulated PVC copper conductor, #12 solid strand wire that straps and runs with the pipe.

4. *Polyethylene plastic pipe:* Pipe or tubing shall comply with AWWA C800 and AWWA C901, 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 with a minimum Standard Dimension Ratio (SDR) of nine. Fittings shall be brass, equipped with compression type connections.

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

6. *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-pound standard. Mueller #615 or #715, assuring a full circumferential seal, or approved equal.

b. Service saddles shall be as manufactured by Smith & Blair Inc., Ford, or Rockwell. Units for cast or ductile iron and PVC pipe shall be double strap. Sealing gasket shall be BUNA-N rubber and straps shall be stainless steel.

7.6. Valves.

7.6.1. *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.

1. *Valves for underground service:* Valves from two inches through 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. Valves greater than 12 inches in size shall be equipped with a gear reduction to facilitate ease of operation under full line pressure. All valves shall be resilient seated valves which meets all C-509 requirements of AWWA (water). Mueller A2370-20, American Darling CRS-80, Clow 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.

2. *Valves for above-ground service for water systems only:* Valves shall be iron body, bronze mounted resilient seat gate valves, conforming to AWWA C-509, 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.

3. *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 Gate valve. The use of this type of valve would have to be approved by the city.

7.6.2. *Backflow devices.*

1. Backflow devices shall be designed to specifications of the USC Cross Connection Control Laboratory, AWWA and A.S.S.E. #1015. Backflow device assembly from 2 1/2 inches and up shall be furnished with OS & Y gate valve shut-offs.
2. Shut-off valves on backflow assembly for sizes three-fourths-inch through two inches shall be provided with ball valves, assemblies above two-inch shall be provided with resilient seat full flow gate valves.

7.6.3. *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, American Darling #52SC, Kennedy or M & H.

7.6.4. *Plug valves (PV).* Valves for wastewater application shall be semi-steelbody, nonlubricated, eccentric type, with resilient faced plugs, and capable of drip-tight shut-off 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., Clow, Milliken or approved equal.

7.6.5. *Butterfly valves.* Butterfly valves require specific City Engineer approval for use and 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 Pratt.

7.6.6. *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 around their tops concrete pads, which will be flush with the top of the curb, with minimum dimensions of 24 inches X 24 inches X six inches and rebar as per details.

7.6.7. *Meter boxes.* Plastic meter boxes, Model D-1200, DFW, with cast iron read lid cover or approved equal.

7.6.8. *Fire hydrants.* Fire hydrants shall be of Mueller Supercenturian 200 oil reservoir, American Darling six-inch B-84-B, 5 1/4-inch Clow Medallion UL/FM, or AVK.

7.6.9. *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 or Ford. Corp stops to be Mueller or Ford. Curb stops shall have padlock wings.

Note: Service layout must be approved by the city. All services that cross under streets from the mainline shall be encased in Schedule 40 PVC pipe.

7.7. Installation.

7.7.1. General requirements.

1. Piping, fittings, valves and appurtenances shall be installed in accordance with these standards.

2. 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.

3. 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.

4. 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, 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.

5. 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.

6. 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.

7. Underground pressure piping systems shall be thoroughly braced with 2500 psi 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.
8. 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.
9. Ductile iron pipe is required at all ditch, stream or swamp crossings, culvert crossings or with bore and jack crossings.
10. 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 C651.
11. Cast and ductile iron pipe (CI & DI) installation shall be performed in accordance with the applicable provisions of the latest AWWA specifications.
12. Polyvinyl chloride (PVC) pipe-lubrication and/or solvent for pipe and fitting joints shall be non-toxic (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.

7.8. Sanitary gravity sewers.

7.8.1. *General.* This section includes general technical criteria for the design and installation of sanitary gravity sewer systems.

7.8.2. *Design standards.* The developer shall comply with the applicable requirements specified within WPCF Manual of Practice No. 9, and the Ten-State Standards-Recommended Standards for Sewage Works and as established by the Florida Department of Environmental Protection.

