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FORWARD

This Utilities and Engineering Standards Manual was developed by the City of Coconut Creek. These standards are intended to serve the City of Coconut Creek, developers, engineers, engineering consultants, and contractors. The effort was focused on incorporating the City's Land Development Code into the Utilities and Engineering Standards Manual. The design criteria in these standards are intended for more conventional situations and practices. The City Engineer, or such designee, reserves all rights to perform the essential functions of that position, notwithstanding any inconsistency created hereby.

The Utilities and Engineering Department supports and enhances a high quality of life for the City of Coconut Creek residents and businesses by providing well-planned cost effective infrastructures, water and wastewater utilities, and services to promote public health and personal safety. Specific delineation of requirements is included to safeguard the public health or protect water quality justifying such definite actions.

These standards are intended to provide limiting values for items upon which an evaluation of the plans and specifications will be made by the City during the document review stage and to establish and to ensure, as far as practicable, component standardization so that an efficient and cost effective maintenance and operation is in effect upon construction completion, or once the system is turned over to the City.

It is understood that any references to specific City codes or Florida Statutes are as amended from time to time, and any such reference herein is a reference to then-existing current codes or statutes as of the date of the City's Notice to Proceed or the City's Permit Issuance, whichever is later in time.

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SECTION 1

GENERAL INFORMATION

1.01 PURPOSE

The Utilities and Engineering Standards Manual was created to plan for and establish technical standards for management of the roads, stormwater systems, water distribution systems, wastewater collection systems, and reclaimed water distribution systems within the City of Coconut Creek's utility service area and within and outside of City limits to accomplish the following goals:

A. To plan for and better accommodate transportation and utility users

B. To establish user procedures, not expressly stated in the City's Ordinances

C. To establish user service policies, not expressly stated in the City's Ordinances

D. To establish minimum technical specifications and standards for approval of water, wastewater and reclaimed water transmission, collection and distribution systems to be constructed within the utility service area (herein sometimes referred to as "utility" or "utilities"), and

E. To establish minimum technical specifications and standards for approval of transportation infrastructure and stormwater systems within City limits.

1.02 DEFINITIONS

Except where specific definitions are used within a specific section, the following terms, phrases, words, acronyms, and their derivation must have the meaning given when consistent with the context (see Table 1 for the list of definitions). Words used in the present tense include the future tense; words in the plural number include the singular number; and words in the singular number include the plural number. The word "must" is mandatory, and the word "may" is permissive. Any reference to a standard must be taken to mean the latest published edition unless otherwise noted.

TABLE 1. Definitions

Definitions	
AADT	Annual Average Daily Traffic
AASHTO	American Association of State Highway and Transportation Officials
ACOE	Army Corps of Engineers
ADA	Americans with Disabilities Act, as amended
ADF	Average Daily Flow
ADT	Average Daily Traffic
AFBMA	American Bearing Manufacturers Association
ANSI	American National Standards Institute
APPLICANT/DEVELOPER	the person, firm, or corporation engaged in developing or improving real estate for use or occupancy
ARV	Air Release Valve
ASCE	American Society of Civil Engineers
ASTM	American Society for Testing Material
ATSSA	American Traffic Safety Service Association
AutoCAD	Automated Computer-Aided Design
AWWA	American Water Works Association
BCEPGMD	Broward County Environmental Protection and Growth Management Department
BMP	Best Management Practices
BRM	Brinnell Hardness Number
BUILDER	the person, firm or corporation engaged in developing or improving real estate for use or occupancy; used interchangeably with the word Developer
BFV	Butterfly Valves
CV	Check Valves
CITY	City of Coconut Creek and/or its Utilities and Engineering Department and/or its designated representative(s)
CITY ENGINEER	the Director of the City of Coconut Creek Utilities and Engineering Department or authorized designee
CONTRACTOR	the person, firm, or corporation with whom the contract for work has been made by the owner, the Builder, or the City
DEPARTMENT	the City of Coconut Creek Utilities and Engineering Department; used interchangeably with “City”

Definitions	
DEVELOPER/BUILDER'S ENGINEER	an Engineer or engineering firm registered with the State of Florida Department of Professional Regulation, retained by the Developer to provide professional engineering services for a project
DIP	Ductile Iron Pipe
DIPRA	Ductile Iron Pipe Research Association
DRAWINGS	engineering drawings prepared to show the proposed construction
DRC	Development Review Committee (Coconut Creek)
ENGINEER OF RECORD (EOR)	an Engineer or Engineering firm registered with the State of Florida Department of Professional Regulation
EPA	United States Environmental Protection Agency
ERC	Equivalent Residential Connection
FAC	Florida Administrative Code
FC	Friction
FDEP	Florida Department of Environmental Protection
FDOH	Florida Department of Health
FDOT	Florida Department of Transportations
FEMA	Federal Emergency Management Agency
FHA	Federal Highway Administration
FIRM	Flood Insurance Rate Map
FSS	Federal Supply Schedule
Gmp	Gallons Per Minute
GSA	General Services Administration
GV	Gate Valves
GEOTECHNICAL/SOILS ENGINEER	a Registered Florida Engineer who provides services related to terrain evaluation and site selection, subsurface exploration and sampling, determination of soil and rock properties, foundation engineering, settlement and seepage analysis, design of earth and earth retaining structures, the design of subsurface drainage systems and the improvement of soil properties and foundation conditions, and testing and evaluation of construction materials
HDPE	High-Density Polyethylene
ID	Internal Diameter
IEEE	Institute of Electrical and Electronics Engineers
ITE	Institute of Transportation Engineers

Definitions	
LCD	Longitudinal Channelizing Devices
LBR	Lime Rock Bearing Ratio
LIFT STATIONS (Wastewater and Stormwater)	a wet well that collects wastewater or stormwater in order to pump wastewater or stormwater (under pressure) to a higher elevation
LOS	Level of Service
MANUAL	this City of Coconut Creek Utilities and Engineering Standards Manual, as may be amended from time to time
MAS	Maintenance Access Structures
MGD	Million Gallons per Day
MUTCD	the United States Department of Transportation Manual on Uniform Traffic Control Devices
NAVD 88	North American Vertical Datum 1988
NGVD 29	National Geodetic Vertical Datum 1929
NEMA	National Electrical Manufacturers Association
NPDES	National Pollution Discharge Elimination System
NSF	National Sanitation Foundation
NPHSR	Net Positive Suction Head Required
NPT	National Pipe Thread
OD	Outer Diameter
OSHA	Federal Occupational Safety and Health Administration
OWNER	the person, firm, corporation, or governmental unit holding right of possession of the real estate upon which construction is to take place
PDF	Portable Document Format
PLANS	drawings, as defined above
PV	Plug valves
PPFA	Plastic Pipe and Fitting Association
PVC	Polyvinyl Chloride
RECLAIMED WATER MAINS	water used more than once before it is passed back into the water system
ROADWAY	paved area within public rights-of-way or private property
RTU	Remote Terminal Unit
SFWMD	South Florida Water Management District
SDR	STANDARD DIMENSION RATIO
SP	Superpave

Definitions	
STANDARD DRAWINGS	the detailed drawings in this Manual related to utility materials and installation
STORMWATER SYSTEMS	A system that is a tool for managing the runoff from rainfall
SURVEYOR	person licensed in Florida under Chapter 472 of the Florida Statutes to practice land surveying in the State of Florida
SWPPP	Storm Water Pollution Prevention Plan
TTCP	Temporary Traffic Control Plan
UL	Utilities Laboratories
USDA	United States Department of Agriculture
USDOT	United States Department of Transportation
UTILITIES	water, wastewater, reclaimed water utilities, along with communication utilities
UTILITY ACCOMMODATION Manual	FDOT Utility Accommodation Manual
UTILITY SERVICE AREA	the utilities service area defined by the City's Code of Ordinances
WASTEWATER MAINS	wastewater transmission mains, ARV's, distribution mains, pipes, fittings, valves, services, meters, and miscellaneous related appurtenances
WATER MAINS	water transmission mains, distribution mains, ARV's, pipes, automatic flushers, fittings, valves, hydrants, blow-off assemblies, sample points, services, meters and miscellaneous related appurtenances
WCD	Water Control District
WORK	the labor, materials, equipment, supplies, services, and other items necessary for the execution, completion, and fulfillment of the contract

1.03 CRITERIA OF REVIEW

No utilities may be constructed in the utility service area without obtaining prior City approval. The City evaluates applications for approval to construct such facilities based upon the following criteria:

A. Compliance to the procedures and technical specifications of the Department, as contained within this Manual

B. Compliance with the City's planning and zoning regulations, where applicable

C. Compliance with the City's Comprehensive Plan, as amended, and

D. Compliance with the City's Land Development Code of Ordinances.

1.04 GENERAL INFORMATION

The information set forth in this document is intended to provide minimum standards for approving design and construction of infrastructures, paving, traffic, water distribution, reclaimed water distribution, wastewater collection, and storm water drainage systems.

A. It must be the responsibility of the applicant to secure proper existing utility information and prepare drawings (including plan and profile sheets) in accordance with these minimum standards. It remains the right of the applicant to exceed these standards.

B. Construction drawings must contain City-approved plan and profile sheets showing all utilities and storm drains. No changes must be made on approved drawings without approval of the City, and construction must not begin prior to plan approval and required permits.

C. Contractor must always have a City-approved set of drawings and specifications on the project site. This set must be the only official record set for construction.

D. Contractor must use accurately marked piping and covers (maintenance access structures, valves, etc.) for any piping projects.

E. The applicant must furnish shop drawings, approved by the Engineer, to the City for approval prior to construction on all materials incorporated in a project.

F. Plans that depict Site, Landscaping, and Survey drawings must be a part of the final engineering set and must be approved by the City.

1.05 PLANS AND SPECIFICATIONS

A. All submitted plans must be standard size sheets 24 inches by 36 inches, with a title block. Graphic scale(s) must be provided on each sheet, and all lettering must be 1/8 inch or larger to permit photographic reproduction. Submittal of specifications must be required for all proposed improvements. All plan sheets and the title page of submitted specifications must be signed, sealed, and dated by the Developer's Engineer.

B. The entire utility system must be shown on a single master plan. The master plan must indicate the general locations of all mains, maintenance access structures, valves, hydrants, drainage structures, pump stations, water services, and service laterals, with respect to the proposed development improvements and the existing utility systems. Main sizes and materials must be indicated on the master plan. A master paving, grading, and drainage plan must show all existing and finished grades, all stormwater inlets/catch basins, and all conveyance systems.

C. All proposed wastewater mains, and stormwater mains must be drawn in plan and profile view. All potable and reclaimed water mains may be shown in plan view. All finished surface grades must also be shown on the plan and profile sheets.

D. All roadways must be drawn in plan and profile view.

E. Potable water, reclaimed water, wastewater, and stormwater systems must be shown on separate plan sheets.

F. All drawings' coordinate datum must be NAVD 88.

G. As a minimum, the plan and profile drawings must include the following information:

1. General information, such as north arrow, names of Developer, and Engineer, revision block with dates, graphic scale(s), and sheet number

2. Profile with elevations at 50-foot intervals, or more frequently if required by good design practice

3. Development layout with horizontal and vertical controls

4. All conflicts with other utility and stormwater systems

5. All maintenance access structure locations and rim elevations for maintenance access structures outside of paved areas

6. Pipe data, including size, lengths, material, and slopes

7. Size, type, and locations of fittings, valves, hydrants, air release/vacuum relief, and other related appurtenances

8. Limits of pipe deflection

9. Limits of special exterior coatings

10. Limits of special bedding requirements

11. Pipe restraint requirements

12. Details of connection to existing systems

13. Location(s) and general layout of wastewater and Stormwater pumping stations

14. Construction notes regarding cover, horizontal and vertical control, special construction requirements, and references to standard and special details

15. Location and size of all relevant structures

G. The plans must include all applicable standard drawings, as shown in this Manual. Special details must be prepared by the Developer's Engineer for aerial and underwater crossings of rivers, streams, canals, and ditches. Other details may be prepared by the Developer's Engineer, as required.

H. The master plan must be prepared at a scale not to exceed 1 inch to 200 feet. Plan and profile sheets must not exceed a scale of 1 inch to 50 feet. Special details must be of sufficiently large enough scale to show pertinent construction information.

1.06 ADMINISTRATIVE PROCEDURES

This section covers all utility improvements that are to be dedicated to the City. Such improvements must be designed, reviewed, constructed, and accepted in accordance with the criteria established herein.

A. Design of utility improvements must comply with the design standards and the specifications outlined in this Manual. Plans will be reviewed and approved by the City, as part of the Final Engineering review process. The review process consists of the following seven (7) steps:

1. Final Engineering review applications, plans, and fee submittal

2. Application/Plans review by the City

3. Comments returned to Developer

4. Execution of Water and Wastewater Agreement, as applicable

5. Final plan submittal and payment of City fees for approval

6. Execution of construction bonds, as applicable

7. City Engineer signs applications from Florida Department of Environmental Protection (FDEP) and other agencies, as applicable

B. According to Chapter 13, sections 13-186 and 13-187, before an engineering permit is issued, a Surety/Performance bond must be posted to the City by the Developer and executed by a company authorized to do business in the State of Florida that is satisfactory to the City, payable to the City in the amount of 100 percent of the estimated construction cost of all required transportation and utility improvements to be owned and maintained by the City. Such bond must guarantee construction of all

improvements intended to be owned and maintained by the City. As an alternative to the provision of a Surety/Performance Bond, the Developer may provide a deposit of cash in an escrow account.

C. The City must inspect all construction subject to these standards and specifications. These inspections must include substantial and final completion inspections. Non-compliance with approved plans or specifications or evidence of faulty materials or workmanship will be called to the attention of the Developer or Developer's Engineer. If not corrected in an expeditious manner, all work on the project must be suspended and/or the certificate of occupancy withheld. Laboratory tests may be required when appropriate.

D. After all required improvements have been installed, the Developer's Engineer must submit certification to the City that the improvements have been constructed substantially, according to approved plans and specifications.

E. The Engineer of Record (EOR) must submit a certified set of Record Drawings to the City prior to final engineering inspection of the improvements. The Developer's Engineer must be responsible for recording information on the approved plans concurrently with construction progress. After approval by the City Engineer, Record Drawings must be submitted to the City in digital format (AutoCAD). Digital format is to be compatible with the City's GIS standards. The drawing coordinate datum must refer to NAVD88. The Drawings must comply with all the following requirements:

1. One (1) full size and complete set of Record Drawings certified by the EOR along with electronic files in AutoCAD and PDF.

2. Drawings must be legibly marked to record actual construction.

3. Drawings must show the actual location of all underground and above ground utilities and related appurtenances. All changes to piping location, including horizontal and vertical locations of utilities and appurtenances, must be clearly shown and referenced to permanent surface improvements. Drawings must also show actual installed pipe material, class, etc.

4. Drawings must clearly show all field changes of dimension and detail, including changes made by field order or by change order.

5. Drawings must clearly show all details not on original contract drawings but constructed in the field. All equipment and piping relocations must be clearly shown.

6. Locations of all maintenance access structures, drainage structures, lift stations, hydrants, meters, ARVs, blow-off assemblies, valves, and valve boxes must be shown. All valves must be referenced from at least two, and preferably three, permanent tie points.

7. Dimensions between all maintenance access structures must be field verified and shown. The inverts and grade elevations of all maintenance access structures must be shown.

8. Record drawings submittal must include Survey, Site Plan, Traffic, PD&G, Water, and Wastewater, Profiles, Details, and Landscaping plans.

F. Each sheet of the plans must be signed, sealed, and dated by the EOR as being “Record Drawings.” Construction plans simply stamped “Record Drawings" and lacking in above requirements will not be accepted and will be returned to the Developer’s Engineer. The Performance Bond release must not be processed until correct Record Drawings have been submitted and approved.

G. After successful completion of all engineering improvements, a final inspection must be performed and accepted by the City Engineer; and after receipt of the required documents, the EOR must provide the City with a Certificate of Completion. The required documents must include Record Drawings, Contractor’s final waiver of lien, applicable operation and maintenance manuals, Bill of Sale, Utility Easement Dedication to the City, as needed, Consent to Easement, and final construction cost information based on actual construction costs.

H. A Maintenance Bond in the amount of 25 percent of the Surety/Performance Bond must be required before final approval. The Maintenance Bond must remain in effect for one (1) year. After the one (1)

year warranty period and verification by the City of satisfactory performance of all engineering improvements, the City must issue the "Approval for Maintenance," thereby releasing the Developer from further responsibilities.

1.07 LIST OF MATERIALS AND APPROVED MANUFACTURERS

A list of materials and approved manufacturers for the various products specified in this Manual is included in Appendix A. It is the intent of the City to review and update Appendix A as appropriate to ensure efficient operation of the services and facilities under the jurisdiction of this Manual. For this purpose, the City must evaluate technical submittals from interested manufacturers or suppliers at least once every three (3) years.

1.08 PERSONS TO CONTACT

Key persons to contact concerning this Manual are as follows:

Director of Utilities and Engineering Department
City of Coconut Creek
5295 Johnson Road
Coconut Creek, Florida 33073
Telephone: (954) 973-6786

1.09 PAYMENT OF FEES

Fees, as adopted by the City, must be applied in conjunction with each application. Fees must consist of an engineering permit fee and all applicable connection fees, impact fees, and capital recovery costs for the system connection. Payment of fees must be as follows:

A. At the time of Final Engineering Review for utility systems, a Water and Wastewater and/or Reclaimed Water Agreement must be executed, as applicable, and impact and other related fees must be paid according to the Land Development Code, Chapter 13 of the City of Coconut Creek's Code of Ordinances, as same describes when the Developer must make payment of such impact fees.

B. Before the issuance of the engineering permit, the engineering permit fee must be paid according to the Land Development Code, Chapter 13 of the City of Coconut Creek Code of Ordinances.

1.10 REGULATORY PERMITS

All permits required from Federal, state, or local government entities having jurisdiction over the facilities proposed to be installed must be obtained by the applicant prior to issuance of engineering permit. Any application that fails to meet the requirements of all Federal, state, and local governing bodies will be deemed incomplete by the City.

1.11 FEES SUBJECT TO CHANGE

Impact fees must be adjusted according to the Engineering News Record Construction Cost Index. Applicants who have secured capacity reservations or allocations under this policy must be subject to such changes provided that they are in compliance with the provisions of the large user agreement. Applications made after changes in the impact fees must be subject to such changes.

1.12 ZONING

Plans for construction of utilities may be subject to review by the City. For this purpose, the property must be appropriately zoned or platted to support the proposed facilities and must comply with all appropriate aspects of the applicable planning and zoning codes.

SECTION 2

GENERAL CONSTRUCTION REQUIREMENTS

2.01 GENERAL

This section sets forth the general requirements for construction and installation of transportation infrastructure and utilities.

2.02 GRADES, SURVEY LINES, AND PROTECTION OF MONUMENTS

A. Grades

All work must be constructed in accordance with the lines and grades shown on the approved plans. The full responsibility for keeping alignment and grade must rest upon the Developer. Benchmarks and base line controlling points must be established prior to beginning work. Reference marks for lines and grades as the work progresses must be located to cause as little inconvenience to the performance of the work as possible. The Contractor must place excavation and other materials to cause no inconvenience in the use of the reference marks provided. The Contractor must remove any obstructions placed contrary to this provision.

B. Surveys

The Contractor or Surveyor must furnish and maintain, at their own expense, stakes and other such materials, and give such assistance, including qualified helpers, for setting reference marks to the satisfaction of the City and the Engineer. The Contractor must check the reference marks by such means as they may deem necessary and, before using this, the Contrctor must call the City's Engineer for any inaccuracies. The Contractor must, at their own expense, establish all working or construction lines and grades, as required from the reference marks, and must be solely responsible for the accuracy thereof.

C. Monument Preservation

Property corners and survey monuments must be preserved using care not to disturb or destroy them. If a property corner or survey monument is

disturbed or destroyed during construction, whether by accident, careless work, or required to be disturbed or destroyed by the construction work, the property corner or survey monument must be restored by a professional mapping land surveyor registered in the State of Florida. All costs for this work must be paid for by the Contractor.

2.03 UTILITY COORDINATION

A. Location of Utilities

Per the “Underground Facility Damage Prevention and Safety Act,” Chapter 556, Florida Statutes, prior to proceeding with excavation, the Contractor must contact Sunshine 811 for aid in locating existing underground facilities. It is the Contractor’s responsibility to contact Sunshine 811 for markings at least two (2) working days before starting construction. The Contractor must proceed with caution in the excavation and preparation so that the exact location of underground utilities may be determined. The Contractor must take all reasonable precautions against damage to existing utilities. However, in the event of a break with an existing utility, the Contractor must immediately notify the responsible official of the organization operating the interrupted utility. The Contractor must lend all possible assistance in restoring services and must assume all cost, charges, or claims connected with the interruption and repair of such services.

B. Deviations Occasioned by Structures or Utilities

Wherever obstructions are encountered during the progress of the work and interfere to such an extent that an alteration in the plans is required, the City must have the authority to order a deviation from the line and grade or arrange with the structures’ owners for the removal, relocation, or reconstruction of the obstructions. Where existing utilities are an impediment to the vertical or horizontal alignment of the proposed utility, the City must approve a change in grade or alignment or must direct the Contractor to arrange with the owners of the utilities for their removal. If a change in-line or grade of gravity lines are necessary, the City may require the addition of any maintenance access structures needed to maintain the integrity and flow of the system.

C. Soft Digs

Soft digs for the purpose of locating underground utilities or structures in advance of the construction must be excavated, backfilled, and restored by the Contractor. All appropriate utility companies must be notified 48 hours in advance of any test pit investigation. Test pits must be backfilled immediately after their purpose has been fulfilled and maintained in a manner satisfactory to the City. Costs associated with such test pits must be the responsibility of the Contractor.

2.04 TEMPORARY TRAFFIC CONTROL/MAINTENANCE OF TRAFFIC AND ROAD CLOSURES

A. The Contractor must carry on the work in a manner that will cause a minimum of interruption to traffic. A Temporary Traffic Control Plan (TTCP) in accordance with the latest edition of The Florida Department of Transportation's (FDOT) Design Standards, Broward County Minimum Standards, or Manual of Uniform Traffic Control Devices (MUTCD), must be submitted to the City and the responsible authorities having jurisdiction. The approved TTCP must always be on-site. Where traffic must cross open trenches, the Contractor must provide suitable bridges at street intersections and driveways. The Contractor must post suitable signs indicating that a street is closed and necessary detour signs for the proper maintenance of traffic. Prior to closing any streets, the Contractor must notify, when applicable, the Broward County Traffic Engineering Division, FDOT, and the City to obtain the approval of responsible authorities. TTCP applications must include a worksite traffic supervisor with a valid FDOT or American Traffic Safety Service Association (ATSSA) certification. TTCP submittals with an FDOT Standard Index or a Typical Application figure from the MUTCD, must submit an Intermediate Level Certification Card. If a sketch is submitted with the standard index, an Advanced Level Certification Card will be required. The certification card is required to contain the student's name, instructor's name, course provider, course category (Advance or Intermediate), date course was successfully completed, and date when training or refresher course is required. The certified worksite traffic supervisor must be present to direct the initial set up of the traffic control plan and must be available on a 24-hour basis.

1. Permission to close a street must be received in writing from the proper authority (City, County, FDOT, etc.). All excavated material must be placed so that vehicular and pedestrian traffic may be always maintained. If the Contractor's operations cause traffic hazards, the Contractor must clean and/or repair the road surface, provide temporary pathways for pedestrians, erect wheel guards or Longitudinal Channelizing Devices (LCD), or take other measures for safety satisfactory to the City. If a road or lane closure is proposed, proper notification must be given to City agencies (Police, Fire, etc.) or take other measures for safety satisfactory to the City.

2. Detours around construction will be subject to the approval of the authority having jurisdiction and the City. Where detours are permitted, the Contractor must provide all necessary barricades and signs as required to divert the flow of traffic. While traffic is detoured, the Contractor must expedite construction operations.

3. It must be the sole responsibility of the Contractor to take precautions to prevent injury to the public due to open trenches. Nighttime personnel may be required where special hazards exist, or police protection may be provided for traffic while work is in progress. The Contractor must be fully responsible for damage or injuries whether or not protection has been provided.

4. All Maintenance of Traffic (MOT) traffic control devices deployed within the City of Coconut Creek shall be removed from the roadways during AM and PM peak travel periods, unless approved by the City Engineer and/or their designee. Peak travel periods are defined as 7:00 a.m. to 9:00 a.m. and from 4:00 p.m. to 6:00 p.m. Prior to re-opening of all roadways, bike lanes or sidewalks, it is the contractor's responsibility to ensure all facilities shall be free of grease, oil, debris, loose impediments and any other physical hazards.

2.05 PROTECTION OF PUBLIC AND PROPERTY

A. Barricades, Guards, and Safety Provisions

The Contractor must be solely responsible for adhering to the rules and regulations of the Occupational Safety and Health Administration (OSHA) and appropriate authorities regarding safety provisions. To protect persons from injury and to avoid property damage, adequate barricades, construction signs, lights, and guards must be placed and maintained by the Contractor at their expense during the progress of the work and until it is safe for traffic to use the roads and streets. All storage of materials, equipment, and pipes that may serve as obstructions to traffic must be enclosed by fences or barricades and must be protected by proper lights when visibility is poor. All signs and barricades must be in accordance with the most recent edition of the MUTCD and/or current version of FDOT Design Standards.

B. Protection of Utility Structures

Temporary support, adequate protection, and maintenance of all underground and surface utility structures, including inlets, utility mains, maintenance access structures, hydrants, valves, ARV's, covers, power poles, and other miscellaneous utility structures encountered in the progress of the work, must be furnished by the Contractor at their expense, as approved by the City. Any such structures that may have been disturbed must be restored immediately upon completion of the work.

C. Open Excavation

All open excavations must be adequately safeguarded by providing temporary barricades, caution signs, lights, and other means to prevent accidents to persons and damage to property. The Contractor must, at their own expense, provide suitable and safe bridges with hand railings that comply with the Americans with Disabilities Act (ADA), and other crossings for accommodating travel by pedestrians and workers. Bridges provided for access to private property during construction must be removed when no longer required. The length of an open trench must be controlled by the particular surrounding condition but must be limited to 300 feet unless otherwise approved by the City. If the excavation becomes a hazard, or if it excessively restricts traffic at any point, the City may require special construction procedures such as limiting the length of open trench, fencing, prohibiting excavated material in the street, and requiring that the trench must not remain open overnight. The Contractor must take

precautions to prevent injury to the public due to open trenches. All trenches, excavated material, equipment, or other obstacles that could be dangerous to the public must be well lit at night. If applicable, temporary trench restoration must be suitable for traffic loads or applicable traffic-rated steel plates must be placed.

D. Excavation Site Safety

Whenever an excavation site or trench is left unattended by the Contractor or when an area is not within 100 feet of observation by the Contractor, the excavation site or trench must be filled and/or, at the City's discretion, protected by other means to prevent accidental or unauthorized entry. Such protection must include barricades and other protection devices requested by the Engineer or City, including temporary chain link fencing, LCDs and/or plastic water barriers fencing or temporary "structure" tape. Such safety items must not relieve the Contractor of any site safety requirements or liabilities established by Federal, state, and local laws and agencies, including OSHA, but is intended as additional safety measures to protect the public. Trench construction must comply with the Florida Trench Safety Act and OSHA 1926.651 Specific Excavation Requirements.

E. Protection of Trees and Shrubs

A tree removal or replacement permit must be obtained from the City when applicable. All trees and shrubs not shown to be removed on the plans must be protected by the Contractor, in compliance with subdivision 4 of the City of Coconut Creek Land Development Code, and at their expense. No excavated materials must be placed to injure such trees or shrubs. Trees or shrubs destroyed by the Contractor's negligence, or their employees must be replaced, as approved the Landscaping Division, at the sole expense of the Contractor. Replacement may mean mitigation to recover lost canopy which is calculated per City code.

Standards and requirements for root barrier, structural soil, and soil cells can be found in the Landscape Standards and Requirements section of the City of Coconut Creek Land Development Code, Article IV.

F. Protection of Lawn Areas

Lawn areas must be left in equal or better condition as before the start of the work. Where sod is to be removed, it must be carefully restored with new sod of the same type.

G. Restoration of Fences

Any fence, or part thereof, that is damaged or removed during the work must be replaced or repaired by the Contractor and must be restored to an equal or better condition as before the starting of the work. The manner in which the fence is repaired or replaced, and the materials used must be subject to the approval of the City.

H. Protection Against Siltation and Bank Erosion

The Contractor must arrange their operations to minimize siltation and bank erosion on construction sites and on existing or proposed water courses and drainage ditches according to the Storm Water Pollution Prevention Plan (SWPPP), as set forth in the National Pollution Discharge Elimination System (NPDES) program in Section 403.0885, Florida Statutes. The Contractor must provide for the interception and retention of small amounts of sediment (silt) from construction sites in order to prevent silt from leaving the site. Filter barriers or silt fences must be employed in this regard. Filter barriers composed of burlap or standard weight synthetic fabric stapled to wooden stakes must be used in ditch lines, around drop inlets, and at temporary sites where construction affects the earth contour and water runoff. Filter barriers must be used where flows not exceeding one (1) cubic foot per second are expected. Silt fences must be employed where sheet or overland flows are expected. Filter barriers and silt fences must be constructed according to the guidelines set forth by FDEP. The Contractor, at their own expense, must remove any siltation deposits and restore the site to the original grade.

2.06 ACCESS TO THE PUBLIC SERVICES

A. Neither the materials excavated, nor the materials or equipment used in the construction of the work must be so placed to prevent free access to public services. All excavated material must be stored in a manner that will not endanger the work and that will avoid obstructing streets, sidewalks, and driveways. Excavated material suitable for backfilling must be

stockpiled separately and protected on the site. No material must be placed closer than two (2) feet from the edge of an excavation. Fire hydrants under pressure, valve pit covers, valve boxes, curb stop boxes, or other utility controls must be left unobstructed and accessible until work is completed. Gutters must be kept clear, or other satisfactory provisions made for street drainage. Natural water bodies must not be obstructed nor polluted. Surplus material and excavated material unsuitable for backfilling must be transported and disposed of offsite in disposal areas obtained by the Contractor.

2.07 PUBLIC NUISANCE

A. The Contractor must not create a public nuisance, including, but not limited to, encroachment on adjacent lands, flooding of adjacent lands or excessive noise, vibration or dust. The Contractor must eliminate noise and be within United States Environmental Protection Agency (EPA) Standards and the City's Code of Ordinances to the greatest extent as possible.

2.08 CONSTRUCTION HOURS

A. All construction activity must be done in accordance with the City's Code of Ordinances Sec. 14-28 between the hours of 7:00 a.m. and 7:00 p.m. Monday through Friday, between 8:00 a.m. and 7:00 p.m. on Saturdays, and between 8:00 a.m. and 6:00 p.m. on Sundays and national holidays. Construction during additional hours and/or nighttime work will require an Extended Hours Permit approved by the City Manager. Written notification prior to starting construction must be provided to the City a minimum 48 hours before commencement.

2.09 CONSTRUCTION IN EASEMENTS, RIGHTS-OF-WAY, AND PRIVATE PROPERTY

A. Construction in Easements: Work within easements may require an engineering permit and must comply with the Engineering Permits Sec. 13-40 in the City's Code of Ordinances. In easements across private property, the Contractor must confine all operations within the easement

area and must be responsible and liable for all damage outside of the easement area. Trees, fences, shrubbery, or other type of surface improvements located within easements must be protected per landscape requirements, noted in the Land Development Code, during construction. If trees, fences, shrubbery, or other types of surface improvements must be removed due to construction, then they must be replaced as approved the Landscaping Division. Replacement may mean mitigation to recover lost canopy which is calculated per City code. Precautions must be taken by adequate sheeting or other approved method to prevent any cave-in or subsidence beyond the easement limits or damage to improvements within the easement. In general, the easement area is intended to provide reasonable access and working area for efficient operations by the Contractor. Where easement space for efficient operations is not provided, the Contractor must be responsible for organizing operations to perform within the restrictions shown on the plans.

B. Construction in FDOT Rights-of-Way: The Contractor must strictly adhere to the requirements of the FDOT where construction work is in a right-of-way under the jurisdiction of the State of Florida and must take care to avoid any unreasonable traffic conflicts due to such work.

C. Construction in City of Coconut Creek Rights-of-Way and Property Within City Limits: Work must be governed by City of Coconut Creek regulations as amended.

D. Construction in Broward County Rights-of-Way: The Contractor must strictly adhere to the requirements of Broward County where construction work is in the rights-of-way under jurisdiction of Broward County and must take care to avoid any unreasonable traffic conflicts to work in the road rights-of-way.

2.10 SUSPENSION OF WORK DUE TO WEATHER

A. During inclement weather, all work that might be damaged or rendered inferior by such weather conditions must be suspended. During suspension of work from any cause, the work must be suitably covered, secured for public safety, restrained/strapped, and protected to preserve it from damage by the weather or otherwise.

2.11 USE OF CHEMICALS

A. All chemicals used during project construction or furnished for project operations, whether herbicide, pesticide, disinfectant, polymer, reactant, or other classification, must show approval from either the EPA or the United States Department of Agriculture (USDA). Use of all such chemicals and disposal of residues must be in strict conformance with label instructions. All chemicals in contact with potable water must be National Sanitation Foundation (NSF) approved. Proper disposal of chemicals must be required and verified in writing.

2.12 COOPERATION WITH OTHER CONTRACTORS AND FORCES

A. During construction, it may be necessary for other contractors and City employees to work in or about the site. The City reserves the right to put other contractors to work and to afford such access to the construction site and at such times as the City deems proper. The Contractor must cooperate with the other contractors for proper prosecution of work.

2.13 SUBSURFACE EXPLORATION

A. The Contractor must make subsurface explorations, as the Contractor believes necessary, to perform the work or as directed by the EOR.

2.14 CLEANING

A. During Construction

The Contractor must always keep the construction site and adjacent premises free from material, debris, and rubbish, as practicable, and must remove the same from any portion of the site, if in the opinion of the City such material, debris, or rubbish constitutes a nuisance, or is objectionable. Dust, erosion, and sediment control must be maintained during construction.

B. Final Cleaning

At the conclusion of work, all tools, equipment, temporary structures, and materials belonging to the Contractor must be promptly removed. The Contractor must remove and promptly dispose of all water, dirt, chemicals, rubbish, or any other foreign substances.

2.15 SALVAGE

A. Any existing City-owned equipment or material, including, but not limited to, valves, pipes, fittings, couplings, etc., that is removed or replaced because of construction may be designated as salvage by the City and, if so, must be carefully removed from the site and delivered to a storage area designated by the City.

2.16 SHOP DRAWINGS AND SAMPLES

A. If requested by the City, the Contractor must, prior to construction, submit shop drawings signed by the Developer's Engineer to the City. The data shown on the shop drawings must be complete with respect to dimensions, design criteria, materials of construction and the like to enable review of the information as required. The Contractor must, if requested by the City, furnish certificates, affidavits of compliance, test reports or samples for analysis for any of the materials specified in this Manual.

2.17 CLEARING AND GRUBBING

A. The Contractor must obtain an engineering permit for clearing and grubbing.

B. Erosion and sediment control measures and Best Management Practices (BMP) according to the SWPPP, must be in place prior to and during clearing and grubbing and inspected by the Engineering inspector.

C. The Contractor must clear and grub all the area within the limits of construction, as shown on the plans and approved by the City, prior to the

beginning of any work. All site work must conform to the City's applicable site clearing, landscaping, and tree ordinances.

1. Clearing

The surface of the ground for the area to be cleared and grubbed must be completely cleared of all timber, brush, stumps, roots, grass, weeds, rubbish, and all other objectionable obstructions resting on or protruding through the surface of the ground. However, trees and shrubs must be preserved as specified in Section 2.05E. Clearing operations must be conducted to prevent damage to existing structures and installations and to those under construction and as to provide for the safety of employees and others.

D. The removal of trees may require a tree removal permit. The Contractor must contact the City of Coconut Creek's Landscaping Division for details.

2. Grubbing

Grubbing must consist of the complete removal of all stumps, roots larger than 1 1/2 inches in diameter, matted roots, brush, timber, logs, and any other organic or metallic debris not suitable for foundation purposes resting on, under or protruding through the surface of the ground to a depth of 18 inches below the subgrade. All depressions excavated below the original ground surface for or by the removal of such objects must be refilled with suitable materials and compacted to a density conforming to the surrounding ground surface.

3. Stripping

In areas so designated, topsoil must be stripped and stockpiled. Topsoil stockpiled must be protected until it is placed as specified. Any topsoil remaining after all work is in place must be disposed of by the Developer.

2.18 EXCAVATION, BACKFILL, COMPACTION, AND GRADING

A. Contractor Furnish Labor, Materials, Equipment, Incidentals

The Contractor must furnish all labor, materials, equipment, and incidentals necessary to perform all excavation, backfill, fill, compaction, grading, and slope protection required to complete work shown on the plans and specified herein. Work must include, but not necessarily be limited to, pump stations, maintenance access structures, vaults, conduit, pipe, roadways, paving, backfilling, fill and required borrow, grading, disposal of surplus and unsuitable materials, and all related work, such as sheeting, bracing, and water handling.

B. Examination and Subsurface Investigations

The Contractor must examine the site and undertake subsurface investigations, including soil borings before commencing work. The City will not be responsible for presumed or existing soil conditions in the work area.

C. Existing Utilities

The Contractor must locate existing utilities in the areas of work by following proper locating procedures as stipulated under the Florida Underground Facility Damage Prevention and Safety Act as specified in Section 2.03. If utilities are to remain in place, the Contractor must provide adequate means of protection during earthwork operations. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, the Contractor must consult the owner of such piping or utility immediately for directions. Payment for damage and repair to such piping or utilities is the Contractor's responsibility. The City must not be responsible for uncharted or incorrectly charted water and wastewater mains or other utilities. It is the Contractor's responsibility to ensure that such facilities exist at the presumed point prior to commencing construction.

D. Materials Bedding and Backfill

Materials for use as bedding and backfill, whether in situ or borrow, must be as described under this section. The Contractor must, upon request by the City, make an appropriate sample of this material available for testing by the City or its designated representative.