1. *System design:*

- a. Average daily flow (ADF). The sewer system design shall be based on full ultimate development as known, or projected. The average daily flow (ADF) from domestic units shall be calculated at the minimum rate of 300 gallons per day per equivalent residential unit, but should conditions be unfavorable such as high groundwater conditions, an additional allowance shall be included for infiltration. Single-family residences shall be computed at the rate of 3.5 persons per connection and multifamily or mobile home dwellings at 2.5 persons per unit. Flow requirements from commercial, industrial, institutional, or other special development areas shall be established from existing records or by estimated

projections using the best available data; however, in no case shall a rate of less than 2,000 gallons per acre per day be used, unless specifically approved otherwise.

b. Maximum daily flow. Gravity sewers shall be designed on the basis of ultimate development maximum rates of flow. The maximum flow ranges from 2.5 as a minimum up to a maximum of 4.0 times the cumulative ADF, depending on the number of houses contributing.

c. Sewer size computation. Sanitary sewers shall be sized to provide ample capacity for the maximum flow rates. The minimum allowable size for any sewer, other than service connections, shall be eight inches in diameter. All sewers shall be designed at slopes providing a minimum velocity of not less than two feet per second when flowing full or half-full. Said computation shall be based on Manning's Formula using a roughness coefficient ("N") of not less than 0.013, unless justifiably approved otherwise. In general, the following minimum slopes shall be provided for sewer sizes to 24 inches:

MINIMUM SLOPE

TABLE INSET:

Sewer Size (inches)	(Feet per 100 feet)
8	0.35
10	0.28
12	0.22
14	0.17
15	0.15
16	0.14
18	0.12
20	0.11
21	0.10

Minimum slopes slightly less than those indicated may be considered in extreme situations; providing the depth of flow will not be less than 0.3 of the pipe diameter or the velocity less than 1.6 feet per second at design average daily flow, and justifiable reasons for the modification are presented to the city.

d. Design considerations:

1. Sewers 24 inches in diameter or less shall be installed with straight alignment and grade between manholes, with manhole spacing not to exceed 400 feet for sewers 15 inches or less, and 500 feet for sizes larger.
2. All sanitary sewers shall terminate at manholes.

7.8.3. *Standard requirements.*

1. *General:* The materials of construction and general installation procedures shall comply with the specific applicable standards set forth within these specifications.

7.8.4. *Manholes.*

1. 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.
2. 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.
3. Manholes are to be located in dedicated right-of-way or utility easement.
4. Manhole frames and covers shall be gray cast iron conforming to ASTM Designation A48, Class 30, and shall have a minimum 22 1/4-inch opening and rated for heavy traffic. 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.
5. 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.
6. 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.

7. Sewer clean-outs 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 24 by 24 by four inches with reinforcement.

8. Manholes shall not be located in drainage swales or any other low area likely to collect or pond water during rains.

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

7.8.6. *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.

7.8.7. *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.

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

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

7.8.10. *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 or easement line, perpendicular to said line, terminating with stoppered ends or fittings. The minimum service pipe size shall be four inches in diameter for single connections and six inches in diameter for double connections. On curbed streets, the exact location for each installed service shall be marked by etching or cutting an "S" in the concrete curb and painted red. Where no curb exists or is planned, locations shall be adequately marked by a one-half-inch steel rebar, three inches below final grade.

7.8.11. *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. Said protection shall consist of completely encasing, six inches minimum, the sewer pipe in concrete for a minimum distance of ten feet each side of the water main, or installation of pressure-tight joint cast or ductile iron pipe for the same dimension.

7.9. Polyvinyl chloride (PVC) sewers.

7.9.1. *General.* This section includes the material and installation standards for pipe, fittings and appurtenances as applicable to PVC sanitary gravity sewer systems. The relevant provisions included in these specifications and standards shall be applicable to this section, unless otherwise indicated herein or approved by the applicable regulatory agency.

7.9.2. *Materials.* Polyvinyl chloride (PVC) pipe and fittings for gravity sewage lines shall be manufactured from polyvinyl chloride resin conforming to ASTM Designation D1784. Pipe and fittings of this material shall conform to ASTM Designation D-3034 of F-949, STANDARD SPECIFICATION FOR TYPE PSM POLYVINYL CHLORIDE (PVC) SEWER PIPE AND FITTINGS. All pipe and fittings shall have a Standard Dimension Ratio (SDR) of not more than 35.

7.9.3. *Pipe lengths.* PVC pipe for gravity sewers shall be furnished in a maximum of 13-foot lengths, with integrally formed bell joints.

7.9.4. *Joints.* PVC pipe and fittings for gravity sewers shall be furnished with joints conforming to ASTM D-3212, Standard Specification for Sewer Pipe Joints Using Elastomeric Seals. All pipes shall have a factory installed rubber sealing ring. Field solvent weld fittings shall not be acceptable.

7.9.5. *Non-shrink mortar.* All holes in manholes and/or wetwells, provided for their handling, and the annular space between the wall and the pipe coupling adapter shall be thoroughly plugged with Embecco No. 167 Mortar, or approved equal non-shrinking mortar, applied and cured in strict conformity with the manufacturer's recommendations so there will be zero leakage through openings and around pipes. The mortar shall be finished smooth and flush with the adjoining interior and exterior manhole and/or wetwell wall surfaces.

7.9.6. *Special backfill.* Where the soil in the excavated trench bottom is unsuitable (unstable), the contractor shall over excavate the trench bottom and backfill with crushed stone or gravel defined as Class I, except sizing shall be one-fourth-inch to three-fourths-inch, under the U.S.C.S. Soil Classification System (FHA Bulletin No. 373), or crushed shell. In dry conditions, graded sands may be used.

7.9.7. *PVC pipe laying and backfilling.*

1. *Dewatering required:* Water shall not be allowed in the trenches while the pipe is laid. The use of a wellpoint dewatering system is a requirement on any runs of PVC pipe where such pipe will be below the groundwater elevation at the specific site. Sump and pump type trenching may be used only on short shallow runs where wellpoints would be impractical and excessively expensive, and only with the prior approval of the applicable regulatory agency. In all cases, density testing up to a point at least one foot above the

water table shall be completed prior to removal of dewatering equipment. On sewer lines installed using wellpoints, service laterals shall be installed while the wellpoints are in operation.

2. *Pipe alignment:* Care must be taken to fit the joints together properly so that the centers of the pipes shall be in a straight line. All adjustments to line and grade must be made by scraping away or filling in under the barrel of the pipe and not by wedging or blocking up any portion of the pipe. In no case shall the pipe be walked on either before or after the joints have been made. Any pipe that has its grade alignment or joints disturbed will be taken up and relaid. Pipe shall not be driven to grade by striking it with any unyielding object.

3. *Backfill and deflection:* Immediately after the pipe has been jointed and inspected, backfilling shall be placed to a minimum of 12 inches above the crown of the pipe to adequately protect the pipe from injury and movement, in accordance with ASTM D2321. Before and during the backfilling of any trench, precaution should be taken against flotation of pipe lines therein due to entry of large quantities of water into the trench which could cause uplift of the pipe line. The diameter deflection of PVC pipe shall not exceed five percent after completion and approval of construction, and for a period of one year thereafter.

4. *Compaction;* The mechanical compaction of backfill over sewer lines and appurtenances, within right-of-way and under all roadways, drives (including dirt drives), and parking areas shall be compacted to 98 percent of maximum density per AASHTO T-180. In unpaved areas outside of the right-of-way, the backfill shall be compacted to a minimum density of 95 percent of maximum density.

7.10. Testing.

7.10.1. 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.

7.10.2. 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.

7.10.3. Infiltration and exfiltration shall not exceed 300 gallons per day per inch of diameter per mile as measured between manholes.