1. Materials for structural fill must be bedding rock or select common fill as specified herein or other suitable material as approved by the City.

2. Common fill must consist of mineral soil and be substantially free of clay, organic material, loam, wood, trash and other objectionable material that may be compressible or that cannot be compacted properly. Common fill must not contain stones larger than six (6) inches in any dimension, asphalt, broken concrete, masonry, rubble, or other similar materials. It must have physical properties such that it can be readily spread and compacted during filling. Additionally, common fill must be no more than 15 percent by weight finer than the No. 200 mesh sieve unless finer material is approved for use in a specific location by the City. Common fill to be Class A-1 or A-3 according to American Association of State Highway and Transportation Officials (AASHTO) Soil Classification System. Material falling within the above specifications encountered during excavation may be stored in segregated stockpiles for reuse. All material that, in the opinion of the City, is not suitable for reuse, must be spoiled as specified herein for disposal of unsuitable materials.

3. Select common fill must be as specified above for common fill except that the material must contain no stones larger than 1 1/2 inches in their largest dimension and must be no more than 35 percent by weight finer than the No. 200 mesh sieve.

4. Bedding rock must be 3/16-inch to 3/4-inch washed and graded stone (FDOT #57). This stone must be graded so that 90–100 percent will pass a 3/4-inch screen and 95–100 percent will be retained on a No. 8 screen. No stones larger than 3/4 inch in any dimension must be acceptable.

E. Sheeting and Bracing in Excavations

All sheeting and shoring of excavations must be in accordance with the Florida Trench Safety Act and OSHA. If required to support the sides of excavations to prevent any movement that could in any way diminish the width of the excavation below that necessary for proper construction or to

protect employees, adjacent structures, existing piping, and/or foundation material from disturbance, undermining, or other damage, the Contractor must construct, brace, and maintain cofferdams consisting of sheeting and bracing. Care must be taken to prevent voids outside of the sheeting. If voids are formed, they must be immediately filled and rammed.

1. For trench sheeting for pipes, no sheeting is to be withdrawn if driven below mid-diameter of any pipe and no wood sheeting must be cut off at a level lower than one (1) foot above the top of any pipe unless otherwise directed by the City. If during the progress of the work the City decides that additional wood sheeting should be left in place, the City may direct the Contractor to do so. If steel sheeting is used for trench sheeting, removal must be as specified above unless written approval is given by the City for an alternate method of removal. All sheeting and bracing not left in place must be carefully removed in such a manner as not to endanger the integrity of other structures, utilities, existing piping, or property. Unless otherwise approved or indicated on the drawings or in the specifications, all sheeting and bracing must be removed after completion of the substructure. All voids left or caused by withdrawal of sheeting must be immediately refilled with sand by ramming with tools specially adapted to that purpose, by watering or otherwise as may be directed.

2. The right of the City to order sheeting and bracing left in place must not be construed as creating any obligation on its part to issue such orders and its failure to exercise its right to do so must not relieve the Contractor from liability for damages to persons or property occurring from or upon the work occasioned by negligence or otherwise growing out of a failure on the part of the Contractor to leave in place sufficient sheeting and bracing to prevent any caving in or moving of the ground.

3. The Contractor must construct the cofferdams and sheeting outside the minimum influence area of the foundation unless indicated otherwise to the extent they deem it desirable for their method of operation. Sheeting must be plumb and securely braced and tied in position. Sheeting, bracing, and cofferdams must be adequate to withstand all pressures for which the structure will be subjected. Pumping, bracing, and other work within the cofferdam must be

done in a manner to avoid disturbing any construction already performed. Any movement or bulging that may occur must be corrected by the Contractor at their own expense to provide the necessary clearances and dimensions.

F. Dewatering, Drainage, and Flotation

The Contractor must excavate, construct, and place all pipelines, concrete work, fill, and bedding rock in-the-dry. In addition, the Contractor must not make the final 24 inches of excavation until the water level is a minimum of one (1) foot below proposed bottom of excavation. For these specifications, "in-the-dry" is defined to be within 2 percent of the optimum moisture content of the soil. The City reserves the right to ask the Contractor to demonstrate that the water level is a minimum of one (1) foot below the proposed bottom of excavation before allowing the construction to proceed.

1. Discharged water must be clear with no visible soil particles and clear from contamination. Discharge from dewatering, as approved by the City, must be disposed of in such a manner that it will not interfere with the normal drainage of the area in which the work is being performed, create a public nuisance, nor cause ponding. The operations must not cause damage to any portion of the work completed or in progress or to the surface of streets or to private property. The dewatering operation must comply with the requirements of appropriate regulatory agencies. Additionally, where private property will be involved, advance permission must be obtained by the Contractor.

2. The Contractor during construction must always provide and maintain proper equipment and facilities to remove promptly and dispose of properly all water entering excavation. The Contractor must keep such excavations dry to obtain a satisfactory undisturbed subgrade foundation condition until the fill, structure, or pipes to be built thereon have been completed to such extent that they will not be floated or otherwise damaged by allowing water levels to return to natural elevations.

3. Dewatering must always be conducted in such a manner as to preserve the natural undisturbed bearing capacity of the subgrade soils at the proposed bottom of the excavation.

4. It is expected that well points will be required for pre-drainage of the soils prior to final excavation for some of the deeper in-ground structures or piping and for maintaining the lowered groundwater level until construction has been completed to such an extent that the structure, pipeline, or fill will not be floated or otherwise damaged. Well points must be surrounded by suitable filter sand and negligible fines must be removed by pumping.

5. The Contractor must furnish all materials and equipment and perform all work required to install and maintain the drainage systems for handling groundwater and surface water encountered during construction of structures, pipelines, and compacted fills.

6. During backfilling and construction, water levels may be measured in observation wells located as directed by the City. Continuous pumping will be required as long as water levels are required to be below natural levels.

G. Excavation

Authorized excavation consists of removal, storage, and disposal of material encountered when establishing required grade elevations and in accordance with the notes shown in the plans. Unauthorized excavation consists of removal of material beyond the limits needed to establish required grade and subgrade elevations without specific direction of the City. Unauthorized excavation as well as remedial work directed by the City must be at the Contractor's expense. Remedial work must be performed as directed by the City if located within the City’s limits.

1. If requested by the City, when excavation has reached required subgrade elevations, a Geotechnical/Soils Engineer must inspect conditions. If the subgrade is unsuitable, the Contractor must carry the excavation deeper and replace excavated material with select common fill or bedding rock, as directed by the City.

2. If the Contractor excavates below grade through error, for their own convenience, through failure to properly dewater the excavation or because they disturb the subgrade before dewatering is sufficiently complete, they may be directed by the City to excavate below grade and refill the excavation using select common fill or bedding rock.

3. Slope sides of excavations must comply with local codes and ordinances, Florida Trench Safety Act, and with OSHA requirements. The Contractor must shore and brace where sloping is not possible due to space restrictions, or the stability of the material excavated. Sides and slopes must be maintained in a safe condition until completion of backfilling.

4. The Contractor must stockpile satisfactory excavated materials at a location approved by the City until required for backfill or fill. When needed in the work, material must be located and graded at the direction of a Geotechnical/Soils Engineer.

5. Stockpiles must be placed and graded for proper drainage, erosion, and sediment control. All soil materials must be located away from the edge of excavations. All surplus and/or unsuitable excavated material must be legally disposed of by the Contractor. Any permits required for the hauling and disposing of this material must be obtained by the Contractor prior to commencing hauling operations.

H. Excavation for Structures

All such excavations must conform to the elevations and dimensions shown on the approved drawings within a tolerance of plus or minus 0.10 feet and extend a sufficient distance from the footings and foundations to permit placing and removing formwork, installation of services and other construction, and for inspection. In excavating for footings and foundations, care must be exercised not to disturb the bottom of the excavation. Bottoms must be manually trimmed to required lines and grades to leave a solid base to receive concrete.

I. Trench Excavation

Excavation for all trenches required for the installation of utility pipes must be made in accordance with the drawings, to the depths indicated on the approved drawings (Trench Type Class B drawing) and in such a manner and to such widths as will give suitable room for laying the pipe within the trenches for bracing and supporting and for pumping and drainage of facilities.

1. The bottom of the excavations must be firm and dry and, in all respects, acceptable to the City. Excavation must not exceed normal trench width as specified in the standard drawings. Any excavation that exceeds the normal trench width must require special backfill requirements, as determined by the City.

2. Where pipes are to be laid in bedding rock (Trench Type Class A drawing), select common fill or encased in concrete, the trench may be excavated by machinery to, or just below, the designated subgrade provided that the material remaining in the bottom of the trench is no more than slightly disturbed.

3. Where the pipes are to be laid directly on the trench bottom, the lower part of the trenches must not be excavated to grade by machinery. The last parts of the material being excavated must be done manually in such a manner that will give a shaped bottom, true to grade, so that the pipes can be evenly supported on undisturbed material, as specified in the standard drawings. Bell holes must be made as required.

J. Bedding and Backfill

Material placed in fill areas under and around structures and pipelines must be deposited within the lines and to the grades shown on the plans or as directed by the City, making due allowance for settlement of the material. Fill must be placed only on properly prepared surfaces that have been inspected and approved by the City. If sufficient select common or common fill material is not available from excavation on-site, the Contractor must provide fill as may be required.

1. Fill must be brought up in substantially level lifts starting in the deepest portion of the fill. The entire surface of work must be

maintained free from ruts and in such condition that construction equipment can readily travel over any section.

2. Fill must be placed and spread in layers by machinery or other approved method unless otherwise specified. Prior to the process of placing and spreading, all materials not meeting those specified under Section 2.18D must be removed from the fill areas.

3. If the compacted surface of any layer of material is determined to be too smooth to bond properly with the succeeding layer, it must be loosened by disking, harrowing, or by another approved method before the succeeding layer is placed.

4. All fill materials must be placed and compacted "in-the-dry." The Contractor must dewater excavated areas as required to perform the work and, in such manner, to preserve the undisturbed state of the natural inorganic soils.

5. Prior to filling, the ground surface must be prepared by removing vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials. The Contractor must plow, disk or break up sloped surfaces steeper than one (1) vertical to four (4) horizontal so that fill material will bond with the existing surface. When the existing ground surface has a density less than that specified under Section 2.18I for the area classification, the Contractor must break up the ground surface, disk, pulverize, moisture-condition to the optimum moisture content, and compact to the required depth and percentage of maximum density.

6. Before compaction, material must be moistened or aerated as necessary to provide the optimum moisture content. Material that is too wet must be spread on the fill area and permitted to dry, assisted by disking harrowing, if necessary, until the moisture content is reduced to allowable limits. If added moisture is required, water must be applied by sprinkler tanks or other sprinkler systems that will ensure uniform distribution of the water over the area to be treated and give complete and accurate control of the amount of water to be used. If too much water is added, the area must be permitted to dry before compaction is continued. The Contractor must supply all hose, piping, valves, sprinklers, pumps, sprinkler

tanks, hauling equipment, and all other materials and equipment necessary to place water in the fill in the manner specified. The Contractor must compact each layer to the required percentage of maximum dry density or relative dry density in accordance with Section 2.18I.

K. Bedding and Backfill for Structures

Bedding rock must be used for bedding under all structures, as indicated on the standard drawings. The Contractor must take all precautions necessary to maintain the bedding in a compacted state and to prevent washing, erosion or loosening of this bed. Structural fill must be used as backfill against the exterior walls of the structures. Fill must be compacted sufficiently in accordance with Section 2.18I of these specifications. If compaction is by rolling or ramming, material must be wetted for optimal moisture as required.

1. Backfilling must be carried up evenly on all walls of an individual structure. No backfill must be allowed against walls until the walls and their supporting slabs, if applicable, have attained sufficient strength.

2. The surface of filled areas must be graded to smooth true lines strictly conforming to grades indicated on the plans. No soft spots or uncompacted areas will be allowed in the work as determined by the Engineering Inspector.

3. Temporary bracing must be provided, as required, during construction of all structures to protect partially completed structures against all construction loads, hydraulic pressure, and earth pressure. The bracing must be capable of resisting all loads applied to the walls as a result of backfilling.

L. Bedding and Backfill for Pipes

Bedding for pipes must be as is shown on the plans and detailed on the standard drawings. The Contractor must take all precautions necessary to maintain the bedding in a compacted state and to prevent washing, erosion, or loosening of this bed.

1. Backfilling over and around pipes must begin as soon as practicable after the pipes have been laid, jointed, and inspected. All backfilling must be prosecuted expeditiously and as detailed on the standard drawings.

2. Any space remaining between the pipes and sides of the trench must be carefully backfilled and spread by hand or an approved mechanical device and thoroughly compacted with a tamper as fast as placed up to a level of one (1) foot above the top of the pipes. The filling must be carried up evenly on both sides. Compaction must be in accordance with the standard drawings and Section 2.18I.

3. The remainder of the trench above the compacted backfill, as described above, must be filled and thoroughly compacted in uniform layers. Compaction must be in accordance with the standard drawings and Section 2.18I.

M. Compaction

The Contractor must control soil compaction during construction to provide the percentage of maximum density specified. The Contractor must provide the City with copies of all soils testing reports, prepared by a Geotechnical/Soils Engineer, demonstrating compliance with these specifications. When the existing trench bottom has a density less than that specified under Section 2.18I.1, the Contractor must break up the trench bottom surface, pulverize, moisture-condition to the optimum moisture content, and compact to required depth and percentage of maximum density.

1. Percentage of Maximum Density Requirements

   a. Backfill from the bottom of the utility trench to one (1) foot above the pipe must be densified to a minimum density of 95 percent of the maximum dry density, as determined by AASHTO T-99-C (Standard Proctor Test). Based on the water elevation, densities must be taken 18 inches above the water.

b. If not under roadways, parking lots, sidewalks or driveways, backfill from one (1) foot above utility pipes to grade must be densified to a minimum density of 95 percent of the maximum dry density, as determined by AASHTO T-99-C (Standard Proctor Test).

c. If under roadways, parking lots, sidewalks, or driveways, backfill from one (1) foot above utility pipe to grade must be densified to a minimum density of 98 percent if in the travel way of the maximum dry density, as determined by AASHTO T-99-C (Standard Proctor Test) or AASHTO T-180 (Modified Proctor Test), unless compaction materials and methods are approved by the City Engineer on a special case basis.

d. Back fill in roadways and parking lots must be densified to a minimum density of 98 percent of the maximum dry density, as determined by AASHTO T-99-C (Standard Proctor Test) or AASHTO T-180 (Modified Proctor Test), unless compaction materials and methods are approved by the City Engineer on a special case basis.

2. Compaction Tests

One (1) compaction test location must be required for each 100 linear feet of pipe and for every 100 square feet of backfill around structures as a minimum. The City may determine that more compaction tests are required to certify the installation depending on field conditions. The locations of compaction tests within the trench must be in conformance with the following schedule:

a. One (1) test at the spring line of the pipe.

b. At least one (1) test for each 12-inch layer of backfill within the pipe bedding zone for pipes 24 inches and larger.

c. One (1) test at an elevation of one (1) foot above the top of the pipe.

d. One (1) test per lift of fill placed in continuously constructed areas or 2400 square feet of fill, whichever is less.

If fill is placed below the density in the Geotechnical/Soils Engineer testing report, then the Contractor must provide additional compaction and testing prior to commencing further construction.

N. Grading

All areas within the limits of construction, including transition areas, must be uniformly graded to produce a smooth uniform surface. Areas adjacent to structures or paved surfaces must be graded to drain away from structures and pavement. Ponding must be prevented. After grading, the area must be compacted to the specified depth and percentage of maximum density. No grading must be done in areas where there are existing pipelines that may be uncovered or damaged until such lines have been relocated.

O. Maintenance

The Contractor must protect newly graded areas from traffic and erosion and keep them free of trash and debris. The Contractor must repair and reestablish grades in settled, eroded, and rutted areas. Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, the Contractor must scarify the surface, reshaping and compacting it to the required density prior to further construction.

P. Inspection and Quality Assurance

The Contractor must examine the areas and conditions under which excavating, filling, and grading are to be performed and not proceed with the work until unsatisfactory conditions have been corrected. The Contractor must examine the existing grade prior to the commencement of work and report to the City if the elevations of existing grades vary from the elevations shown on the plans.

1. All work must be performed in compliance with applicable requirements of governing authorities having jurisdiction. The Contractor, at their expense, must engage soil testing and inspection services for quality control testing during earthwork operations. The testing and inspection service must be subject to the approval of the City.

2. Quality control testing must be performed during construction to ensure compliance with these specifications. The Contractor must allow the testing service to inspect and approve fill materials and fill layers before further construction is performed. The Contractor must give copies of all test results in a report form to the City Engineer and the EOR to demonstrate compliance with the compaction requirements stipulated in this Manual.

SECTION 3

MATERIALS

3.01 GENERAL

This section includes the material and installation standards for pipes, fittings, valves and appurtenances, as applicable in utility installations. The data included herein is to be used as the standard for approved materials indicated under specific facility installations as set forth in other sections. A listing of materials and approved manufacturers can be found in Appendix A. All materials and chemicals in contact with potable water must be NSF-approved.

Materials referred to by brand name in this section and Appendix A of this Manual represent specific requirements of the City. If desired, requests for substitutions of specified materials must be made in writing to the City prior to construction. Determination of the equality of substitute materials will be at the sole discretion of the City. All equipment and materials to be installed must be new and unused.

When a standard is specified by a reference (i.e., AWWA, ANSI, American Society for Testing Material [ASTM], NSF), it refers to the latest edition thereof.

Required specialty items not included under this section must be of high quality and consistent with approved standards of the industry for the approved materials which must be American made, indicated under specific facility installations, as set forth in other sections.

3.02 PIPES AND FITTINGS

A. General

All materials and chemicals in contact with potable water must be NSF-approved. All pipes and fittings for water, wastewater, reclaimed water, and stormwater systems must be clearly marked with the name or trademark of the manufacturer, the batch number, the location of the plant, and the strength designation, as applicable.

B. Ductile Iron

1. Ductile Iron

Pipe must be in accordance with American National Standards Institute (ANSI)/AWWA C151/A21.51standards, minimum thickness Class 52 or Pressure Class 350, unless heavier class is required for design conditions.

2. Fittings

Ductile iron pipe (DIP) fittings must conform to ANSI/AWWA C110/A21.10and ANSI/AWWA C153/A21.53 standards. A Class 250 minimum pressure rating is required.

3. Joints

a. "Push-On" and mechanical type joints must be in accordance with ANSI/AWWA C-111/A21.11 standards. Gaskets must be neoprene.

b. Restrained joint DIP must be TR-FLEX, as manufactured by US Pipe, or Flex Ring, as manufactured by American, or an approved equal.

c. Flexible type joints must be of the boltless type, with a joint deflection of up to 15 degrees and must be specifically designed for flexible joint use.

d. Flanged connections must be in accordance with ANSI Standard B16.1, Class 125 and must have full-faced type rubber gaskets 1/8-inch thick. Bolts and nuts must be Grade B conforming to the ASTM A307 specification for Steel Machine Bolts and Nuts and Tap Bolts.

e. Restraining Devices: Joint restraining devices for Ductile Iron mechanical joint pipe and fittings must be EBAA Iron Inc., Series 1100, or an approved equal. Joint restraining devices for push joint DIP and fittings must be EBAA Iron Inc., Series

1700, or an approved equal. Joint restraining devices for polyvinyl chloride (PVC) pipe with MJ fittings must be EBAA Iron, Inc., Series 2000 PV, or an approved equal. Joint restraining devices for Ductile Iron push joint fitting must be EBAA Iron Inc., series 1600 or 2800, or an approved equal.

f. Bolts and nuts must be Ductile Iron or 300 Series Stainless Steel, T-Head type with hexagonal nuts. Bolts and nuts must be machined through and must be tapped at right angles to a smoother bearing surface.

4. Coatings and Linings

a. DIP and fittings for underground service must receive an *exterior* bituminous coating of coal tar varnish or asphalt base paint, one (1) mil film thickness in accordance with ANSI/AWWA C-151/A21.51.

b. Exposed DIP and fittings for service must receive a factory applied *exterior* coating of a universal rust-inhibitive primer, two (2) mils dry film thickness. This coating must be followed by field painting of an intermediate and final field coats of Alkyd applied in accordance with the paint manufacturer's recommendations. Final color must be blue for potable water, green for raw wastewater and purple for reclaimed/reuse water, unless otherwise approved by the City.

c. DIP and fittings for wastewater service must receive a factory applied *interior* ceramic epoxy coating with a minimum dry thickness of 40 mils in accordance with ANSI/AWWA C104/A21.4. Protecto 401, DFT = 40 mils for DIP wastewater force mains.

d. DIP and fittings for water and reuse service must receive an exterior coating as specified above under paragraphs 3.02 B.4.a or 3.02 B.4.b and must be cement mortar lined and bituminous sealed in accordance with ANSI/AWWA C104/A21.4.

e. Machined surfaces must be cleaned and coated with a suitable rust preventive coating at the shop immediately after being machined.

C. Polyvinyl Chloride (PVC)

1. Gravity wastewater PVC pipes and fittings must be manufactured from polyvinyl chloride resin conforming to ASTM Designation D1784. Pipes and fittings of this material must conform to ASTM Designation D3034 and F679, “Standard Specifications for Type PSM polyvinyl chloride Sewer Pipe and Fittings.” All pipes and fittings must have a Standard Dimension Ratio (SDR) of no more than 26.

2. PVC pipe for gravity wastewater mains must be furnished at a maximum of 20-feet lengths with integrally formed bell joints.

3. All PVC pipe and accessories less than two (2) inches in diameter must be Schedule 80 and must be of rigid normal impact polyvinyl chloride. The pipe and accessories must conform to ASTM Specification D1785 and Product Standard PS21-70. All materials must be furnished complete to perform the work, including solvent cement, etc.

4. Connections: A Hardco sand collar is preferred. Connection of PVC gravity wastewater lines to maintenance access structure must be made by using a PVC maintenance access structure coupling adapter connecting piece manufactured from a two (2)-foot piece of PVC pipe with a water stop. The connection must provide a watertight connection at the structure.

D. Service Pipe

1. Water Service Pipe

All potable water service lines must be one (1)-inch, 1 1/2-inch, or two (2)-inch blue polyethylene tubing conforming to AWWA C-800 and C-901, with blue tracer wire installed.

2. Wastewater Service Lateral

All wastewater service laterals must be PVC and have a minimum diameter of six (6) inches and must conform to ASTM D3034, SDR 26 based on the depth requirements.

E. Bore and Jack

1. Pipe Material

a. Steel casings must conform to the requirements of ASTM Designation A139 (straight seam pipe only) Grade “B” with a minimum yield strength of 35,000 psi. The casing pipes must have the minimum nominal diameter and wall thickness, as Table 2 shows.

TABLE 2. Steel Casings

Carrier Pipe	Casing	Minimum Casing
4	16	0.250
6	18	0.250
8	20	0.250
10	24	0.250
12	30	0.312
16	30	0.312
20	36	0.375
24	42	0.500
30	48	0.500
36	54	0.500
42	60	0.500

b. Field and shop welds of the casing pipes must conform to the American Welding Society standard specifications. Field welds must be complete penetration, single-bevel-groove type joints. Welds must be airtight and continuous over the entire circumference of the pipe and must not increase the outside pipe diameter by more than 3/4 inch.

c. The carrier pipe must be minimum thickness Class 52 or Pressure Class 350 DIP with restrained joints. DIP must comply with the specification outlined herein.

d. The carrier pipes must be supported within the casing pipes so that the pipe bells do not rest directly on the casing. The load of the carrier pipes must be distributed along the stainless steel carriers with Teflon skids or “The Booster” Casing Spacer being on center and restrained. All nuts and bolts must be high strength, low alloy meeting AWWA C-111. Runners must be made of a high molecular weight polymer with inherent high abrasion resistance and a low coefficient of friction. Spacers must be installed seven (7) feet or less, on center.

F. Pressure Pipe Restraints

1. Pressure Pipe Fittings Bracing

Pressure pipe fittings and other items requiring restraint must be braced with manufactured pipe joint restraints or other mechanical restraining assemblies. All DIP must be restrained using or restraint joints or mechanical restraining devices (i.e., Megalug or equal). Use of thrust blocks for pressure pipe is not allowed.

2. Restrained Joints

Sections of piping requiring restrained joints must be constructed using pipe and fittings with restrained "locked-type" joints manufactured by the pipe and fitting manufacturer, and the joints must be capable of withstanding withdrawal for line pressures 505 above the normal working pressure. Mechanical joint DIP retainer glands are not permitted. Any restrained joints that allow for elongation upon pressurization will not be allowed in those locations where the pipe comes out of the ground. Restrained pipe joints that achieve restraint by incorporating cut out sections in the wall of the pipe must have a minimum wall thickness at the point of cut out that corresponds with the minimum specified wall thickness for the rest of the pipe.

2.1 The minimum number of restrained joints required for resisting forces at fittings and changes in direction of pipe must be determined from the length of restrained pipe on each side of the fittings and changes in direction necessary to develop adequate resisting friction with the soil. The required lengths of restrained joint DIP must be determined by the Engineer and shown in a tabular form and shown as a “Restrained Pipe Joint Schedule” drawing.

2.2 Wherever two (2) 45-degree bends are used in place of a 90-degree bend, the minimum restrained joints required for the 45-degree bends is that of a 90-degree bend located midway between the two (2) 45-bends, or that for an individual 45-degree bend, whichever is greater.

3. Mechanical Restraining Devices

These types of devices may be substituted for the restrained "locked-type" joints manufactured by the DIP and fitting manufacturer. The number of joints to be restrained must be based on the “Restrained Pipe Table” in the drawings.

3.1 Mechanical joint restraint must be incorporated in the design of the follower gland and must include a restraining mechanism that, when actuated, imparts multiple wedging action against the pipe, increasing its resistance as the pressure increases. Flexibility of the joint must be maintained after burial. Glands must be manufactured of DI conforming to ASTM A536. Restraining devices must be of DI heat treated to a minimum hardness of 370 Brinnell Hardness Number (BHN). Dimensions of the gland must be such that the gland can be used with the standardized mechanical joint bell and tee-head bolts conforming to ANSI A21.11 and ANSI/AWWA C-153/A21.53. Twist-off nuts must be used to ensure proper actuating of the restraining devices. The mechanical joint restraint device must have a working pressure of at least 250 psi with a minimum safety factor of 2:1.

G. Special Items

1. Expansion Joints

   Pipe expansion joints must be suitable for the applicable service with a minimum 150-psi working pressure.

2. Flanged Coupling Adapters

   Units must be compatible with ANSI Standard B16.1, 125-lb. flanges.

3. Cast Iron Sleeves and Wall Pipes

   Units must have integral annular ring water-stops and also conform to other requirements for cast iron fittings specified in this section. Sleeves and wall pipes to have laying length and ends required for proper installation.

4. Tapping Saddles

   Units must be fabricated of DI and suitable for either wet or dry installation. The sealing gasket must be the "O-Ring" type suitable for the applicable service. The outlet flange must be ANSI B16.1, 125 lb. standard. Tie straps and bolts must be of a corrosion resistant alloy steel (see drawing).

5. Tapping Sleeves and Valves

   Units must be of the mechanical joint type or fabricated steel type sleeves for pressure connections four (4) inches and larger. All “size on size” taps must utilized mechanical joint sleeves.

   a. Steel tapping sleeves must have a welded steel body with flat faced steel flange, recessed for a tapping valve, in accordance with MSS-SP6-6. Gaskets must be neoprene "O" ring type with some type of gasket restraint incorporated in the sleeve. A test plug must be provided on the outlet throat.

   b. Cast iron tapping sleeves must be of the mechanical joint type having a flat faced cast iron flange, recessed for a

tapping valve. All end and side gaskets must be totally confined. The throat section of tapping sleeves through 12-inch size must conform to MSS-SP6-60. A test plug must be provided on the outlet throat.

c. Minimum tap sizes for water transmission lines:

12" through 16"	6" tap
18" through 30"	8" tap
30" through 36"	10" tap
42" and larger	12" tap

d. Tapping gate valves four (4) inches and larger must comply with AWWA Standard C500 latest revision and must comply with paragraph “e” below. The valve port must be free and full to allow clutter passage without interference.

e. All gate valves are to be iron body, bronze, mounted, double disc, resilient seat non-rising stem, parallel fit type, opening left (counterclockwise). Non-geared valves must be furnished with "O" rings packing (two [2] "O" rings). The valves must have an unobstructed waterway equal to or greater than the full nominal diameter of the valve (full port valve).

6. Service Saddles

Saddles for DIP must be double strap, anchored by a minimum four (4) bolt pattern on a DI saddle body. Service saddles for PVC pipe must have a double strap sized exactly to the pipe outside diameter. Sealing gaskets must be suitable for the applicable service and straps must be corrosion resistant alloy steel. The City requires stainless steel straps and fusion epoxy or nylon coated DI body with stainless steel hardware in areas designated as corrosive.

7. Polyethylene Encasement

Encasement must have a minimum thickness of eight (8) mils and comply with the applicable provisions of ANSI/AWWA C-105/A21.5,

"Polyethylene Encasement for Gray and Ductile Iron Piping for Water and Other Liquids."

8. High-Density Polyethylene (HDPE) Pipe

HDPE pipe must be in accordance with AWWA C906 and must have an outside diameter equal to DIP for the same size. Pipe must have a minimum dimensional ratio of 11 for use with DI fittings and have a working pressure of 150 psi. Pipe must be color coded per utility design use.

9. Reclaimed Water Pipes, Valves, and Appurtenances

Joints for DIP must be push-on or mechanical joints conforming to ANSI/AWWA C111/A2.11. Where called for in the plans, restrained or flanged joints must be provided. Flanged points must conform to ANSI standard B 16.1Class 125. HDPE pipe joints must conform to AWWA C906.

10. Fittings

HDPE mechanical joint adapter must be joined to the HDPE pipe by butt-fusion. HDPE mechanical joint adapter must be molded or fabricated conforming to AWWA C906. Molded fittings must conform to ASTM D 2683 for socket-type fittings, ASTM D3261 for butt-type fittings or ASTM F1055 for electrofusion-type fittings.

11. PVC Pipe

PVC push-on pipe must be of the compression rubber gasket type.

12. Fittings

Fittings for PVC pressure pipe must be DI with mechanical joints having, at a minimum, the same pressure rating as the pipe.

3.03 VALVES

A. General

The valve type, size, rating, flow direction arrow, if applicable, and manufacturer must be clearly marked on each unit. Valves must open left (counterclockwise) with an arrow cast in the metal of the operating hand wheels and nuts indicating the direction of opening.

B. Gate Valves (GV)

1. General

All GV must be resilient seat GV and must be resilient seated, manufactured to meet or exceed the requirements of AWWA C-509. The valve body, bonnet, and bonnet cover must be cast iron and comply with ASTM A126, Class B. The valves must be non-rising stem with the stem made of cast, forged, or rolled bronze, as specified in AWWA C-509. Two (2) stem seals must be provided and must be "O-Ring" type. The stem must be independent of the gate. The resilient sealing mechanism shall provide zero leakage at the system working pressure when installed with the line flow in either direction. All ferrous surfaces inside and outside must have a fusion bonded epoxy coating. All nuts, bolts, washers, and springs must be 316 stainless steel. The valves must have an unobstructed waterway equal to or greater than the full nominal diameter of the valve (full port valve).

2. Underground Service

Valves must be iron body, bronze mounted, conforming to AWWA C-509, resilient seat, non-rising stem type, bolted bonnet, mechanical joint, and must be equipped with two (2)-inch square cast iron wrench nuts.

3. Aboveground Service

Valves must be iron body, bronze mounted GV, bolted bonnet, flanged, conforming to AWWA C-509, resilient seat, with the exception that the valves must be outside screw and yoke, rising stem type. Valves must have cast iron hand wheels or chain operators with galvanized steel chains, as required.

4. Tapping Valves

Valves must conform to the specifications set forth under paragraphs 3.03B.1.and2.for the applicable service conditions. Additionally, units must be compatible with the connecting sleeve or saddle and specially designed for wet tapping installation operations.

5. Valves Two (2) Inches and Smaller

Valves must be bronze, wedge disc, 150-psi minimum working pressure, equipped with wrought steel or cast iron operating hand wheels.

6. Actuators

Valves 16 inches and larger must be equipped with approved gearing actuators with sealed enclosures for buried or submerged service and must be furnished by the valve manufacturer. Position indicators must be furnished as required.

7. Horizontal Installation

Valves 16 inches in diameter or larger must be installed horizontally and must be additionally equipped as specified under the applicable section of AWWA C-500, as follows:

a. Installations in vertical pipe with a horizontal stem must be fitted with approved slides, tracks, and shoes to assist the travel of the gate assembly.

b. Installations in horizontal pipe with a horizontal stem must be equipped with approved rollers, tracks, and scrapers to assist the travel of the gate assembly and to clear the track of obstructions.

C. Check Valves (CV)

1. General Service

   Valves must be iron body, bronze mounted, stainless steel hinge pin, outside lever and spring operated, single disc swing non-slam type, and equipped with removable inspection covers and must meet the requirements of AWWA C-500. The ends must be 125-lb. ANSI B16.1 flanges. The units must be rated for 175-psi minimum working pressure and must permit a full flow area equal to that of the connecting pipe. Valves must be constructed to allow the disc and body seat to be easily removed and replaced without removing the valve from the line. Valves must be fitted with an extended hinge arm with outside lever and weight. If pump shut-off exceeds 77 feet, then an air-cushioned assembly must be installed. All exposed nuts, bolts, washers, and springs on buried and on above ground outdoor service valves must be type 316 stainless steel. (Please refer to approved products list Appendix A.)

2. Valves Two (2) Inches and Smaller

   Valves must be bronze body and disc, swing check type, with removable inspection covers and rated 150-psi minimum working pressure.

D. Plug Valves (PV)

1. Eccentric plug valves four (4) inches and larger must be of the non-lubricated type and comply with AWWA C-504 and C-507. Minimum pressure rating of valves four (4) inches through 12 inches must be 175 psi, valves 14 inches through 72 inches must be 150 psi. Valve bodies must be cast iron ASTM A126, Class B, in compliance with AWWA C-504 and C-507. Unless otherwise noted, port areas for all valves must be 100 percent of the full pipe area. Resilient plug facings must be of Hycar, Nitrile Butadiene rubber or neoprene.

2. Valve ends must be flanged (or grooved end couplings) or mechanical joint for above ground and underground installation, respectively. Valve body seats must have a welded in overlay of not less than 90 percent nickel for all parts which come in contact with the plug face. Packing must be safely adjustable and replaceable

without removing the valve from service with the body pressurized to its full rated pressure. Bearings must be permanently lubricated type 316 stainless steel in both upper and lower journals in accordance with AWWA Standard C-507. The valve supplied must have drip tight shut off with flow in either direction at the full pressure rating of the valves. All exposed nuts, bolts, springs, and washers on buried and on above ground outdoor service valves must be type 316 stainless steel. No hollow pins will be allowed.

3. All body, bonnet, and flange thickness must be designed and rated in accordance with the specified valve pressure rating and ANSI B16.1, per AWWA standards C-504 and C-507. Mechanical joint ends must be to the AWWA Standard C-111, Class B. Screwed ends must be to the NPT standard.

4. Valves must be furnished with permanently lubricated stainless steel or oil-impregnated bronze upper and lower plug stem bushings. These bearings must comply with AWWA C-504 and C-507. Valve shaft seals must be adjustable and comply with AWWA Standard C-507.

5. Operation of all valves 10 inches or larger and smaller sizes in exposed locations, which require hand wheels or chain wheels, must be, by approved gear actuators, equipped with position indicators and stops and must be furnished by the valve manufacturer. Gear actuators for buried or submerged installations must be furnished with sealed enclosures. Valves must be equipped with actuating nuts, cast iron hand wheels, or chain operators, with galvanized steel chains, as appropriate, for the installation and type of operator.

E. Butterfly Valves (BFV)

Valves must be cast or DI body that conforms to ASTM A126, Class B. All retaining segments and adjusting devices must be of corrosion resistant material. The valves must have bonded or mechanically restrained seats, as outlined in AWWA C-504. Valve seats must be a natural rubber or synthetic rubber compound. The valve shaft must be turned, ground, and polished, constructed 18-8 stainless steel, and designed for both torsional and shearing stresses when the valve is operated under its greatest

dynamic or seating torque. The shaft must be a one (1) piece unit, extending full size through the valve disc. The valves must be of either a short or long body type with the valve class, shaft size, and other special requirements selected in accordance with the specific design and must comply with the provisions of AWWA C-504, "Rubber Seated Butterfly Valves." Valve operation must be by approved gear actuators with sealed enclosures for buried or submerged service. Position indicators must be furnished, as required. Units must be equipped with actuating nuts, cast iron hand wheels, or chain operators with galvanized steel chains, as appropriate for the installation. All exposed nuts, bolts, springs, and washers on buried and on above ground outdoor service valves must be type 316 stainless steel. Appurtenances must be furnished by the valve manufacturer.

F. PVC Ball Valves

PVC ball valves must be provided, as required, for chemical service installations and must be full port area and sufficiently large to accommodate a cleaning pig.

G. Corporation Stops and Curb Stops

Units must be 5/8-inch, 1-inch, 1-1/2-inch, or 2-inch brass equipped with connections compatible with the connecting service pipe type, threaded in accordance with AWWA Standard C-800 and C-901 and installed at 90 degrees on the pipe spring line parallel to the ground surface. Curb stops must be sized to match the meter size and conform to AWWA C-800 and C-901. Fittings must be brass, cast, and machined in accordance with AWWA C-800 and C-901, with compatible polyethylene tubing connections.

H. Backflow Preventers

The assembly must be of the type approved by the City (see drawing) based on the type of service and must comply with the applicable provisions of AWWA Standards and City regulations.

I. Air Release Valves

1. Wastewater and Reclaimed Water Service Automatic Air Release Valve

   The valve body and cover must be cast iron construction, ASTM A126 Class B, and all internal parts must be of type 300 series stainless steel. The venting orifice must be 1-inch in diameter and the seating material must be of Viton, or an approved equal. (Please refer to approved products list Appendix A.)