7.10.4. The contractor shall utilize low-pressure air testing in accordance with Uni-Bell PVC Pipe Association, UNI-B-6-90, "Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe," latest revisions. Testing shall proceed for a continuous period of two hours, with infiltration amounts measured by methods approved by the sewer department.

7.10.5. 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.

7.10.6. 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.

7.10.7. All sanitary gravity sewer lines shall be lamped.

7.10.8. Record Drawings to be furnished to the city upon completion of project, with actual linear measurements from permanent points to all sewer system components, including location of each house lateral and actual field measured rim and invert elevations. As-builts to be prepared by a professional land surveyor.

7.11. Sanitary sewage force main.

7.11.1. General.

1. This section includes the general requirements for design and installation of force main systems serving sanitary sewage pumping stations.

2. The relevant provisions of other sections of this specification shall be applicable to this section unless otherwise indicated herein or approved by the city.

7.11.2. *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, if not in conflict with other requirements.

7.11.3. *System design.* Force main systems shall be of adequate size to efficiently transmit the total ultimate peak operational flows, applied by the connected sewage pumping station(s) to the effluent point. Consideration shall be given to possible future connecting other gravity sewers pumping stations and force mains and this probability shall be reviewed with the city. Capacity computations shall be coordinated with the proposed pumping system(s), along with any future flow requirements, if applicable. In order to provide adequate pipeline cleansing, force main flow velocity shall not be less than two feet per second at ultimate design minimum pumping capacity; however, with multiple pumping station systems or phase development, this requirement may be difficult to meet and the system design shall receive special attention regarding cleaning maintenance, pumping rates, future upgrading of systems by changing impellers, pump changes, parallel force mains and other ways to increase future capability.

7.11.4. *Operational cost considerations.* In addition to initial capital expenditure, long-term pumping station operational costs shall also receive consideration when sizing force main systems or making decisions concerning whether gravity service or lift station service is to be provided.

7.11.5. *Standard requirements.* The materials of construction and general installation procedures shall comply with the specific applicable standards set forth within these specifications.

7.11.6. *Joint restraining.* Pressure piping fittings and other items requiring restraint shall be braced with mechanical 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. Thrust blocks require city engineer's specific written approval.

7.11.7. *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.

7.11.8. *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.

7.11.9. *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.

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

7.11.11. *Clean out 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 and pigging connections shall be provided.

7.11.12. *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 down-slope of the force main shall not exceed 45 degrees, and adequate air venting shall be provided at the profile breakpoint.

7.11.13. *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.

7.11.14. *Testing.*

1. 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.

2. 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.

3. 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 AWWA provisions for PVC-AWWA Publication M-23 and for DIP-AWWA Standard C600, Section 4. The allowable rate of leakage shall be less than the number of gallons per hour determined by the following formulas:

TABLE INSET:

	PVC		DIP
L =	$\frac{NDP \ 1/2}{7400}$	L =	$\frac{SDP \ 1/2}{133,200}$

For 100 psi; test: L = 0.00135 ND (PVC)

For 100 psi; test: L = 0.000075 SD (DIP)

L = Allowable leakage in gallons per hour

N = Number of joints in section tested

S = Length of pipe tested, in feet

D = Nominal diameter of the pipe in inches

P = Average test pressure maintained during the leakage test impounds per square inch gauge.

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.

c. Pipe sections to be pressure tested shall be subjected to a hydrostatic pressure of 100 psi for a duration of two hours by means of a pump.

7.12. Sewage pumping stations.

7.12.1. *General.*

1. This section includes the general requirements for the design criteria and installation of sewage pumping stations.
2. The relevant provisions included in these specifications shall be applicable to this section, unless otherwise indicated herein or approved by the city.

7.12.2. *Design standards.*

1. *Reference:* The developer shall comply with the applicable regulations established by the Florida Department of Environmental Protection. Additionally, the criteria provided in "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, if not in conflict with state, county, city, or other regulatory agency requirements. See typical submersible lift station design drawing, attached [following this section].