2. Water Service

   The valve must be a heavy-duty automatic air release type for 150-psi working pressure, tested to 300 psi. Body, cover, and baffle must be cast iron. All internal parts must be type 300 series stainless steel, and the inside of the valve must be coated with a rust inhibitor that does not contain any lead base material. The valves must be provided with a vacuum check to prevent air from reentering the line. All valves must comply with AWWA C-512.

J. Special Items

1. Water Meters

   The 5/8-inch through 2-inch meters must be AWWA approved Sealed Register Displacement or Velocity Type Meters. The water meters that are three (3) inches and larger meters must be AWWA Approved Turbo-Meters, Compound Meters, or preferably an approved Velocity Meter. Meters six (6) inches and larger must be equipped with a strainer. All meters must be equipped with "electronic read" components.

2. Floor Stands

   Units must be cast iron, equipped with convenient grease fittings for all approved lubrication points, and suitable for the applicable operation. Stem guides must be cast iron and adjustable with bronze bushings.

3. Valve Boxes

Units must be American Flow Control Trench Adapter, or an approved equal, minimum interior diameter of five (5) inches with covers cast with the applicable inscription in legible lettering on the top: "SEWER," “WATER," and “RECLAIMED WATER.” Boxes must be suitable for the applicable surface loading and valve size. Sewer and force main covers must be painted green, reclaimed water must be painted purple, and potable water must be painted blue. If other assemblies are approved, they must conform to the following.

a. Valve boxes must be of the heavy-duty, traffic bearing cast iron, adjustable screw type with a drop cover. The valve box assembly must consist of a bottom section, top section, and cover, which is cast from gray iron, formulated to ASTM specification A-48 latest revision, class 30 minimum, and must be free from blowholes, shrinkage, or other imperfections not true to pattern. The shaft size must be 5 1/4 inch and the adjustable length must be from 18 inches to 24 inches. The wall thickness must be 3/16 inch $\pm$ 1/16 inch. The weight of the assembly must be 61 pounds $\pm$ 2 pounds, with the cover weight being a minimum of 12 pounds.

b. The name of the manufacturer and foundry of origin must be cast into each of the components of the assembly in legible form. The assembly must be suitable for highway traffic wheel loads of 16,000 pounds and must withstand a proof load test of 25,000 pounds without failure or permanent deflection, as per Federal Specification RR-F-621-C, latest revision. The valve box must be cast, machined, assembled, and packaged within the United States and must fully comply with the Buy American provisions of Public Law 102-240, enacted 12/18/91. Valve boxes must be manufactured by OPELIKA FOUNDRY COMPANY, Opelika, Alabama, or TYLER PIPE DIVISION, Tyler, Texas, or an approved equal.

4. Meter Boxes

Meter boxes must be plastic injection mold units, or an approved equal, of a size comparable with the meter.

5. Service Boxes

Service boxes for reclaimed water connections must be plastic injection mold, or an approved equal, with a jam lock cover. Boxes must be purple (Pantone 522C) in color.

3.04 INSTALLATION

A. Potable Water, Reclaimed Water, and Wastewater Force Main Pipe

1. Piping, fittings, valves, and appurtenances must be installed in accordance with these standards, including the attached "standard details," all applicable AWWA standards, and with the manufacturer's recommendations for the applicable service.

2. All types of pipes must be handled in such a manner that will prevent damage to the pipe or coating. Accidental damage to the pipe or coating must be repaired to the satisfaction of the City or be removed from the job site. When not being handled, the pipe must be supported on timber cradles or on properly prepared ground, graded to eliminate all rock points and to provide uniform support along the full length. When being transported, the pipe must be always supported in a manner that will not permit distortion or damage to the lining or coating. Any unit of pipe that, in the opinion of the City, is damaged beyond repair by the Contractor must be removed from the site of the work and replaced with another unit. Joint gaskets must be stored in a clean, dark, dry location until immediately before use.

3. Dirt or other foreign material must be prevented from entering the pipe or pipe joint during handling or laying operations and any pipe or fitting that has been installed with dirt or foreign material in it must be removed, cleaned and re-laid. At all times when the pipe laying is in progress, the open ends of the pipe must be closed by a watertight plug or by other means approved by the City to ensure absolute cleanliness inside the pipe.

4. Water mains that are laid in the vicinity of pipelines designated to carry raw wastewater, reclaimed/reuse, or wastewater effluent must meet the requirements outlined in Section 6.03.

5. Piping must be installed along a straight line and grade between fittings, maintenance access structures, or other defined points unless definite lines of the alignment, deflection, or grade change have been established. Modification to the approved alignment or grade during construction must receive prior approval from the City, and all resulting design considerations must be resolved by the Contractor.

6. Materials must be cleaned and maintained clean, with all coatings protected from damage. The interior of the pipe must be free of dirt and debris, and when work is not in progress, all open ends must be plugged. Also, materials for potable water systems, including taps, repairs, etc., must be disinfected in compliance with AWWA C-651.

7. Pipe, valves, fittings, or other items must be inspected prior to installation, and any items showing a fracture or other defect must be rejected. Additionally, any pipe or fitting which has received a severe blow that may have caused an incipient fracture, even though not visible, must also be rejected. However, DIP 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.

8. The Contractor must prevent water from entering the trench during excavation and pipe laying operations to the extent required to properly grade the bottom of the trench and allow for proper compaction of the backfill. Pipe must not be laid in water and specifications outlined in Section 2.18 must apply.

9. Pipe must be laid to the lines and grades shown on the plans. The Professional Land Surveyor or Professional Engineer must provide line and grade stakes at 100-foot maximum spacing and at all line and/or grade change locations. The professional land surveyor must provide temporary benchmarks at maximum 1,000-foot intervals. The minimum top of pipe depth must be three (3) feet

below finished grade surface or three (3) feet below the edge of the pavement of the road surface, whichever is greater. Gravity wastewater mains must have a minimum top of pipe depth of four (4) feet below finish grade.

10. Long radius curves, either horizontal or vertical, may be laid with standard pipe deflections at the joints. The maximum deflections at pipe joints and laying radius for the various pipe lengths must be 50 percent of that recommended by the pipe manufacturer.

11. Underground piping must not be driven to grade by striking it with an unyielding object. When the pipe has been properly bedded, enough compacted backfill must be placed to hold the utility in correct alignment. If necessary, precaution must be taken to prevent flotation.

12. The installation of casing pipe underneath existing roadways must be by the method of boring and jacking and must meet the requirements outlined in Section 3.04D.

13. Jointing must be by an approved method and must not require undue force to accomplish full satisfactory seating and assembly. Connections at structures must be cut accurately and worked into place without forcing and must align with the connecting point. Flanged joints must be made up tight, but with care taken to prevent undue strain upon equipment or other items. Suitable flange filler rings must be installed where required to provide suitable joints. The installation must be permanently watertight, with no visible leakage at joints or connections with structures. Any joint that does not remain completely seated and/or watertight must be rejected.

14. Underground pressure piping systems must be, and other items requiring restraint, must be braced with manufactured pipe joint restraints or other mechanical restraining assemblies. All DIP must be restrained using restrained joints or mechanical restraining devices (i.e., Megalug or equal). Use of thrust blocks for pressure pipe, valves, and plugs, must not be allowed, unless other restraining designs are applicable, as specified in Section 3.02F. Fittings must be protected by polyethylene film (eight [8] mil) prior

to placing thrust block. Minimum compressive strength for concrete must be 2,500 psi. Fittings must 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, must be provided when restrained joint assemblies are used. Pipe joints must be restrained on each side of the fitting for a continuous discharge in accordance with DIPRA "Thrust Restraint Design for Ductile Iron Pipe."

15. Requirements for bedding and backfill for the pipes are outlined in Section 2.18.

16. Proper provision for pipe expansion or contraction must be provided by installation of expansion joints or other suitable methods. Additionally, flexible connections must be provided to expedite equipment or piping system removal.

17. Subaqueous pipe laying may be permitted where conditions make it impractical to lay pipe "in-the-dry," provided the Developer submits his plans for laying pipe underwater to the City and obtains advance approval from the City.

B. DIP

Installation must be performed in accordance with the applicable provisions of AWWA Standard C-600. The opening cut in the pipe wall for installation of tapping saddles and sleeves must be made by a special tapping machine designed for this specific service.

1. Testing of piping systems must be performed by the Contractor in accordance with the specifications set forth under the Standard for the applicable service. These testing procedures must be in accordance with AWWA standards. Prior to testing, all piping must be thoroughly cleaned and flushed with clean water to clear the lines of all foreign matter. This work must be done with care to avoid damage to any inside coating.

2. The Contractor, following approved hydrostatic testing, must accomplish disinfecting of all potable water. Unless alternate procedures are set forth under the applicable service standard,

disinfection procedures must be in accordance with AWWA Standard C-651 and as required by the appropriate local approval agency.

3. All connections to existing pressure pipes must be made by the Contractor only after the connection, procedure, and work schedule have been reviewed and permitted by the City.

4. All connections must only be made upon scheduling of inspection. The Contractor must not operate any valves in the City's system.

5. During construction, sufficient length of main must be exposed to allow for the installation of the tapping sleeve and valve and the operation of the tapping machinery. The main must be supported on concrete pedestals or bedding rock at sufficient intervals to properly carry its own weight, plus the weight of the tapping sleeve and machinery. Any damage to the pipe due to improper or insufficient supports must be repaired at the Contractor's expense.

6. The inside of the tapping sleeve and valve, the outside of the main, and the tapping machine, must be cleaned and swabbed or sprayed with 10 percent liquid chlorine prior to beginning installation for water system pressure connections. After the tapping sleeve has been mounted on the pipe, the tapping valve must be bolted to the outlet flange, making a pressure tight connection. Prior to beginning the tapping operation, the sleeve and valve must be pressure tested at 150 psi to ensure that no leakage will occur.

7. For pressure connections 12 inches in diameter or less, the minimum diameter cut must be 1/2 inch less than the nominal diameter of the pipe to be attached. For pipes 14 inches through 20 inches in diameter, the minimum diameter must be 1 1/2 inches less; for larger taps, the allowable minimum diameter must be two (2) to three (3) inches less than the nominal diameter of the pipe being attached. After the tapping procedure is complete, the Contractor must submit the coupon to the City.

8. For pressure connections to wastewater force mains, the tapping valve must be placed horizontally. After the tapping procedure is

complete, a plug valve must be attached to the tapping valve. The tapping valve must be left in the open position prior to backfilling.

9. Adequate restrained joint fittings must be provided to prevent movement of the installation when test pressure is applied. The pipe restraints must meet the requirements of Section 3.02F.

C. Excavation Site Safety

Whenever an excavation site or trench is left unattended by the Contractor or when an area is not within 100 feet of observation by the Contractor, the excavation site or trench must be filled and/or, at the City's discretion, protected by other means to prevent accidental or unauthorized entry. Such protection must include barricades, LCD, and other protection devices requested by the Engineer or City, including temporary fencing, mesh fencing, or temporary "structure" tape. Such safety items must not relieve the Contractor of any site safety requirements or liabilities established by Federal, State, and local laws and agencies, including OSHA, but is intended as additional safety measures to protect the public.

D. Gravity Wastewater Mains

1. The Contractor or Surveyors must set temporary benchmarks at a maximum of 500-foot intervals. The Contractor must constantly check line and grade of the pipe by laser beam method. In the event line and grade do not meet specified limits described hereinafter, the work must be immediately stopped, the City notified, and the cause remedied before proceeding with the work.

2. All pipe must be inspected handled and installed, as specified under Section 304A.

3. Laying of gravity wastewater pipe must be accomplished to line and grade in the trench only after it had been dewatered and the trench has been prepared in accordance with Section 3.18. Mud, silt, gravel, and other foreign material must be kept out of the pipe and off the jointing surface. All pipe laid must be retained in position to maintain alignment and joint closure until sufficient backfill has been completed to adequately hold the pipe in place. All pipes must be laid to conform to the line and grade shown on the plans.

4. Variance from the established line and grade, at any point along the length of the pipe, must not be greater than 1/32 of an inch per inch of pipe diameter and not to exceed one (1) inch provided that any such variation does not result in a level or reverse sloping invert.

5. The gravity wastewater pipe, unless otherwise approved by the City, must be laid upgrade from the point of connection on the existing gravity wastewater or from a designated starting point. The gravity wastewater pipe must be installed with the bell end forward or upgrade. When pipe laying is not in progress the open end of the pipe must be kept tightly closed with an approved temporary plug.

6. All PVC pipe must be installed in accordance with the standards set forth in the Uni-Bell "Handbook of PVC Pipe Design and Construction."

7. Laying of DIP must conform to the specifications outlined in AWWA Standard C-600.

8. All applicable provisions of Section 3.18 must apply with regards to trench excavation, dewatering, bedding material, backfill, compaction, fill, and grading.

9. The Contractor must hand-grade bedding to proper grade ahead of the pipe laying operation. Bedding must provide a firm, unyielding support along the entire pipe length. If, without direction from the City, the trench has been excavated below the required depth for pipe bedding material placement, the Contractor must fill the excess depth with pipe bedding material to the proper grade. The Contractor must excavate bell holes at each joint to permit proper assembly and inspection of the entire joint.

10. The Contractor must provide bedding material in accordance with the standard drawings.

11. Gravity wastewater that are laid in the vicinity of pipelines designated to carry potable water must meet the requirements set forth in sections 3.04A.3. and 6.03.

12. Plugs for pipe branches, stubs or other open ends which are not to be immediately connected must be made of an approved material and must be secured in place with a joint comparable to the main line joint.

13. The type of joint must conform to the requirements outlined in Section 3.02 of this Manual.

E. Maintenance Access Structures and Precast Structures

1. Base sections must be placed on bedding rock, conforming to the requirements outlined in Section 2.18H.1. The bedding rock must be firmly tamped and made smooth and level to ensure uniform contact and support of the precast element in accordance with Section 2.18.

2. The cast-in-place bases must be utilized only when specifically approved by the City. Unless otherwise specified, cast-in-place bases must be at least eight (8) inches in thickness and must extend at least six (6) inches radially outside of the outside dimension of the structure. Reinforcement and connection to the riser sections must be designed by the Developer's Engineer and submitted to the City for approval.

3. A precast base section must be carefully placed on the prepared bedding to be fully and uniformly supported in true alignment and making sure that all entering pipes can be inserted on proper grade. Precast maintenance access structure and lift station sections must be handled by lift rings or non-penetrating lift holes. Such holes must be filled with non-shrink grout after installation of the structure. The first precast section must be placed and carefully adjusted to true grade and alignment. All inlet pipes must be properly installed to form an integral watertight unit. The sections must be uniformly supported by the base structure and must not bear directly on any of the pipes.

4. Precast sections must be placed and aligned to provide vertical alignment with a 1/4-inch maximum tolerance per five (5) feet of depth. The completed maintenance access structure must be rigid, true to dimensions, and watertight.

5. The excavation and backfilling must conform to the requirements outlined in Section 2.18.

6. Castings for maintenance access structure must be adjusted to grade by precast concrete donuts with mastic or by fully bedded in mortar with adjustment brick courses placed between the frame and maintenance access structure. Bricks must be a minimum two (2) and four (4) courses. Max-Mortar must conform to ASTM C-270, type M, and the bricks must be clay and conform to ASTM C-216, grade SW, and have the dimensions of 3 1/2 inches wide by 8 inches long and 2 1/4 inches high.

7. The top of the maintenance access structure castings that are in pavement, shouldered areas, and sidewalks must be flush with the finished grade. The top of maintenance access structure castings that are located outside of these areas must be placed two (2) inches above the finished grade.

8. Maintenance access structure flow channels must be as shown on the standard drawings, with smooth and carefully shaped bottoms, built up sides, and benching constructed using cement and brick with no voids. Channels must conform to the dimension of the adjacent pipe and provide changes in size, grade, and alignment evenly. Cement must be Portland Cement Type II only.

9. Special care must be taken to see that the openings through which pipes enter the structure are provided with watertight connections. For DI and PVC pipe, connections must conform to ASTM C-923. Drop Maintenance access structure connections must conform in all respects to details shown on the standard drawings.

10. All newly constructed maintenance access structure and lift stations must be cleaned of any accumulation of silt, debris, or foreign matter of any kind, and must be free from such accumulations at the time of final inspection. If plug fails at the connection to the existing system, the Contractor must be responsible to clean existing system until no contaminates are shown in the pipe and to the City’s satisfaction.

11. All precast maintenance access structure must conform to ASTM C478 as a minimum. Other designs require an Engineer's signature and seal.

F. Bore and Jack

1. General

Applicable provisions of sections 4 through 8 must apply concurrently with these specifications. Boring and jacking operations must be performed within the right-of-way and/or easements shown on the plans.

a. All casing pipe to be installed may be inspected at the site of manufacture for compliance with these specifications by an independent laboratory. The manufacturer's cooperation must be required in these inspections. All casing pipe must be subjected to a careful inspection prior to being installed. If the pipe fails to meet the specifications, it must be removed and replaced with a satisfactory replacement at no additional expense to the City.

2. Pipe Handling

Care must be taken in loading, transporting, and unloading to prevent injury to the pipe or coatings. Pipe must not be dropped. All pipe must be examined before laying, and no piece must be installed which is found to be defective. Any damage to the pipe or coatings must be repaired to the satisfaction of the City.

3. Work Coordination

It must be the Contractor's responsibility to perform the boring and jacking work in strict conformity with the requirements of the agency in whose right-of-way or easement the work is being performed. Any special requirements of the agency, such as insurance, flaggers, etc., must be strictly adhered to during the performance of work. The special requirements must be performed by the Contractor at no additional cost to the City.

a. Dewatering through the casing during construction must not be permitted. All dewatering methods must be approved by the City before construction work begins.

b. Excavation adjacent to the roads must be performed in a manner to adequately support the roads. Bracing, shoring, sheeting, or other supports must be installed as needed. The Contractor must install suitable reaction blocks for the jacks as required. Jacking operations must be continuous and precautions must be taken to avoid interruptions, which might cause the casing to "freeze" in place. Upon completion of jacking operations, the reaction blocks, braces, and all other associated construction materials must be completely removed from the site.

c. Correct line and grade must be carefully maintained. Earth within the casing must not be removed too close to the cutting edge in order to prevent the formation of voids outside the casing. If voids are formed, they must be satisfactorily filled with grout by pumping.

d. The sections of steel casing must be field-welded in accordance with the applicable portions of AWWA C-206 for field-welded pipe joints. The Contractor must wire brush the welded joints and paint with Inertol Quick-Drying Primer 626 by Koppers Company or an approved equal. After completion of jacking, the Contractor must clear the interior of the casing of all excess material.

G. Valves

1. General: Valves must be carefully inspected, opened wide and then tightly closed, and all the various nuts and bolts thereon must be tested for tightness. Special care must be taken to prevent joint materials, stones, or other substances from becoming lodged in the valve seat. Valves, unless otherwise required, must be set with their stems vertically above the center line of the pipe. Any valve that does not operate correctly must be adjusted to operate properly or removed and replaced.

2. Buried valves must be installed vertically where depth of cover permits. Where depth of cover does not permit, an alternative offset valve must be installed. Extension stems must be provided on all buried valves when the operating nut is deeper than four (4) feet below the final grade and with sufficient stem extension to place the nut not more than four (4) feet below grade or as approved by the City Engineer or designee. Where extension stems are required within valve boxes, approved insert stem guides must be provided.

3. Valve boxes must be carefully centered over the operating nuts of underground valves to permit a valve wrench to be easily fitted to the nut. The tops of valve boxes must be set to the required grade. The valve box must not transmit surface loads directly to either the pipe or valve. Care must be taken to prevent earth and other material from entering the valve boxes. A concrete support collar must be provided for the valve box. The American Flow Control Trench Adapter, or an approved equal, is the preferred valve box and extension system.

4. Where floor stands and/or extension stems are required, for exposed valves, adjustable wall brackets and extension stems must be furnished. Generally, brackets must not be more than six (6) feet apart, with floor stands and guides set so that the stems must run smoothly and in true alignment. Stands and guides must be firmly anchored to the concrete.

5. After installation, all valves must be subjected to the field test for piping as outlined in sections 4 through 8 of this Manual. Should any defects in materials or workmanship appear during these tests, the Contractor must correct such defects to the satisfaction of the City.

6. All flanged and mechanical joints must be made with stainless steel nuts, bolts, and washers.

H. Directional Drilling

1. Pipe Handling

Care must be taken in loading, transporting, and unloading to prevent damage to the pipe or coatings.

2. Work Coordination

It must be the Contractor's responsibility to perform the directional drilling work in strict conformity with the requirements of the agency in whose right-of-way or easement the work is being performed. Any special requirements of the agency, such as insurance, flaggers, etc., must be strictly adhered to during the performance of work. The special requirements must be performed by the Contractor at no additional cost to the City.

3. General

The directional boring machine must consist of a hydraulically powered system to rotate, push, and pull hollow drill pipe into the ground at a variable angle while delivering a pressurized fluid mixture to a guidable drill (bore) head.

4. Guidance System

The guidance system must be of a proven type and must be set up and operated by personnel trained and experienced with this system.

5. Mixing System

A self-contained, closed, boring fluid mixing system must be of sufficient size to mix and deliver boring fluid composed of bentonite clay, potable water, and appropriate additives.

6. Other Equipment

Pipe must be protected from damage by rollers or other methods during installation.

7. Utility Locates

Per the “Underground Facility Damage Prevention and Safety Act,” Chapter 556, Florida Statutes, the Contractor must contact Sunshine 811 for aid in locating existing underground facilities. It is the Contractor’s responsibility to contact Sunshine 811 for markings at least two (2) working days before commencing boring operations.

8. Pilot Hole

Pilot hole must be drilled on bore path with no deviations greater than 5 percent of depth over a length of 100 feet.

9. Reaming

Upon successful completion of pilot hole to the required diameter, Contractor will ream bore hole to a minimum of 25 percent greater than outside diameter of pipe using the appropriate tools.

10. Pullback

After successfully reaming bore hole to the required diameter, Contractor will pull the pipe through the bore hole.

I. Reclaimed Water

1. Pipe must be laid to the lines and grades shown on the plans. The Professional Land Surveyor or Professional Engineer must provide line and grade stakes at a maximum of 100 foot spacing. A professional land surveyor must set temporary benchmarks at a maximum of 1000 foot intervals.

2. All pipe must be inspected, handled, and installed, as specified under Section 3.04A2.

3. Laying of reclaimed water pipe must be accomplished to line and grade in the trench prepared in accordance with Section 2.18. Mud, silt, gravel, and other foreign material must be kept out of the pipe and off the jointing surface. All pipe laid must be retained in position to maintain alignment and joint closure until sufficient backfill has been completed to adequately hold the pipe in place.

4. All PVC pipe must be installed in accordance with the standards set forth in the Uni-Bell "Handbook of PVC Pipe Design and Construction."

5. All applicable provisions of Section 2.18 must apply with regards to trench excavation, bedding material, backfill, compaction, fill, and grading.

6. Reclaimed water pipes that are laid in the vicinity of pipelines designated to carry potable water must meet the requirements set forth in Section 6.03H.

7. Plugs for pipe branches, stubs, or other open ends, which are not to be immediately connected, must be made of an approved material and must be secured in place with a joint comparable to the main line joint.

8. The type of joint must conform to the requirements outlined in Section 3.02B.3.a. of this Manual.

9. HDPE pipe: HDPE pipe must be in accordance with AWWA C906 and must have an outside diameter equal to DIP for the same size. Pipe must have a minimum dimensional ratio of 11 for use with DI fittings and have a working pressure of 150 psi. Pipe must be color coded pantone purple 62-55.320 (21) B3, FAC.

3.05 COLOR/COATINGS

A. Color Coding

1. All above ground pipe and fitting, PVC pipe and fitting, metallic and non-metallic marking tapes, valve boxes, air release valve covers, and any other marking device, must be color coded in accordance with the Utility Location and Coordination Council Uniform Color code, which is as follows:

   Red – Electrical power line, cable, conduit, and lighting cable

Yellow – Gas, oil, steam, petroleum or gaseous materials

Orange – Communication, telephone, alarm, or signal lines, cable, or conduit

Blue – Water, irrigation, or slurry line

Green – Wastewater, drain lines and force mains.

Purple – Reclaimed water

2. Services of all valve boxes and air release valve vault covers must be painted with appropriate color of paint, corresponding to the type of service (i.e., blue for water, green for wastewater, purple for reclaimed/reuse).

3.06 TRACER WIRE

A. Tracer Wire Open Trench

Trace wire must be #12 AWG Copper Clad Steel. Extra High Strength part # 1230*HS with break load of 452 pounds and 30 ml HDPE coating is suggested as minimum thickness.

B. Trace Wire – Directional Drilling/Boring

Trace wire must be #8 AWG Copper Clad Steel. Extra Strength part # 845*EHS with break load of 2785 pounds, and 30 ml HDPE coating is suggested as minimum thickness.

C. Trace Wire – Pipe Bursting/Slip Lining

Trace wire must be #8 AWG Copper Clad Steel. Extra Strength part #PBX-50 stranded CCS with break load of 4700 pounds and coating 50 ml HDPE coating is suggested as minimum thickness.

D. Connectors and Approved Hand Holes for Tracer Wires

1. Direct bury wire connectors, including three (3)-way lockable connector: Dryconn three (3)-way Direct Bury Lug: Copperhead Part # 3WB -01 or an approved equal. Main line splice to service line connection must be specifically manufactured for use in underground trace wire installation, must be dielectric silicon filled to seal out moisture and corrosion and must be installed in a manner to prevent any uninsulated wire exposure.

2. All mainline trace wires must be interconnected in intersections, at tees and crosses. At tees, the three (3) wires must be joined using a single three (3)-way lockable connector. At crosses, the four (4) wires must be joined using a four (4)-way connector. Using two three (3)-way connectors with a short jumper wire between them is an acceptable alternative. Copperhead three (3)-way locking connector: Part # LCS1230*.

E. Termination/Access (H-20 or Greater Hand Hole)

All trace wire termination points must utilize an approved trace wire access box (above ground or grade level/in-ground, as applicable), specifically manufactured for this purpose. A minimum of two (2) foot of excess wire is required in all grade level trace wire access boxes after setting at final grade.

F. Grounding

Trace wire must be properly grounded at all dead ends/stubs. Grounding of trace wire must be achieved by use of a drive-in magnesium grounding anode rod with a minimum of 20 foot of #14 HDPE copper clad wire connected to anode (minimum 1.0 pound), specifically manufactured for this purpose and buried at the same elevation as the utility. Drive-in Magnesium Anode: Copperhead Part # ANO-10005.

G. Installation – General

Trace wire installation must be performed in such a manner that allows proper access for connection of line tracing equipment, proper locating of wire without loss or deterioration of low frequency (512Hz) signal for distances in excess of 1,000 linear feet, and without distortion of signal caused by multiple wires being installed in close proximity to one another. Trace wire must be installed as a continuous single wire. A conductivity

test must be performed prior to signing off on the project. No looping or coiling of wire is allowed.

SECTION 4

WATER DISTRIBUTION

4.01 GENERAL

A. This section sets forth the general requirements for design and installation of water distribution systems for potable water service. Pipe used in water distribution must be DIP, as specified in Section 3 of this Manual.

B. The Contractor must be responsible for all materials furnished and storage of the same until the date of substantial completion. The Contractor must replace, at the Contractor's expense, all material found to be damaged or defective in handling or storage. The Contractor must, if requested by the City, furnish certificates, affidavits of compliance, test reports, or samples for check analysis for any of the materials specified in this Manual as it relates to water systems. All pipe delivered to the project site for installation is subject to random testing for compliance with the designated specifications.

4.02 DESIGN STANDARDS

A. Required Reference

The Contractor must comply with the design and installation requirements as established by FDEP, or the delegated authority, and additional specific requirements stated in this Manual. The criteria set forth in the most recent edition of “Recommended Standards for Water Works (Ten States Standards)” and Insurance Services Office should be used as a design guide, if not in conflict with State, County, or other regulatory agency requirements. Additional resources include the AWWA Manuals of Standard Practice, Distribution Network Analysis for Water Utilities, and Sizing Water Service Lines and Meters.

B. Water Main Locations

Water mains must be located in dedicated rights-of-way or utility easements. All water mains located outside of dedicated rights-of-way must require a minimum 12-foot utility easement or as required by the City. Additional easement widths must be required when the pipe size or

depth may dictate. No water mains must be placed under retention ponds, tennis courts, or structures, as determined by the City Engineer. Preferably, water mains must not be located along side or rear lot lines. Placement of a water main along a side or rear lot line may be allowed on a case-by-case basis if such a water main configuration results in efficient placement and utilization of the water distribution system.

C. System Design

All water main systems must be looped. Dead ends are allowed if looping is not possible as determined by the City Engineer. A fire hydrant must be installed at dead-end locations. Future connections to adjacent properties must be considered, if applicable.

1. Normal Flow Demands

Flow demands for design must be calculated on the basis of the ultimate development as known or projected. The average daily flow for domestic use must be calculated at the minimum rate of 185 gpd average water demand or 246 gpd maximum day water demand per ERC or as determined by Broward County’s Water and Wastewater Engineering Department. Flow demands for commercial, industrial, or other special developments must be established using the Land Development Code, Chapter 13, of the City's Code of Ordinances.

2. Peak Flow Demands

Maximum daily flow must be determined by applying a peak factor of 2.5 to the average daily flow calculated above. Peak hour flow must be determined by applying a peak factor of 4.0 to the average daily flow calculated above.

3. Fire Flow

Minimum system requirements for fire flow rates, duration (time) for total flow, as related to the total ultimate maximum day demand, must be designed in conformance with the Insurance Services Office Fire Suppression Rating Schedule, 2012 or the latest edition. All fire flow rates and fire protection systems must also be in

complete conformance with applicable local and state fire code regulations. Minimum fire flow rates required for maximum day demands must be based on population, density, and/or other hazardous features of the proposed construction, as specifically required. Where fire flow requirements exceed the anticipated available fire flow from the central water system, an on-site fire protection system, or other fire department-approved mitigation measures must be utilized. The Developer may also be required to make improvements to the central water system to boost its fire flow capability.

4. Fire Hydrant Location

Spacing for hydrants located within low density areas must in no case exceed 800 feet (measured along the fire apparatus access road) and must be connected to eight (8)-inch diameter water mains, which are of satisfactory loop design. Connection to dead-end stubs are acceptable, as determined by the City. Hydrants located in commercial, industrial, or other high-density areas must be spaced no further than 500 feet apart (measured along the fire apparatus access road) and must connect to looped water mains eight (8) inches in diameter or larger if required by the design flow demand. A fire hydrant must be placed a minimum of 150 feet from a public street intersection and 300 feet from any building in residential districts. All hydrants must be located no less than four (4) feet and no more than seven (7) feet from the edge of pavement of the adjacent roadway and no less than four (4) feet from any physical feature that may obstruct access or view of any hydrant unless otherwise approved by the City. Exact locations of fire hydrants will be in complete conformance with local and state fire code regulations. Private hydrants are allowed only when a water distribution system remains private, as determined by the City, and must be identified in all red.

5. Hydraulic Modeling

The minimum design for water distribution systems must provide for at least 100 percent of the combined maximum day demand rate with the required fire flow for said rate or peak hourly flows, whichever is greater. The Engineer must model the defined

systems required. The allowable minimum service pressure under said design condition must be not less than 20 pounds per square inch. However, minimum service pressure under maximum daily flow alone must not be less than 50 psi, unless approved by the City. The Developer's Engineer must request a fire flow test and must submit signed, sealed, and dated design calculations with the drawings for all water distribution projects. The calculations must show that the water distribution mains will have sufficient hydraulic capacity to transport peak hourly flows and the combination of maximum daily flows and fire flows while meeting a minimum pressure of not less than 20 psi. Head losses through meters and backflow devices must also be included in the calculations. The Developer may also be required to make improvements to the central water system to maintain minimum standards throughout the system.

6. Valve Locations

Valves must be provided for all branch connections, main 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 must be 500 feet in commercial, industrial, or high-density residential districts, or 1000 feet in other areas.

7. Pipeline Pigging

Designs must incorporate provisions for pigging water mains eight (8) inches and greater in diameter, where sufficient cleaning/flushing velocity cannot be achieved. Appropriate valves must be installed along these mains to allow a soft pig to pass through.

4.03 STANDARD REQUIREMENTS

A. Approved Pipe, Fittings, and Valves

DIP of nominal diameter of four (4) inches through 36 inches must conform to ANSI/AWWA A21.51/C-151. A minimum thickness of Class 52 or Pressure Class 350 must be supplied for all sizes of pipe unless specifically required by the City. The types tabulated in Table 3, within the size range indicated and for the applicable service, are approved for water distribution system construction:

TABLE 3. Pipe and Fittings Tabulation

Pipe and fittings	Size range (inches)
DIP and fittings—cement mortar lined	No limit
Polyethylene pipe and brass fittings	Service connections only (up to 2 inches)
Resilient seated GV	No Limit
Butterfly valves (BFV)	Greater than 24 inches
Corporation stops and curb stops	Service connections only

1. Looping of Water Mains Not Practical

   Where looping of water mains is not practical, a minimum eight (8)-inch water main must be required unless detailed calculations are submitted to substantiate the sufficiency of six (6)-inch water mains. In commercial, industrial, and high-density residential areas, larger size water mains must be required, if necessary, to allow the withdrawal of the required fire flow while maintaining the minimum residual pressure of 20 psi.

2. Joints

   Joints for DIP and fitting joints must be push-on or mechanical joints conforming to ANSI/AWWA A21.11/C-111. Where called for by the City, restrained or flanged joints must be required. Restrained joints must meet the requirements of Section 4.02F of this Manual. Flanged joints must conform to ANSI/ASME Standard B16.1, class 125.

3. Fittings

All fittings must be mechanical joint DI or gray iron conforming to ANSI/AWWA A21.10/C-110, 250 psi minimum pressure rating.

4. Coatings and Linings

Interior and exterior coatings for DIP must conform to the requirements outlined in Section 3.02B.4 of this Manual.

B. Fire Hydrants

1. Hydrants must comply with ANSI/AWWA Standard C-502, "Dry Barrel Fire Hydrants" and must be equipped with a minimum of one (1) pumper outlet nozzle 4 1/2 inches in diameter and two (2) hose nozzles 2 1/2 inches in diameter, all having National Standard hose threads. Units must be traffic type with breakable safety clips or flange and stem with safety coupling located below the barrel break line to preclude valve opening. Fire hydrant must be of ample length for burial depth. Outlet nozzles must be on the same plane with a minimum distance of 18 inches and no greater than 24 inches from the center of the nozzles to ground line. The valve must be compression type with a 5 1/4 inches minimum valve opening and shoe inlet connection to be six (6) inches minimum. Fire hydrants must be equipped with "O-Ring" packing.

2. All iron parts of the hydrant both inside and outside must be painted in accordance with AWWA C-502. All inside surfaces and the outside surfaces below the ground line must be coated with asphalt varnish. They must be covered with two (2) coats. The outside of the hydrant above the furnished ground must be painted with two (2) coats of yellow paint. Private hydrants must be painted red.

3. Hydrants must be installed plumb and in true alignment with the connection pipes to the water main. They must be secured with restraining assemblies. Installation must be as shown on "Fire Hydrant Assembly drawing." Final field location of all hydrants must be approved by the City. Guard posts (see standard detail) around fire hydrants are required in all commercial areas and in some residential areas as determined by the City.

C. Dead Ends

In order to provide increased reliability of service and reduce head loss, dead ends must be minimized by making appropriate tie-ins whenever practical, as determined by the City. Where dead-end mains occur, they must be provided with a fire hydrant or blow-off for flushing purposes. Flushing devices must be sized to provide flows that will provide a velocity of at least 2.5 feet per second in the water main being flushed. No flushing device must be connected to any sewer.

D. Valves

Sufficient valves must be provided on water mains so that inconvenience and sanitary hazards will be minimized during repairs. Valves must be located at not more than 800-foot intervals in commercial, industrial, and high-density residential areas and at not more than 1,000-foot intervals in all other areas. Appropriate valve placement must also be provided at all areas where water mains intersect to ensure effective isolation of water lines for repair, maintenance, or future extension. Additional valves can be requested, as determined by the City Engineer, or designee, to ensure safe and expeditious isolation of water main for repairs. The acceptable valves, installation methods and other specialty items are identified in Section 3 of this Manual.

E. Joint Restraining

Pressure piping fittings and other items requiring restraint must be braced with restraining assemblies, as specified under Section 3. Said restraining devices must be designed for the maximum pressure condition.

F. Pipe Depth and Protection

The standard minimum cover for water distribution systems must be 30 inches from the top of the pipe to finish grade, 36 inches is preferred. Should this design not be feasible, alternatives must be reviewed for acceptance.

G. Separation of Water Mains and Sewers

Water mains installed in the vicinity of pipelines designated to carry raw wastewater or wastewater effluent must meet the horizontal and vertical separations specified herein in accordance with F.A.C. Rule 62-555.314.

1. Horizontal Separation

   Water mains must be located at least six (6) feet horizontally from any wastewater and/or reclaimed water pipe, 10 feet being preferred. Water mains must be located at least three (3) feet horizontally from stormwater pipes.

2. Vertical Separation

   Water mains must be laid to provide a minimum separation of at least six (6) inches, 12 inches is preferred, between the bottom of the water main and the top of the sewer pipe. Water mains must preferably be installed above wastewater. When a water main must be below other pipes, the minimum separation must be 12 inches. Adequate structural support for both the water main and sewer must be provided to prevent excessive deflection of joints and settling. Water mains must be constructed of DIP and the length must be a minimum of six (6) feet on each side of the crossing. The sewer must be centered at the point of crossing so that the joints will be equidistant and as far as possible from the water main.

H. Aerial/Underwater Crossings

1. Aerial Crossings

   Structural supports must be provided for all joints in pipes utilized for aerial crossings and must be designed to prevent overturning and settlement. Expansion joints must be provided between the aerial and buried sections of pipe. The impact of flood waters and debris must be considered, and the bottom of the pipe must be placed no lower than that specified by Cocomar Water Control District (WCD) standards.

   a. Flanged DIP, minimum Class 51, must be used for all aerial crossings. The above ground pipe must be painted, as specified in Section 3.02B.4.b, for aboveground water mains.