2. *Design flows:* Sewage pumping stations shall be designed for the total ultimate development flow from all contributory areas. The design average daily flow shall be computed at the unit rates set forth under section 5. The maximum required pumping capability shall be the product of selected peak factors times the accumulative average daily flow (ADF) from the total service area. In general, the following factors shall be applicable for the range of flow contributions indicated (million gallons per day average daily flow: MGD-ADF), unless larger values are required or smaller amounts are justified, with prior approval from the city.

TABLE INSET:

Flow Range	Peak Factor
0.00 to 0.05 MGD-ADF	3.5 to 4.0
0.05 to 0.25 MGD-ADF	3.0
0.25 to 2.00 MGD-ADF	2.5

Note: Special analysis shall be made for flows beyond 2.00 MGD-ADF and peak factors less than 2.5.

3. *Pump selection:*

- a. For pumping stations with a maximum flow demand of 1,000 gallons per minute (GPM) or less, a minimum of two pump units shall be provided. Where the peak design flow exceeds 1,000 GPM, three or more units shall be included in the facility (with two operating to meet maximum demand and one on standby).
- b. The selected sewage pump system shall have the minimum capability of pumping the design peak flow at the maximum computed system total dynamic head (TDH) requirements.
- c. Head-capacity curves shall be prepared for the proposed pumping system in order to determine the various operational conditions. Hydraulic computations shall be in accordance with good engineering practice, with pipe friction loss calculated by the "Hazen-Williams Formula," using standard friction factors based on the materials utilized.

4. *Wet well design:*

- a. The wet well structure shall provide a minimum capacity between operational water levels sufficient to allow a minimum of five minutes between successive starts of the pumps, when the effluent rate is one-half the maximum one pump capacity. Low water levels shall provide adequate submergence to preclude pump inlet vortexing, air binding or other design considerations. Operational maximum high water levels shall not exceed the invert elevation of the lower effluent pipe, with high water alarm no higher than the 0.8 point of said pipe. A minimum size hopper bottom shall be provided, with the wet well floor sloping to said bottom at a slope of not less than one to one. Additionally, where the wet well extends below the groundwater table, the structure shall be designed to eliminate any possibility of flotation.
- b. Odor control shall be provided as required and specified by the city.

5. *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.

6. *Emergency pump connections:* Sewage pumping stations shall be equipped with stationary standby power generator connections for emergency auxiliary pumping. Standard generator plugs 20 HP and over shall be 200 AMP, Russell Stoll #JRS 2044FR and for pumps under 20 HP generator plugs shall be 100 AMP, shall be used, unless otherwise approved by the city.

7. *Sewage pumps, motors, and standby generators:*

a. 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.

b. Pump motors. Pump motors should be non-overloading, 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 over-temperature condition. See attached drawing [following this section].

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 with test switch shall change the starting sequence on each pump cycle. A high water level alarm system with flashing light shall be provided. A separate AMP meter for each pump in the wetwell. Each sewage pump shall be provided with an elapsed time meter to indicate pump running time. Seal failure indicators, thermal shutdown protection, phase monitor, and ground fault interrupt with circuit breaker shall be provided. The submersible station controls shall be housed within an exterior panel, pole mounted or freestanding 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. The alarm system shall be equipped with a battery back-up system. An allowance of 36-inch separation between wetwell and panel box is required. At the city's direction telemetry may be required at the developer's cost.

d. Submersible pump facilities. 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, or KSB. See Standard Drawing for submersible lift station. Also provide a camlock quick coupling for emergency by-pass at pumping stations.

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 with automatic transfer switch 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.

8. *Valves:*

a. Valve vaults: Valve vaults must be a minimum of six feet by six feet (inside dimension), with no less than 12 inches from the side wall to the valve clearance. Vault must be coated, with Inextol epoxy inside and outside with a finish coat of 32 mils. All metal on the inside of the valve vault shall be coated with Inextol epoxy and will also have a finish coat of 32 mils.

b. Valves: All valves used in station valve boxes shall be DeZurik Series or Clow with 100 percent full flow plug valves. Any valve eight inches or over must be gear operated.