Underground pipe must be provided at both ends of the crossing so that the section can be isolated for testing or repair. The valves must be easily accessible and not subject to flooding. An automatic air release valve must be installed at the high point of the crossing at one end. Appropriate guards must be installed at both ends of the crossing to prevent pipe access to the public.

b. It must be the responsibility of the Developer to obtain all applicable regulatory permits. When the aerial crossing is accomplished by attachment to a bridge or drainage structure, the Developer must meet all requirements of the agencies that own or have jurisdiction over such structures.

2. Underwater Crossings

The pipe material must meet appropriate AWWA Standards for use in submerged conditions. Valves and ARVs must be provided at both ends of the water crossings so that the section can be easily isolated for testing or repair. Isolation valves located within the South Florida Water Management District or Cocomar WCD canal rights-of-way must be approved by the regulatory agency. The valves must be easily accessible and not subject to flooding. Both valves must be provided in a maintenance access structure or valve vault. It must be the responsibility of the Developer to obtain all applicable regulatory permits, including dredge and fill permits.

I. Pipe Bedding

Special care must be exercised in design and installation to provide adequate bedding for the type of pipe used considering trench width and depth, superimposed loadings above grade and the material below trench grade. Pipe loading capabilities must be computed in accordance with established design criteria and special support bedding or facilities must be provided as required.

J. Connections at Structures

Where pipes are to extend into or through structures, flexible joints must be provided at the wall face.

K. Special Exterior Protection for Corrosion

Extra protection must be provided for underground DIP and fittings within areas of severely corrosive conditions. This must be accomplished by the installation of polyethylene encasement, as specified in AWWA C-105, through the area of concern. The soil test evaluation to determine the necessity for extra protection in suspect areas must be as set forth in ANSI Standard A21.5. Additionally, where other existing utilities are known to be cathodically protected, DIP crossing said utility must be protected for a distance of 20 feet to each side and, when installed parallel to and within 10 feet of the said utility, protection must also be provided.

L. Air Venting and Blow Offs

Methods for air release must be provided where the water main profile is such that air pockets or entrapment could occur resulting in flow blockage. Air venting capabilities must be provided for distribution mains by appropriately placing automatic air release valves or blow offs. At critical points on major mains, automatic air release assemblies must be installed. All dead-end water mains, temporary or permanent, must be equipped with a manually operated blow-off at the terminus.

M. Service Connections

1. All service lines must be 1-inch, 1-1/2-inch, or 2-inch polyethylene tubing conforming to AWWA C-800 and C-901.

2. Connections to water mains (other than DI) of four (4) inches and larger must be made by the drilling of the appropriate size hole and the installation of service saddles. Where water services greater than 12 inches are required, dual services must be provided. Services to smaller size mains must be accomplished by in-line fittings. A corporation stop must be placed at the saddle or fitting with the service line extended perpendicular to said line. Installation must be as shown on the drawing.

3. No water service lateral must parallel adjoining lots, run between neighboring property lines or come through the rear of the property's lot line in order to provide utility service unless otherwise approved by the City Engineer.

4. Corporation stops must be 1-inch, 1-1/2-inch, or 2-inch brass, equipped with connections compatible with a polyethylene service line. Curb stops must be sized to match the meter size and conform to AWWA C-800.

5. Fittings must be brass, cast and machined in accordance with specifications in AWWA C-800 compatible with polyethylene tubing.

6. Service saddles must be for service line taps and conform to the requirements outlined in Section 3.02F.6. of this Manual.

N. Water Metering

All service connections must be metered. In general, the method of metering will follow the guidelines listed below. However, the Developer's Engineer must obtain approval before finalizing the design of the metering system. No trees or shrubs must be planted within six (6) feet of the water meter or service line. No trees or shrubs must be planted within six (6) feet of the water meter or service line. 5/8-inch through 2-inch meters must be AWWA approved Sealed Register Displacement or Velocity Type Meters. The water meters that are three (3) inches and larger meters must be AWWA Approved Turbo-Meters, Compound Meters, or preferably an approved Velocity Meter. Meters that are six (6) inches and larger must be equipped with a strainer. All meters must be equipped with "electronic read" components.

1. Single Family, Duplex, and Multifamily Subdivisions with Public Rights-of-Way

   Each unit must be individually metered. Single and double services must be installed at the property lines, as indicated by the standard drawings.

2. Single Family and Duplex Subdivisions with Private Streets

   Individual meters may be permitted in accordance with Section N if the private streets are designed to City Standards and easements are dedicated over the entire private street common areas. In addition, sufficient area must be available to locate water mains,

services, and meters. If the above criteria cannot be met, the subdivision must be metered pursuant to Section N.

3. Commercial, Industrial, Institutional, Multifamily with Private Streets, Apartments, and Condominium Projects with Fire Lines and Automatic Fire Sprinkler Systems

   In general, all such projects must require installation of a fire line double detector check valve. Where on-site fire systems contain less than 75 feet of water main, a dual system (separate domestic and fire lines) may be considered. Dual systems must require installation of a detector check or double detector check, as determined by the City. Water service lines and fire lines must have separate taps off the water main. Fire Lines shall be privately maintained.

4. Shopping Centers

   In general, shopping centers must require installation of a fire line double detector check valve assembly.

5. Meter Installation

   All meters will be installed by the City after payment of applicable fees and charges. All meters two (2) inches and smaller will be installed underground in an approved meter box. All water meters three (3) inches and larger will be installed above ground according to City specifications and standards. For single family lots, when facing the lot, meters preferably to be installed on the right side for odd numbered lots and on the left side for even numbered lots. Installation of meters under sidewalks or pavement must not be permitted. In general, all meters must be located in a utility easement located adjacent to the public rights-of-way.

6. Meter Sizes

   Meter sizes must be determined by the EOR and approved by the City. The Developer’s Engineer must provide sufficient information on estimated peak flows and low flows as well as fixture counts so that a meter size can be determined.

7. Irrigation meters are not allowed. Only under special conditions must an irrigation meter be allowed in commercial or residential areas with specific approval of the City Engineer, or designee.

8. All temporary fire hydrant meters must be installed for the purpose of construction only and have a backflow preventer. Temporary fire hydrant meters must be connected to an approved location and water distribution system.

O. Backflow Prevention

In order to protect the public water supply system from contamination due to cross-connections, the Contractor must install backflow prevention assemblies where there is the potential of a non-potable substance coming into contact with the public water system in accordance with City Code. Some of the common systems requiring backflow prevention are residential multifamily, commercial, and industrial projects, all projects with fire sprinkler and standpipe systems and with extensive on-site water systems and irrigation systems.

1. All multifamily, commercial, and industrial projects must provide backflow prevention in accordance with City Code. The City will determine the degree of hazard and require the appropriate backflow assembly.

2. All backflow prevention assemblies are to be located directly following the water meter on the Developer's property and installed above ground to facilitate maintenance and testing. It must be the Developer's responsibility to pay for, install, and maintain all backflow prevention assemblies. Additional requirements, if any, are contained in the City's cross-connection control ordinance.

4.04 INSTALLATION

A. General

All water mains, valves, and appurtenances must be installed in accordance with sections 3 and 4 of this Manual.

B. Locator Tape

All water main pipes must have a warning tape installed with a minimum four (4) mils and manufactured with heavy metal-free polyethylene tape that is impervious to all known alkalis, acids, chemical reagents, and solvents found in soil. The minimum overall width of the tape must not be less than three (3) inches. Standard rolls must be 2000 feet in length. Tape must be installed 18 inches below the ground surface. The tape must be colored Safety Blue and imprinted with the following message: Caution – Water Main.

C. Tracer Wire

Tracer wire must be considered incidental to the water mains. All tracer wires must have HDPE insulation intended to direct bury, color coated per APWA and per Section 3.06 of this Manual.

4.05 TESTING

A. The Contractor must perform hydrostatic testing of all water distribution systems, as set forth in the following, and must conduct said tests in the presence of representatives from the City or other authorized agencies, with two (2) days advance notice provided. Hydrostatic tests must be conducted on all newly laid pressure pipes, joints, fire hydrants, and valves, including all service lines to the curb stops. Air testing of pressure pipe will not be permitted unless approved by the City Engineer or designee. The Contractor must furnish all necessary equipment and material and make all taps in preparation for the hydrostatic test. No testing must be performed until the City approves the as-built drawings.

B. Piping and appurtenances to be tested must be within sections between valves or adequate plugs, all with prior approval. All piping must 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 must be exercised to permit the escape of air from the sections of pipe that is going to be tested.

1. Hydrostatic testing must be performed at 150 psi for a period of not less than two (2) hours. If during the test the integrity of the tested line is in question, the City may require a six (6) hour pressure test. Testing must be in accordance with the applicable provisions as set forth in Section 4 of AWWA Standard C-600. The Contractor may conduct hydrostatic tests after the trench has been partially backfilled with the joints left exposed for inspection for the Contractor's informational purposes only. The hydrostatic tests for acceptance must only be conducted after the trenches have been completely backfilled and compacted as specified.

2. The procedure for conducting the test will be that each section of pipe to be tested will be slowly filled with water and the specified test pressure must be applied by means of a pump connected to the pipe in a satisfactory manner. Before applying the specified test pressure, all air must be expelled from the pipe. To accomplish this, taps must be made and appropriate valves installed to ensure the bleeding of all air from the main. If defective pipes, fittings, valves, or hydrants are discovered in consequence of this pressure test, all such items must be removed and replaced by the Contractor with sound material and the test repeated until satisfactory results are obtained. The allowable rate of leakage for DIP must be less than the number of gallons per hour determined by the following formula:

$$L = \frac{SD(P)^{1/2}}{148{,}000}$$

L = allowable leakage in gallons per hour

S = length of pipe tested, in lineal feet (maximum length 2,000 feet for calculation)

D = nominal diameter of the pipe in inches

P = average test pressure maintained during the leakage test in pounds per square inch gauge, (minimum 150 psi); pressure loss during test must not exceed five (5) psi

3. The testing procedure must include the continued application of the specified pressure to the test system for the two (2)-hour period by way of a pump taking supply from a container suitable for measuring water loss. The amount of loss must be determined by

measuring the volume displaced from said container. Should the test fail, necessary repairs must be accomplished by the Contractor and the test repeated until it is within the established limits. The Contractor must furnish the necessary labor, water, pumps, gauges, and all other items required to conduct the required water distribution system testing and perform necessary repairs.

4. All water tapping sleeves must be hydrostatically pressure tested in accordance with the latest revision of AWWA C-600. The test must be conducted at 150 psi for a period of two (2) hours. No loss of pressure is allowed.

4.06 DISINFECTION

A. Following pressure testing, the Contractor must disinfect all sections of the water distribution system and receive approval thereof from the appropriate agencies prior to placing in service. In addition, any part of the City's water system that has direct contact with finished water and has been out of service for repair, alteration, or replacement must be disinfected. Two (2) days advance notice must be provided to City before disinfecting procedures start. The disinfection must be accomplished in accordance with the applicable provisions of AWWA Standard C-651, "Disinfecting Water Mains," and all appropriate approval agencies.

B. Sections of pipe to be disinfected must first be flushed (full diameter) to remove any solids or contaminated material that may have become lodged in the pipe. All taps required for chlorination or flushing purposes, or for the temporary or permanent release of air, must be provided for by the Contractor as a part of the construction of water mains. All such taps must be sealed to the satisfaction of the City.

C. Before being placed into service, all new mains and repaired portions of or extensions to existing mains must be chlorinated so that the initial chlorine residual is not less than 50 mg/L and a chlorine residual of not less than 25 mg/L remains in the water after 24 hours in the pipe. Chlorine may be applied as a liquid chlorine (gas-water mixture) or a mixture of water and high-test calcium hypochlorite. The Contractor must assume the responsibility for safe handling of chlorine and must meet the

requirements of OSHA and other regulatory agencies for the safe handling of chlorine.

D. The preferred point of application of the chlorinating agent must be at the beginning of the pipeline extension, or any valved section of it, and through a corporation stop inserted in the pipe. The water injector for delivering the chlorine-bearing water into the pipe should be supplied from a tap made on the pressure side of the gate valve controlling the flow into the pipeline extension. Alternate points of applications may be used when approved by the City.

E. Maximum distance between sampling points must be as follows:

Transmission mains:	Every 1,500 ft.
Distribution mains:	Every 1,000 ft.
Isolated mains:	Less than 1,000 ft: two (2) sample points
	Greater than 1,000 ft: three (3) sample points

F. Following chlorination, all treated water must be thoroughly flushed from the newly laid pipe at its extremity until the replacement water throughout its lengths shows, upon test, the chlorine measurement not in excess of that normally carried in the system. After flushing, water samples must be collected on two (2) successive days from the treated piping systems, as directed by the City, and must show acceptable bacteriological results. All bacteriological testing must be the responsibility of the Contractor and must be performed by a laboratory certified by the State of Florida. In addition, proper chain of custody procedures must be followed, and samples must only be collected by certified personnel in the presence of City personnel. Copies of testing results and all related correspondence with the FDEP must be submitted to the City. The Contractor must be solely responsible for the cost of collecting and processing the bacteriological samples.

G. Should the initial treatment result in an unsatisfactory bacterial test, the original chlorination procedure must be repeated by the Contractor until satisfactory results are obtained.

SECTION 5

GRAVITY WASTEWATER SYSTEMS

5.01 GENERAL

This section includes general technical criteria for the design and installation of gravity wastewater systems.

5.02 DESIGN STANDARDS

A. Required Reference

The Contractor must comply with all applicable requirements, as established by the FDEP. Additionally, the criteria set forth in the most recent edition of "Recommended Standards for Wastewater Facilities (Ten States Standards)," may generally be used as a design guide, if not in conflict with State, County, or other regulatory agency requirements.

B. Gravity Wastewater Locations

Gravity wastewater systems must be located in dedicated rights-of-way or utility easements. Whenever possible, wastewater systems must be located under pavement in dedicated rights-of-way. All wastewater systems located outside of dedicated rights-of-way must require a 12-foot easement. If gravity wastewater systems are located adjacent to a road right-of-way, a minimum 10-foot easement must be provided. Additional easement widths must be provided when the pipe size or depth of cover, in both cases, so dictates. No gravity wastewater systems must be placed under retention ponds or drainage ditches, sport courts, or other structures. In general, gravity wastewater systems must not be located along side or rear lot lines. Placement of gravity wastewater systems along a side or rear lot line may be allowed on a case-by-case basis if such wastewater systems configuration results in efficient placement and utilization of the wastewater systems and must be approved by the City. In addition, no maintenance access structures must be placed alongside or rear lot lines.

C. System Design

1. Average Design Flows

The wastewater system design must be based on full ultimate development as known or projected. The average daily flow (ADF) from domestic units must be calculated at the minimum rate of 100 gallons per capita per day. Flow requirements from commercial, industrial, average design flows: the wastewater system design must be based on full ultimate development, as known or projected. The ADF from domestic units must be calculated at the minimum rate of 100 gallons per capita per day. Flow requirements from commercial, industrial, institutional, or other special development areas must be established using 2500 gpd / acre. Equivalent Residential Connection (ERC) gallons per day equivalence must follow Broward County Water & Wastewater Engineering Division Equivalent Residential Unit factors.

2. Peak Design Flows

Gravity wastewater systems must be designed on the basis of ultimate development maximum rates of flow, which will be the product of selected peak factors times the cumulative ADF for the subject portion. In general, the following peak factors must be applicable for the range of ADF rates indicated (million gallons per day [MGD]), unless larger values are required for specific conditions or prior approval is received for modification thereof.

Flow range, MGD-ADF	Peak factor
0.000 to 0.100	4.0
0.100 to 0.250	3.5
0.250 to 1.000	3.0
1.000 to 4.000	2.5

Note: Special analysis must be made for flows beyond 4.000 MGD-ADF or peak factors less than 2.5.

3. Wastewater Pipe Size Computation

Wastewater pipes must be sized to provide ample capacity for the required ultimate population/development peak flow rates. The minimum allowable size for any wastewater system, other than service connections, must be eight (8) inches in diameter. All wastewater pipes must be designed at slopes providing minimum velocities of not less than two (2) feet per second when flowing full or half-full. Said computation must be based on Manning's Equation, using a roughness coefficient ("n") of 0.012 for PVC pipe and 0.013 for other pipe material, unless justifiably approved otherwise. In general, the following minimum slopes must be maintained:

Sewer diameter (Inches)	Minimum slope (Feet per 100 feet)
8	0.40
10	0.28
12	0.22
16	0.15
18	0.12
20	0.10
24 and larger	0.08

4. Design Considerations

a. Wastewater pipes must be installed with straight alignment and grade between maintenance access structures, with maintenance access structure spacing not to exceed 300 feet. However, special provisions may be considered.

b. All wastewater pipes must initiate and terminate at maintenance access structure.

c. There should be a minimum drop of 0.10 feet in the channel across the maintenance access structure.

d. Wastewater pipes of the same size must always join at maintenance access structures with no size conversions between maintenance access structures. If the entrance pipe elevation exceeds two (2) feet above the effluent

wastewater, drop maintenance access structure connections must be provided.

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

f. Wastewater extensions should be designed for projected flows even when the diameter of the receiving wastewater pipe is less than the diameter of the proposed extension at a maintenance access structure with special consideration of an appropriate flow channel to minimize turbulence when there is a change in wastewater pipe size. The appropriate reviewing authority may require a schedule for construction of future downstream wastewater relief.

g. Flow direction changes in excess of 90 degrees must not be included in wastewater pipe alignments without special consideration. When directional changes exceeding 45 degrees occur, an extra flow line elevation drop of 0.1 feet across maintenance access structure must be provided.

h. Where design velocities greater than 10 feet per second are attained, special provisions must be provided for wastewater protection.

i. The minimum cover over gravity wastewater pipes must be no less than 36 inches calculated from the finished grade unless the pipe is a DIP.

j. All wastewater pipe extensions for future connections must terminate at a maintenance access structure.

k. The EOR must submit signed, sealed, and dated design calculations with the drawings for all wastewater projects. Calculations must show that the effluent will have sufficient

hydraulic capacity to transport all design flows, including lift station capacity.

5.03 STANDARD REQUIREMENTS

A. Approved Pipe and Fittings

PVC pipe ranging in diameter from four (4) to 16 inches must meet the requirements for ASTM D3034, SDR 26. PVC pipe with a diameter greater than 18 inches must meet ASTM F679, SDR 26. For gravity mains buried deeper than 15 feet, SDR must be 26. The joints must be integral bell elastomeric gasket joints manufactured in accordance with ASTM D3212 and ASTM F477. All PVC gravity wastewater pipe must meet the requirements of Section 3 of this Manual. Unless otherwise specified, wye branches must be provided in the gravity wastewater main for service lateral connections. Wyes must be six (6)-inch inside diameters unless otherwise approved by the City. All fittings must be the same material as the pipe. Plugs for stub outs must be of the same material as the pipe and utilize the same gasket material as the pipe joint.

B. Wastewater Maintenance Access Structures

1. Maintenance access structures must be precast concrete, as detailed herein. Alternate maintenance access structure materials and designs must receive prior approval. The minimum inside diameter of maintenance access structure must be 48 inches for wastewater pipe sizes up to 24 inches in diameter or less. For wastewater pipes larger than 24 inches, the minimum inside diameter must be 60 inches. A minimum access cover diameter of 24 inches must be provided. Installation of maintenance access structure must be in compliance with the "Gravity Wastewater Pipe Detail."

2. Precast reinforced maintenance access structure must be in accordance with ASTM C478, with preformed flexible plastic joint sealer conforming to Federal Specification SS-S-0021 (US General Services Administration [GSA]-Federal Supply Schedule [FSS]).

3. The minimum wall thickness must be eight (8) inches. Precast maintenance access structure must be constructed with a precast monolithic base structure as shown on the standard drawings. The minimum thickness must be eight (8) inches.

4. Maintenance access structure frames and covers must be US Foundry model 420-C and must be gray cast iron conforming to ASTM A48, Class 30. Castings must be true to pattern in form and dimensions and free from pouring faults and other defects that would impair their strength or otherwise make them unfit for service intended. The seating surfaces between frames and covers must be machined to fit true. No plugging or filling will be allowed. Lifting or pick holes must be provided.

5. Casting patterns must conform to those shown or indicated on the standard drawings. Covers must have no perforations and must be marked with the words "SANITARY SEWER DEPT," with City logo stamped. Grade rings must be set with preformed flexible plastic gasket meeting ASTM-990 with a minimum size of one (1) inch. Maximum height of adjusting grade rings must be 12 inches. Frames must be suitable for the future addition of cast iron rings for upward adjustment of top elevation. All maintenance access structure frames, rings, and covers must be traffic bearing to meet AASHTO H-20 loadings.

6. Maintenance access structure flow channels must be smooth, with carefully shaped bottoms, built up sides, and benching constructed from concrete. Channels must conform to the dimension of the adjacent pipe and provide changes in size, grade, and alignment evenly. Flow directional changes of greater than 90 degrees must not be included in wastewater alignments without special consideration. When directional changes exceeding 45 degrees occur, an additional flow line elevation drop of 0.1 foot across maintenance access structure must be provided. Benching must be provided to have a minimum slope of two (2) inches per foot.

7. The interior/exterior surfaces of all maintenance access structure must be protected by the application of two (2) coats of epoxy, Koppers 300-M or its equal. The first coat must be red and the second coat black. Each coating must have a minimum dry film

thickness of 16 mils. Exterior surfaces must receive two (2) coats of Koppers 300-M or equal, with a minimum dry film thickness of 16 mils. Surface preparation and paint application must comply with the manufacturer's recommendations.

8. Where additional pipe connections or modification of existing factory-made openings are required on new or existing precast concrete maintenance access structure, all cutting must be performed only by a power-driven abrasive wheel or saw. Notably, such connections to existing maintenance access structure must be sealed with non-shrinking grout.

9. An outside drop pipe must be provided for a wastewater pipe entering a maintenance access structure where its invert elevation is 24 inches or more above the maintenance access structure invert. Where the difference in elevation between the incoming wastewater pipe and the maintenance access structure invert is less than 24 inches, the maintenance access structure invert must be filleted to prevent solids deposition.

10. Concrete for maintenance access structure must be Type II, 4,000 psi at 28 days. Barrel, top, and base sections must have tongue and groove joints. All jointing material must be cold adhesive performed gaskets, conforming to FDOT Article 942-2.

11. Maintenance access structure sections must be cured by an approved method for at least 28 days prior to painting and must not be shipped until at least two (2) days after having been painted.

12. Precast concrete top slabs must be used where cover over the top of the pipe is less than four (4) feet. Lift rings or non-penetrating lift holes must be provided for handling precast maintenance access structure sections. Non-penetrating lift holes must be filled with non-shrinking grout after installation of the maintenance access structure sections.

C. Pipe Depth and Protection

The minimum allowable cover for gravity wastewater pipes must be three (3) feet from the top of the pipe to finish grade. Where waterways are

crossed, protective concrete slabs must be installed across and to 10 feet each side of the bottom. Additionally, approved utility crossing signs must be placed on the pipe alignment at each side of any waterway crossed, along with fan guards.

D. Pipe Bedding

Special care must be exercised in 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 loading capabilities must be computed in accordance with established design criteria and special supporting bedding or facilities must be provided, as required.

E. Special Exterior Protection for Corrosion

Extra protection must be provided for underground DIP and fittings within areas of severe corrosive conditions. This must be accomplished by the installation of polyethylene encasement, as specified in AWWA C-105, through the area of concern. The soil test evaluation to determine the necessity for extra projection in suspect areas must be set forth in ANSI Standard A21.5. Additionally, where other existing utilities are known to be cathodically protected, DIP crossing the utility must be protected for a distance of 20 feet to each side, and when installed parallel to and within 10 feet of same, protection must also be provided.

F. Connections at Structures

Where wastewater pipes connect to structures, pipe joints must be provided at the wall face. Further, where the connection is to wet wells or other installations where backfill exists below trench grade, one joint (14 to 20 feet) of C-900 pipe must extend outward from the structure. When it is necessary to extend wastewater pipes through structures, such as conflict structures, the pipe within must be DI or C-900 with no inside joints.

G. Transition Connections

Where pipes of alternate materials (PVC to DI, etc.) are to be connected between maintenance access structures, suitable approved transition couplings must be installed. Couplings must be "C-T Adapters." Special

designed units may be submitted for approval. However, concrete collars are not acceptable.

H. Service Connections

Installation must be as shown on "Service Lateral Details," including the wye branches installed in the wastewater main at the point of connection, service pipe and required fittings extended to the property line, perpendicular to said line, terminating with stoppered ends or fittings and clean-outs, as indicated. The minimum service pipe size must be six (6) inches in diameter and not more than 150 feet in length for single or double connections, with slope a minimum of 1 percent. Service laterals must not be allowed to discharge into sanitary maintenance access structure. However, special conditions may be considered at the discretion of the City Engineer. A case-by-case exception to this requirement may be allowed if the lateral discharges at the same elevation as the maintenance access structure invert.

1. Clean-outs

Clean-outs must be provided and brought to final grade at the property or easement line for all wastewater laterals. Clean-outs must not be located in driveways. One six (6) inch diameter clean out must be installed for each service connection with a hexagonal cleanout box at a maximum spacing of 100 feet.

2. Wastewater Service Lateral

No wastewater service lateral must parallel adjoining lots, run between neighboring property lines, or come through the rear of the property’s lot line in order to provide utility service, unless otherwise approved by the City Engineer, or designee.

I. Protection of Water Systems

The horizontal separation between wastewater pipes and existing or proposed water mains must not be less than six (6) feet but 10 feet is preferred. Unless wastewater pipes cross below water mains with a vertical separation of 12 inches but 18 inches preferred, between the bottom of the water pipe and the top of the wastewater pipe, special

protection must be provided for a minimum distance of 10 feet on each side of the water main. All separation requirements must be in accordance with F.A.C. Rule 62-555.314.

5.04 INSTALLATION

A. All gravity wastewater pipes, maintenance access structure, and appurtenances must be installed in accordance with Section 3 of this Manual. All wastewater piping must be installed by utilizing a pipe laser.

B. All gravity wastewater pipes must have a warning tape installed with a minimum four (4) mils and manufactured with heavy metal-free polyethylene tape that is impervious to all known alkalis, acids, chemical reagents, and solvents found in soil. The minimum overall width of the tape must not be less than three (3) inches. Standard rolls must be 2000 feet in length. Tape must be installed eighteen (18) inches below the ground surface. The tape must be colored Safety Green and imprinted with the following message: Caution – Sanitary Sewer Below or Force Main Below (depending on the pipe).

C. Tracer wire must be considered incidental to the wastewater mains. All tracer wires must have HDPE insulation intended to direct bury, color coated per APWA and per Section 3.06 of this Manual.

5.05 TESTING

A. The Contractor must perform testing of all gravity wastewater pipes, as set forth in the following, and must conduct the tests in the presence of representatives from the City Engineering Division, with two (2) days advance notice provided. No testing will be performed until the City has received as-built drawings.

B. Lamping of all gravity wastewater piping will be required.

C. Gravity wastewater pipes to be tested must be within sections as previously approved. Testing must not proceed until all facilities are complete, in place and concrete cured. All piping must be thoroughly

cleaned prior to testing to clear the lines of all foreign matter. Testing must be completed at least 30 days after installation.

D. Air testing method procedures must be completed using pneumatic plugs, having a sealing length equal to or greater than the diameter of the pipe to be tested, placed at both ends of the pipe to be tested and must be inflated to 25 psig. The sealed wastewater pipe must then be pressurized to four (4) psig above the average back pressure of ground water over the wastewater pipe and the air pressure allowed to stabilize for at least two (2) minutes.

E. After the stabilization period, the line must be pressurized to 3.5 psig and the time (in minutes) measured for pressure to drop to 2.5 psig. If ground water is present, the air pressure within must be increased to 3.5 psig above the level of the ground water and the drop of one (1) pound of air pressure measured in minutes (see Table 4).

F. Air testing techniques must be in accordance with the latest ASTM standard practice for testing wastewater pipes by low-pressure air test method for the appropriate pipe material, except that the time must not be less than double that shown in the air test table.

TABLE 4. Air Test Table

Specification time (min:sec) required for pressure drop from 3.5 to 2.5 psig when testing one pipe diameter only								
Length of wastewater pipe (in feet)	Pipe diameter in inches							
	6	8	10	12	15	18	21	24
25	0:10	0:18	0:28	0:40	1:02	1:29	2:01	2:38
50	0:20	0:35	0:55	1:19	2:04	2:58	4:03	5:17
75	0:30	0:53	1:23	1:59	3:06	4:27	6:04	7:55
100	0:40	1:10	1:50	2:38	4:08	5:56	8:05	10:34
125	0:50	1:28	2:18	3:18	5:09	7:26	9:55	11:20
150	0:59	1:46	2:45	3:58	6:11	8:30	---	---
175	1:09	2:03	3:13	4:37	7:05	---	---	---
200	1:19	2:21	3:40	5:17	---	---	---	12:06
225	1:29	2:38	4:08	5:40	---	---	10:29	13:36
250	1:39	2:56	4:35	---	---	8:31	11:35	15:07

Specification time (min:sec) required for pressure drop from 3.5 to 2.5 psig when testing one pipe diameter only								
275	1:49	3:14	4:43	---	---	9:21	12:44	16:38
300	1:59	3:31	---	---	---	10:12	13:53	18:09
350	2:19	3:47	---	---	8:16	11:54	16:12	21:10
400	2:38	---	---	6:03	9:27	13:36	18:31	24:12:00
450	2:50	---	---	6:48	10:38	15:19	20:50	27:13:00
500	---	---	5:14	7:34	11:49	17:01	23:09	30:14:00

G. Deflection testing for flexible thermoplastic pipe by pulling a go-no-go mandrel through the pipe from maintenance access structure to maintenance access structure. The mandrel must not exceed 5 percent of the base internal diameter (ID) of the pipe. Base ID must be calculated in accordance with the following:

Average ID = Average outer diameter (OD) – 2(1.06)T
Tolerance Package = $(A^2+B^2+C^2)^{\wedge}½$
Where:

A = OD of Tolerance (ASTM 03034)
B = Excess Wall Thickness Tolerance = 0.06T
C = Out-of-Roundness Tolerance = 0.013 (Avg. OD)
T = Minimum Wall Thickness (ASTM D3034)
Base ID = Avg. ID – Tolerance Package

H. Should the test fail, necessary repairs must be accomplished by the Contractor and the test repeated until the results are within the established limits. The Contractor must furnish the necessary labor, water, and all other items required to conduct the required testing and must perform the necessary system repairs required to comply with the specified test.

I. Maximum ring deflection of PVC pipe under load must be limited to 5 percent of the vertical internal pipe diameter.

J. Three (3) television inspections must be completed on the wastewater gravity system. The first must be completed prior to FDEP approval or certification. The second television inspection will be completed prior to release of the Performance Bond and the City's acceptance. The third television inspection must be prior to release of the Maintenance Bond.

The television inspections must be performed in accordance with The National Association of Sewer Service Companies "Recommended Specifications for Sewer Collection System Rehabilitation." The television inspection must be performed by City staff unless authorized by the City Engineer. If either inspection reveals cracked, broken or defective pipe or pipe misalignment resulting in vertical sags in excess of 1/2 inch of water, and/or more than three (3) sags in between maintenance access structure, the Contractor must be required to replace the pipe, as determined by the City Engineer. Prior to replacement of failed wastewater pipe, the method of replacement must be submitted to the City for approval. Pressure grouting must not be considered an acceptable method of replacement.

K. The results of all testing must be provided to the City in legible form by the Contractor.

SECTION 6

WASTEWATER FORCE MAINS

6.01 GENERAL

This section includes the general requirements for design and installation of force main systems servicing wastewater pumping stations.

6.02 DESIGN STANDARDS

A. Required Reference

The Contractor must comply with the applicable design and installation requirements, as established by the FDEP and the most recent edition of "Recommended Standards for Wastewater Facilities (Ten States Standards)."

B. System Design

Force main systems must 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 should be given to possible future connecting pumping stations and this probability must be reviewed by the City. Capacity computations must be coordinated with the proposed pumping system(s) along with any future flow requirements, if applicable. Force main flow velocity must not be less than 2.5 feet per second or more than 10 feet per second.

C. Average Design Flows

The force main system design must be based on full ultimate development as known or projected. The ADF from domestic units must be calculated at the minimum rate of 100 gallons per capita per day. One ERC must be equal to the rate of 246 gallons per day. Flow requirements from commercial, industrial, institutional, or other special development areas must be established using Chapter 20 of the City's Code of Ordinances.

D. Peak Design Flows

The peak design flow rate must conform to the requirements outlined in Section 7.02B.

1. At design pumping rates, a scouring velocity of a least 2.5 feet per second should be maintained at all times. The maximum velocity at design pumping rates should not exceed 10 feet per second. The minimum force main diameter must be four (4) inches unless approved by the City Engineer.

2. Friction losses through force mains must be based on the Hazen-Williams formula. In the use of the Hazen-Williams formula, the values for "C" must be 120 for new DIP, PVC Pipe, or HDPE pipe. When initially installed, the force mains may have a significantly higher "C" factor. The higher "C" factor should be considered only in calculating maximum power requirements and duty cycle time of the pump station.

3. The force main and fittings, including all restrained joint fittings, must be designed to withstand pump operating pressures and pressure surges but not less than 100 pounds psi.

4. Force mains must not terminate directly into a gravity sewer line. Force mains should enter a maintenance access structure built with a proper channel.

E. Design Calculations

The Developer’s Engineer must submit signed, sealed, and dated design calculations for all wastewater force main projects and pump stations. The calculations must show that the force main and any existing pump stations where connection occurs will have sufficient hydraulic capacity to transport all design flows. The Developer may be required to make improvements to the City’s collections system to maintain capacity downstream of the development.

F. Operational Cost Considerations

In addition to initial capital expenditure, long-term pumping station operational costs must also receive consideration when sizing force mains. Should a pipe size option be available within the design limits, the cost of wastewater pumps and motors, force main system, and pump operating power (computed for design ADF rate for 10 years at existing electricity cost) must be compared to like amounts for the alternate designs. The final force main size selection must be directed toward the system with the least long-range capital and operational cost. The cost analysis must be subject to review.

G. Force Main Location

Force mains must be located in dedicated rights-of-way or utility easements. When installed in rights-of-way, force mains must maintain a consistent alignment with respect to the centerline of the road. All force mains located outside of dedicated rights-of-way must require a minimum 12-foot easement or as required by the City. Additional easement widths must be needed when the pipe size or depth may dictate. No force main must be placed under retention ponds, drainage ditches, sport courts or structures as determined by the City Engineer, or designee.

6.03 STANDARD REQUIREMENTS

Force main pipe material to be determined by the City Engineer on all projects.

A. Approved Pipe, Fittings and Valves

Pipe used for force main systems must be DIP. All DIP must conform to ANSI/AWWA A21.51/C-151. The DIP must be a minimum thickness Class 51 pipe unless a higher-class pipe is specifically required by the City. The types tabulated below within the size range indicated and for the applicable service are approved for wastewater force main construction. Force mains must be a minimum of four (4) inches in diameter.

Pipe and fittings	Size range (inches)
DIP and fittings*	4” and greater

(*) Interior coating or lining requirements must receive special consideration in regard to operational conditions.

Valves	Size range
Pug Valves	No limit

B. Joints

Joints for DIP and fittings must be push-on or mechanical type joints conforming to ANSI/AWWA A21.11/C-111, unless otherwise required by the City. Flanged joints, if required, must conform to ANSI B16.1 Class125.

C. Joint Restraining

Pressure piping fittings and other items requiring restraint, must be braced with restraining assemblies. The restraining devices must conform to sections 3.02 and 4.03E of this Standard and must be designed for the maximum pressure condition (testing).

D. Approved Pipe

HDPE or PVC of nominal diameter of four (4) inches through 36 inches must conform to PE-3408 SDR 11 for HDPE pipe and AWWA C-900, C-905, and C-909 for polyethylene pressure pipe and fittings.

1. HDPE butt-fused pipe must meet ASTM D-3350 cell classification of 345434C. Bends in HDPE pipe must not be within 10 pipe diameters from any fitting or valve. The minimum radius of curvature must be 30 pipe diameters and bending must not cause any kinking.

2. All polyethylene piping must have DIP dip nominal outside diameters. PVC pipe must conform to the requirements of AWWA C-900 (four ([4] inches through 12 inches), AWWA C-905 (14” through 36”), AWWA C-909 (4 inches through 24 inches) and must be Class 150 DR 18 for open cut and direct bury installations. C-900, C-905, and C-909 pipes must have an integral bell formed with a race designated to accept the gasket in accordance with the respective AWWA requirements. The spigot end must have a bevel and a stop mark on the outside diameter to indicate proper insertion depth. All surfaces of the joint where the gasket may bear must be smooth, free of cracks, fractures, or imperfections that could

adversely affect the performance of the joint. The minimum radius of curvature must be 30 pipe diameters and bending must not cause any kinking. For shallower depth, the type of pipe and installation must require City approval.

Pipe and fittings	Size range (niches)
HDPE and PVC pipe fittings	4” and up
Resilient seated GVs	No limit
BFVs	Greater than 24 inches
Full port PVs	4” and up

E. Pipe Bedding

Special care must be exercised in 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 loading capabilities must be computed in accordance with established design criteria and special support bedding or facilities must be provided, as required.

F. Pipe Depth and Protection

The standard minimum cover for wastewater force main systems must be three (3) feet from the top of the pipe to finished grade. Where waterways and canals or other cuts are crossed, protective concrete slabs must also be installed across and to 10 feet on each side of the bottom. Additionally, approved utility crossing signs must be placed on the pipe alignment at each side of the canal, etc.

G. Separation of Water Mains and Wastewater Force Mains

1. Horizontal Separation

The horizontal separation of water pipe must be located a minimum of six (6) feet horizontally from any wastewater force main, 10 feet preferred. All separation requirements must be in accordance with F.A.C. Rule 62-555.314. See standard drawing.

2. Vertical Separation

The vertical separation must be six (6) inches, 12 inches preferred above the top of the wastewater pipe. Water mains can be laid 12 inches below the bottom of the wastewater pipe (not preferred). The vertical separation must be 12 inches above or below the outside of the pipeline for gravity mains, wastewater force mains, and reclaimed/reuse water mains. Adequate structural support for both water mains and gravity wastewater pipes must be provided to prevent excessive deflection of joints and settling. Water mains must be constructed of DIP and the length must be a minimum of 10 feet on each side of the crossing. The wastewater main must be centered at the point of the crossing so that the joints will be equidistant and far as possible from the water main, as per standard drawing. All separation requirements must be in accordance with F.A.C. Rule 62-555.314.

H. Aerial/Underwater Crossings

1. Aerial Crossings

Structural supports must be provided for all joints in pipes utilized for aerial crossings and must be designed to prevent overturning and settlement. Expansion joints must be provided between the aerial and buried sections of pipe. The impact of flood waters and debris must be considered, and the bottom of the pipe must be placed no lower than one (1) foot above the 100-year flood elevation and or in accordance with the current flood insurance rate map.

1.1 Flanged DIP, minimum Class 51, must be used for all aerial crossings. The above ground pipe must be painted green. Underground valves must be provided at both ends of the crossing so that the section can be isolated for testing or repair. The valves must be easily accessible and not subject to flooding. Both valves must be constructed in a maintenance access structures or valve vault. An automatic air release valve must be installed at the high point of the crossing at one end. Appropriate guards must be installed at both ends of the crossing to prevent pipe access to the public.

1.2 It must be the responsibility of the Developer to obtain all applicable regulatory permits. When the aerial crossing is accomplished by attachment to a bridge or drainage structure, the Developer must meet all requirements of the agencies that own or have jurisdiction over such structures.

2.0 Underwater Crossings

The pipe material must meet appropriate AWWA Standards for use in submerged conditions. Valves and ARV's must be provided at both end of the water crossings so that the section can be easily isolated for testing or repair. Isolation valves located within the South Florida Water Management District or Cocomar WCD canal rights-of-way must be approved by the regulatory agency. The valves must be easily accessible and not subject to flooding. Both valves must be constructed in a maintenance access structures or valve vault. It must be the responsibility of the Developer to obtain all applicable regulatory permits, including dredge and fill permits.

I. Connections at Structures

Where pipes are to extend into or through structures, flexible joints must be provided at the wall face.

J. Air Venting

Where the force main profile is such that air pockets or entrapment could occur, provisions for automatic air release must be provided. The air release valves must conform to the requirements outlined in Section 6.03 of this Manual. Automatic air release assemblies must be installed where venting is required, on all major force mains, and at critical points on lesser mains. Air release valve assemblies must be provided at profile break points on major force mains, such as tops of hills, negative elevations, curvatures, or depressed crossings, etc., where free flow will occur during operation or after pumping stops. Air release valves must be suitably housed in a properly vented underground chamber. Installation must be as is shown on the drawing.

K. Valves

Plug valves as specified in Section 3.03 must be used on all wastewater force mains. All plug valves must be installed so that the direction of flow through the valve is in accordance with the manufacturer's recommendations. Seat end to be located at pressure side force main.

L. Valve Locations

Valves must be installed on all subsidiary force mains at the point of connection to the major main in order to isolate the pipeline for maintenance. Where force mains are to be extended, valves must be placed at the future connection point to preclude line shutdown at the time of extension. At future connection branches or ends, the valves must be restrained by methods other than thrust blocking in order to facilitate the connection without system shutdown. On straight runs of force mains, valve spacing must not exceed 1,000 feet.

M. Branch Connections

Where the receiving force main liquid transmission sectional area is less than four (4) times that of the subsidiary main, connections must be through wye fittings. Tee fitting connections are acceptable within the allowable range (receiving main sectional area more than four [4] times that of the branch) with tapping saddles recommended for receiving mains 24 inches and larger.

N. Alignment Direction Change

When changes in the direction of alignment are required, fitting angles must not exceed 45 degrees, unless specific design considerations dictate otherwise. For example, at a 90-degree turn, two 45-degree bends will be used in place of one 90-degree bend.

O. Terminal Discharge

Force mains must enter the terminal facility (gravity wastewater maintenance access structure, pumping station wet well, or other) at a point as detailed in the drawing.

P. Tracer wire

Tracer wire must be installed for all force mains except DI. All force main pipes must have a tracer wire domestically manufactured. All tracer wire must have HDPE insulation intended to direct bury, color coated per APWA standard.

1. Open Trench: Tracer wire must be #12 AWG Copper Clad Steel. Extra High Strength part # 1230*HS – break load 452 lb., 30 ml HDPE coating is suggested as minimum thickness.

2. Directional Drilling/Boring: Tracer wire must be #8 AWG Copper Clad Steel. Extra Strength part # 845*EHS – break load 2785 lb., 30 ml HDPE coating is suggested as minimum thickness.

3. Pipe Bursting: Tracer wire must be #8 AWG Copper Clad Steel. Extra Strength part # PBX-50 stranded CCS-break load 4700 lb., 50 ml HDPE coating is suggested as minimum thickness.

4. Connectors: Direct bury wire connectors, including three (3)-way lockable connector: Dryconn three (3)-way Direct Bury Lug; Copperhead Part # 3WB -01, or an approved equal. Main line splice to service line connection must be specifically manufactured for use in underground trace wire installation, must be dielectric silicon filled to seal out moisture and corrosion, and must be installed in a manner so as to prevent any uninsulated wire exposure.

5. All mainline tracer wires must be interconnected at intersections, at tees and crosses. At tees, the three wires must be joined using a single three (3)-way lockable connector. At crosses, the four (4) wires must be joined using a four (4)-way connector. Using two three (3)-way connectors with a short jumper wire between them is an acceptable alternative. Copperhead three (3)-way locking connector: Part # LCS1230.

6. Termination/Access: All tracer wire termination points must utilize an approved trace wire access box (above ground or grade level/in-ground as applicable), specifically manufactured for this purpose (see drawing). A minimum of two (2) feet of excess wire is required

in all grade level trace wire access boxes after setting at final grade.

7. Grounding: Tracer wire must be properly grounded at all dead ends/stubs. Grounding of trace wire must be achieved by use of a drive-in magnesium grounding anode rod with a minimum of twenty (20) foot of #12 HDPE copper clad wire connected to anode (minimum 1.0 lb.) specifically manufactured for this purpose and buried at the same elevation as the utility. Drive-in Magnesium Anode: Copperhead Part # ANO-10005.

8. Installation: Tracer wire installation must be performed in such a manner that allows proper access for connection of line tracing equipment, proper locating of wire without loss or deterioration of low frequency (512Hz) signal for distances in excess of 1000 linear feet, and without distortion of signal caused by multiple wires being installed in close proximity to one another. Tracer wire must be installed as a continuous single wire. No looping or coiling of wire is allowed. Lay mainline trace wire continuously, by-passing around the outside of maintenance access structures and any other structures on the north or east side. Any damage occurring during installation of the trace wire must be immediately repaired in an approved waterproof method. Taping and/or spray coating must not be allowed.

Q. Warning Tape

All wastewater pipes must have a warning tape installed with a minimum four (4) mils and manufactured with heavy metal-free polyethylene tape that is impervious to all know alkalis, acids, chemical reagents, and solvents found in soil. The minimum overall width of the tape must not be less than three (3) inches. Standard rolls must be 1000 feet in length. Tape must be installed 18 inches below the ground surface. The tape must be colored Safety Green and imprinted with the following message: Caution – Buried Wastewater Main Below.

R. Fittings

1. HDPE pipe joints must be butt-fused fittings or electrofusion fittings.

2. Fittings for DIP and butt-fused pipe must be cement mortar or fusion bonded epoxy coated DI with mechanical joints rated to 350 psi and conforming to AWWA C-153 and C-111. All MJ fitting connections to polyethylene pipe must be restrained with Megalug restrainers. The HDPE pipe must be reinforced on the ends with stainless steel wedge internal stiffeners. The mechanical connection to MJ fittings and sleeves must use mechanical restraint that meet specification requirements. If size on size mechanical connection to PVC or DIP is approved by the City Engineer, DI sleeves with Megalug restrainers must be installed.

3. Fittings for polyethylene pipe must be DI in accordance with AWWA Specification C-153 and have the same pressure rating of the connecting pipe. All DI fittings must be cement mortar or fusion bonded epoxy coated. All exposed fasteners, such as bolts, nuts, fasteners, washers, and threaded rods must be “COR-TEN” or Cor-blue coated. Mechanical joint bolts must not protrude more than 1/2 inch through the nut after joints are assembled.

4. All stainless steel fastener threads must be coated with an anti-seize compound as approved by the City.

6.04 INSTALLATION

A. All force mains, valves and appurtenances must be installed in accordance with sections 2 and 3 of this Standard.

6.05 TESTING

A. The Contractor must perform hydrostatic testing of all wastewater force mains, as set forth in the following, and must conduct said tests in the presence of representatives from the City and/or other authorized agencies with two (2) days advanced notice provided. Hydrostatic tests must be conducted on all newly laid pressure pipes, joints, and valves. Air testing of pressure pipe will not be permitted unless approved by the City Engineer, or designee. The Contractor must furnish all necessary equipment and material and make all taps in preparation for the

hydrostatic test. No testing must be performed until the City approves the as-built drawings.

B. Piping and appurtenances to be tested must be within sections between valves or adequate plugs, all with prior approval. All piping must 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 must be exercised to permit the escape of air from the sections of pipe that is going to be tested.

C. Hydrostatic testing must be performed at 150 percent of the maximum operating pressure of the tested system, of the connected sewage pump shut-off pressure, or at 150 psi. The testing procedure must continue for an uninterrupted period of not less than two (2) hours. Testing must be in accordance with the applicable provisions as set forth in Section 4 of AWWA Standard C-600. The allowable rate of leakage for piping must be less than the number of gallons per hour determined by the following formula:

$$L = \frac{SD(P)^{1/2}}{148{,}000}$$

L = allowable leakage in gallons per hour

S = length of pipe tested, in linear feet (maximum length is 2,000 feet for calculation)

D = nominal diameter of the pipe in inches

P = average test pressure maintained during the leakage test in pounds per square inch, gauge min 150 psi. Pressure loss during test must not exceed $\pm$5 psi.

D. The testing procedure must include continuous application of the specified pressure to the test system, for the two (2) hour period, by way of a pump taking supply from a container suitable for measuring water loss. The amount of loss must be determined by measuring the volume displaced from the container.

E. All wastewater tapping sleeves must be hydrostatically pressure tested in accordance with the latest revision of AWWA C-600. The test must be

conducted at 150 psi for a period of two (2) hours. No loss of pressure is allowed.

F. Should the test fail, necessary repairs must be accomplished by the Contractor and the test repeated until it is within the established limits. The Contractor must furnish the necessary labor, water, pumps, gauges and all other items required to conduct the required wastewater force main testing and must perform the necessary system repairs required to comply with the specified hydrostatic test.

SECTION 7

WASTEWATER LIFT STATIONS

7.01 GENERAL

This section includes the general requirements for the design criteria and installation of wastewater lift stations discharging less than 3,000 gallons per minute (gpm). All such lift stations must be submersible duplex or triplex type lift stations. All design calculations and plans for wastewater lift stations must be signed, sealed and dated by a professional Engineer registered in the State of Florida. Only approved pumps and equipment listed in Appendix A and/or Appendix B must be allowed.

7.02 DESIGN STANDARDS

A. Required Reference

The Developer must comply with the applicable requirements established by the FDEP. Additionally, the criteria provided in the most recent edition of "Recommended Standards for Wastewater Facilities (Ten States Standards)", may generally be utilized as design guidelines, if not in conflict with State, County or other regulatory agency requirements.

B. Design Flows

Wastewater lift stations must be designed for the total ultimate development flow from all contributory areas. Said contributions must include the immediate gravity system, subsidiary sources and known or projected future development within the designated station service area. The design ADF must be computed at the unit rates set forth herein. The maximum required pumping capability must be the product of selected peak factors times the cumulative ADF from the total service area. In general, the following factors must be applicable for the range of flow contributions indicated (MGD-ADF), unless larger values are required.

Flow range, MGD-ADF	Peak factor
0.00 to 0.05	4.0
0.10 to 0.25	3.5

0.25 to 1.00	3.0
1.00 and greater	2.5

Note: Special analysis must be made for flows beyond 2.00 MGD-ADF and peak factors less than 2.5 may be considered if substantiated by supporting data.

In general, no more than one (1) lift station per quarter section (160 acres) must be allowed.

If a proposed lift station is within 300 feet of an existing water body, a Soil Engineer's Report with recommendation for wet well construction must be provided.

C. Pump Selection

1. For lift stations with a maximum flow demand of 1500 gpm or less, a minimum of two (2) pumping units must be provided. Where the peak design flow exceeds 1500 gpm, three (3) or more units must be included in the facility. In all cases, stand-by pumping capability must be provided such that if any one (1) pump is out of service, an alternate unit is available at equal or greater capacity. Pumps must be capable of meeting all system hydraulic conditions without overloading the motors.

2. The selected sewage pump system must have the minimum capability of pumping the design peak flow at the maximum computed system total dynamic head requirements with the largest pumping unit out of service.

3. Head-capacity curves must be prepared for the proposed pumping system in order to determine the various operational conditions. Hydraulic computations must be in accordance with good engineering practice with pipe friction loss calculated by the Hazen-Williams formula using standard friction factors based on the material utilized. However, it must not be greater than "C=120" unless the justification for higher values are approved. Pump curves for the proposed pump must be included with head-capacity curves for City review. Hydraulic Modeling must be performed, and results provided to the City for review and acceptance. The system

head-capacity analysis must provide the following and be subject to review:

a. Hydraulic modeling of wastewater lift stations must be performed to demonstrate the pumping capacity and results must be provided to the City for review and acceptance.

b. System operations under peak flow conditions with all pumps pumping. The flow for the receiving force main system must be calculated for when all pumps at all lift stations are operating.

c. Pumping capability with one (1) pump running at every station on the interconnect force main, all units operating in parallel and other combinations, if applicable.

d. Lift station with only one (1) pump running.

D. Wet Well Design

The wet well structure must provide a capacity between operational water levels sufficient to allow a minimum of 15 minutes between successive starts of the pumps under the following condition: influent rate of one-half the maximum one (1) pump capacity and one (1) pump running at said maximum. The wet well bottom must be a minimum of five (5) feet below the lowest invert. Low water levels must provide a minimum of one foot of pump submergence to preclude pump inlet vortexing, air-binding, or other design considerations. Operational maximum water levels must not exceed the invert elevation of the influent pipe.

In general, the normal operational water level must provide a positive suction head for the sewage pumps. Operational maximum or high water levels must not exceed the invert elevation of the lower influent pipe. No interior ladders must be permitted in the wet well.

Buoyancy calculations verifying that adequate provisions have been made to prevent wet well flotation must be submitted to the City. These calculations must assume that the wet well is empty.

E. Design Calculations

The Developer’s Engineer must submit signed, sealed and dated design calculations for all wastewater lift stations. Calculations must include head-capacity curves with copies of certified published manufacturer's pump curves, hydraulic analysis of the force main system, operating cycle calculations with wet well sizing and buoyancy calculations.

F. Ventilation

Wet wells for submersible installations or others without free access must be ventilated with not less than one (1) 4-inch diameter open vent pipe with end covered by an insect screen. A 4-inch odor control line may be required. Top elevation must be above the 100-year flood elevation.

G. Water System

Wastewater lift stations must be provided with a water supply system with adequate capacity (minimum two [2] inch line) and pressure for station washdown and other requirements. The station water system must be completely separated from the potable water supply by means of a reduced pressure backflow preventer or other City-approved system.

H. Emergency Operation

All lift stations must be provided with an emergency pump out connection and an emergency power receptacle as specified herein. Lift stations with pumping capacity of 1500 gpm and greater must be provided with on-site emergency power generation.

I. Site

Lift station parcels must be minimum 30 feet x 30 feet and must not be located within 100 feet of the top of the bank of any water body. Lift stations must not be installed within the right-of-way, must be readily accessible and must have adequate area provided for operation and maintenance of the facility. The site must be readily accessible by maintenance vehicles during all weather conditions. The wastewater lift station structures and electrical and mechanical equipment must be protected from physical damage by a 100-year flood event. The

wastewater lift stations should remain fully operational and accessible during 100-year flood events. Regulations from the City, Health Departments, State agencies, and Federal agencies must be considered.

The lift station sites must be sized and dedicated easements must also be required around the site as delineated on the "Lift Station Site Plan" in the standard drawing. The Developer must dedicate the lift station site free of encumbrances by warranty deed or plat to the City. All lift station sites must be fenced and landscaped.

J. General

Engineering design plans must be provided indicating the following:

1. Reference to the nearest street

2. Adequate access

3. Auxiliary power plug or the generator location and automatic power transfer switch

4. Power pole or transformer location

5. The water meter with backflow prevention and hose bib location

6. All landscaping

7. Pump and lift station specifications and performance data to include:

    a. Operator's Manual

    b. A layout block diagram showing location of different components attached to the control panel

    c. Performance curves for the pump submitted showing that it will operate generally in the center part of the curve and not approach either upper or lower extreme

d. Electrical schematics and wiring diagram, including a parts schedule containing information on type, model, and rating of components

e. Motor controls, including backspin/reverse polarity motor protection, phase protection, and pump alternator

8. Installation of emergency alarm system circuitry

9. All US made copper wiring is required

10. All National Electrical Manufacturers Association (NEMA) 4X stainless steel outside enclosures

11. A lock out/pump down switch at the wet well (this function has to be interrelated with the main auto/off/Manual MCC switch)

12. A light pole with light to illuminate the wet well and the control panel

13. All required telemetry conduits installed for telemetry construction

7.03 GENERAL REQUIREMENTS

A. Piping Systems

1. Approved Pipe, Fittings, and Valves

The following material or item must be suitable for the indicated operational service:

a. Gravity Sewer and Force Main Influent Pipe and Fittings: All influent piping to the wet well must meet the requirements of sections 3, 5, and 6 of this Manual, except that the influent pipe to the wet well must be of same material as gravity sewer pipe to prevent blockage. Other wastewater collection system materials are, as specified in sections 3, 5, and 6 of this Manual.

b. Wastewater Pressure Pipe and Fittings: All pipe within 18 feet of the discharge side of the valve vault must be C-900 pipe and meet the City Standards.

c. Wastewater Service Valves: Plug valves with operators for underground or exposed service and check valves must meet the requirements outlined in sections 3.03B, C, D, E, and F of this Manual.

2. Connections at Structures

Where DIP are to extend into or through structures from the exterior, flexible connections (mechanical or push-on type joints) must be provided at the exterior wall face.

3. Wall Pipes or Sleeves

For pipes passing through structural walls, wall pipes must be installed where the location is below the surface of the ground or at any point where water levels will exceed the installed pipe elevation. Sleeves with watertight caulking must be suitable at other locations.

4. Piping Flexibility

In order to provide for expansion and contraction or to expedite installation and maintenance, flexible connections (flanged coupling adapters, expansion joints, couplings, etc.) must be provided.

B. Valves

1. Check Valves

Check valves for DIP must be swing type and must meet the requirements of AWWA C-500 and Section 3.03C of this Manual.

2. Plug Valves

Plug valves for DIP must be eccentric full port and must meet the requirements of AWWA C-504 and C-507, and Section 3.03D of this Manual.

C. Pressure Sensor

Gauges and sensors must be provided on each wastewater pump discharge pipe downstream of the check valve, as well as other locations where pressure sensing is desirable. Each pressure gauge must be a direct-mounted, annular-sealed stainless steel sensing element, and liquid-filled, with a two (2)-inch dial and furnished with a clear glass crystal window and a 1/4-inch shut-off valve. All gauges must be weatherproofed. The dial face must be white finished aluminum with jet black graduations and figures. The dial face must indicate the units of pressure measured in psi, with a 0 to 60 psi range. Pressure sensors must be Red Valve Series 40 Sensor or Fluid Isolator Technologies Series FF-4000 or SE 4000, or approved equivalent.

D. Emergency Pump Connections

Connections must be provided for emergency auxiliary pumping and must be coupled to the discharge main through a fitting with valuing as required for making a dead hook-up. The connection pipe must be DI of suitable size, but in no case less than four (4) inches in diameter. Plug valves on full port gear side are required to be installed on both sides of an emergency pump out connection in order to isolate force main as well as wet well pumping station.

E. Surge Control

Surge control valves, or other approved systems, must be provided for all wastewater lift stations where hydraulic conditions indicate the necessity.

F. Wastewater Pumps and Motors

1. General

The wastewater pumping units must be capable of handling raw, unscreened wastewater and must be capable of passing a sphere of at least three (3) inches in diameter. Pumps must be electric

motor-driven and of a proven design that has been in sewage service under similar conditions for at least five (5) years. The pumps must provide the required peak design performance requirements and be suitable for operation within the total hydraulic range of operation without continuous change of impeller.

2. Submersible Pumps

The pump design must provide easy removal and replacement for inspection or maintenance purposes without bolts or other fasteners to be removed. Slide rails must be a single tee bar for each pump. The units must be non-clog, mechanical seal, and submersible sewage pumps.

3. Shaft

The pump shaft must be of series 300 or 400 stainless steel. The shaft and bearings must be adequately designed to meet the maximum torque required for start-up or operating conditions and minimize vibration and shaft deflection. As a minimum, the pump shaft must rotate on two (2) permanently lubricated bearings. The upper bearing must be a single row ball bearing. The lower bearing (thrust bearing) must be a two (2) row angular contact ball bearing, if required, to minimize vibration and provide maximum bearing life.

4. Impeller

The impeller must be constructed of ductile cast iron, ASTM A536. Each pump must be provided with a replaceable stainless steel wear ring system to maintain pump efficiency. As a minimum, one (1) stationary wear ring provided in the pump volute or one (1) rotating wear ring provided on the pump impeller must be required. In addition, a two (2) part system is acceptable.

5. Mechanical Seal

Each pump must be provided with a balanced tandem-type enclosed block seal made with silicon carbide seal faces running in an oil reservoir. The pumped liquid must be sealed from the oil reservoir by one (1) face seal and the oil reservoir from the oil-filled

motor chamber by the other face seal. The seals must require neither maintenance nor adjustment and must be easily replaced. Conventional double mechanical seals with a single spring between the rotating faces requiring constant differential pressure to effect sealing and subject to openings and penetration by pumping forces must not be considered equal to the tandem seal specified and required.

6. Guides

A sliding bracket must be an integral part of the pump casing and must have a machined connecting flange to connect with the cast iron discharge connection. All guide rails must be Wilo compatible. The bracket must be bolted to the floor of the wet well with stainless steel anchor bolts and designed to receive the pump discharge flange without the need of any bolts or nuts. Sealing of the pumps to the discharge connection must be accomplished by a simple linear downward motion of the pump with the entire weight of the pumping unit guided by a tee bar. No portion of the pump must bear directly on the floor of the wet well and no rotary motion of the pump must be required for sealing. Sealing at the discharge connection must be by means of a replaceable Buna-N sealing rubber gasket. If it is necessary to meet the above specification, approved pump manufacturers must provide a sliding guide bracket adapter. The design must be such that the pumps must be automatically connected to the base elbow when lowered into place on the discharge connection. The pumps must be easily removable for inspection or service and must require no bolts, nuts, or fasteners to be removed for this purpose. There must be no need for personnel to enter the wet well. Each pump must be fitted with a Type 304 stainless steel, 3/4-inch lifting chain of adequate strength. A 1/4-inch stainless steel cable, aircraft rating, must be provided between the cable holder and the lifting chain.

7. Pump Motors

All motors must be built in accordance with the latest NEMA, Institute of Electrical and Electronics Engineers (IEEE), ANSI, and American Bearing Manufacturers Association (AFBMA) Standards where applicable. Pump motors must be housed in an oil-filled,

watertight casing and must have Class F insulated windings that must be moisture resistant. Motors must be NEMA Design B, rated 311 degrees Fahrenheit maximum. Pump motors must have cooling characteristics suitable to permit continuous operation in totally, partially or non-submerged conditions. The pump must be capable of running continuously in a non-submerged condition under full load without damage for extended periods. The motor must be capable of a minimum of 10 starts per hour. Before final acceptance, and if required by the City, a field running test demonstrating this ability with 24 hours of continuous operation under the above conditions must be performed for all pumps being supplied. Motors of 25 horsepower and pump voltage must be 208/230 volt, 3-phase, and motors greater than 25 horsepower must be 460 volt, 3-phase. All pump motors must be designed with a 1.15 service factor and must not be less than five (5) horsepower unless approved. Pumps must be capable of meeting all pump curve conditions without exceeding the motor's rated horsepower.

8. Cables

Cables must be designed specifically for submersible pump applications and must be properly sealed. A type CGB watertight connector with a neoprene gland must be furnished with each pump to seal the cable entry at the control panel. The pump cable entry seal design must preclude specific torque requirements to ensure a watertight and submersible seal. The cable entry must be comprised of a single compressible Buna-N grommet flanked by washers. The washers must have a close tolerance fit against the cable outside diameter and the entry inside diameter and they must be compressed by the entry body containing a strain relief function separate from the function of sealing the cable. The cable entry junction chamber and motor must be separated by a stator lead sealing gland or terminal board that must isolate the motor interior from foreign material gaining access through the pump top. Secondary sealing systems utilizing epoxy potting compounds may be used. When this type of sealing system is used, the manufacturers must supply a cable cap as part of the spare parts for each pump. All cables must be continuous without splices from the motor to the control panel. The junction chamber containing the terminal board must be perfectly leak proof.

G. Pump Control Panel

1. Control Panel

The control panel must respond to a liquid level pneumatic bubbler system to automatically start and stop pumps. A float and an alarm at high wet well levels must be provided. The control panel must operate all electrical submersible pumps at the power characteristics stipulated. The control function must provide for the operation of the lead pump under normal conditions. If the incoming flow exceeds the pumping capacity of the lead pump, the lag pump must automatically start to handle this increased flow. As the flow decreases, the pumps must shut down (completely off) halfway in the pumping cycle when specified elevation is achieved. The pumps must alternate positions as lead pump at the end of each cycle. A failure of the alternator must not disable the pumping system. The alternator must include a safe, convenient method for manual alternation and have provisions to prevent automatic alternation without disturbing any wiring. Should the “pump on” regulator fail, the float system must keep the station in operation and provide a visual indication of the regulator failure.

The control panel must consist of main circuit breakers and generator breaker with mechanical interlock, a Russellstoll 100-amp Model JRS1044FR emergency power receptacle, a circuit breaker and magnetic starter for each pump motor, and 15 amp, 120 volt circuit breakers as required. All pump control operations must be accomplished by a bubbler liquid level control system with all control components mounted in one (1) common enclosure. Control switches must provide means to operate each pump manually or automatically. When operated in the automatic mode, the control assembly must provide means to manually select or automatically alternate the position of the "lead" and "lag" pumps after each pumping cycle. A bubbler pneumatic liquid level control system, including differential pressure switches, must continuously monitor wet well liquid level and control operation of the low-level cutoff for the pumps. Dual air compressors must be provided to furnish a redundant level of reliability.

Pump controls must be designed to provide pump off elevation at a minimum of one (1) foot above the top of the pumps. The lead pump on, lag pump on and high level alarms must be below the lowest inlet invert so that the gravity system is not used for storage at any time. The lag pump elevation (in a duplex station) must be below the high level alarm elevation for the bubbler. The high level float elevation must be above the lag pump elevation and one (1) foot below the influent invert.

2. Panel Construction

The panel must be housed in a NEMA 4X, Type 304, 14 gauge stainless steel enclosure with 30 percent extra mounting space for additional equipment and for enlarging pump motors. The enclosure must have provisions for padlocking the door and a dead front inner door unit for mounting controls. All exterior hardware and hinges must be stainless steel. In addition, there must be affixed to the interior side of the exterior door both a nameplate and a 10 inch by 12 inch pocket for log sheet storage. The nameplate is to be removable for replacement in the event a pump upgrade is performed. The nameplate must contain the following information: voltage, phase, rated horsepower, speed, date manufactured, pump, and control panel manufacturer's name, address and telephone number, pump data, including impeller data, operating point and head, KW, and amps at the operating point and at least two (2) other points on the pump curve.

3. Power Supply and Main Disconnect

The power supply to the control panel must be either 240 volt, three (3)-phase, 4-wire or 480 volt, three (3)-phase, four (4)-wire. Minimum service must be 100 amp. Single phase power must not be accepted. Non-fusible safety service main disconnects must be installed at all stations. In all 240 volt systems, disconnects should be installed between the meter and the panel, and on all 480 volt systems disconnect should be installed ahead of the meter. LED power available indicators must be supplied on all legs.

4. Circuit Breakers

a. Main Breakers

The panel must have an interlock system between the normal power main breaker and the emergency breaker to ensure only one (1) breaker in the "on" position at a time. Both breakers must be equal in size.

b. Circuit Breakers

All circuit breakers must be heavy-duty molded-case breakers. The handle on the circuit breakers must be operational through the inner door.

5. Motor Circuit Protectors

Each pump must be protected by a three (3)-pole motor circuit protector. The motor circuit protector must be operated by a toggle-type handle and must have a quick-make, quick-break over-center switching mechanism that is mechanically trip-free from the handle so that the contacts cannot be held closed against a short circuit and abnormal currents that will cause the motor circuit breaker to trip. Tripping must be clearly indicated by the handle automatically assuming a position midway between the normal "on" and "off" positions. All latch surfaces must be ground and polished. All poles must be so constructed so that they open, close and trip simultaneously. The motor circuit protector must be completely enclosed in a high strength glass polyester-molded case. Ampere ratings must be clearly visible. Contacts must be of non-welding silver alloy. Arc extinction must be accomplished by means of arc chutes. A manual push-to-trip button must be provided for manual exercising of the trip mechanism. Each pole of these motor circuit protectors must provide instantaneous short circuit protection by means of an adjustable magnetic-only element.

6. Motor Starter and Selector Switches

The panel must contain two (2) motor starters. The motor starter must be across the line magnetic starter with individual overload protection on each lower leg with reset installed through the inner door unit. Selector switches must be installed on the face of the

inner door unit. Selector switch must be a heavy-duty oil-tight "Hand-Off-Automatic" three (3) position switch to control the operation mode of each pump motor starter.

7. Lights and Alarms

   a. Indicator Lights: Heavy-duty oil-tight indicator lights as shown on the standard drawings must be installed on the face of the inner door unit.

   b. Alarm Light: A vapor-proof red light and horn must be mounted on a separate pole adjacent to the control panel. In addition, there must be an alarm silence push-button on the inner door and a silence relay that will silence the horn and automatically reset when these signals are restored to normal. The push-button must be heavy-duty oil tight. The red globe must be the screw-on type.

8. Emergency Power Receptacle

   The control panel must have an external mounted generator receptacle, namely, a Russellstoll 100-amp Model JRS1044FR, or an approved equal.

9. Additional Requirements

   a. All power wires must be THW or THWN 167 degrees Fahrenheit insulated stranded copper conductors and must be appropriately sized for the given load application. All control circuit wire must be type THW, stranded wire type. All wiring within the enclosure must be neatly routed by the use of slotted wiring duct with snap-on type covers. Wiring on the rear of the inner door must be neatly bundled with nylon ties and include sufficient loop across the hinges to prevent wire damage with each end of the conductor marked, as indicated below:

WIRE NO	**COLOR**	**DESCRIPTION**
1	Black	120 Volt Hot

2	White	120 Volt Common Ground
3	Green	Ground
4	Green	Dedicated Ground
5	Orange	Service Key Switch
6	Orange	Service Key Switch – Common
7	Brown	Bubbler Failure
8	Brown	Bubbler Failure – Common
9	Brown	Wetwell High Level Alarm
10	Brown	Wetwell High Level Alarm - Common
11	Brown	Wetwell & Valve Vault Intrusion
12	Brown	Wetwell & Valve Vault Intrusion – Common
13	Purple	Phase Failure
14	Purple	Phase Failure
15	Purple	Control Circuit Failure
16	Purple	Control Circuit Failure
17	Gray	Pump Station Disable/Enable Control from Remote Terminal Unit (RTU)
18	Gray	Pump Station Disable/Enable Control from RTU - Common
19	Gray	Pump Station Disabled Report
20	Gray	Pump Station Disabled Report
21	Orange	Control/Phase Failure
22	Orange	Control/Phase Failure - Common
23	Yellow	Pump 1 On
24	Blue	Pump 2 On
25	Red	Pump 3 On
26	White	Pumps On – Common
27	Yellow	Pump 1 Failure
28	Yellow	Pump 1 Failure – Common
29	Yellow	HOA 1 Not in Auto Position
30	Yellow	HOA 1 Not in Auto Position - Common
31	Blue	Pump 2 Failure
32	Blue	Pump 2 Failure - Common
33	Blue	HOA 2 not in Auto Position
34	Blue	HOA 2 not in Auto Position - Common
35	Red	Pump 3 Failure
36	Red	Pump 3 Failure – Common
37	Red	HOA 3 not in Auto Position
38	Red	HOA 3 not in Auto Position - Common

39	Twst Pr	Force Main Pressure (+) (4-20 ma Twisted Pair)
40	Twst Pr	Force Main Pressure (-) (4-20 ma Twisted Pair)
41	Gray	Alarm Silence from RTU
42	Gray	Alarm Silence from RTU – Common
43	Orange	Drywell Flooding
44	Orange	Drywell Flooding – Common
45	Orange	Sump Pump 1 On
46	Orange	Sump Pump On – Common
47	Red	12VDC (+) From RTU
48	Black	12VDC (-) From RTU
49	Twst Pr	Water Main Pressure (+) (4-20 ma Twisted Pair)
50	Twst Pr	Water Main Pressure (-) (4-20 ma Twisted Pair)
51	Twst Pr	Water System Pressure (+) (4-20 ma Twisted Pair)
52	Twst Pr	Water System Pressure (-) (4-20 ma Twisted Pair)
53	Twst Pr	Wetwell Level (+) (4-20 ma Twisted Pair)
54	Twst Pr	Wetwell Level (-) (4-20 ma Twisted Pair)
55	Twst Pr	Discharge Flow (+) (4-20 ma Twisted Pair)
56	Twst Pr	Discharge Flow (-) (4-20 ma Twisted Pair)

b. Terminal points of all terminal strips must be permanently identified. All terminal numbers and identifying nomenclature must correspond to and be shown on the electrical diagrams. All wiring must be permanently shown on the electrical drawings.

c. All circuit breakers, control switches, indicator pilot lights, and other control devices must be identified with permanently affixed legend plates and lamicoid-type engraved nameplates.

d. A surge protector must be included and wired to protect motors and control equipment from lightning-induced line surges. All surge protectors must be Underwriter's Laboratories (UL) approved and installed per the respective power company's requirements and manufacturer's specifications. Surge protectors must be attached to the main disconnects.

e. Elapsed time meters must be 115 volt not-reset type and must totalize pump running time in hours and tenths of hours to 99999.9 hours.

f. On the face of the inner door unit, there must be installed a 15 amp, 120 volt, duplex convenience receptacle. It must be provided with its own single pole, 15 amp circuit breaker for protection. Ground fault interrupt type must be required.

g. Control terminal blocks must be of the clamp screw type, rated for 600 volts. Amperage rating must accommodate the control circuit amperage. An additional 30-space terminal strip must be installed in the cabinet for future use with RTU equipment.

h. There must be a control power transformer with a minimum size of 500VA to provide 120VA power for coils for starters, 15A duplex receptacle, indicator pilot lights, alarm horn, alarm light, pump alternator, elapsed time meters, etc. The secondary side must have one (1) leg fused and the other grounded. This control power transformer is required only on 480 volt control panels. The signal required by the float switches and relays must be 24VAC. This must be provided by a 24VAC control power transformer properly sized with a fused secondary.

7.04 TYPE OF LIFT STATION CONSTRUCTION

Wastewater lift stations of the submersible type are suitable where the peak design flow rate does not exceed 3,000 gpm or the pump motor size is 50 horsepower or less. The installation must include the removable pump units.

Aluminum access frame and cover, stainless steel pipe pump guide bars, pump discharge connection, and other necessary appurtenances. Individual discharge pipes must extend from each pump to an accessible drained pit where the plug or gate and check valves must be installed.

7.05 REQUIRED SUBMITTALS

A. The Contractor must provide to the City the following information regarding the wastewater pumping equipment:

1. Shop and erection drawings showing all important details of construction, dimensions, and anchor bolt locations.

2. Descriptive literature, bulletins, and/or catalogs of the equipment.

3. Data on the characteristics and performance of each pump. Data must include guaranteed performance curves based on actual shop tests of similar units, which show that they meet the specified requirements for head, capacity, efficiency, Net Positive Suction Head Required (NPSHR), submergence and horsepower. A certified shop test will be required for pumps greater than 50 horsepower. Curves must be submitted on 8 1/2-inch by 11-inch sheets at as large a scale as is practical. Curves must be plotted from no flow at shut off head to maximum manufacturer recommended pump capacity. Catalog sheets showing a family of curves will not be acceptable. A system head curve should also be plotted on the pump curves.

4. Complete layouts, wiring diagrams, elementary or control schematics, including coordination with other electrical control devices operating in conjunction with the pump control system. Suitable outline drawings must be furnished for approval before proceeding with the manufacture of any equipment. Standard preprinted sheets or drawings simply marked to indicate applicability will not be accepted.

5. A drawing showing the layout of the pump control panel must be furnished. The layout must indicate and completely identify all devices mounted on the door and in the panel.

6. The weight of each pump.

7. Complete motor data must be submitted, including:

   a. Nameplate identification

   b. No-load current

   c. Full-load current

   d. Full-load efficiency

   e. Locked-rotor current

   f. High potential test data

   g. Bearing inspection report

7.06 TOOLS AND SPARE PARTS

A. One (1) set of all special tools required for normal operation and maintenance must be provided. All such tools must be furnished in a suitable steel tool chest complete with lock and duplicate keys.