9. *Telemetry.* All sewage pumping stations to be dedicated, given, or sold to the city shall be equipped with telemetry systems designed and constructed to city specifications. These systems must be manufactured by a manufacturer of equal or higher quality as the manufacturer used by the city. Any dispute concerning the quality of the telemetry system to be installed shall be resolved by the city in the city's sole and absolute discretion.

10. *Generators.* All sewage pumping stations to be dedicated, given, or sold to the city shall be equipped with standby power generator systems designed and constructed to city specifications. Generator sizing shall be based on across-the-line starting for all motors 50 horsepower and less. For motors larger than 50 horsepower, the use of reduced voltage starting devices will be considered on an individual basis. Any decision on the use of reduced voltage starting devices shall be made by the city in the city's sole and absolute discretion.

7.13. Water distribution systems.

7.13.1. *General.* This section sets forth the general requirements for design and installation of water distribution systems for potable water service.

7.13.2. *Design standards.*

1. Reference: Normal flow demands for design shall be calculated on the basis of full ultimate development as known, or projected. The average daily flow for domestic use shall be calculated at the minimum rate of 350 gallons per equivalent residential unit. Maximum day instantaneous demand to be used for design shall be 1.0 gallon per minute (GPM) per single-family residence and 0.7 GPM per dwelling unit for each multifamily or mobile home unit. Flow demands for commercial, industrial or other special developments shall be established from existing records or by estimated projections, using the best available data.

2. Water distribution systems and/or water main extensions shall be designed and constructed in accordance with the fire protection requirements of the Insurance Services Office (National Board of Fire Underwriters), as stated in their publication "Guide for the Determination of Required Fire Flows," if not in conflict with the following:

a. Fire flows in single-family residential areas shall provide a minimum of 600 GPM at 20 psi residual pressure.

b. Fire flows in commercial, institutional, industrial areas and apartment or multiunit complexes, shall provide a minimum of 1,500 GPM at a 20 psi residual pressure. Larger commercial/industrial, major shopping centers, schools, and similar uses shall have a fire flow capacity as determined necessary by the fire department.

c. Fire hydrants: Distance from or spacing of fire hydrants shall be a minimum of 600 feet from the furthest point of any residential structure and 300 feet from the furthest point of any commercial structure, as the fire department would lay hose or as otherwise specified by the fire department to meet determined water flow requirements for fire protection and/or increase fire protection effectiveness. Fire hydrants shall be connected to water mains of eight-inch mains in all areas. Connection to dead end stubs are acceptable, provided that said stubbed water main is not less than eight inches and will provide acceptable flow.

d. System size computation: The minimum design for water distribution systems shall provide for at least 100 percent of the combined maximum day-demand rate and required fire flow for said rate, with special provisions for peak flows in excess thereof. The allowable minimum service pressure under said design condition shall not be less than 20 pounds per square inch. Design computation shall be by the "Hardy Cross" procedure, or other applicable methods, as dictated by the system configuration. Design flows and method of computation shall be subject to review and approval by the city.

e. Valve locations: Valves shall be provided for all branch connections, loop ends, fire hydrant stubs, or other locations, as required to provide an operable, easily maintained, and repaired water distribution system. Valves are to be placed so that the maximum allowable length of water main required to be shut down for repair work shall be 500 feet in commercial, industrial or residential districts, or 800 feet in other areas.

7.13.3. *Standard requirements.*

1. *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 7.3, "Utility excavation, trenching and backfilling," section 7.4, "Boring and jacking," and section 7.5, "Pipe, fittings, valves and appurtenances," as well as "Standard details-water distribution systems."

2. *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, with the approval of the city (water and fire department).

3. *Joint restraining:* Pressure piping fittings and other items requiring restraint, shall be braced with 2,500 psi concrete thrust blocks or other 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.

4. *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, ductile iron pipe shall 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.

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

6. *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 as 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.