B. Spare parts must be properly packaged and labeled for easy identification without opening the packaging and suitably protected for long-term storage under humid conditions. The manufacturer must furnish the following spare parts for each pump supplied:

   1. One (1) upper bearing

   2. One (1) lower bearing

   3. One (1) set of upper and lower shaft seals

   4. One (1) set of "O-Rings" or gaskets required for replacement of bearings and seals

5. One (1) impeller wear ring

6. One (1) shaft sleeve, if applicable

7. One (1) cable cap, if applicable

8. One (1) influent debris cage

7.07 DETAILS

Pump station details must be as is set forth in this Manual.

7.08 INSTALLATION AND TESTING

A. The lift station pumps, controls, electrical system, piping, valves and associated appurtenances must be installed in accordance with sections 3, 5, and 6 of this Manual.

B. A factory representative knowledgeable in pump operation and maintenance must inspect and supervise a test run at the lift station. A minimum of one (1) working day must be provided for the inspections. Additional time made necessary by faulty or incomplete work or equipment malfunctions must be provided as necessary to meet the requirements in this Manual at no additional cost to the City. A minimum of 48 hours written notice must be given to the City to witness the test(s). Upon satisfactory completion of the test run, the factory representative must issue the required manufacturer’s certificate.

The test run must demonstrate that all items of this Manual have been met by the equipment as installed and must include, but not be limited to, the following confirmation tests:

1. That all units have been properly installed

2. That the units operate without overheating or overloading any parts and without objectionable vibration

3. That there are no mechanical defects in any of the parts

4. That the pumps can deliver the specified pressure and quantity

5. That the pumps are capable of pumping the specified material

6. That the pump controls perform satisfactorily

C. Warranty and Service

1. Warranty

The products must be guaranteed to be free from defects in material and workmanship under normal use and service for a period of 12 months after start-up.

2. Service

Service must be available for in situ repair of the products. Manufacturer's repair personnel must be based in Florida to ensure a reasonable response time of not more than two (2) working days.

3. Critical Service

In the event that both pumps fail and are out of service, response time will be no more than four (4) hours.

SECTION 8

CLEARING AND GRADING

8.01 GENERAL

This section outlines the City of Coconut Creek's clearing and grading requirements. Prior to commencing work described in this section, all erosion measures must be installed and inspected (e.g., silt fencing, filter fabric, etc.).

8.02 CLEARING

A. General Tree Removal Requirements

Landscaping requirements and tree conservation are addressed in Chapter 13 of the City of Coconut Creek Land Development Code.

B. Disposal of Material (Burning/Hauling)

All burning activities must be approved by the City of Coconut Creek Fire Department.

C. Landscape Replacement Requirements

Landscape replacement must be in conformance with the City of Coconut Creek Code of Ordinances and as approved by the Landscape Division.

D. Clearing of Wetlands

Any clearing activity within a wetland of the City of Coconut Creek must be in compliance with the City of Coconut Creek Code of Ordinances, SFWMD, FDEP, and Broward County.

8.03 GRADING

A. Open Space (Pervious) and Lot Grading

1. Residential

    a. Residential areas must be graded such that proper runoff conveyance is provided away from the habitable structures and flowing toward stormwater management facilities or to the location of the runoff prior to development. In no case must runoff be routed such that it will adversely affect adjacent properties.

    b. Residential subdivisions that propose to individually sell lots to other developers must provide adequate assurance that future lot grading and impervious surface will be in conformance with an approved master grading and drainage plan. This master grading and drainage plan must identify which lots (or portions thereof) drain to the inlets, structures, or ponds in accordance with the approved drainage calculations for the master stormwater facilities.

    c. Lowest floor elevations for building structures must be those shown on the current version of Broward Country's 100 year flood map or the current flood insurance rate map (FIRM) developed by the Federal Emergency Management Agency (FEMA) and per Chapter 10, plus any changes or revisions made in the future plus elevations shown on the ASCE 24-14 Flood Resistant Design and Construction developed by the American Society of Civil Engineers (ASCE) with an effective date of July 2015, plus any changes or revisions made in the future. The higher of the two (2) maps must govern the minimum elevation of the structure.

2. Commercial/Industrial

    a. Commercial and Industrial areas must be graded such that proper runoff conveyance is provided away from all building structures and to approved stormwater management facilities.

    b. Commercial/Industrial subdivisions that propose to individually sell lots to other developers must indicate on the construction plans future lot grading and impervious surface

will be in conformance with an overall master lot grading and drainage plan identifying which lots (or portions thereof) drain to the inlets, structures, or ponds indicated in the approved drainage calculations for the master stormwater facilities.

c. Lowest floor elevations for building structures must be those shown on the current version of Broward Country's 100 year flood map or the current FIRM developed by the FEMA and per Chapter 10, plus any changes or revisions made in the future plus elevations shown on the ASCE 24-14 Flood Resistant Design and Construction developed by the ASCE with an effective date of July 2015, plus any changes or revisions made in the future. The higher of the two maps must govern the minimum elevation of the structure.

3. Stormwater Storage Facilities

a. Grading

The grading of stormwater storage facilities must be performed in such a manner as to provide side slopes that are easily stabilized, perpetually maintainable, reasonably safe to the public health and aesthetically pleasing in keeping with the adjacent land uses so as not to detract from the overall property value or objectives of the adjacent land uses. The minimum side slopes required for grading ponds is dependent upon whether the pond is designed to have a normally dry bottom or a wet bottom. Table 5 gives the requirements for grading dry storage facilities. Information regarding wet detention design is given in Section 11, Stormwater Management.

b. Grading Standard

Those facilities to be maintained by the City must be graded by the standard set forth in this manual.

c. Fencing Requirements

Fences must be mandatory for all facilities with slopes steeper than those values listed in Table 5. In addition, fencing may be required on specific facilities regardless of slope if, in the opinion of the City Engineer, or designee, fencing is necessary to protect the health, safety or general welfare of the public.

TABLE 5. Stormwater Storage Facilities Slide Slope Grading Requirements

	Retention/detention pond		Retention swale
Depth range (feet)	W/O fence (recommended)	(Minimum allowed)	W/O fence
≤ 1'	4:1	3:1	3:1
< 3'	4:1	4:1	4:1
3 to 4	4:1	4:1	4:1
4 to 6	5:1	4:1	N/A
> 6'	6:1	4:1	N/A

Note: See Table 6 for the notes for tables 5 and 6.

Slopes steeper than what is indicated above must require fencing. The maximum allowable side slopes of fenced retention/detention ponds and swales must be 2:1.

4. Stormwater Conveyance Facilities

a. Privately Maintained Facilities

The grading of private stormwater conveyance facilities must be performed in such a manner as to provide side slopes that are easily stabilized, perpetually maintainable, reasonably safe to the public health, and aesthetically pleasing in keeping with the adjacent land uses so not to detract from the overall property value or objectives of the adjacent land uses. The minimum side slopes required for grading conveyance facilities is dependent upon whether the facility is designed to have a normally dry bottom or a wet bottom. Table 6 gives the requirements for grading "dry" conveyance facilities. Information regarding the design of

wet detention facilities is given in Section 11, Stormwater Management.

b. City-Maintained Facilities

Those facilities to be maintained by the City must be graded by the standards set forth in this Manual. Tables 5 and 6 must be used as a minimum guide.

TABLE 6. Stormwater Conveyance Facilities Slide Slope Grading Requirements

Depth range (in feet)	Conveyance canal or ditch without fence	Conveyance swale without fence
≤ 1'	N/A	2:1
< 3'	4:1	3:1
3 to 4	4:1	N/A
4 to 6	4:1	N/A
> 6'	4:1	N/A

Notes:

(1) Depth is measured from top of bank to bottom.
(2) Side slopes are measured as horizontal to vertical ratio (H:V).
(3) "Retention swales" are those manmade swales designed to retain water; have a dry bottom with vegetation suitable for stabilization, surface water treatment and nutrient uptake; and are less than four (4) feet deep.
(4) "Conveyance swales" are those dry, sodded areas designed to convey stormwater, slope toward a positive outfall and are no deeper than 3 feet.
(5) "Dry" ditches are those facilities designed to "convey" stormwater but do not qualify by definition as "conveyance swales."
(6) Side slopes steeper than 2:1 must be considered in a case-by-case basis for retention ponds, ditches and canals providing that a suitable fence is placed to prevent public access to the facility (see fencing requirements) and that the side slopes are stabilized with a material other than sodding, such as concrete, stone, brick, rip rap, fabric-form, or other suitable material approved by the City Engineer, or designee.
(7) Swale type facilities are not intended to be fenced. Canal or ditch type facilities may be required to be fenced.

Slopes steeper than what is indicated above must require fencing. The maximum side slope of a fenced conveyance canal or ditch must be 2:1.

5. Roadway Sections

   a. All roadways must be graded to provide adequate drainage, safe traffic operation and proper site distances.

   b. Longitudinal slopes must be no flatter than 0.30 percent with curb and gutter sections and 0.50 percent without curb and gutter.

   c. Cross-sectional slopes through paved roadway surfaces must be a minimum of 1.5 percent and a maximum of 2.0 percent.

   d. Cross-sectional slopes through non-paved surfaces must be a minimum of 0.50 percent to promote adequate drainage and prevent erosion.

   e. Cross-sectional slopes across sidewalks must be a maximum of 2.0 percent.

   f. Longitudinal slopes along sidewalks must be a maximum of 5.0 percent unless otherwise approved by the City Engineer, or designee.

   g. Sidewalks steeper than 5.0 percent are considered ramps and must be designed to meet ADA guidelines and FDOT standards.

6. Public Parking Areas

   a. Public parking lots must be graded to provide adequate drainage and safe vehicle operation.

   b. Parking service isles must be designed as a typical roadway section when possible. Cross-sectional slopes and longitudinal slopes must be a minimum of 0.50 percent to promote drainage.

SECTION 9

EXCAVATION AND FILL

9.01 EXCAVATION AND FILL

This section outlines the City of Coconut Creek's excavation and fill requirements.

9.02 EXCAVATION

A. Engineering Construction

No land development activity, including clearing and grubbing, filling or excavation work, road construction, underground utility installation and/or rehabilitation, and/or other activity, must commence without first obtaining engineering plan approval and an engineering construction permit from the City.

B. Engineering Excavation

No excavation must commence without first obtaining engineering plan approval and permit of the excavation activity. At least two (2) working days prior to excavation, Sunshine 811 must be contacted for all existing utility locates. The City of Coconut Creek must be contacted if conflicts with City Utilities are identified.

C. Excavation Within Wetlands

All letter (or copies) of permit approvals, or determinations of non-jurisdiction, granted by the South Florida Water Management District (SFWMD), Cocomar WCD, FDEP, U.S. Army Corps of Engineers, EPA, and Broward County Environmental Protection and Growth Management Department (BCEPGMD) for excavation within wetlands must be submitted to the City prior to commencing any excavation in wetland areas.

9.03 FILL

A. Fill Within Wetlands

All letters (or copies) of permit approvals, or determinations of non-jurisdiction, granted by the SFWMD, Cocomar WCD, FDEP, U.S. Army Corps of Engineers. EPA, and BCEPGMD for filling activities within wetlands must be submitted to the City prior to the commencement of any filling within any wetland areas.

SECTION 10

EROSION AND SEDIMENTATION CONTROL

10.01 GENERAL

This section pertains to the provisions for temporary erosion and sedimentation control in the construction areas and stockpile areas, including temporary seeding, the construction of temporary swales, slope protection, and sedimentation basin, as required and shown on the design drawings. All construction areas, where existing vegetation and grass cover have been bared by construction activities, must be protected from erosion.

Contractor is responsible for meeting all local, state, and Federal regulations regarding erosion control, including the applicable provisions of the NPDES, Phase II, regulations from the Clean Water Act of Elimination System.

A. Regulations

Contractor to adhere to drawings within the SWPPP.

B. Stormwater Pre-Construction Meetings

Stormwater pre-construction meetings must be conducted with the site Contractor, all ground disturbing subcontractors, EOR (or someone from their office familiar with the site and SWPPP) and state or local agency personnel in accordance with requirements of the special conditions.

C. Inspection

A mandatory erosion control inspection from the City is required prior to commencement of any construction activity.

D. Retention Systems

Unless required within a shorter timeframe by the applicable NPDES permit for stormwater discharge associated with construction activity, sites that disturb five (5) acres or less that will not be graded or actively worked for a period of 14 days or more must be temporarily stabilized with vegetation or other acceptable means in accordance with the contract

documents. For sites that disturb five (5) acres or more that will not be graded or actively worked for a period of seven (7) days or more must be temporarily stabilized with vegetation or other acceptable means in accordance with the contract documents. In the event it is not practical to seed areas, slopes must be stabilized with fiber log rolls, straw wattles, netting, blankets, or other means to reduce the erosive potential of the area.

E. Inspect all erosion control systems and devices at least once every seven (7) calendar days.

F. Inspect all erosion control systems and devices within 24 hours of the end of any storm that results in precipitation of ½ inch or more.

G. Correct deficiencies within one (1) working day.

H. Complete a report of each inspection. Report must contain the following minimum information: inspector's name, inspection date, actions taken if necessary to correct deficiencies, listing of areas where construction operations have permanently or temporarily stopped, and authorized signature.

10.02 EROSION AND SEDIMENT CONTROL AND SLOPE PROTECTION IMPLEMENTATION

A. Erosion and Sediment Control

Plan the site's erosion and sediment control systems in accordance with the drawings and SWPPP or as dictated by site conditions in order to maintain the requirements of the specifications and permits. This must include, but not necessarily be limited to, stormwater inlet protection and silt fence installation per approved permit plans. Owner has authority to limit surface area of erodible earth material exposed by clearing and grubbing, excavation, borrow and embankment operations, and to direct Contractor to provide immediate permanent or temporary pollution control measures.

B. Correcting/Modifying SWPPP and Site Plans

The SWPPP and Site Plans must be corrected or modified as site conditions change. Contractor must obtain approval from EOR prior to modifying or substituting BMP. Changes during construction must be noted in the SWPPP and posted on the drawings.

C. Sediment and Control Systems

Maintain erosion and sediment control systems as dictated by site conditions, indicated in the construction documents or as directed by governing authorities or owner to control sediment until final stabilization. Contractor must respond to maintenance or additional work ordered by owner or governing authorities immediately, but in no case more than 48 hours. Failure to comply will result in a “Stop Work” order.

D. Permanent Erosion Control Features

Contractor must incorporate permanent erosion control features, paving, permanent slope stabilization, and vegetation into project at earliest practical time to minimize need for temporary controls.

E. Seed and Mulch

Permanently seed and mulch the cut and fill slopes as construction proceeds to the extent considered desirable and practical.

F. Stabilized Construction Access

The work must consist of the installation of temporary erosion protection and sediment control for an aggregate stabilized construction entrance access point. Entrance must be completed prior to commencement of construction activities according to the specifications and construction drawings.

G. Concrete Wash Out Areas

The work must consist of the installation of a concrete wash out pit to control runoff from ready mix trucks.

SECTION 11

STORMWATER MANAGEMENT

11.01 GENERAL

This section provides the City of Coconut Creek's stormwater management requirements.

11.02 SURFACE WATER MANAGEMENT SYSTEM COMPONENTS

All stormwater drainage systems must be designed in accordance with the requirements of the Broward County Code of Ordinances, the City of Coconut Creek Code of Ordinances, and Cocomar WCD design criteria.

11.03 DRAINAGE MAP

The Project Engineer must include in the construction plans a master drainage map showing all existing and proposed features. The map is to be prepared on a 24-inch by 36-inch sheet on a scale not to exceed one (1) inch to 200 feet. Below are the features to be included on the drainage map:

A. Drainage bounds, including all offsite areas draining to the proposed subdivision

B. Sufficient topographical information with elevations to verify the location of all ridges, streams, etc. (one [1]-foot contour intervals)

C. Highwater data on existing structures upstream and downstream for the subdivision

D. Notes indicating sources of highwater data

E. Notes pertaining to existing standing water, area of heavy seepage or springs

F. Existing drainage features (ditches, roadways, ponds, etc.)

G. Subdivision layout with horizontal and vertical controls

H. Proposed drainage features, including location of inlets, swales, ponding areas, etc.

I. Delineation of drainage sub-areas

J. Retention/detention areas and ingress/egress areas for retention/detention facilities

K. General type of soils (obtain from soil survey of Broward County).

L. Flood hazard classification.

M. Description of current ground cover and/or land use

N. Recent aerial photograph delineating project at no smaller scale than one (1) inch = 400 feet

O. Drainage calculations

11.04 CANALS AND DITCHES

A. All canals and ditches must have a five (5) foot minimum bottom width unless approved otherwise by City Engineer.

B. All canals and ditches must have graded side slopes conforming to the standards given in Section 8, Clearing and Grading (see tables 8-1 and 8-2).

11.05 SECONDARY CONVEYANCE PERFORMANCE STANDARDS

Public roadways, private roadways and drainage connections to receiving water bodies require a design utilizing a 10-year return frequency for storm events.

11.06 ROADWAY AND PAVEMENT DRAINAGE SYSTEMS

A. Physical Standards

1. The minimum size pipe allowed in rights-of-way is 15 inches unless otherwise approved by the City Engineer.

2. All drainage pipes within right-of-way and easements must be reinforced concrete pipe or an approved equal HDPE pipe per FDOT Standard Specifications for road and bridge construction, unless otherwise approved by the City Engineer.

3. Corrosive pipe materials will not be permitted within R/W where corrosive soil environments are suspected.

4. Driveway crossings must have a minimum culvert diameter of 15 inches.

5. Minimum cover over culverts within rights-of-way is 30 inches below grade unless acceptable loading calculations supporting a lesser depth are submitted and approved by the City Engineer.

B. Hydraulic Standards

1. Secondary Conveyance Systems

   All roadway and paving projects must verify that secondary conveyance systems perform properly during the design storm event.

2. Stormwater Calculations

   Stormwater calculations must include the following:

   a. Locations and types of structures

   b. Types and lengths of pipes

   c. Drainage sub-area tributary to each structure

   d. Runoff coefficient per sub-area

e. Time of concentration to structure

f. Hydraulic gradient for the five (5)-year or 10-year frequency storm event is classified as zone 11

g. Estimated receiving water (tailwater) elevation with sources of information, if available

h. Diameter of pipes

i. Outlet and other pipe velocities

3. Hydraulic Grade Line Calculations

a. The Hydraulic Grade Line (HGL) computed through the storm sewer system must be 1.0 foot below gutter line for arterial streets during a 10-year storm and 0.5 feet below gutter line for minor collector and local streets during a 5-year intensity storm event.

b. The HGL for the stormwater system must be computed taking into consideration the design tailwater on the system and the energy losses associated with entrance into and exit from the system; friction through the system; and turbulence in the individual maintenance access structures/catch basins/junctions within the system.

c. The energy losses associated with the turbulence in the individual maintenance access structures are minor for an open channel or gravity stormwater system and can typically be overcome by adjusting (increasing) the upstream pipe invert elevations in a maintenance access structures by a small amount. However, the energy losses associated with turbulence in the individual maintenance access structures can be significant for a pressure or surcharged stormwater system and must be accounted for in establishing a reasonable hydraulic gradient line.

d. There must be a drop of 0.10 foot in the channel across a maintenance access structures. Stormwater pipes of the

same sizes must always join maintenance access structures with no size conversions between maintenance access structures. When a smaller stormwater pipe joins a larger one, the invert of the larger stormwater pipe should be lowered sufficiently to maintain the same energy gradient. An approximate method for securing these results is to place the 0.8 depth point of both stormwater pipes at the same elevations.

4. Stormwater Encroachment into Traveled Lane

   a. Inlets must be spaced at intervals of 300 feet or less at all low points, intersections and along continuous grades to prevent the spread of water from exceeding tolerable limits as determined by the City Engineer.

   b. The acceptable tolerable limits for arterial and collector roadways is defined as approximately one-half of the traveled lane width. Acceptable tolerable limits for interior subdivision roadways are defined as a maximum of one (1) inch above the crown of the road.

5. Tailwater Conditions for Stormwater Systems

   Tailwater conditions for stormwater systems must consider the receiving facility. In the case where the detention pond is the receiving facility, the design tailwater level can be estimated from the information generated by routing through the pond the hydrograph resulting from a 10-year frequency storm of duration equal to that used in designing the pond. Then the design tailwater level can be assumed to be the 10-year pond level corresponding to the time that peak inflow occurs from the stormwater into the pond. In lieu of the above detailed analysis, however, a simpler design tailwater estimate can be obtained by averaging the established 25-year Design High Water elevation for the pond and the pond bottom elevation for "dry bottom" ponds or the top of the pollution abatement volume for "wet bottom" ponds.

6. Minimum and Maximum Velocities

Public roadway pipe systems must be designed such that the minimum flushing velocity in all pipes is 2.5 feet per second (fps) for a 10-year intensity storm event when flowing full. The maximum velocity allowed within the pipe system is 15 fps and no greater than six (6) fps exiting the system, provided that sufficient energy dissipation is included in the design.

7. Inlet Interception Rates and Capacities

Maximum inlet interception rates must be based on the Inlet Capacity Chart contained in the FDOT Drainage Manual.

11.07 PRIVATE ROADWAY AND PAVEMENT DRAINAGE SYSTEMS

All private roadways and paving should be designed in accordance with this manual.

11.08 TERTIARY CONVEYANCE PERFORMANCE STANDARDS

This includes minor drainage systems such as parking lots and service roads intended for public use on private property. The design storm event is a 10-year return frequency.

11.09 PARKING LOT DRAINAGE SYSTEMS

A. Sheet Flow Standards

For sheet flow less than 300 feet, use Manning's Kinematic solution to compute time of concentration (Tt). Mustow concentrated flow can be determined from soil conservation method (see US Department of Agriculture Soil Conservation service, "Engineering Division, Chapter 2 Urban Hydrology for small watersheds, Technical Release 55 or FDOT Drainage Handbook – Hydrology"). Parking lots must not be designed as stormwater storage, unless approved by the City Engineer or designee.

B. Pipe Flow Standards

The minimum pipe size must be 15" between stormwater runoff inlet and maintenance access structures. Roof drainage, special structure drain pipes and other minor drainage structures must be no smaller than 6" in diameter.

11.10 SWALE DRAINAGE

These systems must meet the performance standards for stabilization and grading as outlined in this Manual.

11.11 ROOF DRAINAGE

All roof drainage outlets must be shown on the construction plans. The plans must give evidence that stormwater runoff from the building structure will be directed to the pond, inlet or structure intended to receive the stormwater runoff in accordance with stormwater management calculations.

11.12 EROSION PROTECTION PERFORMANCE AND DESIGN STANDARDS

A. General

Erosion protection and earth stabilization is mandatory for all sites. The velocities generated by stormwater runoff must not erode, washout or otherwise affect the intended performance of the drainage system during the design storm event of the facility. Erosion and sediment control must also be enforced during construction as specified in this Manual.

B. Acceptable Standards Practice

Acceptable stabilization practices include, but are not limited to:

1. Sodding/Paving

The method of ground stabilization will be selected based upon the anticipated design storm velocity of the facility or the steepness of slope (see Table 7).

TABLE 7. Table Maximum Channel Velocy/Slope

Stabilization practice	Velocity	Slope
Seed/Grass & Mulched	0-2 Fps	<2.0%
Sodded	2-4 Fps	2.0–5.0%
Paved or Fixed	>4 Fps	>5.0%

a. Maximum channel velocities and slopes must be according to FDOT Standards.

b. All swales are required to be completely sodded.

c. Ditches (or canals) are required to have sodded side slopes from their top of bank to their normal water level (or bottom).

d. All ponds are required to have sodded side slopes from top of bank to their normal level or dry bottom.

e. Dry bottoms may be seeded and mulched or grass and mulched, as an alternative to sodding.

2. Flumes

Concrete or Asphalt flumes are required whenever concentrated storm water leaves a parking area or road or enters a stormwater management facility.

3. Check Dams

Check dams may be used to dissipate the velocity of swales but must be completely sodded.

4. Culvert End-Treatments

All culverts discharging to a stormwater management facility must have end treatment. These structures are to prevent undermining of the pipe, and providing a readily maintainable entrance/exit for stormwater flow, free from vegetative overgrowth. Standard FDOT concrete or rip rap headwalls and mitered end sections are

acceptable. Pour in-place collars may also be acceptable on smaller diameter pipe.

5. Energy Dissipaters

Whenever stormwater is discharged from a pipe, flume or other conveyance channel at a velocity sufficient to cause erosion, energy dissipation devices must be employed.

6. Splash Pads

Splash pads are required to stabilize the soil of all stormwater discharge structures with outlet velocities in excess of 2.5 fps. Energy dissipaters may also be required in addition to splash pads in order to reduce outlet velocities from the splash pad.

11.13 EROSION AND SEDIMENT CONTROL DURING CONSTRUCTION

Erosion and sediment must be controlled during construction. This includes the prevention of both wind erosion and water erosion (turbidity).

A. Inlet Protection

All inlets and catch basins must be protected from sediment laden storm runoff until completion of all construction operations that contribute sediment to the inlet.

B. Temporary Seeding

Disturbed areas 5 acres or less that will not be graded or actively worked for a period of 14 days or more must be temporarily stabilized with a growing grass species appropriate for the season that will not compete with permanent grassing, and be applied at a rate of 30 lbs./acre. Disturbed areas 5 acres or more that will not be graded or actively worked for a period of 7 days or more must be temporarily stabilized with a growing grass species appropriate for the season, which will not compete with permanent grassing, and be applied at a rate of 30 lbs./acre.

11.14 STORMWATER DRAINAGE STRUCTURE PERFORMANCE AND DESIGN STANDARDS

A. Acceptable Structures

All drainage structures within public right-of-way or easements must be standard FDOT inlets, maintenance access structures and junction box types unless special requirements require a unique structure design. Such instances will be reviewed on a case-by-case basis.

B. Placement and Spacing

1. Maintenance Access Structures

Stormwater maintenance access structures must, in no instance, be spaced no further than 300 feet from one another. Public drainage systems may require closer spacing subject to the review of the City Engineer.

2. Inlets

Inlets are to be spaced so to provide adequate stormwater runoff evacuation to prevent unacceptable stormwater spreading into the traveled lanes.

a. The maximum distance for flow in a curb and gutter to the first point of removal for any roadway must be 300 feet.

b. All low point (sump) location inlets must be designed to intercept 110 percent of the design flow, including by-pass flow from upstream inlets.

c. All intermediary inlets (not at low points) must be designed to intercept at least 80 percent of the design flow.

d. All roadway inlet structures and ditch bottom inlets within the right-of-way that are subject to vehicular collision must be set flush with finished grade. This is not meant to preclude the installation of weir-type control structures but to limit fixed

protruding concrete structures from serving as hazards to motorists.

3. Acceptable Structures

Maintenance access structures and inlets must have a drop of 0.10 feet across the base of the structure unless designed as a sump.

4. Placement and Spacing

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

11.15 GENERAL STORMWATER PIPE PERFORMANCE AND DESIGN STANDARDS

A. Physical Design Standards

1. Clearance Requirements

There must be a minimum cover of 30 inches over all concrete pipes under flexible or rigid pavement. Thirty inches minimum cover must be maintained over all corrugated steel or aluminum pipe. Larger diameter culverts (greater than 54 inches in diameter) require additional cover as determined by the City Engineer. Refer to FDOT Roadway Design Standards Manual for minimum cover with respect to culvert diameter and material. Non-doweled rigid pavement must require a minimum of 30 inches of compacted soil or base (98 percent AASHTO T-180) between the concrete and the top of pipe.

2. Minimum Size Requirements

a. All pipe sizes should be designed to produce a minimum flushing velocity (whenever possible) without producing velocities that cause erosional problems.

b. The minimum pipe size to be used in a right-of-way or any stormwater facility to be maintained by the City must be 15 inches regardless of velocity.

c. Any pipe sizes less than those described are at the discretion of the City Engineer.

3. Material Requirements

a. Portland Cement Reinforced Concrete Pipe or an approved equal for City-maintained storm sewers.

b. HDPE or an approved equal for privately maintained street for storm sewer.

B. Hydraulic Design Standards

1. Maximum/Minimum Design Velocities

All pipes should be designed to produce flushing velocities of 2.5 fps (3.0 desirable) and must not exceed 10 fps.

SECTION 12

RECLAIMED WATER SYSTEMS

12.01 GENERAL

A. This section sets forth the general requirements for design and installation of reclaimed water distribution and irrigation systems. Pipe used in reclaimed water distribution or irrigation systems must be HDPE, DIP, or PVC pressure pipe, as specified in Section 3 of this Manual.

B. The Developer/Contractor must be responsible for all materials furnished and storage of the same until the date of substantial completion and transferred ownership to the City. The Contractor must replace at their expense all material found to be damaged or defective in handling or storage. The Developer/Contractor must, if requested by the City, furnish certificates, affidavits of compliance, test reports, or samples for check analysis for any of the materials specified in this Manual as it relates to reclaimed water distribution. All pipe delivered to the project site for installation is subject to random testing for compliance with the designated specifications.

12.02 DESIGN STANDARDS

A. Additional Resources

The design of the reclaimed water system must not be in conflict with State, County, or other regulatory agency requirements. Additional resources include the AWWA Manuals of Standard Practice, Distribution Network Analysis for Water Utilities, and Sizing Water Service Lines and Meters.

B. Reclaimed Water Mains

Reclaimed water mains must be located in dedicated rights-of-way or utility easements. All reclaimed water mains located outside of dedicated rights-of-way must require a minimum 12-foot easement or as required by the City. Additional easement widths must be needed when the pipe size

or depth may dictate. No reclaimed water mains must be placed under retention ponds, sport courts, or structures, as determined by the City. Reclaimed water mains must not be located along side or rear lot lines unless approved by the City Engineer or designee. Placement of a reclaimed water main along a side or rear lot line may be allowed on a case-by-case basis if such a reclaimed water main configuration results in efficient placement and utilization of the distribution system.

C. System Design

1. Dead ends are allowed with flushing hydrants, blow-off assemblies, or automatic flusher located on dead ends. Future connections to adjacent properties must be considered.

2. Normal Flow Demands: Flow demands for design must be calculated on the basis of the ultimate development as known or projected.

3. Pipe must be sized to maintain a minimum distribution main pressure of 45 psi during peak conditions.

4. Minimum size of distribution mains must be eight (8) inches.

5. Backflow prevention is required in accordance with PL93-523, the Federal Safe Drinking Water Act, and subsequent amendments; and F.A.C. 62-555.360 for the safe protection of the water system.

6. Cross-connections between reclaimed water and the potable water systems, other pressurized systems, sources, mechanical apparatus, or equipment within the private property footprint is prohibited.

7. Prior to receiving reclaimed water, a dual check valve backflow prevention device, as a minimum, will be installed downstream of each residential customer’s water meter.

8. Multifamily and commercial property with master-metered potable water service and master-metered reclaimed water service must be required to install a Reduced Pressure Principal type backflow prevention device downstream of the master water meter.

D. Valve Locations

Valves must be provided for all branch connections as required to provide an operable, easily maintained and repaired reclaimed water distribution system. All reclaimed water mains must have GV.

12.03 STANDARD REQUIREMENTS

A. Approved Pipe, Fittings, and Valves

HDPE must have a minimum SDR 11 minimum. HDPE butt-fused pipe must be made from PE 3608 HDPE, with a cell classification of 345464C, as determined by ASTM D-3350. The HDPE pipe must have co-extruding purple longitudinal stripes into the pipe's outside surface for reclaimed water. Bends in HDPE pipe must not be within 10 pipe diameters from any fitting or valve. The minimum radius of curvature must be 30 pipe diameters and bending must not cause any kinking. Directional bore HDPE must have a #8 gauge wire installed during horizontal drilling.

PVC of nominal diameter of four (4) inches to 12 inches must be DR-18 manufactured to DIP outside dimensions and in compliance with AWWA Standard C-900 (Pressure Class 150). The pipe must have an integral bell end and gasket seal with the joint in compliance with the requirements ASTM D3139 for open cut and direct bury installations with a minimum of 36 inches of cover. The PVC pipe color must be purple with "Reclaimed Water Main" permanently printed on three (3) sides for the entire length of pipe.

PVC of nominal diameter of 14 inches to 20 inches must be DR-18 manufactured to DIP outside dimensions and in compliance with AWWA Standard C-905 (Pressure Class 235). The pipe must have an integral bell end and gasket seal with the joint in compliance with the requirements ASTM D3139 for open cut and direct bury installations with a minimum of 36 inches of cover. The PVC pipe color must be purple with "Reclaimed Water Main" permanently printed on three (3) sides for the entire length of pipe.

Reclaimed Water Service Automatic Air Release Valve: The valve body and cover must be cast iron construction, ASTM A126 Class B, and all internal parts must be of type 300 series stainless steel. The venting orifice must be one (1)-inch in diameter and the seating material must be of Viton, or an approved equal. (Please refer to approved products list Appendix A.)

B. C-900 and C-905 Pipes

C-900 and C-905 pipes must have an integral bell formed with a race designated to accept the gasket in accordance with the respective AWWA requirements. The spigot end must have a bevel and a stop mark on the outside diameter to indicate proper insertion depth. All surfaces of the joint where the gasket may bear must be smooth, free of cracks, fractures or imperfections that could adversely affect the performance of the joint. The minimum radius of curvature must be 30 pipe diameters and bending must not cause any kinking.

C. Wire Installation

All piping must have tracer wire install 18 inches above the pipe upon backfilling.

Pipe and fittings	Size range (in inches)
HDPE and PVC pipe and fittings	4” and up
HDPE and PVC pipe and fittings	Service connections only (up to 2”)
Resilient seated GV	No limit
Gate valves	No limit
Corporation stops and curb stops	Service connections only

1. Where looping of reclaimed water mains is not practical, a minimum eight (8)-inch reclaimed water main is required. In commercial, industrial and high-density residential areas, larger size reclaimed water mains must be required.

2. HDPE joints must be butt-fused fittings or electrofusion fittings.

3. Fittings for butt-fused pipe must be cement mortar or fusion bonded epoxy coated DI with mechanical joints rated to 350 psi and conforming to AWWA C-153 and C-111. All MJ fitting connections to polyethylene pipe must be restrained with Megalug restrainers. The HDPE pipe must be reinforced on the ends with stainless steel wedge internal stiffeners. The mechanical connection to MJ fittings and sleeves must use mechanical restraints that meet specification requirements. If size on size mechanical connection to HDPE and PVC pipe is approved by the City Engineer, DI sleeves with Megalug restrainers must be installed.

4. Fittings for HDPE and polyethylene pipe must be DI in accordance with AWWA Specification C-153 and have the same pressure rating of the connecting pipe. All DI fittings must be cement mortar or fusion bonded epoxy coated. All exposed fasteners, such as bolts, nuts, fasteners, washers, and threaded rods must be “COR-TEN” or Cor-blue coated. Mechanical joint bolts must not protrude more than 1/2 inch through the nut after joints are assembled.

5. All stainless steel fastener threads must be coated with an anti-seize compound as approved by the City Engineer or designee.

D. Blow-Off Assemblies

1. Where dead-end mains occur, they must be provided with a blow-off for flushing purposes. Blow-off assemblies must be stainless steel. Blow-off devices must be sized to provide flows which will provide a velocity of at least 2.5 feet per second in the reclaimed water main being flushed. No flushing device must be connected to any sewer.

2. Final field location of all blow-off assemblies must be approved by the City. Guard posts (see standard detail) around blow-off assemblies are required in all commercial areas and in some residential areas, cases will be determined by the City Engineer.

E. Valves

Sufficient valves must be provided on reclaimed water mains so that inconvenience and sanitary hazards will be minimized during repairs. Valves must be located at not more than 1000-foot intervals in

commercial, industrial, and high-density residential areas, and at not more than 1500-foot intervals in all other areas. Appropriate valves must also be provided at all areas where reclaimed water mains intersect to ensure effective isolation of reclaimed water lines for repair, maintenance, or future extension. Additional valves can be requested as determined by the City Engineer to ensure safe and fast isolation of the reclaimed water main for repairs. The acceptable valves, installation methods, and other specialty items are identified in Section 3, paragraph 3.03 of this Manual.

F. Ductile Iron Fittings

1. All fittings must be in accordance with AWWA Specification C-153, latest revision, and have the same pressure rating of the connecting pipe. The DIP fittings covered by this specification must be mechanical joint type, centrifugally cast to conform to all requirements of AWWA Specifications C-151 and C-153, latest revisions.

2. All fittings must have a cement mortar or fusion bonded epoxy coating in accordance with the AWWA Specifications, latest revision.

3. Polyethylene material must conform to ASTM Standard Specification D1248-68, latest revision. The nominal wall thickness must be plainly marked on each piece of pipe and the pipe installed so that the markings can be read from the top of the trench.

4. Rubber gasket joints must be in accordance with AWWA Specification C-111 latest revision.

G. Flushing Hydrants

Flushing hydrants must be dry barrel spaced at 1500-foot intervals or less as measured by the centerline of the roadway. All hydrants must be no less than four (4) feet and no more than seven (7) feet from the edge of pavement. All dead ends to have a flushing hydrant.

H. Pipe Depth and Protection

The standard minimum cover for reclaimed water distribution systems must be forty eight (48) inches from the top of the pipe to finish grade.

I. Reclaimed Water Mains

All reclaimed water mains must have a tracer wire which is domestically manufactured. All tracer wire must have HDPE insulation intended to direct bury, color coated per APWA standard.

1. Tracer Wire Open Trench

Tracer wire must be #12 AWG Copper Clad Steel. Extra High Strength part # 1230*HS – break load 452 lb., 30 ml HDPE coating is suggested as minimum thickness.

2. Tracer Wire – Directional Drilling/Boring

Tracer wire must be #8 AWG Copper Clad Steel. Extra Strength part # 845*EHS – break load 2785 lb., 30 ml HDPE coating is suggested as minimum thickness.

3. Tracer wire – Pipe Bursting/Slip Lining

Tracer wire must be #8 AWG Copper Clad Steel. Extra Strength part # PBX-50 stranded CCS-break load 4700 lb., 50 ml HDPE coating is suggested as minimum thickness.

4. Connectors

Direct bury wire connectors, including three (3)-way lockable connector: Dryconn three (3)-way Direct Bury Lug: Copperhead Part # 3WB -01 or an approved equal. Main line splice to service line connection must be specifically manufactured for use in underground trace wire installation, must be dielectric silicon filled to seal out moisture and corrosion, and must be installed in a manner so as to prevent any uninsulated wire exposure.