7. *Air venting and blowoffs:* Where the watermain 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. *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 or easement line, perpendicular to said line, and terminating with a plugged curb stop and meter box with standard plastic meter box with cast iron lid. Concrete boxes shall be used in high traffic areas 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 one-half-inch steel rebar, three inches below final grade.

7.13.4. *Testing.*

1. 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, in writing.

2. Piping and appurtenances to be tested shall be within sections between valves, not exceeding 2,000 feet 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.

3. 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 AWWA provisions for PVC-AWWA Publication M-23 and for DIP-AWWA Standard C600, Section 4. The allowable rate of leakage shall be less than the number of gallons per hour determined by the following formulas:

TABLE INSET:

	PVC		DIP
L =	NDP 1/2	L =	SDP 1/2

	7400		133,200
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For 150 psi; test: $L = 0.00165 ND$ (PVC)

For 150 psi; test: $L = 0.000092 SD$ (DIP)

L = Allowable leakage in gallons per hour

N = Number of joints in section tested

S = Length of pipe tested, in feet

D = Nominal diameter of the pipe in inches

P = Average test pressure maintained during the leakage test impounds per square inch gauge.

4. 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.

5. 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.

6. Pipe sections to be pressure tested shall be subjected to a hydrostatic pressure of 150 psi for a duration of two hours by means of a pump.

7.13.5. *Disinfecting.* 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, "Disinfecting Water Mains" and all appropriate agency approvals. Computation of the amounts of chlorine to be used for disinfection should be approved by the city or its engineer consultant.

1. 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.

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

3. Contractor shall provide the city with 48 hours advanced notice of disinfection.

7.13.6. *Record drawings.* The developer must provide one complete set of mylars and four complete sets of white copy prints 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 built" 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. Record drawings shall be the full set of approved construction drawings conformed to actual construction conditions.

7.14. Reclaimed water systems.

7.14.1. *General.* All developments shall be encouraged to install reclaimed water lines in such a manner as to provide service to the entire property of the development, and the main lines shall be of the size as designated by the director of public services and be extended across total property frontage to facilitate future extensions. The system shall be designed by a Florida registered engineer in accordance with regulations of the city and state department of environmental protection.

7.14.2. *Intent.* The reclaimed water system will eventually provide water for irrigation and structures constructed with dual plumbing systems. Therefore, the reclaimed water system shall be designed in accordance with the applicable section of this division. Discussions with the director of public services is required prior to designing improvements to discuss the applicability and availability of the installation of reclaimed water lines.

7.14.3. *System routing.* The city shall establish routes for the major distribution (transmission) lines of the reclaimed water system and developments which contain or abut these routes shall install the transmission line in an appropriate easement. Where routes have been established, the city engineer may require main line extensions in an appropriate easement across the full property frontage to facilitate future connection and extensions.

7.14.4. *Materials.* For the purposes of material specifications, reclaimed water lines shall be purple PVC of the same class as specified for potable water lines. Identification shall be as specified below:

All PVC pipe shall be of a solid purple color with white or other contrasting lettering as per lettering specifications listed below or shall have locating material as listed below, buried directly above the pipe. This locating material shall be purple with white or other contrasting lettering.

1. Within a reclaimed water system tracing wire shall be purple and brought to the surface and shall be attached to valves, hydrants, and tees. Tracing wire shall be installed

below all reclaimed water mains and service lines. Tracing wire installed with service lines shall connect to the tracing wire installed below the main and extended to the curb stop.

7.14.5. *Testing.* All hydrostatic testing shall conform to that specified for potable water mains.

7.14.6. *Promulgation and enforcement of reclaimed water service procedures and regulations.*

1. The director of public services shall have the power to promulgate procedures and regulations with respect to the following matters which procedures and regulations shall become effective upon a resolution approving same being adopted by the city:
 - a. Application procedures and requirements.
 - b. Installation requirements including specifications of acceptable materials, devices and regulations to help prevent backflow or cross-connections with other systems.
 - c. Procedures for enforcements of the ordinances and regulations pertaining to reclaimed water including procedures for inspection of the customer's system.
 - d. Procedures for the orderly expansion of the reclaimed water system.
 - e. Procedures and regulations for the efficient operation of the reclaimed water system.
2. Notwithstanding the foregoing, the director of public services may, when necessary for the efficient operation of the reclaimed water system or for the health or safety of the general public or the customer, establish regulations regarding the following matters which regulations shall become effective at the time of promulgation without the need for city approval:
 - a. The time(s) of day or night during which the reclaimed water may be used by customers.
 - b. The maximum rate of use of the reclaimed water.
3. No persons shall construct, operate, maintain or allow to remain present on property owned or controlled by him, any device or system which is connected to the city's reclaimed water system which is not in compliance with all provisions of this code related to reclaimed water and with all procedures and regulations promulgated pursuant to this section. The person who owns or controls the property upon which such a noncomplying device or system is found shall be liable to the city for the amount by which the costs associated with the securing and/or removal of the noncomplying device or system is located.
4. Any customer whose reclaimed water system is in violation of any city ordinance, regulation or procedure shall be subject to immediate discontinuance of reclaimed water service. Such discontinuance of service shall not relieve any person of liability for civil actions or for criminal or municipal ordinance violation prosecution.

7.14.7. *Unauthorized work on reclaimed water system.*

1. No persons, unless expressly authorized by the director of public services or his designee, shall tamper with, work on, or in any way alter or damage any city reclaimed water facility. Tampering or work shall include, but not be limited to, opening or closing of valves, turning on hydrants, or causing of any water to flow from the system. Nor shall any person or persons be authorized to:

- a. Cut into or make any improper connection with the system.
- b. Use any bib (faucet type connector), quick coupler (snap-on or lock-type connector), or any other device or mechanism that could be used for the reclaimed water system.
- c. Cause or allow their reclaimed water system to have any cross-connections (between two or more water supplies), any illegal connections or tie-ins, or any discharge of reclaimed water into the public water system.
- d. Let or rent to any other party or property any part of the reclaimed water system or use of the reclaimed water system in any manner or for any purpose other than described in the agreements and documents governing the reclaimed water system usage and executed by the user of the reclaimed water and the City of Crescent City. Any violations of the types listed above may result in discontinuance or termination of the reclaimed water service. The offending person shall be liable for the cost of all charges attributable to the correction of such tampering, including legal expenses, but payment of or correcting of such damage shall not relieve the offending person or persons from civil or criminal penalties the city or a court of law may impose for a violation of a city ordinance.

2. Any person who shall violate any of the provisions of the ordinance or regulations governing the reclaimed water system or who shall fail to comply therewith shall severally for each such violation and noncompliance respectively be levied such penalties as prescribed.

3. The service valve located between the reclaimed water customer's irrigation system and the city's distribution system may be operated by the customer when his private valve, required on the customer's premises, requires repair.

7.14.8. *Inspection.*

1. To ensure that the provisions of the city ordinance and regulations and procedures are being observed, the city reserves the right and privilege of inspecting, removing and/or securing any or all devices installed by the customer which connect to or control the reclaimed water.

- a. Inspections without cause to believe that an ordinance or regulation is being violated shall be at reasonable times and shall not exceed a reasonable frequency.

- b. Inspections where there is reasonable cause to believe that an ordinance or regulation is being violated shall be at such times and shall occur with such frequency as is necessary to establish that an ordinance or regulation is or is not being violated.
2. Each customer of reclaimed water shall, by application, give prior written consent of entry upon his premises, and thereby waives any other written notice for such inspection. Failure of the city to obtain such a written waiver shall not affect the right of the city to proceed pursuant to subsection (a) of this section.
3. Refusing to permit an authorized city agent or employee to enter onto the premises for the purpose of inspecting the customer's reclaimed water system pursuant to this section of the code shall constitute a violation of this section of the city code and shall be grounds for immediate discontinuance of the reclaimed water service by the city to the subject premises.