All mainline tracer wires must be interconnected in intersections, at tees and crosses. At tees, the three (3) wires must be joined using a single three (3)-way lockable connector. At crosses, the four (4) wires must be joined using a four (4)-way connector. Using two three (3)-way connectors with a short jumper wire between them is

an acceptable alternative. Copperhead three (3)-way locking connector: Part # LCS1230.

5. Termination/Access

All tracer wire termination points must utilize an approved trace wire access box above ground or grade level/in-ground as applicable, specifically manufactured for this purpose. A minimum of two (2) foot of excess wire is required in all grade level trace wire access boxes after setting at final grade.

6. Grounding

Tracer wire must be properly grounded at all dead ends/stubs. Grounding of tracer wire must be achieved by use of a drive-in magnesium grounding anode rod with a minimum of 20 feet of #14 HDPE copper clad wire connected to anode (minimum 1.0 lb.) specifically manufactured for this purpose and buries at the same elevation as the utility. Drive-in Magnesium Anode: Copperhead Part # ANO-10005.

7. Installation – General

Tracer wire installation must be performed in such a manner that allows proper access for connection of line tracing equipment, proper locating of wire without loss or deterioration of low frequency (512Hz) signal for distances in excess of 1000 linear feet, and without distortion of signal caused by multiple wires being installed in close proximity to one another. Tracer wire must be installed as a continuous single wire. No looping or coiling of wire is allowed.

8. Damage

Any damage occurring during installation of the tracer wire must be immediately repaired in an approved waterproof method. Taping must not be allowed.

I. Locator Tape

All reclaimed water pipes must have a warning tape installed with a minimum four (4) mils and manufactured with heavy metal-free polyethylene tape that is impervious to all known alkalis, acids, chemical reagents, and solvents found in soil. The minimum overall width of the tape must not be less than three (3) inches. Standard rolls must be 2000 feet in length. Tape must be installed 18)inches below the ground surface. The tape must be colored Safety Purple and imprinted with the following message: Caution – Reclaimed Water Main Below - depending on the pipe.

12.04 INSTALLATION

A. General

All reclaimed water mains, valves, and appurtenances must be installed in accordance with this section.

B. No Reclaimed Water Service Lateral

No reclaimed water service lateral must parallel adjoining lots, run between neighboring property lines, or come through the rear of the property's lot line in order to provide utility service, unless otherwise approved by the City.

C. Reclaimed Water Mains Near Other Water Mains

Reclaimed water mains that are installed in the vicinity of water mains must meet the horizontal and vertical separations specified herein, in accordance with F.A.C. 62-555.314, as shown in the standard drawing.

1. Reclaimed water main shall be laid to provide a horizontal separation of a minimum of six (6) feet horizontally from any water main, 10 feet preferred.

2. Reclaimed water mains crossing waterpipes: the vertical separation must be a minimum of six (6) inches, 12 inches preferred, below the bottom of the waterpipe. When reclaimed water mains must be laid above the top of the water main, the minimum vertical separation must be 12 inches (not preferred). (See standards drawing)

D. Aerial/Underwater Crossings

1. Aerial Crossings

Structural supports must be provided for all joints in pipes utilized for aerial crossings and must be designed to prevent overturning and settlement. Expansion joints must be provided between the aerial and buried sections of pipe. The impact of flood waters and debris must be considered, and the bottom of the pipe must be placed no lower than that specified by Cocomar WCD Standards.

2. Flanged DIP

Flanged DIP, minimum Class 51, must be used for all aerial crossings. The above ground pipe must be painted purple. Underground valves must be provided at both ends of the crossing so that the section can be isolated for testing or repair. The valves must be easily accessible and not subject to flooding. Both valves must be constructed in a maintenance access structure or valve vault. An automatic air release valve must be installed at the high point of the crossing at one end. Appropriate guards must be installed at both ends of the crossing to prevent pipe access to the public.

3. Regulatory Permits

All applicable regulatory permits must be obtained. When the aerial crossing is accomplished by attachment to a bridge or drainage structure, the design must meet all requirements of the agencies who own or have jurisdiction over such structures.

4. Underwater Crossings

The pipe material must meet appropriate AWWA Standards for use in submerged conditions. Valves and ARV’s must be provided at both end of the water crossings so that the section can be easily isolated for testing or repair. Isolation valves located within the SFWMD or Cocomar WCD canal rights-of-way must be approved by the regulatory agency. The valves must be easily accessible and

not subject to flooding. Both valves must be constructed in a maintenance access structure or valve vault. All applicable regulatory permits must be obtained, including dredge and fill permits.

E. Pipe Bedding

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

F. Connections at Structures

Where pipes are to extend into or through structures, flexible joints must be provided at the wall face.

G. Special Exterior Protection for Corrosion

Extra protection must be provided for DIP and fittings within areas of severely corrosive conditions.

H. Air Release Valves

Methods for air release must be provided where the reclaimed water main profile is such that air pockets or entrapment could occur resulting in flow blockage. Air venting capabilities must be provided for distribution mains by appropriately placing automatic air release valves or blow offs. At critical points on major mains, automatic air release assemblies must be installed. All dead-end mains, temporary or permanent, must be equipped with a manually operated blow-off at the terminus. The automatic valves must be a heavy-duty automatic air release type for 150- NPDES , tested to 300 psi. Body, cover and baffle must be cast iron. All internal parts must be type 300 series stainless steel, and the inside of the valve must be coated with a rust inhibitor that does not contain any lead base material. The valves must be provided with a vacuum check to prevent air from reentering the line. All valves must comply with AWWA C-512 and in accordance with the details in this Manual.

I. Service Connections

1. All service lines two (2) inches or less in size must meet AWWA C-901, ASTM D-3350 cell classification of 334434C and be permanently marked with the type/size/use of the pipe. PE pipe 2 1/2 inches or three (3) inches in size must meet AWWA C-901, ASTM D-3350 cell classification 334434C and be permanently marked with the type/size/use of the pipe and must only be permitted by specific written approval by the City of Coconut Creek. The minimum radius of curvature must be 30 pipe diameters and bending must not cause kinking. The reclaimed water pipe must be purple in color. Residential services must be one (1)-inch polyethylene tubing (HDPE) for single and dual services.

2. Connections to reclaimed water mains (other than DI) of four (4) inches and larger must be made by the drilling of the appropriate size hole and the installation of service saddles. Where water services greater than 12 inches are required, dual services must be provided. Services to smaller size mains must be accomplished by in-line fittings. A corporation stop must be placed at the saddle or fitting with the service line extended perpendicular to said line.

3. No reclaimed water service line must parallel adjoining lots, run between neighboring property lines, or come through the rear of the property's lot line in order to provide utility service unless otherwise approved by City Engineer or designee.

4. Corporation stops must be 1-inch, 1 1/2-inch, or 2-inch brass, equipped with connections compatible with a polyethylene service line. Curb stops must be sized to match the meter size and conform to AWWA C-800.

5. Fittings must be brass, cast and machined in accordance with specifications in AWWA C-800, compatible with polyethylene tubing.

6. Service saddles must be for service line taps and conform to the requirements outlined in this Manual.

J. Reclaimed Water Metering

All service connections must be metered. In general, the method of metering will follow the guidelines listed below. However, the Developer's Engineer must obtain approval before finalizing the design of the metering system. No trees or shrubs must be planted within six (6) feet of the water meter or service line. 5/8-inch through two (2)-inch meters must be AWWA approved Sealed Register Displacement or Velocity Type Meters. The water meters that are three (3) inches and larger meters must be AWWA Approved Turbo-Meters, Compound Meters, or preferably an approved Velocity Meter. Meters that are six (6) inches and larger must be equipped with a strainer. All meters must be equipped with "electronic read" components. The EOR must obtain approval before finalizing the design of the metering system. No trees or shrubs to be planted within six (6) feet of the reclaimed water line. Reclaimed water meters must preferably be installed in green areas.

For low flow traffic areas such as sidewalk, property line/easement, meter boxes and covers must be at a minimum ANSI/SCTE Tier 8 rated for potable water and reclaimed water, in accordance with the standard drawings.

For medium vehicle traffic areas, such as residential driveway, parking lot, and off roadway applications, water meter boxes and covers must be at a minimum ANSI/SCTE Tier 15 rated water and reclaimed in accordance with the standard drawings.

For high vehicle traffic areas, such as county arterial roadways, state roads, commercial driveways, and industrial parks must be at a minimum ANSI/SCTE Tier 22 rated water and reclaimed meter boxes and covers and is in accordance with the standard drawings.

Reclaimed water meter boxes and covers must be color impregnated or painted based on the meter box and cover materials and be purple in color.

Reclaimed water meter box covers must have a hinged access panel to facilitate the reading of the meter.

1. Single Family, Duplex, and Multifamily Subdivisions with Public Rights-of-Way

   Each unit must be individually metered. Single and double services must be installed at the property lines, as indicated by the standard drawing.

2. Single Family, Duplex, and Multifamily Subdivisions with Private Streets

   Individual meters may be permitted in accordance with this Manual if the private streets are designed to City Standards and easements are dedicated over the entire private street common areas. In addition, sufficient area must be available to locate reclaimed water mains, services, and meters. All hose bibs must be located in a locked box below the ground level.

3. Commercial, Industrial, Institutional, Multifamily, Apartments, and Condominium Projects

   In general, each building must be individually metered. Meter(s) must be located in the public rights-of-way at the property line or within a utility easement. All meters three (3) inches and larger must be located in an accessible meter vault.

4. Meter Sizes

   Meter sizes must be determined by the EOR and approved by the City. The Developer's Engineer must provide sufficient information on estimated peak flows and low flows so that a meter size can be determined.

K. Testing Mains and Tapping Sleeves

1. Pipe

   The Contractor must perform hydrostatic testing of all reclaimed water distribution systems, as set forth in the following, and must conduct said tests in the presence of representatives from the City or other authorized agencies with two (2) days advance notice

provided. Hydrostatic tests must be conducted on all newly laid pressure pipes, joints, fire hydrants, and valves, including all service lines to the curb stops. Air testing of pressure pipe will not be permitted unless approved by the City Engineer or designee. The Contractor must furnish all necessary equipment and material and make all taps in preparation for the hydrostatic test. No testing must be performed until the City approves the as-built drawings.

2. Piping and Appurtenances Testing

Piping and appurtenances to be tested must be within sections between valves or adequate plugs, all with prior approval. All piping must 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 must be exercised to permit the escape of air from the sections of pipe that is going to be tested.

The Contractor must hydrostatically pressure test all HDPE and PVC reclaimed water mains in accordance with the latest revision of AWWA C-600 series as applicable. Oil-filled gauges must only be used for all pressure tests. The tests must be at 150 psi for a period of two (2) hours. The allowable loss for one (1) hour must be determined by the following formula:

$$L = \frac{SD(P)^{1/2}}{148{,}000}$$

L = allowable leakage in gallons per hour

S = length of pipe tested, in linear feet (maximum length is 2,000 feet for calculation)

D = nominal diameter of the pipe in inches

P = average test pressure maintained during the leakage test in pounds per square inch, gauge min 150 psi. Pressure loss during test must not exceed $\pm$5 psi.

3. Testing Procedure

The testing procedure must include continuous application of the specified pressure to the test system, for the two (2)-hour period, by way of a pump taking supply from a container suitable for measuring water loss. The amount of loss must be determined by measuring the volume displaced from said container.

4. Test Failure

Should the test fail, necessary repairs must be accomplished by the Contractor and the test repeated until it is within the established limits. The Contractor must furnish the necessary labor, water, pumps, gauges, and all other items required to conduct the required reclaimed main testing and must perform the necessary system repairs required to comply with the specified hydrostatic test.

5. Tapping Sleeves

All reclaimed water tapping sleeves must be hydrostatically pressure tested in accordance with the latest revision of AWWA C-600. The test must be conducted at 150 psi for a period of two (2) hours. No loss of pressure is allowed.

6. Meter Installation

All meters will be installed underground in an approved City meter box. Installation of meters under sidewalks or pavement must not be permitted unless approved by the City Engineer or designee. Water meters must preferably be installed in green areas. In general, all meters must be located in a utility easement located adjacent to the public rights-of-way. No trees or shrubs must be planted within six (6) feet of the reclaimed water meter or service line.

7. Meter Sizes

Meter sizes must be determined by the EOR and approved by the City.

L. Signage

Signs must be places at all drain valve assemblies, blow-off valve assemblies, and fire hydrants that say “Reclaimed Water – Do Not Drink” per F.A.C. 62-610.469(7)(f).

12.05 CONSTRUCTION REQUIREMENTS

A. Direct Bury and Directional Bore

All direct bury and directional bore for reclaimed water main pipe must be installed to a minimum depth of 36 inches. Contractor must verify the existing utilities by having them located by calling in underground locate requests. All directional bore will require soft digs to verify existing utilities. Open cut reclaimed water main piping must be Class 51 DR-18 for all areas with a minimum of 36 inches of cover. For lower depth, the type of pipe and installation must require prior City approval. All pipes, fittings, and valves must be carefully lowered into the trench in such a manner as to prevent damage to the reclaimed water main materials coatings and lining. Wherever it is necessary to deflect pipe from a straight line in either the vertical or horizontal plane to avoid obstructions or where long-radius curves are permitted, the amount of pipe or joint deflection must not exceed 10 percent of the manufacture’s recommended limit.

B. Open Cutting of Roads

Open cutting of roads for trenching and direct bury of reclaimed water mains must not exceed eight (8) feet in width unless approved by the City Engineer. All effort must be made to minimize the width of the trench and in-turn, the amount of restoration.

C. PVC PIPE

PVC pipe may be laid in the trench in single sections or preassembled multiple sections.

D. System Identification and Signage

All reclaimed water piping and appurtenances must be clearly identified as reclaimed water facilities. The color is pantone purple 522C (Fed-STD-595C #27160 for paint). All identification and signage must be in accordance with F.A.C. 62-610.469(7)(f).

E. Notification of the Public

The public must be notified of the use of reclaimed water by posting advisory signs designating the nature of the reclaimed project site. Signage must be placed, as appropriate, at entrances to residential neighborhoods, where reclaimed water is used for landscape irrigation and at prominent locations at all commercial sites, including multifamily developments, office parks, schools, churches, condominiums, residential common areas, recreational developments, and golf courses.

SECTION 13

ROADWAY SYSTEM

13.01 SUBDIVISION DESIGN STANDARDS

Roadway Standards must conform to the requirements of Chapter 13, Article II of the City of Coconut Creek Land Development Code.

13.02 EXCAVATIONS WITHIN CITY RIGHT-OF-WAY

Open cuts on paved streets within City right-of-way may be permitted on streets functioning as “local” service roadways. Any roadways functioning as “collector” or higher will be considered on a case-by-case basis. Directional bore, micro tunneling, or a bore and jack may be required on high traffic volume roadways. Open cuts must conform to the standard drawings in this Manual for roadway restoration.

13.03 ROADWAY CLASSIFICATIONS

A. Roadways are generally designated as local, collector or arterial as defined by the FDOT (see latest edition). For design guideline purposes, the City recognizes several individual classifications based on ADT volumes. These designations will be used for establishing recommended minimum design standards. Table 8 gives approximate values for ADT based on land use. Table 9 gives the designations based on ADT.

B. Roadway designations are further divided into Residential and Commercial/Industrial. Minimum design standards are adjusted to reflect the heavier design vehicle.

C. An applicant may choose to present justification for values other than those presented as minimum herein for consideration. The source of data must be well documented in such a case.

D. The Broward County Traffic plan should be referred to and will supersede the requirements of this Manual when determining roadway classification.

TABLE 8. Street Classification Table

Standard	**Major arterial**	**Minor arterial**	**Collector**	**Minor collector road**	**Local street**	**Alley or frontage road**
Minimum right-of-way width (feet)	120–200	100–130	80–100	60–0	50	30
Minimum pavement width (feet)	2–36 (6-lanes divided)	2–24 (4-lanes divided)	48 (4-lanes divided)	24	24	16 or 20
Maximum longitudinal grade (%)	5	5	7	7	7-8	10
Design speed (mph)	40–45	35	30	30	25	15–20
Minimum radius of horizontal curvature (feet)	750	500	300	300	180	50–90
Minimum stopping sight distances (feet)	450	275	200	200	175	150

TABLE 9. Minimum Roadway Standards for Vertical Pavement Elements And Return Radii

Road designation	**Asphalt (3)**	**Class**	**Base lime rock**	**Subgrade**	**All conc.**	**Subgrade**	**Min. return radii**	**Design life**
Public parking	1½”	CI	8”	12”	6”	4”	N/A	15yr
Service access	1½” 1½”	R CI	8” 8”	12” 12”	6” 6”	4” 4”	30’ 35’	15yr
Local	1½” 2”	R CI	8” 8”	12” 12”	6” 6”	4” 4”	25’ 25’	20yr
Collector	2” 2”	R CI	8” 8”	12” 12”	6” 6”	4” 4”	35’ Veh.	20yr
Arterial	2” 2”	R CI	10” 10”	12” 12”	7” 7”	4” 4”	Veh. Veh.	20yr
One way cul-de-sac Terminus	1½” 1½” (1)	--- ---	8” 8”	12”12”	6” 6”	4”4”	Veh. (4)	

Notes: R = Residential; CI = Commercial/Industrial (Includes multifamily apartments); Veh.= Design for appropriate vehicular use.

(1) Asphalt depth varies with intended vehicular used to be at the discretion of Utilities and Engineering Director.
(2) Friction course option given also.
(3) Asphalt depth given plus friction course if required (e.g., 1 1/2" + 1").
(4) Minimum return radii must be 25', however, Utilities and Engineering Director may require larger radius for large design vehicles and/or high ADT values.
(5) Design Life: AASHTO Design using 18 KIP equivalent axle loads (equal) and traffic level using FDOT latest design standards.

13.04 ROADWAY LEVEL OF SERVICE (LOS)

A. All public roads within the City of Coconut Creek, including local, County, State, and Federal roads, must be required to operate at LOS D or better on a peak hour basis.

B. The LOS of road segments operating below LOS D according to the Broward County Trips Model as of November 10, 2015, Exhibit 27.B and C, and those segments operating below LOS D as shown in the 2015

Existing LOS Analysis of the Traffic Circulation Element of the Comprehensive Plan must not be permitted to delineate below 110 percent of the capacity of the roadway at LOS D on an Annual Average Daily Traffic (AADT) basis except as provided in the City Land Development Code.

13.05 SIGNING AND STRIPING

All proposed pavement marking and signage shall comply with the minimum standards outlined in the latest version of the MUTCD and/or the recommendations and engineering judgment of the City's Civil Engineer.

13.06 SIGNAGE

All traffic signage must be in accordance with the latest edition of the "Manual on Uniform Traffic Control Devices" by the United States Department of Transportation (USDOT)/Federal Highway Administration (FHA) and Broward County Standards.

13.07 PAVING STANDARDS

All thicknesses given in this section are measured as final, compacted, in place.

A. Asphalt Requirements

Minimum asphaltic surface thickness are given for each roadway classification in Table 9. Concrete paved sections design criteria is also given in Table 9.

1. The maximum paving application tolerance is 1/4 inch over 10 feet.

2. Asphaltic concrete surface courses must be designed for the appropriate roadway classification, usage and projected trips per day. Allowable asphaltic surfaces include FDOT – Friction (FC) and Superpave (SP) structural courses.

3. Prior to placement of asphalt, a design mix for the asphalt, including gradation of all material, content of mix, Marshall Stability, and laboratory density, must be provided to the City for approval. Certification must also be provided to the City showing that the materials comply with FDOT Standard Specifications for Road and Bridge Construction (latest edition).

4. After asphalt is placed, the Contractor must obtain from an independent testing laboratory, at minimum intervals of 300 feet, core borings of the asphalt, which must be submitted to the City for approval, to determine:

   a. Thickness and density
   b. Marshall stability
   c. Sieve analysis of aggregate
   d. Bitumen content of asphalt

B. Base Course Requirements

All public roadways are to have a compacted base. Recommended materials are lime rock or aggregate base course per FDOT, including FDOT index 514 (“Optional Base Group and Structural numbers”). Other materials are available for consideration upon approval by the City. Certified laboratory test results for the specifications described here must be mandatory prior to any dedication of public right-of-way.

Minimum base course thickness are given for each roadway classification in Table 9.

1. The graded aggregate base material must be of uniform quality throughout, substantially free from vegetable matter, shale, lumps and clay balls, and must have a lime rock bearing ratio value of not less than 100. The material retained on the No. 10 sieve must be composed of aggregate meeting the following requirements:

   Soundness Loss, Sodium, Sulfate: ASSHTO T 104…….15%
   Percent Wear: AASHTO T 96 (Grading A)
   Group 1 Aggregates.....45%
   Group 2 Aggregates.....65%

Group 1: This group of aggregates must be limestone, marble dolomite.

Group 2: This group of aggregates must be granite, gneiss or quartzite. Graded aggregate base materials must conform to the latest edition of the FDOT Standard specifications.

2. All lime rock must be primed and compacted to 98 percent of the modified proctor density, AASHTO T-180, and be installed on a stabilized subgrade. In addition, a minimum lime rock bearing ratio (LBR) of 100 is required for all roadway subgrades.

3. Certification from a testing laboratory must be submitted to the City indicating that the material used for the base meets the specified criteria and contains less than 1 percent by weight asbestos and a minimum of 70 percent of calcium and magnesium.

4. After the base is completed, the Contractor must obtain from an independent testing laboratory at minimum intervals of 300 feet, cores to determine base thickness and density. The tests must be submitted to the City for approval.

C. Subgrade Requirements

All public roadways are required to have a compacted subgrade to support the base course. If the in-place soil cannot meet or exceed the LBR specifications listed below, the entire subgrade must be stabilized to do so. Minimum subgrade thicknesses are given for each roadway classification in Table 9.

1. All subgrades must meet or exceed 98 percent modified proctor density AASHTO T-180. In addition, a minimum LBR of 40 will be required of all roadway subgrades.

2. All subgrades are to extend a minimum of 6 inches beyond the base course layer where curbing is omitted.

3. After the subgrade is complete, the Contractor must obtain from an independent testing laboratory at minimum intervals of 300 feet,

density and LBR tests on the subgrade. The tests must be submitted to the City for approval.

D. Concrete Paving Requirements

1. Portland concrete roadway is an acceptable alternative to asphaltic concrete on base. Three (3) construction options are available as follows and must conform to the above sections:

   a. Thickened Edge (Footer) / Road on Subgrade - Edge of road: must have a poured footer at least three (3) inches deeper than the required concrete surface width. The footer must be at least the outer 12 inches of roadway lane edge. Substructure: concrete road surface must be laid on subgrade extending at least 12 inches beyond edge of pavement (footer).

   b. Uniform Edge (No Curb) / Road on Base - Edge of road: no curbing or footer. Substructure: concrete road surface must be laid on a subgrade and must extend at least 12 inches beyond edge of pavement.

   c. Need to add/refer to FDOT index 514 “Optional base group and structural numbers.”

   d. Concrete curb edge / Road on subgrade - Edge of road: must have curbing. Substructure: concrete road surface must be laid on subgrade. Curbing must be laid on subgrade.

2. Minimum concrete thicknesses are given for each roadway classification in Table 9.

3. All concrete must be 3,000 psi minimum compressive strength at 28 days.

4. All bases (or sub-bases) are to extend a minimum of 12 inches beyond the concrete layer where curbing is omitted.

5. Broom finish on all concrete work.

6. Transverse and longitudinal joints must be constructed to a maximum spacing of 15 feet. Transverse joints must extend the entire width of the pavement and through the curbs and be sealed according to FDOT Standard specifications. Longitudinal joints must be required along the centerline of crowned road sections.

13.08 SPECIAL STABILIZATION

All curbing within public right-of-way must be supported by a stabilized subgrade. All roadway shoulders must also be stabilized.

A. Curbing base and sub-base must match asphalt pavements according to Table 9. Shoulders must meet minimum thickness required for lime rock and subgrade for asphalt pavements.

B. Curbing base must match concrete pavement according to Table 9. Shoulders must meet minimum thickness required for subgrade.

C. Base must meet or exceed a LBR of 100.

D Stabilized subgrades and shoulders must meet or exceed a LBR of 40.

E. Base and stabilized subgrades must extend a minimum of six (6) inches beyond curbing.

F. See standard details for subgrade/curb application details.

13.09 RETURN RADII

Minimum return radii for public roadways should be designed based upon AASHTO guidelines for the appropriate design vehicle and best engineering practice. Minimum radii are given for each roadway classification in Table 9.

13.10 CUL-DE-SAC

Cul-de-sacs are to be provided on all public roadways that dead-end for fire protection.

A. The maximum length of a cul-de-sac is 500 feet (measured along center line).

B. Cul-de-sacs may not be required on streets with less than 20 detached dwelling units.

C. Minimum right-of-way required is 110 feet (diameter) for urban and rural roadway sections.

D. Minimum paved radius at the terminus is 45 feet.

E. Sidewalk to end at beginning of cul-de-sac. Sidewalks are not required around cul-de-sac.

F. Cul-de-sac with islands will be permitted if a maintenance association is established. Minimum pavement width must be determined by the City.

G. No temporary cul-de-sacs must be allowed, except in a phased development. A temporary cul-de-sac may not be constructed in a currently approved and developing phase of construction. The temporary cul-de-sac must be constructed outside of the approved phase into the future phase of development with no access allowed adjacent to the cul-de-sac. The temporary cul-de-sac in a phased development must meet regular paving and size requirements. A temporary public easement must also be placed over the cul-de-sac allowing public ingress and egress.

13.11 MINIMUM TANGENT STANDARDS

Minimum tangent standards should be in accordance with latest design guidelines from AASHTO, Institute of Transportation Engineers (ITE), or FDOT.

A. "Broken-Back" Curves

Two consecutive curves in the same direction with a short tangent causes a hazardous and unexpected arrangement. This condition should be avoided whenever possible. Roadways with tangents less than 100 feet

will be prohibited for design speeds faster than 30 miles per hour unless approved by the City.

B. "Reverse" Curves

Two (2) consecutive curves in opposite directions.

1. A sufficient length of tangent between reverse curves is mandatory for super elevation transition and should be in accordance with the latest AASHTO, ITE, or FDOT guidelines.

2. A tangent of not less than 100 feet in length must be provided between reverse curves on all minor collector roadway designations or higher volume roadways.

13.12 MAXIMUM CENTERLINE DEFLECTION WITHOUT A CIRCULAR CURVE

For small deflection angles (< 5 degrees), curves should be lengthened to avoid the distracting appearance of a kink. Such design should be in accordance with the best engineering practices as dictated by AASHTO or FDOT guidelines. Example guidelines for horizontal curves are given below in Table 10 for a deflection angle of two (2) degrees.

TABLE 10. Minimum Horizontal Curve for 2% Deflection Angle (Example Guidelines)

Road designation	Minimum radius
Service access	50–90
Local	**180**
Minor collector	300
Collector	300
Minor arterial	500
Major arterial	750

13.13 VERTICAL GEOMETRY

Refer to FDOT and ITE guidelines.

13.14 MAXIMUM /MINIMUM SLOPE REQUIREMENTS

Longitudinal slope must be a minimum of 0.50 percent (0.30 percent with curb and gutter) and a maximum of 8.00 percent. Transverse slope must be a minimum of 1.50 percent and a maximum of 2 percent. Longitudinal and transverse slope for parking lots must be a minimum of 0.50 percent.

13.15 TRAFFIC CONTROL DURING CONSTRUCTION

A. The Contractor must carry on the work in a manner that will cause a minimum of interruption to traffic. A TTCP in accordance with the latest edition of FDOT's Design Standards, Broward County Minimum Standards, or MUTCD must be submitted to the City and the responsible authorities having jurisdiction. The approved TTCP must be on-site at all times. Where traffic must cross open trenches, the Contractor must provide suitable bridges at street intersections and driveways. The Contractor must post suitable signs indicating that a street is closed and necessary detour signs for the proper maintenance of traffic. Prior to closing any streets, the Contractor must notify, when applicable, the Broward County Traffic Engineering Division, FDOT, and the City to obtain the approval of responsible authorities. TTCP applications must include a worksite traffic supervisor with a valid FDOT or ATSSA certification. TTCP submittals with an FDOT Standard Index or a Typical Application figure from the MUTCD, must submit an Intermediate Level Certification Card. If a sketch is submitted with the standard index, an Advanced Level Certification Card will be required. The certification card is required to contain the student's name, instructor's name, course provider, course category (Advance or Intermediate), date course was successfully completed, and date when training or refresher course is required. The certified worksite traffic supervisor must be present to direct the initial set up of the traffic control plan and must be available on a 24-hour basis.

1. Permission to close a street must be received in writing from the proper authority (City, County, FDOT, etc.). All excavated material must be placed so that vehicular and pedestrian traffic may be maintained at all times. If the Contractor's operations cause traffic hazards, the Contractor must clean and/or repair the road surface,

provide temporary pathways for pedestrians, erect wheel guards or LCD, or take other measures for safety satisfactory to the City. If a road or lane closure is proposed, proper notification must be given to City agencies (Police, Fire etc.)or take other measures for safety satisfactory to the City.

2. Detours around construction will be subject to the approval of the authority having jurisdiction and the City. Where detours are permitted, the Contractor must provide all necessary barricades and signs as required to divert the flow of traffic. While traffic is detoured, the Contractor must expedite construction operations.

3. It must be the sole responsibility of the Contractor to take precautions to prevent injury to the public due to open trenches. Nighttime personnel may be required where special hazards exist, or police protection may be provided for traffic while work is in progress. The Contractor must be fully responsible for damage or injuries whether or not protection has been provided.

13.16 DRIVEWAYS AND DRIVEWAY CONNECTIONS TO PUBLIC R/W

Refer to Chapter 13, Section 13-399 of the City of Coconut Creek Land Development Code, FDOT, Broward County guidelines, and the following:

Driveway Type	Maximum Volume (vehicles/ hour)	Driveway Width	Reservoir (feet)	Radius Return (feet)		
				Arterial	Collector	Local
Minor	50	12' ingress, 12' egress	25	30	20	15
Intermediate	200	14' ingress, 4' median, two 12' egress	50	30	20	15
Major	500	14' ingress, 4' median, two 12' egress	100	35	30	20

13.17 INTERSECTION DESIGN STANDARDS

Intersection design should be in accordance with the recommendations and requirements of the latest FDOT Manual of Uniform Minimum Standards for Design, Construction, Maintenance and Utility Operations on the State Highway System, and the FDOT Roadway and Traffic Design Standards (latest edition).

Minimum intersection angles and offset criteria are given in the City of Coconut Creek Land Development Code.

13.18 MEDIAN AND INTERSECTION SPACING AND LANDSCAPING REQUIREMENTS

Median and intersection spacing must be in accordance with the City of Coconut Creek Land Development Code.

13.19 TYPICAL SECTIONS

All construction plans submitted to the Development Review Committee (DRC) for approval must be provided with the construction plan’s typical sections for any of the proposed activities listed below. All sections must specify materials used with load bearing and compaction specifications required for the material as given in this Manual.

13.20 LOCAL / COLLECTOR / ARTERIAL ROADWAYS

See standard details.

13.21 TYPICAL SECTIONS OF CURBING

A. Standard curb (FDOT Type "F")

B. E-curb

C. D-curb

D. See curbing in standard details

13.22 DESIGN AND POSTED SPEEDS

Design speed for all roadways must be indicated on all construction plans. Posted speeds must be reviewed and approved by the City and County.

13.23 LIGHTING PLAN

The lighting plan must be submitted prior to road construction as part of site plan process. Refer to Chapter 13, Section 13-374 of the Land Development Code. Further, all commercial/industrial (non-residential) properties are required to reduce their foot candles to 1.0 after hours (within one hour of closing). The sidewalks or pathways in a ROW may be excluded. Outside the ROW (on private property), fall under the 1 foot candle rule.

13.24 ROADWAY MINIMUM ILLUMINATION STANDARDS

All light poles that the City maintains (in public streets) must be concrete poles, a minimum of 12 ft. high, with FPL-approved LED fixtures. No bulbs shall be visible and lighting shall be directed straight down. Aluminum mast may be used. In residential zoned areas, pole height from 10 ft. (minimum) to 12 ft. (maximum) must be used. In residential zoned areas, FPL-approved fiberglass poles with “traditional post top luminaire” may be used. See Table 11 for the illumination standards.

TABLE 11. Illumination Standards (Expressed in Footcandles)

Type	**Commercial**	Industrial	**Residential**	**Uniformity max./min**
Major and expressway	2.0	1.4	1.0	12:1
Collector	1.2	0.9	0.6	12:1
Local streets and alley	1.0	0.6	0.5	12:1
Adjacent sidewalk	1.0	0.6	0.5	12:1

Adjacent pedestrian way	1.5	1.0	0.5	12:1

SECTION 14

OTHER UTILITIES

14.01 OTHER UTILITIES

A. Communications Facilities must refer to City's Code of Ordinances Subdivision IX.

B. Utilities installation must comply with all State, Federal, and local rules and regulations, as applicable to the permitted facilities and work performed. This includes Federal, State, and local laws, bylaws, ordinances, rules, regulations, orders, permits, or decrees, including environmental laws, rules, regulations, and permits.

14.02 SUNSHINE 811 NOTIFICATION

Sunshine 811 must be notified prior to any excavation or demolition activities to identify any utilities within or around the work area, in accordance with Chapter 556, F.S.

14.03 ENGINEERING PERMITS

A. All engineering permitting must be in accordance with City Code of Ordinances Sec. 13-40.

B. All utilities installation requiring an engineering permit must obtain the permit prior to commencement of the work.

C. The engineering permit application submittal must include the following:

1. A key map showing the proposed installation location and the approximate distance and direction from the proposed work area to the nearest major road intersection.

2. Three (3) sets of plan view drawings (preferably to scale) showing all of the following:

a. The Right-of-Way Lines, limited access lines, and easement lines.

b. The proposed utility and appurtenances.

c. The horizontal distance from the proposed utility to a well-defined feature (such as the edge of travel lane).

d. The limits of the work area (including staging areas, access points, or other areas to be used).

e. For trenchless installations, the proposed method of installation, materials, function, type, size of proposed installation, and bore diameter.

f. Aboveground features, such as utility poles and cabinets within the work area.

g. Underground features, such as existing water pipes, wastewater pipes, drainage pipes, and other utilities within the proposed work area.

h. Significant physical features, such as vegetation, wetlands, or bodies of water.

3. Profile view drawings showing all of the following:

a. The location of the proposed utility and proposed appurtenances.

b. Benchmark information.

c. Horizontal and vertical location of all existing underground facilities, such as existing water pipes, wastewater pipes, drainage pipes, and other utilities within the proposed work area.

d. The proposed utility’s depth below the top of the pavement or existing unpaved ground.

e. Cross-sectional view showing one (1) or more typical cross sections to adequately reflect the proposed installation's location.

4. Any required approvals from other agencies and/or property owner.

5. A TTCP in accordance with Section 14.05.

6. A copy of current Contractor’s license(s), liability insurance, and worker’s compensation.

7. A signed cost estimate/bid contract.

8. Performance bond for any work in City right-of-way.

D. If a staff member from a utility company has been determined to be exempt from the signing and sealing requirements of Chapter 471, F.S., the staff member’s information (name and title) must be shown on the engineering plans title block and a letter verifying employment must be on file. The City retains the right to require, through a Special Instruction on the permit approval, that engineering documents that modify the infrastructure of the City to be signed and sealed.

E. Once the engineering permit has been issued, the permittee must not deviate from the approved plans without a formal revision to the permit.

F. A copy of the approved permit and plans must be kept at the job site.

G. A minimum 48 hour prior notice must be given to the Engineering Division prior to commencement of the work.

H. All work must be coordinated with the property owner and with other permitted work in the area.

I. A Final Engineering Inspection is required upon completion of work.

14.04 NOTIFICATION

A. A pre-construction meeting must be held with the City to discuss coordination of utilities within public rights-of-way.

B. The City must be informed of all existing and proposed utilities within the right-of-way prior to construction and notified at least 48 hours in advance of being installed.

C. A courtesy notice must be deliver to all owners of other facilities within the work areas known to be involved or potentially impacted by the proposed work.

D. All adjacent and affected developments must be notified of the project and related inconveniences to the residents 48 hours prior to the start of construction. Contractor must provide a copy of such notice to the Utilities and Engineering Department prior to the pre-construction meeting.

14.05 MAINTENANCE OF TRAFFIC (MOT)/ TTCP

A. All work requiring MOT/ TTCP must be submitted to the City for review and approval prior to issuance of engineering permit.

B. If submitting an MOT/TTCP with the latest edition of FDOT Design Standards or a typical application figure from the MUTCD, an Intermediate Level Certification Card will be required.

C. If a sketch is submitted, an Advanced Level Certification Card will be required.

D. Work on County/State right-of-way must get MOT/TTCP approval from that agency.

E. MOT/TTCP must be maintained throughout the course of the project to ensure public safety and traffic safety at all times.

14.06 CONSTRUCTION ACTIVITY

Per the City's Code of Ordinances Sec.14-28, construction hours are permitted between 7:00 a.m. and 7:00 p.m. Monday through Friday, 8:00

a.m. to 7:00 p.m. on Saturday and 8:00 a.m. to 6:00 p.m. on Sunday and national holidays. Unless approved by the City Engineer and/or their designee, all roadways and travel lanes shall be open to receive traffic between AM and PM peak hour traffic (7:00 a.m. to 9:00 a.m. and 4:00 p.m. to 6:00 p.m.).

14.07 EMERGENCY WORK

A. Per the City's Code of Ordinances Sec. 13-40 (a) (3), emergency repair work is work which must be done immediately upon discovery, in order to safeguard the public from immediate danger to life or limb, to safeguard public health, safety or welfare, to repair or replace interrupted utility services.

B. In the event of an emergency as defined above, repair work may be started without a permit upon electronic mail (e-mail) to the City Engineer, or designee, with a follow-up verbal notification. If the engineering division offices are closed, then notification must be given as early as possible on the next regular workday.

C. The utility owner must be responsible for safe and efficient traffic control.

D. The utility owner must bear the expense of restoring the right-of-way to the condition prior to the emergency.

E. After the emergency repair is completed, an after the fact engineering permit must be submitted to the engineering division.

F. Work that can be scheduled ahead of time will not be considered emergency work.

14.08 DAMAGE TO CITY RIGHT-OF-WAY

A. If any existing facilities are damaged or affected by the proposed scope of work, the Utilities and Engineering Department must be notified immediately.

B. When any City road is damaged or impaired in any way because of the installation, inspection, or repair of a utility located on such road, the utility owner must, at their own expense, restore the road to its original condition before such damage.

C. If the utility owner fails to make such restoration, the City is authorized to do so and charge the cost to the utility owner.

D. The utility owner is responsible for damage resulting from the issuance of an engineering permit.

E. Restoration of landscaping must be done within 72 hours after the completion of work.

F. Any damage to the existing pavement or curbing must be repaired in compliance with the City Utilities and Engineering Standards Manual or as specified by the City Engineer, or designee.

14.09 UTILITIES POLES

A. A minimum six (6) feet, 10 feet preferred, horizontal separation must be maintained from all City Utilities or as approved by the City Engineer, or designee.

B. Poles placed within City right-of-way and/ or public utility easements require an engineering permit.

C. Poles placed within private property require an engineering permit and property owner permission.

D. Utility poles must adhere to City clear zone requirements within this Manual.

E. Poles must not be placed on sidewalk within City right-of-way unless approved by the City Engineer or designee.

F. Soft dig excavation of City Utilities may be required prior to any pole installation.

G. Erosion and sediment control measures, as required by the engineering division, must be in place during construction.

H. All swales must be maintained for positive drainage when placing new poles.

I. Upon pole hardening and utility transfer, the existing pole must be extracted within a timely manner.

J. Any sidewalk repairs and replacements must fully comply with ADA standards and this Manual.

14.10 UTILITIES CABLES

A. Utility cables must be placed below City Utilities with a minimum of two (2) feet vertical separation.

B. Utility cables must maintain a minimum four (4) feet horizontal separation from all City Utilities.

C. A minimum of 30 inches of cover must be provided for all underground installation.

D. Soft dig excavation of City Utilities may be required prior to any horizontal directional bore work.

E. Any trenching must be done within green areas only, unless approved by the City Engineer or designee.

F. Erosion and sediment control measures, as required by the engineering division, must be in place during construction.

G. Any sidewalk repairs and replacements must fully comply with ADA standards and this Manual.

SECTION 15

SPECIFIC SITE DESIGN REQUIREMENTS

15.01 SIDEWALKS

A. General

Sidewalks are required on all new developments and require an engineering permit.

B. Concrete Sidewalk Requirements

All concrete sidewalks must meet the following requirements or as approved by the City Engineer or designee:

1. Portland cement concrete must meet minimum thickness of four (4) inches.

2. Portland cement concrete must meet minimum thickness of six (6) inches in all traffic bearing sections.

3. All concrete must meet a minimum of 3,000 psi compressive strength at 28 days.

4. The existing subgrade must meet a minimum thickness of 8 inches, must be mechanically compacted and meet or exceed 95 percent density of an AASHTO T-99 proctor.

C. Asphalt Sidewalk Requirements

All asphalt sidewalks must meet the following requirements or as approved by the City Engineer or designee:

1. The minimum asphaltic surface thickness must be 1 1/2 inches.

2. Allowable asphaltic surfaces include FDOT SP structural courses.

3. Tack coat must be applied to all lime rock prior to installation of asphalt.

4. The lime rock base course must be a minimum thickness of four (4) inches and must meet LBR 100.

5. All lime rock must be compacted to meet or exceed 98 percent of a modified proctor density test, AASHTO T-180.

6. The existing subgrade must meet minimum thickness of 12 inches, must be mechanically compacted and meet or exceed 95 percent density of a T-99 proctor.

D. Paver Brick Sidewalk/Walkway Requirements

All paver brick sidewalks/walkways must meet the following requirements or as approved by the City Engineer or designee:

1. Paver bricks must be set on minimum two (2) inches of bedding sand.

2. The existing subgrade must meet a minimum thickness of 12 inches, must be mechanically compacted and meet or exceed 95 percent density of a T-99 proctor.

E. Multiuse Paths Requirements

All multiuse paths must meet the following requirements or as approved by the City Engineer or designee:

1. Multiuse paths are recommended to be a minimum of 10 feet wide with a 1-inch thick asphaltic concrete surface course. An 8-foot wide shared use pathway shall be reviewed and approved by the City Engineer and/or their designee. Appropriate pavement marking and signage shall be included in the design of multiuse pathway facilities.

2. The lime rock base course must be a minimum thickness of four (4) inches and must meet LBR 100.

3. All lime rock must be compacted to meet or exceed 98 percent of the modified proctor density test, AASHTO T-180.

4. The subgrade must meet a minimum LBR 40, minimum thickness of 12 inches, must be compacted to meet or exceed 95 percent of the modified proctor density test, AASHTO T-180.

Or

1. Multiuse paths must be Portland cement concrete with a minimum thickness of six (6) inches.

2. The subgrade must meet a minimum LBR 40, minimum thickness of 12 inches, must be compacted to meet or exceed 95 percent of the modified proctor density test, AASHTO T-180.

F. Design of bike paths/lanes must comply with the requirements of the FDOT, and the "Manual on Uniform Traffic Control Devices," and must be a minimum of four (4) feet wide.

15.02 PATIOS AND POOL DECKS

Paver Brick Patios will require an engineering permit. All other patios and pool decks will require a Building Permit.

15.03 DRIVEWAY STANDARDS

A. Engineering Permit

All residential and commercial driveways will require an engineering permit.

B. Concrete Driveway Requirements

All concrete driveways must meet the following requirements or as approved by the City Engineer or designee:

1. Portland cement concrete must meet minimum thickness of four (4) inches within private property.

2. Portland cement concrete must meet minimum thickness of six (6) inches within City or public Right-of-Way.

3. All concrete must meet a minimum of 3,000 psi compressive strength at 28 days.

4. The existing subgrade must meet minimum thickness of 12 inches, must be mechanically compacted to meet or exceed 95 percent density of an AASHTO T-99 proctor density test.

C. Requirements

All asphalt driveways must meet the following requirements or as approved by the City Engineer or designee:

1. The minimum asphaltic surface thickness must be 1 1/2 inches.

2. Allowable asphaltic surfaces include FDOT SP structural courses.

3. Tack coat must be applied to all lime rock prior to installation of asphalt.

4. The lime rock base course must be a minimum thickness of eight (8) inches and must be LBR 100 with a minimum 70 percent calcium and magnesium carbonates.

5. All lime rock must be compacted to meet or exceed 98 percent of the modified proctor density test, AASHTO T-180.

6. The existing subgrade must meet minimum thickness of 12 inches, must be mechanically compacted to meet or exceed 95 percent density of a T-99 proctor density test.

D. Paver Brick Driveway Requirements

All paver brick driveways must meet the following requirements, or as approved by the City Engineer or designee:

1. Paver bricks must be set on minimum two (2) inches of bedding sand.

2. The lime rock base course must be a minimum thickness of six (6) inches and must be LBR 100 with a minimum 70 percent calcium and magnesium 70 percent carbonates.

3. All lime rock must be compacted to meet or exceed 98 percent of the modified proctor density test, AASHTO T-180.

4. The existing subgrade must meet minimum thickness of 12 inches, must be mechanically compacted and meet or exceed 95 percent density of a T-99 proctor density test.

SECTION 16

SUPPLY AND INSTALLATION OF HDPE PIPE

16.01 SCOPE

A. General

It is the intent of this specification to define the acceptable methods and materials for installing sanitary sewer and reclaimed lines for HDPE pipe installed by directional drilling or in open cut trenches.

B. Installation Plan

(A) At least seven (7) days prior to mobilizing equipment Contractor must submit his detailed installation plan to the EOR. The plan must include a detailed plan and profile of the bores and be plotted at a scale no smaller than one (1) inch equals 20 feet horizontal and vertical. (B) The plan must also include a listing of major equipment and supervisory personnel and a description of the methods to be used.

C. Variations in Plan or Profile

The Contractor may request changes to the proposed vertical and horizontal alignment of the installation and the location of the entry and exit points. Proposed changes must be submitted in writing to the EOR and receive approval of the EOR prior to construction.

D. Alignment

The proposed plan and profile installation locations are based on alignments to accommodate acquired easements, to avoid obstructions, and to properly maintain operation flow velocities

E. Qualifications

Directional drilling and pipe installation must be done only by an experienced Contractor specializing in directional drilling and whose key personnel have at least five (5) years' experience in this work. And the

Contractor must have installed directionally drilled pipe at least as large as 20 inches in diameter, have performed crossings at least 2,000 feet in length, and successfully installed at least 100,000 feet in length.

16.02 MATERIALS

A. General

HDPE pipe in accordance with the manufacturer's standard specifications in addition to these specifications must be used in all HDD installations. All piping system components must be the products of one (1) manufacturer and must conform to the latest edition of ASTM D1248, ASTM D3350, and ASTM F714.

B. Piping and Bends

Piping and bends must be extruded from a polyethylene compound and must conform to the following requirements:

1. The polyethylene resin must meet or exceed the requirements of ASTM D3350 for PE3408 material, with a cell classification of335434C, or better.

2. The polyethylene compound must be suitably protected against degradation by ultraviolet light by means of carbon black, well dispersed by pre-compounding in a concentration of not less than 2 percent.

3. The maximum allowable hoop stress must be 800 psi at 73.4 degrees Fahrenheit.

4. The pipe manufacturer must be listed with the Plastic Pipe Institute as meeting the recipe and mixing requirements of the resin manufacturer for the resin used to manufacture the pipe in all projects.

5. The pipe and bends must have a minimum SDR wall thickness as specified by the EOR.

6. Joining must be performed by thermal butt-fusion in accordance with the manufacturer's recommendations.

7. Sanitary sewer pipe exterior must be green in color or contain green striping. Reclaimed water pipe must be purple in color. Both sanitary sewer pipe and reclaimed water pipe must be light in color on the interior for internal video inspection.

C. Procedures

1. General

All polyethylene pipe must be cut, fabricated, and installed in strict conformance with the pipe manufacturer's recommendations. Joining, laying, and pulling of polyethylene pipe must be accomplished by personnel experienced in working with polyethylene pipe. The pipe supplier must certify in writing that the Contractor is qualified to join, lay, and pull the pipe or representative of the pipe manufacturer must be on-site to oversee the pipe joining. Expense for the representative must be paid for by the Contractor.

2. Transportation

Care must be taken during transportation of the pipe to ensure that it is not cut, kinked, or otherwise damaged.

3. Storage

Pipes must be stored on level ground, preferably turf or sand, free of sharp objects, which could damage the pipe. Stacking of the polyethylene pipe must be limited to a height that will not cause excessive deformation of the bottom layers of pipes under anticipated temperature condition. Where necessary due to ground conditions, the pipe must be stored on wooden sleepers, spaced suitably and of such widths as not to allow deformation of the pipe at the point of contact with the sleeper or between supports.

4. Handling Pipe

The handling of the joined pipeline must be in such a manner that the pipe is not damaged by dragging it over sharp and cutting objects. Ropes, fabric, or rubber protected slings and straps must be used when handling pipes. Chains, cables, or hooks inserted into the pipe ends must not be used. Two slings spread apart must be used for lifting each length of pipe. Pipe or fittings must not be dropped onto rocky or unprepared ground. Slings for handling the pipeline must not be positioned at butt-fused joints. Sections of the pipes with cuts and gouges exceeding 10 percent of the pipe wall thickness or kinked sections must be removed and the ends re-joined. The open ends of all sections of joined and/or installed pipe (not in service) must be plugged at night to prevent animals or foreign material from entering the pipe line or pipe section. Waterproof nightcaps of approved design may be used but they must also be so constructed that they will prevent the entrance of any type of natural precipitation into the pipe and will be fastened to the pipe in such a manner that the wind cannot blow them loose. The practice of stuffing cloth or paper in the open ends of the pipe will be considered unacceptable. Where possible, the pipe must be raised and supported at a suitable distance back from the open end such that the open end will be below the level of the pipe at the point of support.

16.03 INSTALLATION

A. General

1. The Contractor must install the pipelines by means of horizontal directional drilling. The Contractor must assemble, support, and pretest the pipeline prior to installation in the directional drill tunnel.

2. Horizontal directional drilling must consist of the drilling of a small diameter pilot hole from one end of the alignment to the other, followed by enlarging the hole diameter for the pipeline insertion. The exact method and techniques for completing the directionally drilled installation will be determined by the Contractor, subject to the requirements of these specifications.

3. The Contractor must prepare and submit a plan to the EOR for approval for insertion of the HDPE pipe into the opened bore hole. This plan must include pullback procedure, ballasting, rollers, side booms and side rollers, coating protection, internal cleaning, internal gauging, hydrostatic tests, dewatering, and purging.

4. The required piping must be assembled in a manner that does not obstruct adjacent roadways or public activities. The Contractor must erect temporary fencing around the entry and exit pipe staging areas.

B. Joining Pipe Sections

1. Each length of pipe must be inspected and cleaned as necessary to be free of debris immediately prior to joining.

2. Pipes must be joined to one another by means of thermal butt-fusion. Polyethylene pipe lengths to be joined by thermal butt-fusion must be of the same type, grade, and class of polyethylene compound and supplied from the same raw material supplier.

3. Mechanical connections of the polyethylene pipe to auxiliary equipment must be through flanged connections which must consist of the following:

   a. A polyethylene “sub end” must be thermally butt-fused to the ends of the pipe.

   b. Provide ASTM A240, Type 304 stainless steel backing flange, 125-pound, ANSI B16.1 standard, and gaskets as required by the manufacturer.

   c. Stainless steel bolts and nuts of sufficient length to show a minimum of three (3) complete threads when the joint is made and tightened to the manufacturer’s standard. Re-torque the nuts after four (4) hours.

   d. Butt-Fusion Joining: Butt-fusion of pipes must be performed in accordance with the manufacturer’s recommendations as to equipment and technique. Butt-fusion joining must be 100

percent efficient offering a joint weld strength equal to or greater than the tensile strength of the pipe.

C. Testing

1. The pipe must be hydrostatically tested after joining into continuous lengths prior to installation and again after installation. Pressure and temperature must be monitored with certified instruments during the test. After this test, the water will be removed with pigs. Erosion prevention procedures will be used during removal and discharge of the water.

2. Hydrostatic testing must be performed in accordance with AWWAC906-15 and outlined test procedure in C.3 and C.4 below. All costs associated with acquiring water for testing must be included in the established contract unit bid prices.

3. Pressure testing may be conducted prior to pipe installation. All above ground testing must be as specified by the EOR. After the pipe has been fused and filled with water, carefully bleed off any trapped air. Subject the pipe to a hydrostatic test pressure as specified by the EOR for a maximum of two (2) hours. During this time, add water periodically to maintain the test pressure; this compensates for the initial stretching of the pipe. The line pressure tightness is determined by visual observation; therefore, it is not necessary to measure the make-up water. Examine every fused joint; any leakage must be repaired and then retested.

4. Hydrostatic testing in the trench is required for open cut installations. Fill the pipeline with water after it has been laid; bleed off any trapped air. Subject the lowest element in the system to a test pressure that is 1.5 times the design pressure, and check for any leakage. When, in the opinion of the Engineer, local conditions require that the trenches be backfilled immediately after the pipe has been laid, apply the pressure test after backfilling has been completed but not sooner than a time which will allow sufficient curing of any concrete that may have been used. Typical minimum concrete curing times are 36 hours for early strengths and seven (7) days for normal strengths. The test procedures consist of two (2) steps; the initial expansion and the test phase. When test pressure

is applied to a water filled pipe, the pipe expands. During the initial expansion of the pipe under test, sufficient make-up water must be added to the system at hourly intervals for three (3) hours to maintain the test pressure. After about four (4) hours, initial expansion should be complete and the actual test can start.

When the test is to begin, the pipe is full of water and is subjected to a constant test pressure of 1.5 times the system design pressure. The test phase should not exceed three (3) hours, after which time any water deficiency must be replaced and measured. Add and measure the amount of make-up water required to return to the test pressure and compare this to the maximum allowance in the table below.

An alternate leakage test consists of maintaining the test pressure (described above) over a period of four (4) hours and then dropping the pressure by 10 psi (0.69 MPa). If the pressure then remains within 5 percent of the target value for 1 hour, this indicates there is no leakage in the system.

NOTE: Under no circumstances must the total time under test exceed eight (8) hours at 1.5 times the system pressure rating. If the test is not complete within this time limit (due to leakage, equipment failure, etc.), the test section must be permitted to “relax” for eight (8) hours prior to the next test sequence.

Air testing is not recommended unless specified by the EOR and must be conducted per those specifications.

NOTE: It must be the responsibility of the Contractor to ensure that appropriate safety precautions are observed during hydrostatic or air testing above ground. Additional safety precautions may be required when performing air testing.

D. Tolerances

1. Pipe installed by the directional drilled method must be located in plan as shown on the drawings, and must be no lower than shown on the drawings unless otherwise approved. The Contractor must plot the actual horizontal and vertical alignment of the pilot bore at

intervals not exceeding 30 feet. This “as-built” plan and profile must be updated as the pilot bore is advanced. The Contractor must at all times provide and maintain instrumentation that will accurately locate the pilot hole and measure drilling fluid flow and pressure. The Contractor must grant the Engineer access to all data and readout pertaining to the position of the bore head and the fluid pressures and flows. When requested, the Contractor must provide explanations of this position monitoring and steering equipment. The Contractor must employ experienced personnel to operate the directional drilling equipment and, in particular, the position monitoring and steering equipment. No information pertaining to the position or inclination of the pilot bores must be withheld from the EOR.

2. Each exit point must be located as shown ,with an over-length tolerance of 10 feet for directional drills of 1,000 linear feet or less and 40 feet for directional drills of greater than 1,000 linear feet and an alignment tolerance of five (5) feet left/right with due consideration of the position of the other exit points and the required permanent easement. For gravity sanitary sewer installations, sags in the pipeline must not exceed 25 percent of the nominal pipe diameter. Sags will only be allowed where the entering and exiting grades are adequate to provide velocities through the sag area sufficient for moving solids. No more than one (1) sag area must occur between two (2) Maintenance Access Structure. The alignment of each pilot bore must be approved by the EOR before pipe can be pulled. If the pilot bore fails to conform to the above tolerances, the EOR may, at his option, require a new pilot boring to be made.

3. After the pipe is in place, cleaning pigs must be used to remove residual water and debris. After the cleaning operation, the Contractor must provide and run a sizing pig to check for anomalies in the form of buckles, dents, excessive out-of-roundness, and any other deformations. The sizing pig run must be considered acceptable if the survey results indicate that there are no sharp anomalies (e.g., dens, buckles, gouges, and internal obstructions) greater than 2 percent of the nominal pipe diameter, or excessive ovality greater than 5 percent of the nominal pipe diameter. For gauging purposes, dent locations are those defined above which

occur within a span of five feet or less. Pipe ovality must be measured as the percent difference between the maximum and minimum pipe diameters. For gauging purposes, ovality locations are those defined above which exceed a span of five feet.

E. Ream and Pullback

1. Reaming: Reaming operations must be conducted to enlarge the pilot after acceptance of the pilot bore. The number and size of such reaming operations must be conducted at the discretion of the Contractor.

2. Pulling Loads: The maximum allowable pull exerted on the HDPE pipelines must be measured continuously and limited to the maximum allowed by the pipe manufacturer so that the pipe or joints are not over stressed.

3. Torsion and Stresses: A swivel must be used to connect the pipeline to the drill pipe to prevent torsional stresses from occurring in the pipe.

4. The lead end of the pipe must be closed during the pullback operation.

5. Pipeline Support: The pipelines must be adequately supported by rollers and side booms and monitored during installation so as to prevent over stressing or buckling during the pullback operation. Such support/rollers must be spaced at a maximum of 60 feet on centers, and the rollers to be comprised of a non-abrasive material arranged in a manner to provide support to the bottom and bottom quarter points of the pipeline allowing for free movement of the pipeline during pullback. Surface damage must be repaired by the Contractor before pulling operations resume.

6. The Contractor must at all times handle the HDPE pipe in a manner that does not over stress the pipe. Vertical and horizontal curves must be limited so that wall stresses do not exceed 50 percent of yield stress for flexural bending of the HDPE pipe. If the pipe is buckled or otherwise damaged, the damaged section must be removed and replaced by the Contractor at his expense. The

Contractor must take appropriate steps during pullback to ensure that the HDPE pipe will be installed without damage.

F. Handling Drilling Fluids and Cuttings

1. During the drilling, reaming, or pullback operations, the Contractor must make adequate provisions for handling the drilling fluids, or cuttings at the entry and exit pits. To the greatest extent practical, these fluids must not be discharged into the waterway. When the Contractor's provisions for storage of the fluids or cuttings on-site are exceeded, these materials must be hauled away to a suitable legal disposal site. The Contractor must conduct his directional drilling operation in such a manner that drilling fluids are not forced through the sub-bottom into the waterway. After completion of the directional drilling work, the entry and exit pit locations must be restored to original conditions. The Contractor must comply with all permit requirements.

2. Pits constructed at the entry or exit point area must be constructed to completely contain the drill fluid and prevent its escape to the beach or waterway.

3. The Contractor must utilize drilling tools and procedures which will minimize the discharge of any drill fluids. The Contractor must comply with all mitigation measures listed in the required permits and elsewhere in these specifications.

4. To the extent practical, the Contractor must maintain a closed loop drilling fluid system.

5. The Contractor must minimize drilling fluid disposal quantities by utilizing a drilling fluid cleaning system, which allows the returned fluids to be reused.

6. As part of the installation plan specified before, the Contractor must submit a drilling fluid plan which details types of drilling fluids, cleaning and recycling equipment, estimated flow rates, and procedures for minimizing drilling fluid escape.

16.04 DRILLING OPERATIONS

A. General

The Contractor must prepare a plan to be submitted for Engineer approval, which describes the noise reduction program, solids control plant, pilot hole drilling procedure, the reaming operation, and the pullback procedure. All drilling operations must be performed by supervisors and personnel experienced in horizontal directional drilling. All required support, including drilling tool suppliers, survey systems, mud cleaning, mud disposal, and other required support systems used during this operation must be provided by the Contractor. Drill pipe must be API steel drill pipe, Range 2, Premium Class or higher, Grade S-135 in a diameter sufficient for the torque and longitudinal loads and fluid capacities required for the work. Only drill pipe inspected under API's Recommended Practice Specification API RP 7G within 30 days prior to start and certified as double white band or better must be used. A smoothly drilled pilot hole must follow the design centerline of the pipe profile and alignment described on the construction drawings. The position of the drill string must be monitored by the Contractor with the downhole survey instruments. Contractor must compute the position in the X, Y, and Z axis relative to ground surface from downhole survey data a minimum of once per length of each drilling pipe (approximately 31 foot interval). Deviations from the acceptable tolerances described in the specifications must be documented and immediately brought to the attention of the Engineer for discussion and/or approval. The profile and alignment defined on the construction drawings for the bores define the minimum depth and radius of curvature. At no point in the drilled profile must the radius of curvature of the bore be less than 1,600 feet. The Contractor must maintain and provide to the Engineer, upon request, the data generated by the downhole survey tools in a form suitable for independent calculation of the pilot hole profile. Between the water's edge and the entry or exit point the Contractor must provide and use a separate steering system employing a ground survey grid system, such as "TRU-TRACKER" or equal wherever possible. The exit point must fall within a rectangle 10 feet wide and 40 feet long centered on the planned exit point. During the entire operation, waste and leftover drilling fluids from the pits and cuttings must be dewatered and disposed of in accordance with all permits and regulatory agencies requirements. Remaining water must be cleaned by Contractor to meet permit requirements. Technical criteria for bentonite must be as given in API Spec. 13A, Specification for Oil Well

Drilling Fluids Material for fresh water drilling fluids. Any modification to the basic drilling fluid involving additives must describe the type of material to be used and be included in Contractor's drilling plan presented to the EOR. The owner retains the right to sample and monitor the waste drilling mud, cuttings, and water.

B. Environmental Provisions

The horizontal directional drilling operation is to be operated in a manner to eliminate the discharge of water, drilling mud, and cuttings to the adjacent creek or land areas involved during the construction process. The Contractor must provide equipment and procedures to maximize the recirculation or reuse of drilling mud to minimize waste. All excavated pits used in the drilling operation must be lined by Contractor with heavy-duty plastic sheeting with sealed joints to prevent the migration of drilling fluids and/or ground water. The Contractor must visit the site and must be aware of all structures and site limitations at the directional drill crossing and provide the EOR with a drilling plan outlining procedures to prevent drilling fluid from adversely affecting the surrounding area. The general work areas on the entry and exit sides of the crossing must be enclosed by a berm to contain unplanned spills or discharge. Waste cuttings and drilling mud must be processed through a solids control plant comprised as a minimum of sumps, pumps, tanks, desalted/desanded, centrifuges, material handlers, and haulers all in a quantity sufficient to perform the cleaning/separating operation without interference with the drilling program. The cuttings and excess drilling fluids must be dewatered and dried by the Contractor to the extent necessary for disposal in offsite landfills. Water from the dewatering process must be treated by the Contractor to meet permit requirements and disposed of locally. The cuttings and water for disposal are subject to being sampled and tested. The construction site and adjacent areas will be checked frequently for signs of unplanned leaks or seeps. Equipment (graders, shovels, etc.) and materials (such as groundsheets, hay bales, booms, and absorbent pads) for cleanup and contingencies must be provided in sufficient quantities by the Contractor and maintained at all sites for use in the event of inadvertent leaks, seeps, or spills. Waste drilling mud and cuttings must be dewatered, dried, and stock piled such that it can be loaded by a front end loader, transferred to a truck, and hauled offsite to a suitable legal disposal site. The maximum allowed water content of these solids is 50 percent of weight. Due to a limited storage space at the worksites, dewatering and disposal work must be concurrent

with drilling operations. Treatment of water must satisfy regulatory agencies before it is discharged (see Table 12)..

TABLE 12. Allowance for Expansion Under Test Pressure

NOMINAL PIPE SIZE*	**US GALLONS/100 FT. OF PIPE****		
	1 HOUR	**2 HOURS**	**3 HOURS**
2”	0.08	0.12	0.15
3”	0.10	0.15	0.25
4”	0.13	0.25	0.40
5”	0.21	0.41	0.63
6”	0.30	0.60	0.90
8”	0.50	1.00	1.50
10”	0.75	1.30	2.10
12”	1.10	2.30	3.40
14”	1.40	2.80	4.20
16”	1.70	3.30	5.00
18”	2.20	4.30	6.50
20”	2.80	5.50	8.00
22”	3.50	7.00	10.50
24”	4.50	8.90	13.30
28”	5.50	11.10	16.80
30”	6.20	12.60	19.10
32”	7.00	14.30	21.50
36”	9.00	18.00	27.00
42”	12.00	24.00	36.00
48”	15.00	27.00	43.00
54”	18.00	30.00	50.00

Notes:
*mm = 0.03937
**multiply by 11.53 to convert to liters/100 meters of pipe

SECTION 17

REFERENCE STANDARDS

All references are intended to include “as amended” to its most current standard, as adopted at the time of plan submission.

ASTM Specifications

1. ASTM A48
2. ASTM A126
3. ASTM A139
4. ASTM A307
5. ASTM A536
6. ASTM C136
7. ASTM C216
8. ASTM C270
9. ASTM C478
10. ASTM C923
11. ASTM D1784
12. ASTM D1785
13. ASTM D3034
14. ASTM D3212
15. ASTM F477
16. ASTM F679

AWWA Specifications

1. AWWA C-105
2. AWWA C-110
3. AWWA C-111
4. AWWA C-151
5. AWWA C-153
6. AWWA C-206
7. AWWA C-500
8. AWWA C-502
9. AWWA C-504
10. AWWA C-507
11. AWWA C-508

12. AWWA C-509
13. AWWA C-510
14. AWWA C-511
15. AWWA C-512
16. AWWA C-550
17. AWWA C-600
18. AWWA C-651
19. AWWA C-800
20. AWWA C-901

National Sanitation Foundation

Drinking Water Treatment Chemicals – Health Effects NSF 60
Drinking Water System Components – Health Effects NSF61

Other Reference Standards

Recommended Standards for Wastewater Facilities (10 States Standards)
Recommended Standards for Water Works (10 State Standards)
Soil Survey of Broward County Florida
City of Coconut Creek, Code of Ordinances, Chapter 13 (Land Development Code)
City of Coconut Creek, Code of Ordinances, Chapter 20 (Utilities)
Florida Department of Environmental Protection F.A.C. 62-550
Florida Department of Environmental Protection F.A.C. 62-604
Florida Department of Transportation Minimum Standards for Design of Streets (Green Book)
Florida Department of Transportation Roadway and Traffic Design Standards

APPENDIX A

LIST OF MATERIALS AND APPROVED MANUFACTURERS

I. WASTEWATER MATERIALS

EQUIPMENT	MANUFACTURER	MODEL NO./ DESCRIPTION
AIR RELEASE VALVES	1. Empire 2. Apco 3. Val-matic	2" inlet and outlet minimum
AIR RELEASE/VACUUM RELIEF VALVES	1. Empire 2. Apco 3. Val-matic	2" inlet and outlet minimum
CASING SPACERS	1. Cascade 2. PSI	1. CCS-12" Width Min. 2. C12G-2
CAST COUPLINGS	1. Dresser Manufacturing 2. Clow Corporation 3. Baker Coupling Co., Inc.	Not Applicable
CHECK VALVES (4" AND LARGER)	1. APCO 2. M&H Co. 3. Golden Anderson	1. 2. 3.
EXPANSION JOINTS	1. Mercer 2. Metraflex 3. EBAA Iron	
FITTINGS (COMPACT DUCTILE IRON)	1. U.S. Pipe 2. American Cast Iron Pipe 3. Tyler Pipe	
FLANGED ADAPTER COUPLINGS	1. Dresser Manufacturing 2. Clow Corporation 3. Baker Coupling Co., Inc.	

EQUIPMENT	MANUFACTURER	MODEL NO./ DESCRIPTION
MANHOLE FRAME AND COVER	1. U.S. Pipe and Foundry 2. Vulcan	1. USF #225-AS 2. V1357
MANHOLE JOINTING MATERIAL	1. K.T. Snyder Co., Inc. 2. Conseal	1. Ram-Nek 2. CS102
MANHOLE SURFACE COATINGS	1. Koppers	1. Bitumastic 300M
PLUG VALVES	1. Val-Matic 2. Dezurik 3. Clow	1. 5800, 5900 2. Series 100 3. F-5370, F-5365
RESTRAINED JOINTS	1. EBAA Iron Inc. 2. US PIPE	1. Megalug 2. TR_FLEX
TAPPING SLEEVES, FABRICATED STEEL	1. JCM Industries 2. Baker Coupling Co., Inc. 3. Ford Meter Box Co. 4. Mueller Co.	1. 412 2. 428 3. FTSC 4. H-624
TAPPING SLEEVE, MJ	1. U.S. Pipe and Foundry 2. Mueller Co. 3. Tyler Pipe 4. American Cast Iron Pipe	1. T-9 2. H-615 3. S-149 4. A-D
TAPPING VALVES	1. American Cast Iron Pipe 2. U.S. Pipe and Foundry 3. Clow 4. Mueller Co.	1. No. 865 2. Metroseal 250 3. F-5093 4. H-687
VALVE BOXES	1. American Flow Control Trench Adapter 2. Tyler Union 3. Brigham	USF 6850 or Equal 5 1/4” with locked lid
VAULT FRAME AND COVER FOR AIR RELEASE/ VACUUM RELIEF VALVES	1. U.S. Foundry	1. USF 7665

PAINTING: AERIAL PIPING, FITTINGS, AND VALVES		
A. FIELD PRIMER	1. Porter/Int'l 2. Koppers 3. Tnemec 4. Glidden	1. 284 U-Primer 2. Pug Primer 3. 37-77 Chem-Prime 4. Alkyd Metal Primer
B FINISH (EXTERIOR)	1. Porter/Int'l 2. Koppers 3. Tnemec 4. Glidden	1. 2410 Alkyd Gloss 2. Glamortex 501 Enamel 3. Tnemec-Gloss 4. Alkyd Ind. Enamel
PIPE:		
FORCE MAIN DIP	1. American 2. McWane 3. US Pipe and Foundry 4. Griffin	Pressure Class 350 minimum, with interior coating, as specified
GRAVITY SANITARY SEWER PVC	1. CERTAINTEED 2. JOHN MANVILLE	ASTM D3034 SDR35
WASTEWATER PUMP STATIONS:		
GENERATOR CIRCUIT BREAKER	1. Square D 2. Westinghouse	
GENERATOR SYSTEMS	1. Caterpillar 2. Onan (Cummins) 3. Ingersoll&Rand (portable)	
PRESSURE GAUGES	1. Dwyer	
SUBMERSIBLE PUMPS	1. Davis EMU	
WETWELL ACCESS FRAMES AND COVERS	1. Halliday Products, Inc. 2. Bilco Co. 3. U.S. Foundry TPD	
CONTROL PANELS (CP) NEMA 4X ENCLOSURE	1. CC Control Corp. 2. Curry Controls 3. CC Controls.	1. Coconut Creek
FORCE MAIN AND RECLAIMED WATER	1. W L Polyethylene 2. JM Eagle	Pipe and fittings HDPE
RECLAIMED WATER	1. Rom ac	TAPPING SLEEVE SST-H (HDPE)

II. WATER MAIN MATERIALS

AIR RELEASE VALVES	1. Empire 2. Val-matic 3. Apco	1. 920 2. VM-38 3. 200
BUTTERFLY VALVES	1. Mueller Co. 2. Clow Corp. 3. Dezurik 4. American Cast Iron Pipe	1. Lineseal III 2. 2000 3. 4. 150
CASING SPACERS	1. Cascade 2. PSI	1. CCS - 12" Width Min. 2. C12G-2
CAST COUPLINGS	1. Dresser Manufacturing 2. Clow Corporation 3. Baker Coupling Co., Inc.	
CORPORATION STOPS	1. Ford Metal Box Co. 2. A.Y. McDonald Mfg. Co. 3. Mueller Co. 4. Hays/Lee Brass Co.	1. F-1000, FB-1100 2. 4701-T 3. H-15008, H-15013 4. 5200DF, 4400DF
ELECTRONIC READ METERS	1. Sensus Technologies	
METER BOXES	Supplied by Contractor	
CURB STOPS	1. Ford Meter Box Co.	1. Single Service: B43-342W Double Svc./Branch: BA13-232W/U48-43
	2. A.Y. McDonald Mfg. Co.	2. Single Service: 6100 MTW Double Svc./Branch: 4604N/3795-T

	3. Mueller Co.	3. Single Service: H-14350 Double Svc./Branch: H-14265/H-15363
	4. Hays/Lee Brass Co.	4. Single Service: 4317-1DF Double Svc./Branch: 25013/5591DF
EXPANSION JOINTS	1. Mercer 2. Metraflex 3. EBAA Iron	
FIRE HYDRANTS	1. Mueller Co. 2. M&H 3. American Cast Iron Pipe	1. Super Centurion 200 2. B 84 B-6"
FITTINGS (COMPACT DUCTILE IRON)	1. U.S. Pipe and Foundry 2. American Cast Iron Pipe 3. Tyler Pipe	
FLANGED ADAPTER COUPLINGS	1. Dresser Manufacturing 2. Clow Valve Co. 3. Baker Coupling Co., Inc.	
GV RESILIENT SEATED ONLY	1. Clow Valve Co. 2. Mueller Co. 3. U.S. Pipe and Foundry 4. American Cast Iron Pipe	1. 3100 2. A-2370-20 3. Metroseal 250 4. CRS-80 4"-12"
SERVICE SADDLES	1. Ford Meter Box Co. 2. JCM Industries 3. Mueller Co. 4. Baker Coupling Co.	1. FC-202 2. 402 3. Series 10500 4. Shur Seal-O

TRACER WIRE	1. COPPERHEAD	SOLO SHORT EXTREME – PBX-50 CCS TRACER WIRE
TAPPING SLEEVES, FABRICATED STEEL	1. JCM Industries 2. Baker Coupling Co. 3. Ford Meter Box Co. 4. Mueller Co.	1. 412 2. 428 3. FTSC 4. H-624
TAPPING SLEEVES, M.J.	1. U.S. Pipe and Foundry 2. Mueller Co. 3. Tyler Pipe 4. Clow Corp. 5. American Cast Iron Pipe	1. T-9 2. H-615 3. S-149 4. F-5205 5. A-D
TAPPING VALVES	1. American Cast Iron Pipe 2. U.S. Pipe and Foundry 3. Clow Corp. 4. Mueller Co.	1. No. 865 2. Metroseal 250 3. F-5093 4. H-687
VALVE BOXES	1. American Flow Control Trench Adapter 2. Tyler Union	USF 6850 or Equal 5 1/4” with locking lid.
VAULT FRAME AND COVER FOR AIR RELEASE VALVES	1. U.S. Foundry	1. USF 7665
EQUIPMENT	MANUFACTURER	MODEL NO./ DESCRIPTION
PIPE:		
DIP	1. American 2. McWane 3. U.S Pipe and Foundry 4. Griffin	Pressure Class 350 minimum, cement lined
POLYETHYLENE TUBING	1. DRISCOPIPE 2. Yardley 3. Orangeburg	1. 5100

RESTRAINED JOINTS	1. EBAA Iron Inc. 2. US PIPE	1. Megalug 2. TR-FLEX
PAINTING: AERIAL PIPING, FITTINGS, AND VALVES		
A. FIELD PRIMER	1. Porter/Int'l 2. Koppers 3. Tnemec 4. Glidden	1. 284 U-Primer 2. Pug Primer 3. 37-77 Chem-Prime 4. Alkyd Metal Primer
B. FINISH (EXTERIOR)	1. Porter/Int'l 2. Koppers 3. Tnemec 4. Glidden	1. 2410 Alkyd Gloss 2. Glamortex 5013. Tnemec-Gloss 4. Alkyd Ind. Enamel

APPENDIX B

STANDARDS DRAWING DETAILS 001 – 664B

APPENDIX C

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